Links between Memory and the Acquisition of English as a Foreign Language

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By

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Declaration

This work is original and has not been submitted previously in support of any degree qualification or course

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Abstract

Relationships between (levels of) EFL performance and memory were explored in six EFL pupils aged between seventeen to eighteen years old in their last year of high school. The pupils were given multiple memory assessments to establish memory ability and multiple EFL assessments to establish levels of EFL performance in reading, listening comprehension and speech. The tests were first quantified and then the pupils' performance was analyzed qualitatively in a method of multiple cross case analysis.

Qualitative analyses of six case studies suggest that **phonological processing, phonological memory** in general and **phonological working memory** in particular, have an underlying influence on EFL performance. The proposed explanatory link between the phonological aspects of memory and EFL ability is a theorized **inner voice** factor which facilitates the acquisition of EFL through processes of **lexical and phonological priming.** Lexical and phonological priming processes were seen to impact all aspects of EFL looked at in this research: vocabulary, syntax, sentence processing (perception and production) and reading. The impact of inner voice on vocabulary acquisition is twofold. First, it triggers appropriate collocates in a cumulative manner. Second, it facilitates intact decoding which enhances learning of new vocabulary provided in written form. The impact of inner voice on syntactic knowledge is by triggering appropriate sentential colligates. Inner voice, as underlying decoding processes, is also suggested as having a significant function in reading ability. Phonological processing is suggested as prerequisite for **auditory verbal memory** which was seen to have an impact on speech perception and production. The proposed explanatory link between auditory verbal memory and speech performance is auditory word recognition. **Visual memory** is seen to impact both vocabulary acquisition and reading separately. Two links between visual memory and vocabulary acquisition are suggested: visual spatial memory is proposed as facilitating memory for word configurations and visual sequential memory as underlying orthographic awareness. Importantly, it is proposed that visual memory itself is facilitated when supported by phonological memory in the process of reading. Visual memory is also suggested as facilitating reading comprehension processes by applying visual strategies. **The central executive**

function is seen to enhance all aspects of EFL performance which require processing, control, attention switching and retrieval from long-term memory. However, intact central executive function cannot come into play effectively when the elements for integration are imperfect.

Inappropriate learning strategies such as list learning and translation strategy were seen to inhibit EFL acquisition even when memory was intact. In the light of the above, it is suggested that the phonological aspects of processing and memory are the most significant factors underlying EFL performance.

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Chapter 1: Introduction

This thesis deals with the impact of memory on the acquisition of English as a foreign language. It is a multidisciplinary study which touches upon areas of psychology, linguistics, psycholinguistics and second/foreign language acquisition. (Foreign language acquisition, FLA, and second language acquisition, SLA, are used interchangeably in this thesis since the literature does not often clearly distinguish between the two). Naturally, each of these topics has been the subject of extensive research.

Scientific research into issues of memory and issues of language started towards the beginning of the 20th century. On the whole, memory and language were, and often still are, studied as two separate disciplines. Most memory research to date is considered to belong to psychology. Little memory research concerns itself specifically with language, and even less with foreign or second language acquisition. Cognitive memory research nowadays does not view memory as one system, but as many systems operating in synchronization (Baddeley, 1997). The lexicon of memory research now includes such terms as short-term memory and long-term memory which indicate duration, working memory and central executive which indicate processing, and auditory/phonological memory and visual memory which indicate the modality by which input is perceived.

Linguistic research, on the other hand, looks at the ingredients of language and introduces the concepts of phonology, lexis and syntax. It traditionally aims to discover the underlying rules which account for how languages are structured and how they function. Some linguistic research looks at how language is learnt, though less often at how a foreign language is learnt.

Psycholinguistic research bridges the gap between cognitive and language research. It examines the way in which people perceive language. It concerns itself with what actually happens when we understand language, as well as produce it. In order to do so, psycholinguists analyse spoken and written data. They slice language perception and production into very small, preferably measurable, units which may account for human language abilities. The research reported in this thesis is based, to a large extent, on psycholinguistic analyses.

My research attempts to place some findings (from memory and linguistic research)

gained by looking at isolated units in a larger context. It utilises both qualitative and quantitative research tools, the main body of research relying heavily on the former. It is a comparative multiple cross case study research, the subjects being six Israeli pupils in their last year of high school. The quantitative aspect of the research consists of two test batteries: a battery of EFL (English as a foreign language) proficiency tests and a battery of memory tests. The qualitative aspect of the research consists of an in-depth analysis of the subjects' actual performance on the EFL tests. It is this qualitative aspect which is the core of this research.

Foreign language teachers are generally familiar with linguistic theory; less so with memory theory. Although memory, as such, is often acknowledged as a factor in foreign language teaching, memory theory is rarely utilized by EFL teachers to facilitate foreign language acquisition. It is my hope to show that awareness of issues of memory and foreign language learning may be useful in the EFL classroom.

My personal interest in these topics and the interrelations between them derives from being in touch with these issues in my professional line of work, which is teaching English as a foreign language to both mainstream pupils and pupils with specific learning difficulties. Already as a beginning teacher it struck me that some pupils had gaps between their reading, writing, listening comprehension and speech skills. Some pupils had very big gaps amongst their literacy skills and oral skills and these pupils were often defined as having specific learning difficulties. The acquisition of English as a foreign language by pupils with specific learning difficulties was the topic of my Masters dissertation.

During the long hours of working with EFL students, it had often occurred to me that much of their weakness had to do with not being able to remember. Their struggle to remember seemed to manifest itself in all skills and at all levels of learning the second language. It could be observed with zero beginners who did not seem to absorb well the sound-symbol correlations between letters and their sounds or simple vocabulary items, and it was seen in some high-school students who struggled with comprehension and/or did not seem to remember grammar and its applications. Moreover, the difficulty did not seem to be even across pupils or across skills. Some pupils struggled with sound-symbol correlation but had an excellent memory for words, some exhibited an opposite difficulty and some students found it all too overwhelming. I have always felt frustration when my students complained

that they could not remember, but a huge question mark started forming in my mind when one of my pupils (and then another one) said to me "I know, but I cannot remember." I must admit that my first reaction was to say "This is impossible. If you cannot remember you do not know." However, I soon realized that my reaction was too simplistic and that there may be more than meets the eye in this statement. All of the puzzling phenomena described above, along with the striking sentence "I know, but I cannot remember", were the underlying motivation for focusing on memory as the topic of my research. Memory was also a common denominator between the various disciplines which were a part of my everyday life and one of my main interests. I decided that the spectrum of relationships amongst EFL and memory were the issue I wanted to pursue.

This research, therefore, looks at points where cognitive and linguistic lines of research converge, and narrows the scope to focus on the connections between memory and the acquisition of English as a foreign language. From the point of view of memory the parameters which come into play are time, modality and processing. From the point of view of the acquisition of English as a foreign language, the focus will be on the effect these memory traits have on the acquisition of specific aspects of the English language.

I hope to be able to look at the overall construction of these elements by placing the subjects' performance on the tests in a holistic framework of qualitative research. To the best of my knowledge, this particular line of research has not been pursued before.

The research reported in this thesis consists of eleven chapters. Chapter 2 provides the theoretical background for the research and is divided into three sub-sections each reflecting a different discipline underlying the issues raised in my research. Section 2.1 presents memory literature, section 2.2 provides the EFL theoretical background and section 2.3 displays research which discusses the role of memory in second language acquisition. The research presented in these chapters shows clearly that studies which examine the role of memory in second language acquisition traditionally single out a specific parameter and utilize quantitative research tools in order to discern the existence (or lack of existence) between an aspect of memory and a specific aspect of EFL. The novelty of this research is twofold: firstly, it examines the pupils' EFL knowledge and skills vis-a-vis a wide spectrum of memory

functions and places the findings in a framework of interrelations. Secondly, although the quantitative research methods traditionally utilized in research to date have yielded many interesting insights and pointed to numerous connections between memory and the ability to acquire a second language, they have not been able to examine the processes underlying these relationships. My research surfaces some of those underlying processes which could not be seen with quantitative research tools. Chapter 3 explains the methodological aspects of the study. It spells out the research questions and explains the methods used in an attempt to provide insights into the questions raised. Chapters 4-9 provide the analysis of the data. As stated before, both quantitative and qualitative research methods were utilized but the nature of the study is predominantly qualitative. The main research method is a qualitative multiple cross case analysis. However, before presenting a comparison between the cases, chapters 4 and 5 give an in-depth analysis of two of the case studies. This in-depth analysis surfaces many issues which become points of focus in the analyses of the other case studies. Indeed, one of the main findings in this research started surfacing in these in-depth analyses. In chapters 6-9 each chapter deals with another case study and compares the findings to those from the former cases. These comparison processes enabled me to gain support for some of the findings and lose others. As the chapters progress, the information goes through a distilling process ending with my conclusions. The summary of my findings are presented in chapter 10. In chapter 11, findings from my study are discussed vis-a-vis the research questions and in the light of the literature.

Chapter 2: Research Background

The following research background consists of three parts. The first part is a historical and theoretical account of memory theory, purposely excluding additional layers of cognitive theories which have been inspired by it. This section presents issues of time and modality; it highlights the significant role of attention and rehearsal, and shows how interference lays obstacles in the path of good memory. The second part of this chapter presents a theoretical background to foreign/second language acquisition and the third part of the literature review presents research which has looked at how the above components of memory theory are implicated in first and second language acquisition theory. Since there is evidence that, to a considerable extent, first language (L1) aptitude is a predictor of second language (L2) aptitude, each of the issues discussed initially relates to L1 and then to L2. The first factors discussed are overall vocabulary and syntactic acquisition (referred to as sentence processing). Language acquisition is then broken down into oral proficiencies of speech perception and production followed by the literacy elements, specifically reading.

2.1 Memory: Historical and theoretical issues

Memory research theories derive from and feed into varying disciplines such as psychology, neurology, language learning, linguistics and medicine. Despite the vast amount of research into memory issues, and possibly as a result of the variety of academic approaches used to tackle these issues, there are no definite answers to many of the questions raised. There are, however, many assumptions made and directions pointed to, some of which are brought out here.

Since memory is so interdisciplinary by nature, there are a considerable number of definitions reflecting different origins of the theories. A very prominent and much quoted figure in memory research is Baddeley, who in defining memory suggests that:

"...It is not one system but many. The systems range in storage duration from a fraction of a second up to a lifetime, and in storage capacity from tiny buffer stores to the long term memory system that appears to far exceed in capacity and flexibility the largest available computer." (Baddeley, 1997 p.3)

A good part of current memory literature relates to this definition in one way or another, and it is in light of this definition that the following explanations proceed.

One of the most common distinctions among memory theorists is the distinction between time and modality. In relating to the time factor, memory research traditionally distinguishes between short-term memory (STM) and long term memory (LTM) or, as it is also called: memory store. Likewise, in relating to the modality factor there is a distinction between visual/visual-spatial memory and phonological/auditory memory. Each of these terms, however, serves as a jumping board to further research and poses yet more questions.

Some questions regarding short term memory and long term memory are: How short is short term memory? Why and when are things transferred into long term memory? What are the criteria? Are short term memory and long term memory points on a line in a unitary memory system or is each a separate, functionally distinguishable system? What do these systems account for in human cognition and how do they operate?

Questions regarding modality pertain to functions of visual and phonological domains. What is visual-spatial memory? Is visual-spatial memory one system or are there two systems, one visual and the other spatial? What is phonological memory and how does it operate? Do visual and phonological memories interact? What does modality account for? Is there an interaction between time and modality?

In order to get answers to some of these intriguing questions, it will be necessary to look at some historical highlights in memory research.

The first person known to try and measure his students' mental capacity was a teacher named Joseph Jacobs, in 1887. Jacobs devised a test in which he presented to his students a growing list of items and asked them to repeat them. The point at which the subject was right 50% of the time was considered his/her memory span. In fact, short term memory tasks nowadays are very much the same, as is the measuring of short term memory span. (Baddeley, 1997)

Short term memory is defined by the way we measure it; thus it is not defined in terms of time but in terms of span, namely the number of items that can be recalled after novel exposure. The average memory span is widely agreed to be 7 plus or minus 2 chunks (Miller, 1956).

The number of items which can be recalled from short-term memory may vary considerably in number depending on their distinctive features. Indeed, a large part of memory experimentation engages in manipulating these distinctive features. It is widely accepted that memory capacity is very much the same for the number of items as it is for the [same] number of chunks (including more items). For example, if a picture of nine dots spread randomly on a board is flashed in front of us for a second and we are subsequently asked to recall the number of dots, there is a fair chance that we will not succeed in doing so. However, if the dots are grouped in three chunks of three dots there is a much better chance of us recalling that there were nine dots on the board. This means that chunking can increase the number of items recalled considerably. For example: phone numbers which are arranged according to some area code are much easier to remember, since the area code is automatically chunked and there are only the additional numbers to remember. Rhythm and prosodic variation in speech are also known to enhance memory span (Baddeley, 1997).

Some of the early theorists viewed LTM as an extension of STM. Melton (1963) argued that memory was a unitary system. He based his claim on the fact that some items stored in short term memory did not transfer into long term memory due to interference of irrelevant information presented either before or after the elements for recall. This, he claimed, provides evidence that both memories are on a line. If not, the interference factors could be dealt with by a different part of the memory system and not inhibit memory span. Criticism of this position maintained that in order to remember, one first has to identify those items to be remembered, and that item identification involved access to the matching item in LTM. This would necessitate a dual relationship between STM and LTM (Bower, 2000). Studies that support this supposition point to experiments which show that verbal short-term memory span is larger for real words than for non-sense words. The fact that an item has a representation in LTM influences the ability to retain it in memory. This is probably due to an automatic scan in search for representations in LTM. It has also been shown that verbal short-term memory span is larger for high frequency and high imageability words than for low frequency and low imageability ones (Collete et al., 2001). These realizations were later supported by neurological experiments using PET (positron emission tomography) scans, which are able to show brain areas involved in cognitive tasks. The aim of the experiments was to determine whether

similar or different cerebral areas were involved in STM tasks for non-words, which do not have representations in LTM, and for real words, which do have representations in LTM. Results showed that both tasks involved activity in a specific location in the brain called Broca's area, which has long been associated with verbal processing. However, when real words were memorized there was also increased activity in areas associated with processing of semantic and lexical knowledge. These areas were not active during memorization of the non-words. The conclusion was that STM and LTM are two separate systems which interact closely with each other (Collette et al., 2001). One of the most influential models dealing with STM and LTM systems, that took this criticism into account, was the modal model devised by Atkinson and Shiffrin in 1968. The modal model did not view STM and LTM as one unitary system, but did maintain that things must register in STM before they can transfer into LTM. According to this model, information from the environment is taken in by sensory registers and transferred to a short term working memory store, where information is dealt with. This store has a reciprocal relationship with LTM: it both uses LTM information for recognition of familiar materials and transforms information into LTM. Atkinson and Shiffrin believed that the longer information stays in STM, the better are its chances of being transferred to LTM (Baddeley, 1997; Andrade, 2001a; Bower, 2000). The modal model's notion of short term memory as a buffer store of working memory was a big leap in memory research, and indeed the notion of STM as a working memory is still the predominant view at the beginning of the 21st century.

The most influential model of memory is the model of working memory which was devised by Baddeley and Hitch in 1974. The following sections present the workings of this model and additions to it by Baddeley himself and additional theorists. Much of the theory and practice hereafter relates to this model as do issues concerning first and foreign language acquisition.

2.1.1 Working Memory

Baddeley and Hitch, were disturbed by evidence which showed that some patients suffered from STM difficulties but did not manifest difficulties with memory in the long term. They decided to question again the whole notion of STM by asking: What is STM for? (Baddeley, 1997). On the basis of the Atkinson and Shiffrin model they

set out to check whether indeed STM functions as a temporary short term store as well as assisting in the performance of cognitive activities. The assumption was that since STM capacity is limited, performing cognitive tasks along with holding information in short term store will impair performance significantly. They developed a series of dual task tests where subjects were asked to perform digit serial recall tasks whilst engaging in a cognitive activity such as answering sentences like: "A follows B- BA (true/false)" (Baddeley, 1997, p.50) The level of difficulty increased as the test progressed. Other cognitive tasks were reading comprehension tasks or serial recall tasks using lists of unrelated words. To their great surprise, although there was a decline in performance in the dual task in comparison to the one task performance, error rate remained the same. What did change was performance time. There was an increase in latency of about 35%. These findings suggest that the component in STM which stores information is not the same component which activates retrieval from LTM as assumed in the Atkinson Shiffrin model (Baddeley, 1997). However, additional experiments which required activation of functions other than retrieval did result in a decline in performance due to increasing digit load. In an attempt to form a model that could integrate both findings, Baddeley and Hitch presented a model in which short term memory is indeed a working memory, but it is not one unitary system. Rather than that, working memory consists of two sub-systems controlled by a central panel. One sub-system, the phonological loop, is responsible for all auditory information, and the other sub-system, the visuo-spatial sketchpad (or scratchpad) is responsible for all visual information. The central executive is the control system which co-ordinates between the two sub-systems (Baddeley, 1997; Andrade, 2001a).

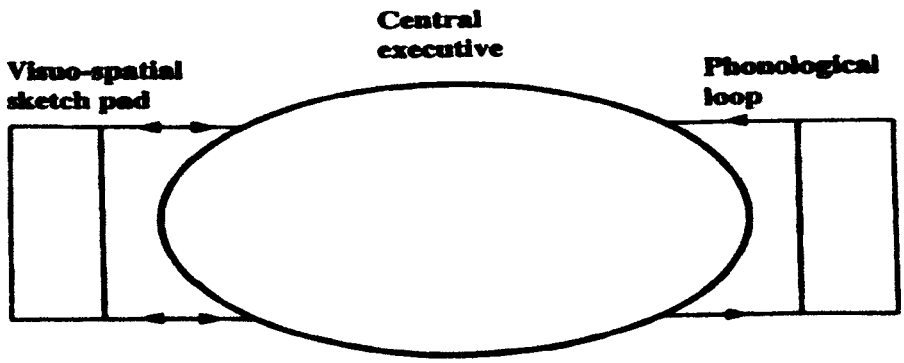

Illustration 2.1: A simplified representation of the working memory model (Andrade 2001a: p.11)

The phonological loop is assumed to consist of two components. One component is the phonological store, which stores speech-based information. The phonological store is very limited in capacity; in fact, after 1.5 – 2 seconds sound traces in the phonological store fade away and are no longer retrievable. The second component in the phonological loop is an articulatory control process, which helps to delay the decay of the sound traces in the phonological store. The articulatory control process rehearses the sound traces by way of inner speech and feeds them back into the phonological store. The articulatory control process is also capable of dealing with visual material by translating it into a phonological code and storing it in the phonological store (Baddeley, 1997).

There has been substantial evidence to back up the notion of the phonological loop. The first piece of evidence is the phonological similarity effect. Conrad & Hull (1964, in Baddeley, 1997) and Baddeley (1966a, in Baddeley, 1997) found that immediate serial recall is impaired when the items for recall sound familiar. For example: for speakers of English R,H,X,K,W,Y are remembered better than P,G,T,V,C,D since they do not rhyme. The phonological loop assumption is that since items are stored in phonological code, storage of similar items, as presented above, makes discriminating among the memory traces harder and results in lower performance. Other evidence is seen in a phenomenon known as the unattended speech effect. In some experiments subjects were shown sequences of numbers and were asked to repeat them back. Performance on this kind of task was impaired if someone read a passage in an unknown language in the background. Similar levels of impaired performance occurred when background interference consisted of real words, nonsense syllables, noise and even music. It seems that all these involve the phonological store and interrupt the phonological loop procedure, resulting in impaired performance (Baddeley, 1997).

Additional evidence for the phonological loop may be found in word length effects. Various experiments showed that long words, on a word recall task, were more difficult to recall than short (i.e. one syllable) words. Moreover, Baddeley, Thomson & Buchanan (1975 b in Baddeley, 1997) found that there is a correlation between the rate at which one speaks and memory span: the faster one speaks, the more he/she can remember. This proved to be true even when the prolonged time to produce speech was due to the fact that subjects' accent produced longer vowel sounds. It is,

therefore, not only the word length, but also the time it takes to produce the words that counts. These findings are in line with the 1.5 – 2 seconds phonological store hypothesis (Baddeley, 1997; Andrade 2001a)

Articulatory suppression causes impaired performance on tasks known to involve the phonological loop. Articulatory suppression is caused by asking a subject to repeat an irrelevant word (for example: *the*) together with a task which involves sub-vocal rehearsal. It was shown that digit span tasks resulted in impaired performance when they were performed with articulatory suppression disturbance. This is presumably due to the fact that articulation of an irrelevant word interrupts the articulatory control process. It both prevents rehearsal of material in the phonological store, and interrupts phonological coding of visually presented material (Baddeley, 1997; Andrade, 2001a).

The phonological loop theory seems to answer for those STM patients with no evident LTM impairment, which prompted Baddeley and Hitch to produce their working memory model. This phenomenon could be explained by suggesting that if short-term memory impairment derives from a phonological store deficit, other cognitive functions such as long term verbal learning may very well function normally, especially since LTM is believed to rely more on semantic coding than on the phonological code (Baddeley, 1997).

Some theorists, however, have questioned the functions of the articulatory loop (Logie, 1995; Hulme, Maughn and Brown, 1991, in Gathercole and Martin, 1996) and articulatory rehearsal as a structural component in working memory (Romani et al., 2005). In the process of doing so, they have challenged Baddeley's claim that word length effects always disappear in conditions of articulatory suppression.

As mentioned before, Baddeley attributed the greater difficulty in recalling lists of long words (as compared with short words) to the fact that the extra time it takes for the long words to be rehearsed in the phonological loop makes their traces more prone to decay. However, in conditions of articulatory suppression there was no difference in recall between long words and short words; in other words, there was no word length effect. Baddeley maintained that this was due to the fact that suppression did not allow any of the words to be rehearsed and therefore there was no difference in recall between long words and short words.

Romani et al., however, set out to show that 1. there are times where word length effects do not disappear under suppression, and that 2. the reason that length effects do disappear does not have to do with lack of opportunity for articulatory rehearsal. They devised three test conditions in both modalities (visual and auditory), one using lists of non words, one presenting lists of real words, and one giving lists of non words which resembled real words. The lists were presented under suppression conditions and the subjects were then asked to recall the words on the lists. Results in both modalities showed that lack of word length effect was apparent only for the real words. The non-words did show word length effects since some very short items could be recalled even in this condition. Romani et al.'s explanation for the disappearance of the length effect for real words was that the real words evoked lexical and semantic representations in memory. Since lexical and semantic cues are not affected by the length of the word, there was no word length effect for the real words under suppression. Interestingly, the non words which resembled real words were less prone to articulatory suppression than complete non-sense words. This was explained by their ability to partially evoke a lexical representation. These results are consistent with these researchers' hypothesis that word length effects are due to the number of phonological units to be remembered and not to the time it takes to rehearse them in the articulatory loop, and that the disappearance of word length effects in situations of articulatory suppression is not due to practice opportunity, but due to the system diverting to lexical and semantic cues which do not depend on word length. These results cast doubt on the articulatory loop component in Baddeley and Hitch's working memory model which associates length and rehearsal (Romani et al., 2005).

There have, however, been many studies across languages that have connected syllabic length to serial recall, so Romani et al. suggest rehearsal as an optional component which can be utilized to increase STM capacity. In light of the above and additional current research, though, it would also be simplistic to say that recall ability is only a time based function of rehearsal or decay (Lovatt & Avons, 2001).

2.1.2 Visuo-Spatial Working Memory / The Visuo-Spatial Sketchpad (VSSP)

The visuo-spatial sketchpad takes in visual information. This information may either be observed in real time via perception or by our creating a visual image in our

imagination (Baddeley, 1997). Unsurprisingly, access to the visual store is visual.

The plausibility of this notion was indicated by experiments using unattended picture effects. In these experiments subjects were asked to face a screen, on which random patches of colour were projected whilst trying to learn a list of words, first by visual imagery techniques and then by verbal rehearsal techniques. The results showed that the unattended pictures disrupted the ability to learn via the visual imagery route significantly, whereas it did not affect the learning via the verbal rehearsal route (Logie, 1986 in Baddeley, 1997; Logie, 1995). Additional evidence for dissociations between visuo-spatial working memory and verbal working memory were presented by De Renzi and Nichell (1975 in Logie, 1995). They described patients with a pathological score on a visuo-spatial task, but with digit span scores of around 7, which is average performance. Similar cases were reported by Hanley, Young, and Pearson (all in Logie, 1995). Neurological evidence points in this direction as well. SPECT (single photon emission computer tomography: a brain imaging technique) tests run by Goldberg et al. (1991 in Logie, 1995) show differential blood flow patterns in the brain during visual imagery tasks and acoustic imagery tasks. Visual imagery tasks pointed to activation in the left inferior occipital region and the left thalamous, whereas acoustic stimuli showed activation of both hippocampal regions and the right temporal lobe (Logie, 1995; Nyberg & Cabeza, 2000).

Further studies have led to the assumption that the visual spatial sketchpad goes into action whilst one consciously creates visual imagery mnemonics, but it does not seem to affect the ability to imagine, visualise and retrieve verbal information from long-term memory. The assumption was made following a series of experiments by Baddeley in an attempt to characterise the visual spatial sketchpad component of working memory. His approach was to try and find a factor, or factors, that disrupt visuo-spatial sketchpad functions, which are generally agreed upon, and check other cognitive functions which are disrupted by the same factors. It was assumed that those cognitive functions involve visuo-spatial activity.

One such factor which was seen to disrupt visuo-spatial functions was pursuit tracking. Pursuit tracking is done by creating a spatial, non-visual task which depends on auditory tracking. The subject is blindfolded and is asked to track a route according to the locations of sounds emitted from an object whilst moving from

place to place (Baddeley, Grant et al. 1975a in Baddeley, 1997; Andrade, 2001a). Baddeley asked some subjects to engage in cognitive tasks whilst tracking. The following task was devised in order to see whether the visuo-spatial sketchpad was involved in facilitating imageability in long-term verbal memory.

The subjects were asked to learn pairs of words, some of which were imageable like: 'bullet-grey' and others were abstract like: 'gratitude-infinite'. They were then told the first word in a pair and asked to say the second one from memory. Later on they were asked to do the same thing whilst tracking. It was assumed that there would be a big advantage to the concrete imageable words and that tracking would severely impair performance. The results, however, were not exactly as expected.

The results showed that: 1.the concrete words were easier to recall. 2. there was a decrease in memory due to tracking. But: 3. there was no difference in memory decrease between the concrete words that were imageable and the abstract words that were not imageable. The conclusion was that the imageability effect does not depend on the visuo-spatial sketchpad, or else there would have been a much greater difference between recall of imageable and non-imageable words while tracking, which is known to impair functions dependent on the visuo-spatial sketchpad (Baddeley, 1997). The big advantage in recall for the concrete imageable words without tracking could be attributed to the fact that they are represented with greater impact in long-term semantic memory, as proposed by Jones (1988 in Baddeley, 1997; Baddeley, 2000).

One hypothesis is that the visual spatial sketchpad has no influence whatsoever on long-term memory, which is highly unlikely, and another is that there are specific instances when images are retrieved from long-term memory and surface on the visual spatial sketchpad for further activation (Baddeley, 1997).The latter possibility was checked by Baddeley by testing whether tracking, which is known to impair visuo-spatial sketchpad functions, interferes with visual imagery mnemonics. It was found that it does (Baddeley, 1997).

The above results suggest that visual imagery mnemonics operate by surfacing onto the visuo-spatial sketchpad whilst interacting with new information. In this instance, it is this interaction between new information and visual imagery mnemonics stored in long-term memory that triggers remembering.

Logie (1995) goes one step further and suggests that visuo-spatial working memory (VSWM) always accesses long-term memory representations first. Among the experiments Logie relates to are studies of ambiguous figures. Loggie used the famous duck-rabbit figure which was introduced into psychological research by Jastrow in the 1890s (Pettit, 2007). When shown figure 2.2 for a period of five seconds, some subjects said they had just seen a duck, whereas others said it was a rabbit.

Illustration 2.2: Example of an ambiguous figure

(Logie, 1995: p.38)

Numerous interpretations have been given to this phenomenon. However, Logie interpreted it in the context of the VSSP of working memory. Logie believed that the fact that different people saw different things suggested that visual stimuli do not enter the VSSP as a station on the way to long-term memory. If this were the case all people would have given the same response since they had all seen the same thing. Instead, it seems that a visual stimulus first activates some subjective representations in long-term memory. This is why in some subjects' LTM it evokes the representation of a duck, whereas in others' it evokes the representation of a rabbit. The interactions between visual stimuli and LTM representations surface on the VSSP for further activating in working memory and eventually each individual will remember what he/she had seen. Logie asserts that auditory stimuli work in very much the same way with the phonological loop (Logie, 1995). The same suggestion was made by Kemps (2001), who tested visuo-spatial recall by block design and was able to show that one prior repetition of a complex block task facilitated recall. The presumption was that assembling the path of designs created representations in LTM which later interacted with visuo-spatial working memory (Kemps, 2001).

Research has shown that visuo-spatial working memory improves with age (Pickering, 2001). The improvement is partially attributed to children's ability to use

phonological, as well as visual, cues for retrieving visually presented material. Pickering (2001) presents research by Longini and Scalisi which shows that young children (approximately 5 years old) do not engage in any conscious activity while activating memory codes and that activation is automatic. Consequently, there can be no switching between visual and phonological codes and, therefore, at this developmental stage visually presented information is retrieved via visual memory codes whereas information presented in spoken form is retrieved via phonological codes. Older children, however, can activate both visual and phonological memory codes while retrieving visually presented information, a fact which may influence the development of visuo-spatial working memory (Pickering, 2001). However, improved performance on visuo-spatial working memory tasks is unlikely to be due only to the addition of phonological coding to the process. A number of additional factors are thought to be involved in this developmental process (Pickering, 2001). The first has to do with overall visual spatial knowledge (acquired with age and experience) which may facilitate information encoding by chunking it. It is also suggested that coding and retrieval are enhanced by familiarity (acquired with age and experience as well). An experiment by Pickering and Jarrold (2001) showed that performance on a visual spatial working memory task was better when the stimuli had high pattern likeness. These results are similar to those found by Kemps (2001) mentioned above. It is suggested, therefore, that familiar structures are better coded in, and retrieved from, visual spatial memory (Pickering and Jarrold, 2001, in Pickering, 2001). The second factor thought to be related to the development of children's visuo-spatial working memory is the use of processing strategies which develop with age (Schneider & Sodian (1997) and Miller (1990) (both in Pickering, 2001). A third factor which may be related to improved visuo-spatial working memory is processing speed, which is thought to improve with age due to neurological maturation. It is suggested that faster processing reduces decay and interference. Although there is no hard evidence that links processing speed with better performance on visuo-spatial working memory tasks, there are anecdotal observations which support this link. The final factor suggested by Pickering to be related to children's development of visuo-spatial working memory is attentional capacity, which is thought to be a developmental process since it is neurologically linked to frontal lobe activity that reaches the stage of maturation in adolescence. Attentional capacity is linked to both attention and inhibition which are theorized to

be in the domain of the central executive that is thought to play a significant part in performance on visuo-spatial tasks. Therefore, improved attentional capacity may be related to the development of visual spatial working memory (Pickering, 2001). We will see whether the development of visual spatial working memory, as described above, can be reflected in the development of certain aspects of foreign language acquisition.

An additional question posed in an attempt to characterise the visual spatial sketchpad is whether the visual system is visual or spatial. It is now generally agreed that it has both visual and spatial elements which interact with each other. Neuro-psychological research reinforces this approach and maintains that the visual system consists of two sub-systems. One sub-system processes information that has to do with what is seen and the other locates the '*what*' in space and processes information dealing with the *'where'*. Each sub-system is believed to have a different location in the brain. The sub-system dealing with visual images is presumed to rely on the occipital lobes, whereas that dealing with spatial information is said to be dependent on the parietal lobes (Ungerlieder & Mishkin, 1982; Weiskrantz,1986; Hunphreys and Riddoch, 1987 all in Baddeley, 1997).

Once again, Logie takes this theory one step further and maintains that there are two completely separate visual elements in working memory: one visual and the other spatial. He bases this assertion on an experiment (Logie & Marchetti, 1991 in Logie, 1995) where subjects were required to retain visual information and spatial information (separately) for ten seconds before recall. In those ten seconds, subjects were first instructed to engage in hand movements, a task which has been known to interfere with spatial tasks (Quinn, 1988, 1991 in Logie, 1995). In a second trial, during those ten seconds, subjects were shown irrelevant pictures, a task which has been known to disrupt visual retention (Logie, 1986, in Logie, 1995). Results showed that the hand movements did indeed disrupt the spatial tasks but not the purely visual ones, whereas the irrelevant pictures disrupted recall of the visual images but not of the spatial positions. These results point to the fact that visual and spatial systems may very well be two separate systems that work in co-ordination rather than one multi-functional system (Logie, 1995).

This suggested separation between the ability to perceive visual and/or spatial imagery is supported by evidence from brain damaged patients who are able to deal

with visual but not spatial information and vice versa (Farah et al., 1988; Luzzatti et al., 1998, in Pickering, 2001a; Della Sala, Gray, Baddeley, Allamano and Wilson, 1999).

However, notwithstanding the research presented above, visual spatial working memory is far from being fully conceptualized and understood. Pickering (2001a) warns against a premature conceptualization of visuo-spatial working memory and maintains that although there is hard evidence for dissociation between visual and spatial working memory, there may be additional, perhaps, overlooked distinctions such as a distinction between static and dynamic tasks. Pickering suggests that adopting a common research language between cognitive psychological researchers, neuropsychological researchers and neuro-anatomical researchers would serve to focus and advance visuo-spatial working memory research.

Although the issue of one multi-element component or two separate systems has remained unresolved, there is extensive agreement as to the functions of the VSSP, many of which have to do with language and literacy.

2.1.3 The Central Executive

The idea of a central executive was conceptualised by Baddeley and Hitch (1974, 1986 in Baddeley, 1997) in the light of experiments which demanded storing information in memory whilst engaging in other cognitive activities. The claim was that both storing and processing are controlled by one control system which is the central executive. Dual task performances involving both processing and storage pointed to the fact that the central executive has a limited capacity. It was shown that an increase in storage demands has the effect of impairing processing ability and an increase in processing demands has the effect of impairing storage capacity (Andrade, 2001a). Viewing the central executive as a dual task performer led to theories which saw it as accounting for attention in addition to retention (Andrade, 2001). Since the central executive was also believed to be the coordinator between the subsidiary systems, some of the relevant questions to be asked were: How is information from the slave systems coordinated? What are the strategies used to deal with simultaneously flowing information? How do attention and retention interact? (Baddeley, 1997; Baddeley, 2000) The original working memory model, however, left the central executive somewhat unspecified. The complexity of coordinating the

various elements coming from various modalities whilst processing and storing simultaneously led Baddeley to adopt the Norman and Shallice (1986) Supervisory Attentional System (SAS) model as a central executive component (Barnard et al., 2001).

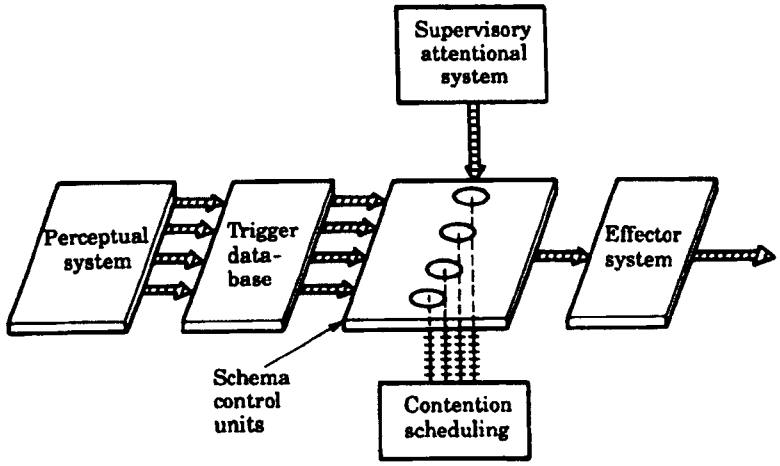

Illustration 2.3: Supervisory Attentional System (SAS) model

(Baddeley, 1997: p. 91)

In this model, ongoing information from the perceptual system triggers a person's data-base.

If one, or both, of the actions are of a well learned skill, they can operate quite automatically simultaneously. For example, a skilled driver is able to drive and think about other things without disrupting either one of the activities. However, it sometimes becomes necessary to give priority to one activity over the other, as is the case when driving, talking and encountering an unexpected event on the road. The Norman and Shallice model accounts for prioritizing with an inhibitory factor named contention scheduling. Contention scheduling enables one of the activities to take priority quite automatically without the need to consciously weigh the options. In the examples given above the driver does not say: 'If I go on driving I will run over this man, but I would really like to complete my line of thought. What shall I do?' Contention scheduling enables us to momentarily give priority to driving until the crisis is over, and then resume both activities.

It sometimes becomes necessary to stop automatic activities in order to make

conscious cognitive decisions. For example, sometimes both driving and talking need to be interrupted in order to make a decision as to which way to go. The component in this model which accounts for such processes is the supervisory attentional system (SAS) which gives its name to the model itself. The SAS component differentiates the Norman and Shallice model from other models devised at the time, since it allows for will to be a part of the controlling system, and accounts for the regulation of both automatic and non-automatic actions or thoughts. It is this SAS element that caused Baddeley to view this model as a possible basis for realizing the central executive functions of working memory.

In the final stages of information processing the filtered information goes through an effector system which activates the actions or thoughts. If thoughts are to be activated, it is the effector system which can place the information in short-term store in order to activate or trigger the data-base which can start the process all over again (Baddeley, 1997). It may be that a similar SAS element accounts for the level of fluency in EFL language production.

Evidence from brain imaging supports the existence of a central executive function. Functional magnetic resonance imagery is a technique that can show the brain activity involved in cognitive tasks. FMRI studies showed that specific frontal areas were activated when tasks were done simultaneously, but were not activated when each task was done separately. They also showed that different specific areas were activated during planning and reasoning. Additional FMRI studies even pointed to a hierarchical model where separate areas within the frontal and prefrontal cortex were activated according to the complexity of executive tasks (comparing two items versus manipulating multiple information items in working memory) (Nyberg & Cabeza, 2000). Task performance of frontal lobe patients seems to reflect these findings as they manifest difficulties in switching and dividing attention (Baddeley and Wilson, 1988, in Barnard et al., 2001). Norman and Shallice also offered evidence to support the SAS model from neuro-psychological patients, specifically those suffering from a frontal lobe syndrome. One of the typical impairments in such patients is that they manifest behaviours of perseveration, i.e. they cannot stop an ongoing activity or rule governed behaviour in order to pay attention to new information, or learn new rules (Baddeley, 1997).

Given this persuasive evidence, the central executive SAS has now been

incorporated into the working memory model as a processing system that takes care of strategy switching, selective attention, retrieval from long term memory and dual task co-ordination (Baddeley, 1996 in Andrade, 2001a).

The main criticism of the central executive and/or the SAS component in the working memory model is that there is inadequate specification as to the way it functions and there certainly is no mention as to situations where it fails to function. In part this is due to no clear definition of and distinction between resources for processing and resources for storage, and in part it is due to no clear statement as to how the central executive communicates with the slave systems (May, 2001).

Being a sophisticated processing system, the central executive is implicated in the higher orders of first and second language acquisition. It is specifically implicated in speech perception and production where information is processed on-line and in higher levels of reading comprehension, where there are multiple instances of inferring and referring. An account of central executive roles in the acquisition of LI and L2 will be given in section 2.3.

2.1.4 Weaknesses of the working memory model

One of the main criticisms of the working memory model refers to its being too simple. Another criticism relates to the central executive. Since there has been no specification as to which cognitive functions are within the domain of the central executive and which are not, it is difficult to show a direction of causality. In other words, does working memory facilitate the development of other cognitive functions or vice versa? In addition, there is a tendency to associate everything which cannot be attributed to the phonological loop or to the visuo-spatial sketchpad to the under-specified central executive, which means that working memory cannot really be tested. Finally, it is unclear which domains are not implicated by working memory (Andrade, 2001b).

In light of these criticisms, Baddeley (2000) has proposed an additional component to the working memory model: an episodic buffer. The episodic buffer has a limited capacity and is said to integrate information from the visuo-spatial sketchpad, the phonological loop and long-term memory into unitary representations or episodes. It is also said to serve as a workplace for further manipulating oncoming data from working memory and long-term memory. The episodic buffer component attempts to

tackle some of the issues felt to be unresolved in the original working memory model. It relates to the issue of interaction between working memory and long-term memory and to the issue of a suitable workplace for the combined information from both modalities after being processed by the central executive (Andrade, 2001b).

The episodic buffer is probably not the final word in working memory theory, but it is generally considered to be an important upgrade for the well established working memory model (Andrade, 2001b).

2.1.5 Strengths of the working memory model

Although some maintain that the simplicity of the working memory model is a drawback, others view it as one of its major strengths. In fact breadth and simplicity give this model its power and durability. The working memory model is broad as it covers issues of modality (visual as well as auditory) and it distinguishes between, and deals with, both processing and storage. The fact that it is uncomplicated has made it a very useful tool for applied research, which leads to an additional advantage: the working memory model has gained a very strong position in cognitive psychology and much research relates to it as a baseline starting point (Andrade, 2001b). Interestingly, current research has shown that the basic structure of working memory is apparent in children from approximately 6 years of age, that the basic proportions between the components remain the same and that its functional capacity can undergo functional expansion (Gathercole, Pickering, Ambridge, Wearing, 2004). These findings make the framework of working memory a stable benchmark in future research.

My research incorporates many theories of working memory since in language research separation between the modalities is essential to understand literacy as opposed to oral comprehension and production, and the distinction between processing and storage is necessary in order to discuss certain aspects of language which demand varying degrees of both. I feel that the strengths of the working memory model far outweigh its weaknesses and that it is a valid tool for this research.

2.1.6 Long-Term Memory

As opposed to short-term memory, long-term memory literature is not analysed in

terms of modality. The focus is rather on why some things stay in one's memory while others do not. Transfer of information into the memory store involves a process of learning which leads to accumulation of knowledge. The accumulation and retention of knowledge independent of the specific episodes where the information had been acquired is called semantic knowledge, and is held in semantic memory. For example, academic knowledge, whereby one accumulates information presented in class or read in books, is mainly semantic (Baddeley, 1997). Foreign language acquisition, which is the focus of this research, involves semantic knowledge, as do some of the memory tests used in this study. Some factors involving semantic knowledge influence processes of storage in long-term memory and have been at the heart of memory research for many years. These factors are attention, practice, and interference. A comprehensive account of these factors is beyond the scope of this chapter; however, since these factors are relevant to the research itself, brief explanations are presented.

2.1.7 Attention

In a classic work on attention by William James (1890, in Schmidt, 2001) he notes:

*"Everyone knows what attention is. It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration of consciousness, are of its essence. It implies withdrawal from some things in order to deal more effectively with others."(*James (1890) in Schmidt, 2001. p.12*)*

It has been shown that without paying attention to semantic information there is very little chance of it being stored in our memory store (Baddeley, 1997). In the Atkinson and Shiffrin modal model (1968 in Brown & Craik, 2000) attention is a prerequisite for information to proceed into the more durable stores. In his book *Human Memory Theory and Practice* Baddley presents an interesting incident concerning attention. It so happened that the B.B.C decided to change wavelengths. Details as to the new wavelengths were broadcast several times for several weeks in various ways. However, as Baddeley noticed, although he himself had heard this information several times, he could not recall the actual details, probably due to the fact that he had not consciously paid attention to what was being said. The information did not register in long-term memory, notwithstanding the frequent exposure to it (Baddeley, 1997). Additional experiments support the notion that lack of attention, or reduced attention, at the stage of learning inhibits the process of storage in the memory store

(Moscovitch, 2000).

A basic view concerning attention is that it is limited in capacity, namely, one can only pay attention to a limited number of things at one time (Broadbent, 1958; Kahneman, 1973, Van Patten, 1994 in Schmidt, 2001). It was found that when two lists were being read out simultaneously, and subjects were asked to repeat one and ignore the other, information could not be held in memory for more than five seconds. It would not stay in memory even if repeated several times (Glucksberg and Cowan, 1970, Murdock, 1965 in Baddeley, 1997). A somewhat different approach was taken by Wickens who saw attention as a multiple but specific resource pool which takes into account brain hemispheres, processing resources and modalities. Wickens showed that attention-demanding activities could be performed better when the attention was divided between the modalities (auditory and visual). Notwithstanding, it was still agreed that the sum total of the resources are still limited (Schmidt, 2001) as was seen in a study where attention was divided between an auditory task of word list recall and a card sorting task. The more complicated the card sorting task became, the fewer words were recalled from the list, presumably due to reduced attention resources available for internalizing the verbal information (Murdock, 1965, Baddley and Hitch, 1974; Baddeley at al, 1984a, in Baddeley, 1997).

An additional characteristic of attention which has been widely agreed upon is that attention is selective. Perhaps due to the limited capacity, attention chooses to focus on one oncoming stimulus rather than on another. Attention is also voluntary in the sense that one can direct attention to specific things. However, there exists an element of involuntary attention which might distract voluntary attention from target. This was demonstrated clearly by the fact that in stroop effect experiments where the word *red* was coloured in green there was clear interference in the ability to name the colour (Dalrymple-Alford & Budayr, 1966 in Schmidt, 2001).

Finally, it is generally agreed that attention is essential for learning. As shown in the modal model and the working memory model, without attention all verbal information would probably decay after a few seconds. In order for information to be moved on to long-term memory it must first be paid attention to (Schmidt, 2001).

Attention issues are very relevant to some aspects of first language acquisition and to all aspects of foreign language acquisition, since foreign language learning is not

automatic and continually involves the need to consciously absorb new information. Does this mean that everything paid attention to will actually be stored in long-term memory? The answer to this is negative; there are additional factors which come into play, one of them being practice or rehearsal.

2.1.8 Rehearsal

"According to our forebears, practice, repetition and frequency lie at the heart of all learning" (Baddeley, 1997, p.108)

The first to explore scientifically the relationship between practice and learning was Herman Ebbinghaus in 1885 (Ebbinghaus, 1913). In a series of experiments he found a linear relationship between practice and retention in memory. In the light of his experiments Ebbinghaus concluded that 1. the amount of material learnt and retained in memory is a direct function of the time spent practising it, namely, the more one practises the more one remembers. 2. Practice distributed over time leads to better memory than practice undertaken in one concentrated period of time (Baddeley, 1997). Although current memory research may deem these findings oversimplified, by and large current findings point in the same direction (Ward, 2001; Brown and Craik, 2000). Miller added that the time given to learning should indeed be actively used for learning; otherwise these observations were no longer apparent (Miller, 1971 in Baddeley, 1997).

Many years after Ebbinghaus, two very influential memory models incorporated rehearsal as an essential factor. The Atkinson and Shiffrin modal model maintains that after adequate attention has been paid to presented information, the chances of its being transferred into long-term memory depend on the amount of rehearsal one has engaged in (Ward, 2001; Brown and Craik, 2000). The Baddeley and Hitch (1974) working memory model on the other hand contains the articulatory loop component (see illustration 2.1 above) which acknowledges the need for rehearsal to prevent decay (Gathercole & Martin, 1996; Ellis, 2001; Baddeley, 1997).

Whereas the notion of 'more practice more learning' is quite straightforward, the notion of distributed practice is less so. How distributed should practice be and over what periods of time? What kinds of things are being practised? How much should be practised at a time? Unfortunately there are so many parameters involved that to

this day there is no agreed theory.

Interestingly, the British Post Office offered a unique opportunity to look at the effect of the amount of practice per day on performance. Some years ago many British postmen were required to learn typing due to a systematic change in postal procedures. The British Post Office approached the Applied Psychology unit at Cambridge University. The question was whether to give the workers a concentrated crash course on typing, or whether to distribute the lessons and give them fewer lessons each day over a longer period of time. In order to answer this question four groups were formed. The first group received a one-hour lesson once a day, the second a one-hour lesson twice a day, the third a two-hour lesson once a day and the fourth two two-hour sessions twice a day. Results showed that the group receiving a one-hour session once a day learnt the keyboard faster than the others, made fewer mistakes and showed the best retention of the material over time. The fourth group, who had received two-hour sessions twice a day, performed the worst. The implications were that short periods of learning distributed over a longer stretch of time were better than long periods of massed learning over a short period of time (Baddeley, 1997). One assumption is that after longer intervals items are encoded somewhat differently from previous encodings. This would mean that spaced rehearsal would presumably leave a richer encoding trail which will be easier to hold on to during recall (Brown & Craik, 2000).

Another assumption is that storage of information in the memory store involves physiological changes in the brain. These depend on neuro-chemical activities which require certain chemical substances. It is assumed that mass learning which puts heavy demands on certain areas of the brain for long periods of time leaves insufficient time for these chemicals to regenerate, resulting in diminished storage in long-term memory (Baddeley, 1997). Attempts to examine the interval length effect on learning words and non-sense syllables did not yield any conclusive results. However, some studies showed that recall ability improved when intervals between presentations of the item for recall were longer. This was seen to be so even when the intervals were filled with other items (Melton, 1970).

These findings seem to pose an additional difficulty: on one hand we are told that long intervals between items facilitate learning, but on the other hand long should not be too long. It must stay within the limits so that correct recall will, in turn, enhance

memory. Landauer and Bjork suggested that "...the optimum is to test a given item at the longest delay compatible with correct recall." (Baddeley, 1997, p. 112) The notion of longest delay here is subject to change. The more an item has been repeated and recalled correctly, the longer the delay can be (Baddeley, 1997).

The observation that longer intervals between presentations and recalls enhance memory is supported by rehearsal theory which suggests that the very activity of rehearsal through recall reduplicates the same cognitive pattern as when the information was initially encoded. In other words, the process of rehearsal is very much the same as the process of perception, and each additional recall phase resembles an additional study phase (Kolers & Roediger 1984; Craik, 1983; Craik & Lockhart, 1972 all in Brown and Craik, 2000). Similar suggestions were made by Kemps (2001) who maintained that correct recall of an item, in itself, facilitates learning since using the retrieval route strengthens the storage in long-term memory (Kemps, 2001).

The above findings have established the necessity of attention at the stage of perception and showed that the quantity of practice over time is a relevant issue in memory research. However, there is also the question of the *quality* of practice to take into consideration. The studies brought forth, so far, have presented rote forms of practice. The following section presents a different form of rehearsal, which is, in fact, thought to be more efficient in triggering memory: elaborate rehearsal or processing.

2.1.9 Processing

It was at the beginning of the 1970s that many researchers began to realize that the transformation of information from short- term store into long-term store is not a direct function of time spent in the short-term store or a function of rote rehearsal, and that these processes are much more complex (Baddeley, 1997; Craik and Watkins in Andrade, 2001a).

Craik and Lockhart suggested studying the actual processes which contribute to memory, rather than focusing on theorized memory structures. They maintained that those elements which remain in memory are facilitated by traces left behind after the process of processing. According to this theory, by following these traces one can recall the original information. Moreover, they suggested that processing is not

always the same. There are, rather, various levels of processing ranging from very shallow processing to deep processing. The deeper the levels of processing, the more substantial are the traces, and the easier it is to recall the original information. They also tended to go along with existing research claiming that short-term memory is usually associated with phonological processing, whereas long-term memory is generally associated with semantic processing. However, in their opinion, modality issues are secondary to the main issue which is the processing itself (Baddeley, 1997; Brown and Craik, 2000).

Owing to their belief that deeper processing leads to better memory, Craik and Lockhart distinguished between two types of rehearsal: maintenance rehearsal and elaborative rehearsal. Maintenance rehearsal is said to fill a short-term function, very similar to that fulfilled by the articulatory control process in the phonological loop, namely, preserving information for a few seconds until it either disappears, or remains, depending on what is done with it. Long-term learning, however, depends on elaborative rehearsal which involves deeper processing (Baddeley, 1997; Brown and Craik, 2000).

In an experiment reported in Craik and Tulving, 1975, they set out to examine the relationship between levels of processing and memory. In this experiment subjects were given three lists of unrelated words and were asked to perform three different kinds of operations with the words - one operation per list. The subjects were not told ahead of time that they were going to be tested so as to reduce the use of additional memory strategies. The first task was to decide whether the words on the list were written in lower case or upper case letters. The level of processing involved in performing this kind of task is quite shallow. The second task, which demanded an intermediate level of processing, was to decide whether a word on the list rhymed with a word presented by the examiner. For example: *"Does the following word rhyme with mat? -----(hat)"* (Baddeley, 1997 p.116) The third task was to decide whether a given word could fit in a given sentence. For example: *"(meal) The man had his* _____." (Baddeley, 1997 p.116) This third task required deep semantic processing. The results conclusively showed that the list remembered best was the one which required the deepest levels of processing (Craik and Tulving, 1975 in Baddeley, 1997; Brown and Craik, 2000). Similar results were seen in foreign language vocabulary acquisition (Hulstijn, 2001). In a recent multi-component study,

subjects were asked to recall word lists presented auditorily in several conditions: listening to the words; writing the words for recall; writing the second letter of the words; counting backwards by threes whilst writing the numbers and simultaneously listening to the words. The results showed that the highest recall levels were when participants wrote the words or the second letter of the words. This is presumably due to the fact that they needed to be highly focused and engage in elaborate rehearsal (Seamon et al., 2003).

Although these results seemed conclusive, the theory of levels of processing has proved to be problematic and has encountered criticism. The first weakness was in the ability to measure levels of processing. How can we measure levels of processing? Is it the case that when information has been well remembered we say that it has undergone deep processing and when it has not been well remembered we say that it has undergone shallow processing? An additional difficulty is that there are no objective means to measure levels of processing. Rather, there is an assumption that the visual perception of letters requires a lower level of processing than the phonological perception of rhyme and that both visual and phonological coding require a lower level of processing than semantic coding.

The second weakness in this theory is that at the time when Craik et al. developed their theories concerning processing, processing was considered serial. Reading, for example, was believed to consist of a series of processing stages beginning with visual perception, followed by phonological decoding and eventually given semantic value. Current theories assume that processing is much more simultaneous and that visual, phonological and semantic processing operates in parallel at several levels. This weakens the basis of the notion of levels of processing. The third weakness has to do with the notions of shallow and deep processing being relative and depending on conditions of retrieval. The same level of processing can prove to be shallow for one purpose and deep for a different purpose. For example a song which includes both words and melody can be processed in terms of melody or in terms of content. Processing in terms of content would probably prove to be shallow in terms of retrieving the melody while processing in terms of melody would probably be shallow in terms of retrieving content, hence the whole concept of processing-depth may be quite subjective.

Despite these weaknesses, the fact is that, measurable or not, the more we *do* with

information presented to us, the more we remember it. In Baddeley's own words:

"My own view on the concept of levels of processing was that although it had limited theoretical power, nevertheless it was likely to prove a useful rule of thumb." (Baddeley, 1997 p.118)

As mentioned above, one of the assumptions behind the concept of levels of processing was that the deepest processing was a rich semantic processing and although there was no way to measure the depth, semantic coding seemed always to yield the best results.

It is generally agreed amongst theorists that the ability to remember specific items has to do with the ability to distinguish between the target memory trace and other irrelevant traces. This idea has been supported by experiments in the area of phonological short-term memory, where it was seen time and again that recall of similar items was considerably more difficult than recall of non-similar items. This was attributed to the fact that similar items leave similar traces, which are difficult to distinguish between (Baddeley, 1997; Andrade, 2001a, Bower, 2000; Gathercole & Martin, 1996). One way to explain why semantic coding yields better results is to show that semantic coding leaves more distinguishable traces. In a series of experiments, several words were presented for different types of processing and then were presented, together with distracters, for recognition. Non-words presented by phonological code alone were remembered less than words, which were presented by semantic code. The assumption was that whereas phonological coding leaves only phonological traces of sound, which survive for only a few seconds, semantic coding leaves several traces such as the physical attributes of the item (colour and shape), functions of the item, one's personal feeling towards this item etc. Consequently, in the incidence of semantic coding the path of traces is wider and clearer (Baddeley, 1997).

It has also been seen that within the semantic coding words that have a concrete image, such as *table* or *horse*, are remembered better than abstract words such as *truth* or *imagination.* This is probably due to the fact that the traces they leave are imageable and can evoke the visual picture of the word in addition to the phonological trace. In this case, there is double coding: visual and phonological. Underlying this kind of interpretation are two basic assumptions: 1.The more distinctive features one encodes, the better he/she can remember. 2. Semantic

encoding yields more distinctive features.

The evidence above shows that processing could be viewed as a more sophisticated kind of practising than simple rote practising. It also points to the fact that processing activities are efficient for storing items in memory. However, whether or not processing should be viewed in terms of levels, and how to measure those levels, are as yet unresolved issues.

Rehearsal in all its forms is an essential factor in foreign language learning. Some of these theories have been incorporated into foreign and second language theories as will be discussed later. It will be interesting to see how foreign language acquisition reflects these theories of practice and processing in general, and how the theories are implicated by the factor of individual differences presented in this research, in particular.

So far, the literature I have presented considers memory structures and theories. There is, however, an additional possibility: to look at memory by changing the vantage-point from theories of memory to theories of forgetting. Is it simply the case that forgetting equals inability to remember? The following section moves to look at what is known to inhibit and disrupt memory. One of the factors which are known to inhibit memory is interference.

2.1.10 Interference: Retroactive and Proactive

The notion of interference refers to information (similar in nature to the target information), which is, nevertheless, not a part of the target information, and which inhibits the absorption of target information. As such, interference is divided into retroactive and proactive interference. Retroactive interference refers to disturbance caused by materials presented after the target information, whereas proactive interference refers to disturbance caused by items presented prior to the target information (Bower, 2000).

2.1.11 Retroactive Interference

McGeoch and McDonald (1931) found that newly presented items interfere with the retention of formerly studied materials. Moreover, they also noticed that the more similar the newly presented items were to the original material, the bigger the interference (McGeoch and McDonald, 1931 in Baddeley, 1997). In traditional

retroactive interference studies subjects are asked to learn two lists of words, list A and list B, where each word in list A has an association with a word in list B. They are then immediately asked to engage in an additional study phase where list A words are the same but have different associations in a new list: list C. It was found that recall of the first A-B lists was seriously impaired after having learned the A-C lists, presumably due to retroactive interference. In a control condition subjects were allowed to rest or engage in a different activity after learning the first A-B lists, and were then asked to recall them. Recall levels in this condition were much higher (Bower, 2000). Subsequent theorists attempted to measure the amount of learning and the amount of forgetting as a function of rehearsal and interference. They asked subjects to repeat complex sentences allowing them two, four or eight repetition rehearsals. After a rest period, they were asked to recall the sentences. In a following trial, the subjects were presented with sentences in the same way; however, this time there was no rest period. Instead, the subjects were presented with additional complex sentences, after which they were asked to recall the first set of sentences. Results showed that the amount of learning was a direct function of the number of repetition trials, and the amount of forgetting was a direct function of the number of interfering trials (Slamecka, 1960 in Baddeley, 1997). Similar results were later reproduced in list trials by Postman, who also concluded that the more one learns the target response list the less it is vulnerable to interference and the more interfering trials there are, the more vulnerable the target list is to interference (Postman, 1971 in Bower, 2000).

The interval between learning two association lists (A-B and then A-C) is also of importance. Longer intervals result in less interference. Furthermore, the longer time there is between the second (A-C) learned lists and testing, the less retroactive interference. One possible explanation is that the associative strengths which have been suppressed by the interfering factors have more time to recover, and the interfering factors begin to fade. It is important to state that although paired associations are a common way to illustrate interference, interference is apparent in all learning situations (Bower, 2000).

An additional aspect of retroactive interference was studied after realizing that witnesses in court can be easily misled by specific phrasing of the questions. This led to a study devised by Elisabeth Loftus in 1977. Loftus showed people a film portraying a road accident, after which they were asked to estimate the speed of the

cars. The questions, however, were phrased differently for each group, the difference being in the verb that described the actual contact between the two cars. The verbs included *contacted; bumped; hit; collided; smashed.* Apparently, people's estimation as to the speed of the cars was influenced by the verb used in the question, presumably due to retroactive interference (Loftus & Loftus, 1977 in Baddeley, 1997).

Later research questioned whether retroactive interference actually destroys the original information or only disrupts it. Findings are inconclusive. Some studies indicate that the original information does not exist any longer (Loftus and Loftus, 1980 in Baddeley, 1997), whereas others maintain that in certain circumstances the original information may be regenerated and has, therefore, not been destroyed (Bekerian & Bowers, 1983 in Baddeley, 1997; Jacoby et al., 2001).

One of these models devised by Jacoby, Hessels and Bopp suggests that retroactive interference does not cause an unlearning situation, but only influences accessibility to the formerly presented materials. The allegedly lost information could actually be recalled by supplying valid priming cues (Jacoby et al., 2001; Koriat, 2000).

2.1.12 Proactive Interference

Amongst the first to relate to proactive interference as a psychological phenomenon was a 19th century German psychologist named Hugo Munsterberg. He noticed that whenever he put his watch in a different pocket, he always automatically reached for it in the pocket it had been put before. It seemed that prior information interfered with register of later information. In the middle of the 20th century, an interference theorist named Underwood set out to check proactive interference systematically. What attracted Underwood's attention was the fact that subjects who had studied a list of non-sense syllables exhibited substantial forgetting 24 hours later. This could not be attributed to retroactive interference since they were not presented with additional lists. Therefore, it presumably had to do with something which had occurred before. Underwood's assumption was that since he had worked with the same subjects for quite some time, lists of words which had been presented before created an interference effect leading to decrease in the retention of items from the last list. A systematic study of this phenomenon showed that the amount of forgetting was a direct function of the number of prior experiments, namely, the more prior

experiments, the less retention there was (Baddeley, 1997). A traditional method to check proactive interference with paired (A-B and A-C) association lists is to examine the decline in recall of the second A-C list after having first learnt the A-B list. In the control condition subjects only learn the A-C list and are asked to recall it (Bower, 2000).

Intervals between learning the lists have a similar effect on proactive interference as they have on retroactive interference, namely, longer gaps between the lists reduces proactive interference. However, as opposed to retroactive interference, proactive interference becomes stronger when the interval after the second learned (A-C) list to testing is longer. This is attributed to the fact that the A-B list, which has been suppressed by the more recent A-C list, begins to recover thereby interfering with the second learned A-C list (Bower, 2000).

There is, however, a possibility that forgetting is not only a function of proactive interference. It could be that subjects who are presented with lists of words in order to examine interference become more and more skilled at learning the words. Consequently, it may be that the number of repetitions needed in order to learn the last list is smaller than the number of repetitions needed in order to learn the former ones. It may very well be that less repetition leads to less retention in long-term memory. In this case it would be difficult to say whether the decrease in retention was caused by proactive interference or less practice (Baddeley, 1997).

An interesting observation concerning proactive interference is that just as spaced practice reduces interference, massed practice in laboratory conditions is very prone to interference (Underwood & Ekstrand, 1966, in Baddeley, 1997; Bower, 2000). However, is it not the case that most memory research is done under massed practice laboratory conditions?

Lustig and Hasher (2002) note that working memory span as a whole might be prone to proactive interference. They tested two groups of people. One group had never before undergone psychological experiments, and the other had taken two WMS (working memory span) tests before the target one. Results showed that the experienced group had smaller WMS than the naive one. These results were interpreted in terms of WMS being prone to proactive interference (Lustig and Hasher, 2002).

An interesting phenomenon concerning proactive interference is *release from proactive interference.* It was found that if subjects were given a number of recall trials consisting of the same type of stimuli e.g. letters, recall drops from one trial to the next. However, if the type of stimuli is changed to numbers, for example, recall levels return to the initial levels (Lockhart, 2000; Lovatt and Avons, 2001). Foreign language learners are constantly learning new material such as lists of words or functions of tenses, usually in a massed practised serial manner. Does interference come into play? Does it have a similar effect on all learners? Later chapters try to shed some light on these questions.

2.1.13 A current view of individual differences in memory

Unsworth and Engle (2007) look at individual performance on various tasks and attempt to account for individual differences in working memory capacity (WMC) by bringing back the notion of primary memory (PM) and secondary memory (SM) (proposed by James in 1890) and placing it in a more current framework of: working memory (Baddeley and Hitch, 1974), attention research (Cowan,1995 in Unsworth and Engle, 2007), the episodic buffer (Baddeley, 2000), and the activation buffer (Davelaar et al., 2005 in Unsworth and Engle, 2007). In this new framework PM is defined as a component which serves "...to maintain a distinct number of separate representations active for ongoing processing by means of the continued allocation of attention." (Unsworth and Engle, 2007, p. 106) According to this theory, PM capacity is limited and theorized to have a four item capacity. SM is defined as "a larger more durable component important for maintaining information over longer time intervals." (Unsworth and Engle, 2007, p. 106) Unsworth and Engle maintain that since PM has a limited capacity of four items, later information drives the former into SM from which it now needs to be retrieved. Durability of information in PM depends on attention; therefore, distraction might eliminate information from PM. In this view, PM is considered to be dynamic, changing according to task demands and receiving information which has been formerly transferred to SM and been recycled back to PM. Retrieval from SM requires a search process which depends on search cues at the stage of encoding information. Since information encoding is associated with contextual elements (in a hierarchical manner), these contextual elements serve to constrain and focus the search during recall. The search is thought to be more effective when contextual cues at encoding are similar to those at recall (encoding

specific) (Unsworth and Engle, 2007). According to Unsworth and Engle (2007), low WMC is attributed to reduced maintenance in PM and/or erratic retrieval from SM. Reduced maintenance in PM can derive from attention being distracted from the task goal, whereas poor retrieval may derive from unfocused, or erratic, contextual cues which activate irrelevant information. The fact that WMC is related to the ability to engage in a controlled–strategic search of SM renders it relevant to higher cognition. One prediction deriving from this new framework is that provision of appropriate cues and reducing retrieval competition may enhance effective recall and perhaps bypass WMC constraints on higher order cognition. Reduction of retrieval competition may be achieved by reducing proactive interference through manipulating the order of presentation and/or manipulating contextual factors (while encoding) (Unsworth and Engle, 2007). However, whereas WMC is thought to constrain controlled cognitive processes, processes reliant on automatic responses do not seem to be restricted by WMC (Unsworth and Engle, 2007). Interestingly research by Gathercole et al. (2004) found that whereas literacy acquisition at a young age was linked to working memory capacity, higher level comprehension and literary analysis (at14) was less so. It may be that at 14 years old automaticity in reading outweighs the impact of controlled thought and therefore WMC does not have the same impact as before. The tension between controlled and automatic processes seems to bear relevance to foreign language acquisition as well, as seen in later analyses.

2.2 Theories and models in Second / Foreign Language Acquisition

This section presents prominent research directions in second/foreign language research from the 1920s up to the present. It first presents two opposing second language acquisition (SLA) theories which reflect the fundamental nurture-nature debate in human learning (Behaviourism versus universal grammar). It then reviews linguistic concepts and trends which differ from, but developed parallel to, universal grammar theories (contrastive analysis, error analysis, interlanguage) as well as a theory which attempted to conceptualize some of those research findings in a comprehensive second language learning theory (Krashen's Monitor Theory). Since the focus of my research is on SLA in terms of memory, the more current SLA theories reviewed are cognitive theories of second language learning and those which

view SLA theory as one which combines properties of the mind and properties of language (lexical priming). The section ends with a review of the literature on what I believe to be one of the major issues in second language acquisition and second language learning – vocabulary.

The SLA theory review presented below begins in the early 20th century when the most influential views of learning were behaviouristic and viewed learning as new habit forming. Behaviouristic theories claimed that when certain stimuli result in an appropriate response the specific behaviour is reinforced until this positive response is learnt. Skinner (1957) believed that language learning, like any other kind of learning, is all about the formation of habits, and that second language learning is about replacing old habits (of L1) with new ones (of L2). The most difficult aspect of foreign language teaching was thought to be in those areas where old habits conflict with new ones, namely where L2 structure fundamentally differs from L1. Fierce criticism of Skinner's behaviouristic theories on second language learning was voiced by Chomsky who published his criticism in a review of Skinner's work in 1959 (Chomsky, 1959). Chomsky claimed that behaviourism cannot possibly account for language creativity and that linguistic rules are too complex and abstract to be learnt by children from the amount of language they are exposed to. Chomsky did not only criticize, but also developed what came to be one of the most influential theories in language acquisition – the theory of universal grammar.

2.2.1 Universal Grammar

A different approach to language research which has been influential since the 1950s is the universal grammar approach developed by Chomsky. As opposed to behaviourist theories which claim that human beings are born *tabula rasa* and believe that language is formed by conditioning responses, Chomsky and his followers claim that all humans are born with an innate language faculty, a blueprint, as it were, for all languages. Chomsky argues that all the traditional forms of grammar (descriptive, prescriptive, reference and pedagogical) presupposed an innate language faculty and built on this innate knowledge in their devised grammars. Chomsky himself developed a generative grammar theory which attempted to address the issues presupposed by the other types of grammar, namely, what it is that humans know instinctively which enables them to use languages and

also make use of the grammatical hints provided by the standard grammars mentioned above.

Universal grammar, by definition, claims that grammar is a universal human property and, as such, leaves little space for variation between human languages (Mitchell and Myles, 2004). Universal grammar theorists concern themselves less with second language acquisition although ignoring L2 acquisition might be thought to ignore a large part of the modern world. Current research which addresses issues of second language learning vis-à-vis universal grammar relates to whether second language learners have full, partial or no access to universal grammar. The latest suggestions tend towards treating universal grammar as modular. Therefore, questions raised by second language research should address the availability of sub-modules of universal grammar to second language learners rather than that of the universal grammar as a whole (Smith and Simply, 1995; Herschensohn, 2000; Hawkins, 2001, all in Mitchell and Myles, 2004).

Chomsky himself has lately taken the notion of the innateness of human language faculty in a direction of interdisciplinary research including linguistics, evolutionary biology, anthropology, psychology and neuroscience (Hauser, Chomsky and Fitch, 2002), work which was much criticized by Bickerton (2009).

2.2.2 Contrastive analysis, error analysis and morpheme studies

As opposed to the universal grammar theory, not all linguistic research took such a long leap in the opposite direction from behaviourism. Much research in the mid 20th century interweaved SLA theory with pedagogical issues and part of that research did initiate from the belief that language learning was about replacing old habits with new ones (Mitchell & Myles, 2004). Theorists who followed that line of thought maintained that effective teaching should dwell on areas where the second language differs most from the native tongue by way of **contrastive analysis** and that contrasting languages was the best way to enhance the acquisition of a second language and to anticipate learner difficulties (Lado, 1957, Wardhaugh, 1970, James, 1980). However, practitioners in the field of second language teaching, who applied contrastive analysis in their work, realized that areas of difficulty for L2 learners were not necessarily the areas of fundamental differences between the languages. This realization led to systematic investigations of the errors committed

by second language learners which became a linguistic system in itself labelled **error analysis** Mitchell & Myles, 2004). Researchers such as Lee (1957) and Whiteman and Jackson (1972) (both cited in Sachachter, 1974) maintained that analyzing errors made by language learners was a more efficient way than analyzing both L1 and a target language, in that it focused our attention on areas that have proven to be difficult rather than on areas that are hypothesized to be so (Sachachter, 1974). Studies in this direction eventually led to the possibility that second language errors were less universal, and more individual in nature than previously believed, an understanding which led to the concept **interlanguage** which was originated by Selinker in 1972 (Cited in Mitchell & Myles, 2004). Interlanguage is the state, or stage, of the second language as produced by the learner. A person's interlanguage is a system of rules formed by the learner and driven by his/her L2 knowledge at a specific point in time. As such, interlanguage is dynamic and changes with the accumulation of L2 knowledge.

Another line of SLA research originated from **morpheme studies** (in L1) which dealt with the order in which language was acquired. First language acquisition findings showed that L1 is acquired in similar stages by all children in all languages, although there are individual differences in pace (Brown, 1973). According to Dulay and Burt (1974), second language acquisition also occurs in systematic stages which are not influenced by the nature of the learner's native tongue.

A conceptual framework which developed from the research trends presented above, and which was also seen to be relevant to some of the findings of my research is the Monitor Model theorized by Krashen (1982).

2.2.3 Krashen's Monitor Model

Krashen (1982) suggests five basic hypotheses for second language learning.

The Acquisition-Learning Hypothesis differentiates between language learning which refers to theoretical knowledge of the rules *(know about)* and language acquisition which is a subconscious process where the L2 language learner is not consciously aware of the rules. He/she has the *feel* for what is right or wrong and uses the target language accordingly *(know how)*. Krashen maintains that L2 which is acquired and L2 which is learnt (theoretically) are absorbed differently, internalized differently and used differently. Moreover, the theoretical learning of L2 will not

necessarily become L2 acquisition. Indeed, some of the students' performances in this research reveal L2 language which does not seem to have been acquired, although it had been learnt, and the performance of other students is closer to the notion of acquisition as defined by Krashen (See sections 5.3, 9.3). Krashen's acquisition-learning hypothesis has been criticized on the grounds of it being difficult to differentiate between knowledge which had been acquired unintentionally by exposure to L2, and knowledge which had been gained intentionally due to explicit teaching (Gass and Selinker, 2001; Mitchell and Myles, 2004).

The Natural Order Hypothesis maintains that there is a predictable order in which rules of a second language are acquired and this order is not necessarily the one taught in the classroom.

The Monitor Hypothesis proposes a monitor which combines the learnt and the acquired systems by altering L2 production according to what he/she *knows about* the rules. Krashen acknowledges that there may be over, or under, use of the monitor. (Examples from my research are in sections 5.3, 9.3). The main criticism of the monitor hypothesis is that it is impossible to test the claim empirically (Gass and Selinker, 2001; Mitchell and Myles, 2004).

The Input Hypothesis maintains that a second language is acquired "by understanding messages, or by receiving 'comprehensible input'" (Krashen,1985, p. 2). Comprehensible input which is effective for second language learning is input which is just beyond the learner's current grammatical competence. The input hypothesis has been criticised for being too vague (Gass and Selinker, 2001; Mitchell and Myles, 2004).

The Affective Filter Hypothesis allows for affect to be influential in successful or unsuccessful second language acquisition. The affective filter hypothesis has also been criticized for being atheoretical (Gass and Selinker, 2001; Mitchell and Myles, 2004).

Although some language learning theories to date touch upon issues similar to parts of Krashen's monitor model, the model has evoked much criticism. For example, Gregg (1984) asserts that:

> *"Each of Krashen's hypotheses is marked by serious flaws: undefinable or ill-defined terms, unmotivated constructs, lack of empirical content and thus of falsifiability, lack of explanatory power." (Gregg, 1984, p. 94)*

Similarly, McLaughlin (1987) criticizes the monitor theory and claims that:

> *"Krashen's theory fails at every juncture...Krashen has not defined his terms with enough precision, the empirical basis of the theory is week, and the theory is not clear in its predictions". (p. 56).*

One aspect which is not addressed in Krashen's model is a specification of how learning becomes acquisition and how the monitor functions. These issues are addressed by some late 20th century theories, theories which adopt a cognitive approach to acquisition processes.

2.2.4 Cognitive Approaches to Second Language acquisition

The ACT (adaptive control of thought) cognitive model of general skill acquisition was developed in the 1980s by Anderson and his associates (Anderson, 1982). The ACT has since been applied to second language learning (Schmidt 1992, Towell and Hawkins, 1994, Johnson 1996 and Anderson 1983, 1985 all in Dekeyser, 2001; DeKeyser, 1997; DeKeyser, 2007; Mitchell and Myles, 2004). Anderson distinguishes between two separate long-term memories in which knowledge is stored: declarative and procedural, hence two separate types of knowledge: declarative knowledge and procedural knowledge. Anderson claims that most knowledge starts out as declarative knowledge of *knowing that* and gradually, after proceduralization processes, becomes procedural knowledge of *knowing how.* The proceduralization of knowledge is actually a qualitative change. Knowing certain historical facts, for example, is considered to be declarative knowledge, whereas being a skilled driver is the result of acquiring procedural knowledge. Language-wise, knowing the grammatical rules is declarative knowledge, whereas actually being able to use a second language correctly is procedural knowledge. Anderson claims that procedural knowledge is essentially a result of production rules which operate in a manner of *if x then y.* In this way, chunks of knowledge stored in declarative long-term memory may be retrieved by a production rule and available in working memory for additional processing. Learning occurs when with practice chunks of knowledge which were retrieved by a production rule become a part of the production rule itself, thus reducing retrieval load and error rate. These processes facilitate automaticity and lay the basis for additional production rules (Anderson, 1993, in DeKeyser, 2001). Hoey's (2005) notion of nesting, in lexical priming theory,

seems to derive from a similar conceptualization of automatization. Anderson maintains that declarative knowledge usually goes through three stages in order to become procedural knowledge: the cognitive stage, the associative stage and the autonomous stage. In terms of second language acquisition the cognitive stage relates to theoretical knowledge about L2; the associative stage refers to actually applying the theoretical rule through practice; the autonomous stage occurs when performance becomes more and more automatic to the extent of the speaker sometimes not being aware of the rule anymore.

Anderson's ACT model has been criticised by first language acquisition theorists. They claimed that knowledge of L1 does not necessarily go through a declarative stage (DeKeyser, 2001).Nevertheless, it seems that where foreign language acquisition is concerned, the distinction between declarative and procedural knowledge could account for various knowledge and performance profiles. DeKeyser (1997) maintains that the development of L2 vocabulary and grammar follows a similar pattern as automatization in other cognitive areas. DeKeyser conducted a study where vocabulary and morpho-syntactic rules of an artificial language were taught to and practiced by 61 subjects for 8 weeks. The learning curve followed the same power function as learning curves in the acquisition of other cognitive skills. Importantly, learning of the morpho-syntactic rules was highly specific: comprehension practice yielded better comprehension, whereas production practice yielded better production (DeKeyser, 1997). Interestingly qualitative analysis in this research also showed that the outcome of L2 practice was specific to encoding contexts.

DeKeyser takes a similar approach to Anderson's ACT model in what is known as **DeKeyser's Skill Acquisition Theory (SAT)** (Dekeyser, 2007). This theory sees levels of automaticity (in L2) as being on a cline where higher levels of automaticity are the result of automatization processes and are gained after extensive practice. According to SAT, in order for acquisition to take place, the sequence of declarative-procedural-automatic must be maintained and learners must be provided with both abstract rules and examples. The abstract rules will constitute declarative knowledge and the real examples will enhance proceduralization processes. DeKeyser believes, nevertheless, that not all language learning can be explained by SAT and that it accounts best for adult beginners who receive L2 formal instruction. Younger

language learners may not be able to understand explicit rules even when quite simple, whereas for adults, advanced language structures may be too complicated to be taught / learned in a rule governed manner and thus may not become incorporated into declarative knowledge. Acquisition of such structures may instead depend on extensive exposure which is thought to enhance implicit language learning (DeKeyser, 2007).

Anderson's ACT model was applied to language learning strategies by O'Malley and Chamot (1990, in Mitchell and Myles, 2004) who claimed that language learning strategies, like any other knowledge, should be taught and can be proceduralized after going through the cognitive, associative and autonomous stages. When effective learning strategies become proceduralized (as a habit) working memory capacity can be freed for additional learning (Mitchell and Myles, 2004).

Towell and Hawkins (1994) applied the ACT model to L2 fluency development. They suggested that when L2 language rules are first learnt, structural hypotheses of the language are stored in declarative long-term memory. When these rules are put to use by producing the target language the knowledge moves to procedural knowledge. Towell and Hawkins propose (somewhat differently from Anderson) that knowledge may be stored in procedural knowledge in two forms: an associative form and an autonomous form. When L2 language is produced, it is first stored in procedural memory in an associative form. Then, after numerous alternating processes of production and reorganization, production becomes autonomous and stored in procedural long-term memory in an autonomous form. At this stage L2 language production becomes fluent (Towell and Hawkins, 1994). This alternation between associative and autonomous storage in procedural memory may account for fluency being on a cline rather than being an all or none phenomenon.

Essentially, all cognitive views of second language learning claim that second language learning is just one example of learning and that underlying second language research is an understanding of how any new information is learnt and how this is affected by individual differences. One prominent cognitive approach to second language acquisition research is the processing approach which attempts to shed light on how the brain processes L2 linguistic information. My research also derives from an information processing approach and aims to learn more about the role of memory in second/foreign language acquisition.

Another interesting model of general information processing which has been adapted to first and second language research was devised by McLaughlin (McLaughlin, 1990, McLaughlin and Heredia, 1996, in Mitchell and Myles, 2004). This model suggests that the first stage in the L2 learning process is a stage of controlled processing which requires considerable attentional resources and is, therefore, constrained by short-term memory capacity. After activation and repetition, L2 language units gradually become automatic and are stored in long-term memory as units which no longer demand much attention. At this stage the learner can absorb new L2 language units which will undergo similar processes. McLaughlin names the process of moving from controlled to automatic processing 'restructuring'.

"Restructuring is characterized by discontinuous, or qualitative, change as the child moves from stage to stage in development. Each new stage constitutes a new internal organization and not merely the addition of new structural elements." (McLaughlin, 1990, p. 117)

This notion of restructuring bears a resemblance to the idea proposed by Towell and Hawkins (see above) suggesting that L2 information moves from associative to autonomous form (in long-term procedural memory) as a result of a production-reorganization-production process. McLaughlin (1990) points to two seemingly contradictory impacts practice may have on L2 language development. On the one hand, practice may lead to more automatic-like performance. On the other hand, practice leads to internal restructuring which may initially interrupt the, until now, safely stored, perhaps chunked, information. Consequently, restructuring may result in L2 acquisition taking the form of a U shaped curve consisting of three stages. In the first stage learners use familiar units of L2 correctly, if not creatively. In the second stage, with the introduction of additional L2 structures, learners restructure their L2 knowledge, thereby disrupting former order, a process which occasionally results in erratic performance. In the third stage there is a continuous process of restructuring knowledge appropriately (McLaughlin, 1990; Gass and Selinker, 2001). This U shaped learning curve is indeed a phenomenon which is observed in the EFL classroom.

Accuracy, fluency and automaticity in language are most noticeable in a person's speech. One of the most influential and cited models of L1 speech production was devised by Levelt and is presented below. Although the model began as mono-

lingual, it has been lately adapted to bilingual speech models (Kormos, 2006).

2.2.4.1 Levelt's model of L1 Speech Production

Levelt's model is modular and consists of four relatively autonomous processing components which operate in this order: conceptualizer, formulator, articulator, and self- monitor. The **conceptualizing** component is responsible for selecting, ordering and monitoring messages. The end product is a preverbal message encoded through a number of stages. Levelt claims that in order to encode a message, the speaker must have access to declarative/propositional/content knowledge which is held in long-term memory. The speaker must also have access to procedural knowledge, which can be seen, in this context, as accounting for the form in which the message will be conveyed. This procedural knowledge operates in the form of production rules, the end results of which surface onto working memory for further processing and interacting with oncoming data. The outcome of conceptualizing is a preverbal message. Importantly, conceptualizing requires varying degrees of attentional resources (as is discussed later). The next component in the model is a **formulating** component which takes care of grammatical and phonological encoding. The formulator receives conceptual information and translates it to linguistic form. The conceptual information undergoes grammatical encoding by accessing lemmas stored as declarative knowledge in the mental lexicon, as well as syntactic structuring information. The grammatical encoding process results in a surface structure consisting of lemmas grouped according to their linguistic functions. The conceptual information (from the conceptualizer) also undergoes phonological encoding where utterances acquire phonetic features and become a phonetic plan (an internal speech representation). The formulating component's output is the input for the next module which is the articulator. The **Articulating** component is concerned with, articulating/speaking the phonetic plan and results in overt speech. The last stage in Levelt's model is that of **self-monitoring**. The self-monitoring process involves the ability to listen and comprehend one's own overt, as well as, covert speech and detect problems before or after overt articulation. Speakers may monitor for the content of their message, the way it was/is being handled, its social appropriateness, its lexical/syntactic correctness, speed, tone etc (Levelt, 1989; Nation, 2001).

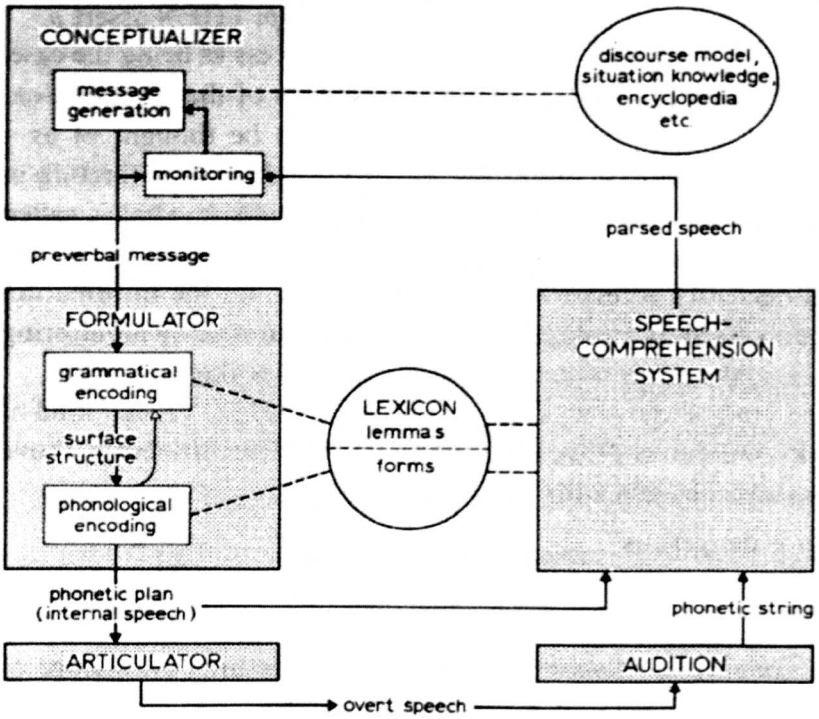

Illustration 2.4: "Blueprint for the speaker" (Levelt, 1989, p. 9)

2.2.4.2 Controlled processing versus automaticity in Levet's Speech Production model

Not all components in this model require the same [amount of] attentional resources. The conceptualizing stage requires much controlled processing, hence a great deal of attentional resources. Speakers need to attend to their initial message, to oncoming information from an interlocutor, to their own response to the interlocutor, to information in long-term memory which they would like to utilize etc. However, the other components, formulator and articulator, are fairly automatic since, once the speaker has conceptualized the message, words and structures (in L1) do not require much in the way of attentional resources (Levelt, 1989; Nation, 2001). It seems safe to assume, however, that in L2 speech production, higher degrees of attention and control are required in all components of the model. Kormos (1999) attributes to attention capacity the fact that errors in L2 speech can go unnoticed by the speaker even when declarative knowledge (of the rules) exists. She also points to the fact that the monitoring stage involves controlled processing which demands attentional resources. Since attentional resources are known to be limited in capacity, they may not suffice when attention is required for all stages of speech production (Kormos, 1999).

2.2.4.3 Kormos' Bilingual Speech Production Model

According to Kormos (2006) there are three main differences between L1 and L2 speech production. Firstly, there is bound to be L1 interference in L2 processing. Secondly, the L2 speaker has only partial knowledge of the language. Thirdly, due to the interference, the incomplete knowledge of the language and the need for controlled processing, speech construction is slower. Kormos maintains that, unlike the development of L1, development of L2 competence involves both the acquisition of declarative knowledge and proceduralization processes. L2 declarative knowledge is acquired through learning words (semantic, phonological and morphosyntactic features) and grammatical rules. Proceduralization occurs via automatization processes which eventually lead to automaticity. According to Kormos, both production rules and word retrieval can become automatized. L2 competence is enhanced when production units held in memory expand and can account for growing communication goals. Proceduralization and automatization are enhanced through practice and exposure (Kormos, 2006). In the light of the above, Kormos (2006) devised a bilingual speech production model based on Levelt's (1989) model for L1 speech, but including two additional components to account for the differences in speech production between L1 and L2. One component added is an L1 and L2 episodic memory component which feeds into the conceptualizer. The episodic memory component can activate concepts triggered by memory of episodes (learning episodes as well as L2 exposure episodes). The second component added is a component which holds L2 declarative rules and feeds into the lexico-grammatical encoding part of the formulator. Kormos remarks that in less proficient speakers the declarative rules component will be activated more whereas with more proficient speakers, the episodic memory component will be activated more (Kormos, 2006).

Both the formulating and the self-monitoring component in Levelt's model of speech production are said to access lemmas and syntactic structures, the former at the initial formulation stage and the latter at the final stage. The exact workings of these components have not been fully specified. It may be that that the underlying processes driving the formulator and the self-monitor are processes of lexical priming.

2.2.5 Lexical Priming

One linguistic aspect which is universal, important in current linguistic research, and also relevant to this research is the notion of word collocations and colligations. Hoey (2005) defines collocations as "the property of language whereby two or more words seem to appear frequently in each other's company" (Hoey, 2005, p. 2) and colligations as "the grammatical company a word or word sequence keeps (or avoids keeping) either within its own group or at a higher rank"(Hoey, 2005, p. 43). Colligations can be also referred to as "grammatical collocations" (Carter, 2002, P. 60). Words are considered to be collocates when they appear close together (usually defined as up to four words apart) in authentic texts more times than can be explained as random (Hoey, 2005). Interestingly, although the phenomenon of collocations is a property of the language, our ability to produce what are felt to be natural collocates/sequences is a property of the mind, a notion not unlike Chomsky's defining language as a faculty of the human brain. This psychological sequential association where a 'priming' word triggers a specific following word, or words, is called **lexical priming.** Lexical priming occurs with words and word sequences. According to Hoey, it is lexical priming which accounts for collocations. What makes the notion of lexical priming fundamental to language development is its cumulative nature. When a child is exposed to a word, or word sequence, time and again, the words become associated with the wider co-texts and contexts in which they appear. The result of this is that a formerly triggered word may eventually become primed along with its co-text as a word combination (rather than relating to the individual words which make the combination) in a way that more and more words and word combinations may become either priming or primed. Hoey (2005) maintains that lexical priming implies lexical tightness. In fact this theory may revise the traditional relationship between lexis, being considered loose, and grammar, being considered systematic, and point to lexis as being systematic and grammar being more loosely organized. For L2 learners the issue of lexical priming is bound to be different since a different but semantically closely related vocabulary has already been primed in L1. This may cause L2 lexical priming to be affected by priming in L1 (Hoey, 2005).

The issue of lexical tightness/looseness is addressed by Wray (2002) who claims that

human language is "an uneasy compromise between a rule-based and a holistic system" (Wray, 2002, p. 283). Wray distinguishes between collocations which are fully formulaic, namely word sequences which appear as fixed, tight and inseparable formulae, and collocations whose order and sequence is somewhat looser. She maintains that, for native speakers, collocations are fully formulaic and only broken down if necessary, whereas for post-childhood L2 learners collocations are essentially separate items which have become paired, hence their looseness and frequently erratic pairing (Wray, 2002). A contrary view is taken by N. Ellis who claims that similar to L1 learners, L2 learners learn complete formulaic sequences and that for them, too, it is chunking that underlies the vocabulary learning process (Ellis, 2001). A current study by Durrant and Schmitt (2010) supports this claim when results of a study with 84 non-native English speakers showed that L2 learners did retain memory for word collocations (Durrant and Schmitt, 2010).

Formulaicity, however, may not necessarily be viewed as an either/or state. Researchers assume a continuum of formulaicity from fixed to loose with varying degrees of collocatedness (Howarth, 1998a, 1998b, in Wray, 2002; O'Keeffe, McCarthy & Carter, 2007). With the development of computer technology which enables linguists to analyze large corpora and discover the statistic collocatedness of words, the statistical findings together with the functional properties of words should influence the decision as to what should be considered/taught as vocabulary (word, word pairs, chunked sequences) and what should be taught as grammar, namely rule driven word combinations (O'Keeffe, McCarthy & Carter, 2007). A connection between collocations, memory, and the ability to acquire a second language is made by Ellis (1996, in Wray, 2002), who suggests that the ability to remember sequences affects the ability to learn a language, since chunks stored in long-term memory facilitate identification of new input and become a basis for grammatical analysis. Hence, formulaic sequences support the acquisition process at various stages. According to Wray, errors committed by L2 learners are due to either overuse or underuse of formulaic sequences (Wray, 2002). Accordingly, teaching should consist of much exposure to and production of L2 vocabulary since exposure and production of words in L2 facilitate knowledge of statistical frequencies and sequential probabilities in L2 (Ellis and Sinclair, 1996. in Hulstijn, 2001).

The notion of collocations, colligations and formulaic sequences differs from the

traditional view of vocabulary in that it actually views words as systems rather than items (Hoey, 2005; Schmitt & Carter, 2004; Wray, 2002; Nation, 2001).

I have already mentioned Hoey's (2005) pointing to the possibility of lexis being tighter than syntax. This approach raises the question of the boundaries between the two. Singleton (2000) asserts that current linguistic research has widened the concept of lexical-syntactic interaction to the extent that it is difficult to tell where the former ends and the latter begins given that even single words hold much grammatical information. In fact, the idea that lexis and grammar cannot easily be separated is not new and is seen in the early work of Halliday (Halliday, 1969). In more recent work (1994), Halliday develops this idea and proposes that lexis and syntax are on a continuum which he names lexicogrammar (Singleton, 2000). Barcroft (2004) who focuses much research on vocabulary acquisition claims that much grammatical competence is at the lexical level. Barcroft adds that whereas reduced grammatical knowledge may reduce communication ability, reduced vocabulary knowledge may completely block communication ability (Barcroft, 2004). Evidence for such a claim can be seen with the case studies of this research.

The review presented above shows that studies of second language vocabulary have come to be a significant issue in current SLA theory. Some of the issues concerning vocabulary in a second language are presented below.

2.2.6 Vocabulary in a second language

"Almost everything in language is related in some way or another to words... conversely, the lexical dimension of language needs to be conceived of as rather more than just a list of lexical items." (Singleton, 2000, p.1)

Words

When looking into theories of L2 vocabulary acquisition one must bear in mind, that there are various dimensions to knowing a word. Whereas knowing a word could be considered as knowledge of individual items, some current linguistic theorists tend to regard it more as system knowledge. Any attempt to define the notion of a *word* surfaces the complexity of the term. For example: the words go/ going / gone are not one word, but neither are they three completely different entities. Rather than that, these words can be considered a family of forms, or lexemes (Singleton, 2000). One may wonder what it means to know the *go* word/words. Does it mean to have three

separate representations in our lexicon, or rather to have a lexeme representation with a readily accessible set of rules to go with it?

Each word has its phonological system, namely its sequence of sounds, as well as its orthographic system, namely its sequence of letters. Each word is a grammatical entity expressed by its morpho-syntax as well as a unit of meaning which could, in certain contexts, be replaced by synonyms (Singleton, 2000). Vocabulary items could be divided according to content words - full words which carry semantic content, and function words – grammatical words. It should be noted, however, that this distinction between grammar and content is somewhat problematic since many so-called grammatical words carry semantic content as well (Singleton, 2000). Naturally, the difficulty in defining a word leads to more difficulty in trying to understand what it actually means to know a word. Carter (2002) seems to cover some of the complexity by defining word knowledge as including semantic, syntactic and pragmatic knowledge of a word.

The notion of words being more than loose units organized by grammatical rules has given rise to the new linguistic theory described before and based on the concept of lexical priming (Hoey, 2005).

Vocabulary knowledge: receptive, productive and beyond

An additional dimension of vocabulary knowledge, which is a property of the mind, is to what extent one's knowledge of vocabulary is receptive and to what extent it is productive. It also raises the issue as to whether receptive and productive knowledge are on a continuum or are qualitatively different from each other.

Nation (2001) defines receptive knowledge as the ability to retrieve the meaning of a spoken or written word. This involves the ability to recognize the written and spoken form of a word, to recognize its parts and their meanings, to understand the word in its context, to recognize its collocations and be sensitive to correct/incorrect use. Nation (2001) defines productive knowledge as the ability to express meaning through speaking and writing. This involves the ability to speak, pronounce and write a word, the ability to choose an appropriate word to convey a specific meaning, to apply correct forms to lexemes and to produce synonyms opposites and collocates (Nation, 2001). One difficulty with this division is the separation between literacy skills (reading –receptive, writing – productive) on the one hand, and combining

reading and oral comprehension on the other, since literacy skills require additional layers of knowledge. This is especially problematic when L2 has a different typology from L1. Significant differences between oral comprehension and reading ability are evident in the performance of some of the case studies in my research.

It is generally agreed that the production of words is considered to be more difficult than the comprehension of words (Carter, 2002; Nation, 2001). There may be a number of reasons for this. Firstly, in order for a word to become a part of one's productive knowledge, the orthographic and phonological forms need to be precise. This poses higher levels of difficulty specifically when the orthographic and phonological systems in L2 are different from those in L1 (Nation, 2001). Secondly, in circumstances of (formal) L2 learning, learners are exposed more to the receptive aspects of the foreign language than to opportunities to use language productively (Nation, 2001). As pointed out above, research has shown that effects of practice are highly specific, namely, comprehension practice yielded better comprehension, whereas production practice yielded better production (DeKeyser, 1997). This could explain why learners who are exposed more to the receptive aspects of L2 vocabulary find it easier to comprehend than to produce words. Indeed, current research has shown that L2 learners have larger receptive than productive vocabularies (Webb, 2008). Thirdly, when a learner hears/sees a word in L2, the main association triggered is the L1 translation, whereas during the production process there are many competing associations to choose from (Nation, 2001).

Although there has been much research on issues of receptive versus productive vocabulary knowledge, the receptive/productive dichotomy has also been criticized for not doing justice to the complexity of word knowledge (Milton, 2009; Grabe and Stoller, 1997). In her article "Three dimensions of vocabulary development" Henriksen (1999) proposes that the issue of vocabulary development be addressed via three dimensions, which are not unlike the theories of overall language acquisition presented in some of the models presented above. The first dimension is that of partial versus precise knowledge, often determined by the ability to provide a precise translation or a correct definition in a multiple choice task. The second relates to the depth of knowledge, which concerns the quality of knowledge, and sees vocabulary knowledge as on a cline from total lack of knowledge, through the ability to recognize and have an idea of what something means, up to completely accurate

semantic and syntactic use of vocabulary. The third dimension relates to receptive/productive language knowledge. According to Henriksen, research which focuses on any one of these dimensions alone might be overlooking the complexity of the semanticization process which includes both mapping meaning onto form and a continuous process of reorganizing the semantic interlanguage (Henriksen 1999). Some of this complexity is captured by Aitchison who also views vocabulary learning as developing in three stages: 1. labelling, which refers to names of things. 2. packaging, which refers to the knowledge as to which words can go with each other. 3. network building, which refers to how words can be tied together in semantic networks (Aitchison, 1994 in Henriksen 1999). The idea of packaging and networking seems to bear a relationship with the notion of collocations, colligations and semantic associations. Henriksen relates to vocabulary development which can be measured via quantitative means, as item learning, as opposed to qualitative vocabulary development which is viewed as system changing. Overall vocabulary learning is seen as both item learning and system changing (Aitchison, 1994 in Henriksen 1999).

Theories of vocabulary development have driven vocabulary learning theories as well as pedagogical considerations of vocabulary teaching. The following section deals with these issues.

Vocabulary learning

The scope of research into L2 vocabulary learning does not allow me to give a full account of all the issues involved in such learning. The main issue addressed is whether L2 vocabulary development is best enhanced via incidental or intentional learning.

Hulstijn (2001) relates to intentional vocabulary learning as learning vocabulary in activities intended to add more lexical information to memory, and incidental vocabulary learning as learning new vocabulary as a product of activities not aimed at vocabulary learning. Nation (2001) is more specific and defines incidental vocabulary learning as learning from context such as extensive reading, listening to stories, TV films and taking part in conversations. L2 vocabulary learning is thought to be enhanced by these activities although the learners' attention is focused on the message rather on the particular vocabulary items (Nation, 2001).

In her comprehensive review of vocabulary acquisition research, Laufer (2009) points to change in research directions from the 1980's and on. Generally speaking, vocabulary learning theories have gone through a few different phases starting with learning theories which advocate incidental learning based on Krashen's input hypothesis (Krashen, 1989; Pigada and Schmitt, 2006), through learning research which advocates intentional learning (Ellis,1990; Horst, Cobb and Meara, 1998; Laufer, 2003; Hulstijn, 1992; Hulstijn, 1997) and research which points to a combination of the two as being more effective than choosing either incidental or intentional routes to learning (Read, 2004).

In the 1980's Krashen's input hypothesis (see above) had a strong influence on foreign language learning and teaching. L2 in general and L2 vocabulary in particular, was believed to be acquired indirectly through much exposure to the target language and engaging in comprehensible reading input (Krashen, 1989). After many years of unpopularity, new support for incidental learning was found in a case study conducted by Pigada and Schmitt (2006). The subject was a learner of French who, for a period of a month, engaged in extensive reading and was then assessed on the knowledge of 133 words. The researchers tested the spelling, meaning and grammatical characteristics of the target words. They also checked whether frequency of appearance in the text had an effect on retention. Results showed that knowledge of 65% of the words was facilitated in some way and that frequency of appearance had a positive effect on retention. The study points to the possibility that extensive reading may play a more important role in L2 vocabulary acquisition than previous studies have suggested.

However, Krashen's theories and the pedagogical practices that followed attracted much criticism, as we have noticed, and a great deal of research was conducted in an attempt to see whether indirect learning was indeed as effective as claimed. As a result of the many experiments conducted in the years that followed Krashen's theories, the pendulum swung in the opposite direction and the direct learning approach seemed to gain weight.

In 1992, Hulstijn held a series of experiments in which learners were tested under several conditions. In regard of the incidental/intentional aspects of learning, learning results showed that when the subjects were not told they would be tested on word meaning (incidental learning), learning scores were very low, whereas when they

were told that they would be tested, learning scores increased substantially (Hulstijn, 1992). In an additional experiment, learners were tested on 45 words after listening to a simplified novel. The extremely low learning scores (average retention of 5 words) point to the limited effects of extensive reading on L2 vocabulary growth (Horst, Cobb and Meara, 1998). Laufer (2003) casted doubt on the effectiveness of extensive reading on gains in L2 vocabulary. In experiments comparing vocabulary retention after extensive reading to vocabulary retention from word focused tasks (sentence completion, sentence writing and fitting the new words into a composition), Laufer found that the task oriented activities resulted in more word retention (Laufer, 2003). Further support for intentional learning can be found in an experiment by Hulstijn (1997) who showed that mnemonic techniques, including the key word method, were very useful for L2 vocabulary retention.

Research in the last decade has pointed to the quality of processing as having a stronger effect on L2 word retention than either incidental or intentional learning (Hulstijn, 2001; Laufer and Hulstijn, 2001; Barcroft, 2007; Laufer and Girsai, 2008) and views the ability to combine incidental, intentional, receptive and productive learning as the optimal route to L2 vocabulary learning (Nation, 2001; 2007; Schmitt, 2008).

Although it was Hulstijn, who conceptualized the terms incidental and intentional vocabulary learning (which have since replaced, to a large extent, the terms direct/indirect, explicit/ implicit) in 2001, he also maintained that what makes the difference in levels of L2 vocabulary retention is not whether the learning was intentional or incidental, but whether the processing quality was high and conditions of rehearsal sufficient (Hulstijn, 2001). The importance of processing and rehearsal quality (and quantity) is further supported by Laufer and Hulstijn (2001) and a strong emphasis is given to learner involvement in the learning tasks.

An interesting insight into the implicit/explicit dichotomy is provided by Carter (2002) who maintains that up to a certain level of L2, vocabulary learning is explicit, but beyond a certain level of proficiency most vocabulary learning is bound to be implicit. Pedagogically this means that explicit vocabulary teaching is important, but opportunities to acquire vocabulary implicitly should not be neglected specifically at the more advanced levels (Carter, 2002).

An integrative theory of L2 vocabulary learning was proposed by Nation (2001;

2007). Nation asserts that a well balanced vocabulary course should be based on four strands: 1- meaning-focused input and learning from extensive reading, theoretically based on (and reintroducing the importance of) the input hypothesis (Krashen, 1989). 2- Meaning-focused output, which derives from the output hypothesis (Swain, 1985). 3- Language focused learning, theoretically anchored in research on form-focused instruction (Ellis, 1990). 4- Fluency development driven by research based on the development of speaking and reading fluency (Nation, 2001). Meaning focused output and fluency development involve language production which is in itself thought to be effective in vocabulary learning (Barcroft, 2007). In a recent comprehensive review of second language vocabulary learning Schmitt (2008) suggests that the four learning strands presented by Nation (2001) be adopted as a framework for combining incidental, intentional, receptive and productive vocabulary learning and emphasizes the importance of learners' engagement in the learning task in order to maximize effectiveness (Schmitt, 2008).

It seems inevitable, that whatever we consider to be a well balanced vocabulary course, a learner's ability to acquire new vocabulary in a second language depends, to a large extent on his/her memory. The issues of L2 vocabulary acquisition vis-à-vis memory are addressed in section 2.3. Reading theories in general and relationships amongst reading in a second language and memory, in particular, are also presented in the following section.

2.3 The role of memory in the acquisition of L1 and L2

The final issue in the research background relates to where memory and SLA/FLA research converge in an attempt to understand the role of memory in foreign language acquisition.

A factor which seems to implicate specific language traits in both LI and L2 is PSTM (phonological short-term memory). Ellis (1996a in Ellis, 2001) tested subjects' ability to recall non-words and phone numbers, presented orally, and found that performance on these tests correlated highly with subjects' vocabulary and syntax in their native tongue and in a foreign language they were studying (Ellis, 2001). Similar findings were presented by Gathercole and Martin (Gathercole and Martin, 1996). Additional research (Meschyan and Hernandez, 2002) which links L1 with L2 was conducted on 80 adult English speaking university students studying Spanish as

a foreign language in California. This research examined native language decoding abilities of pseudo-words (for example: *lindow)* as a predictor of foreign language learning ability. It was hypothesized that decoding ability, which involves both phonological and orthographic skills, and their mapping onto each other, would correlate highly with the ability to learn a new language which also involves learning novel phonological structures and new phonological-orthographic maps. All subjects took a battery of tests which included native language competency, native language pseudo-word decoding, second language word decoding, native language vocabulary skill, second language competency and non-verbal intelligence. Spanish course grades were also recorded. The researchers specified four components to the general hypothesis, which were all confirmed. Firstly, students with good pseudo-word decoding skills in L1 had higher native language competence. Regression analysis showed that this was partly due to the fact that they had attained a more substantial vocabulary skill.

Secondly, students with good pseudo-word decoding ability in their native language developed better decoding ability in the foreign language. This also facilitated larger vocabulary knowledge in L2, and was attributed to the students' ability to create correct phonological representations of new words and store them in LTM. Good pseudo-word L1 decoders had a higher overall competence in the foreign language studied which included vocabulary, grammar and reading comprehension. This was also seen to be mediated (statistically) by word decoding ability.

Thirdly, subjects with higher levels of decoding L1 pseudo-words had higher grades at the end of the first year of the foreign language course (Meschyan and Hernandez, 2002). These findings suggest that native language pseudo-word decoding is indeed related to foreign language learning ability. Additional research yielded similar results when best predictors of 10th grade students' foreign language acquisition were their FL grades at the end of the first year of studying and foreign language word decoding in 10th grade (Sparks et al., 1997).

It is recognized that there are immense individual differences in the ability to learn new languages which are defined as foreign language learning aptitude. Carroll defines foreign language learning aptitude as:

"Some characteristic of an individual which controls, at a given point of time, the rate of progress that he will make subsequently in learning a foreign language." (Carroll in Sawyer & Ranta, 2001, p. 320)

Research tackling individual differences has examined intelligence, aptitude, strategies, attitudes and additional personality traits. Of all these parameters that come into play, language aptitude emerged as the most influential in accounting for individual differences in foreign language acquisition (Sawyer and Ranta, 2001). Language aptitude tests are in themselves quite versatile and include many parameters. However, one parameter which stands out in most language aptitude tests is memory, suggesting the importance of memory in foreign language acquisition.

The MLAT (modern language aptitude test) developed by Carroll and Sapon in 1959 has become a main tool in foreign language aptitude research. There are other batteries (Berkhouse, Mendelson & Kehr, 1959; Pimsleur, 1966; Petersen & Al-Haik, 1976; Parry & Child, 1990 all in Sawyer and Ranta, 2001), but to date, the MLAT is still considered a better predictor of foreign language acquisition (Sawyer and Ranta, 2001). The MLAT consists of four parts, two of which have to do with memory.

The first is the phonetic coding ability test which checks the ability to identify different sounds and signs, learn the correlations between them and retain this information in memory. The subjects are presented with sign-sound correlations, where the signs consist of an unfamiliar orthography and the sounds are nonsense syllables. They are then tested by hearing one of the sounds and having to decide which of four symbols correlates with this sound (Sawyer and Ranta, 2001).

The second component of the MLAT in which memory is an essential factor is the rote learning ability for foreign language materials test. In this test examinees are presented with 24 Kurdish words and their English translations. The subjects are allowed two minutes practice followed by a multiple choice test where the Kurdish words are presented along with four different English translations (Carroll, 1990 in Sawyer and Ranta, 2001).

It was shown by Gajar (1987) that scores in the MLAT tests correlated with university students' scores on FL introductory courses. Moreover, students with difficulties in fulfilling the FL requirements and diagnosed as having a learning

disability, had significantly lower scores on all the MLAT subtests (Gajar, 1987).

A good example of the use of the MLAT battery was provided by Ganschow et al. (1991) in an attempt to provide support for Ganschow and Sparks' (1989) linguistic code differences hypothesis (LCDH). Initially the hypothesis was that people with difficulties in reading and writing in their native tongue have failed to master the phonological orthographic and syntactic aspects of the language, but not the semantics of it. In 1991, Ganschow et al. introduced LCDH into FL literature. They were motivated to do so by findings that showed that there were quite a few university students who failed to fulfil FL course requirements although they seemed not to have difficulties in other academic areas. It was suggested that some had problems with auditory ability which manifested itself in difficulty in creating sound-symbol correlations in the FL (Pimsleur, 1968 in Ganschow et al., 1998), whereas others displayed errors which resembled those of dyslexic students, such as letter reversals (b,d,p,q) as well as erratic spelling and reading in the FL (Dinklage, 1971 in Ganschow et al., 1998). Ganschow et al. claimed that underlying FL difficulties are language difficulties in L1.

The LCDH hypothesis vis-à-vis FL was that:

- foreign language skills depend on language mechanisms.
- difficulties in one of the native language skills affect FL acquisition as well as elements of L1.
- most poor L2 performers manifest weakness in the phonological-orthographic aspects of L2 (Ganschow et al., 1998).

The study performed in 1991 by Ganschow et al. seems to support the LCDH. The study included 30 adult foreign language learners, mean age 22 (range 20-26), 15 of which were successful FL learners and 15 unsuccessful FL learners. The subjects were given a large battery of tests. WAIS-R was used for testing intelligence; MLAT was used for testing language aptitude and included number learning, phonetic script, paired associations, grammar, and reading comprehension. Other tests were used for testing sound blending and spelling of sounds, spelling clues, phonology, and mathematics. Results showed that:

- poor FL learners were just as intelligent as successful FL learners.
- reading comprehension in L1 did not distinguish between the two groups.
- unsuccessful FL learners had weaknesses in tests which checked phonological and syntactic areas.
- spelling sub-tests and the free writing sample differentiated between the two groups.

These results suggest that phonological and syntactic skills in L1 may be predictors of future difficulties in FLA (Ganschow et al., 1991).

The researchers also reported that further research provided support for the LCDH hypothesis by showing that good FL performers have high FL aptitude as measured by the MLAT and high oral and written skills in L1. This was true for both secondary and post secondary educational levels. In light of accumulating research, Ganschow et al. suggest that difficulty in FLA is linked to major or minor difficulties with phonological-orthographic and syntactic structures in L1 (Ganschow et al., 1998; Ganschow et al., 1991).

Current research which investigates L2 acquisition vis-à-vis former L1 attainment also points to relationships between the two. In research by Sparks, Patton, Ganschow, Humbach and Javorsky (2008) children between first and fifth grade were tested on a number of L1 skills including word decoding, spelling, reading comprehension, phonological awareness, receptive vocabulary and listening comprehension. These children were then tested some years later in high school on L2 word decoding and comprehension. Results showed that reading comprehension in L1 predicted reading comprehension in L2 and that when L1 reading comprehension was replaced by L2 word decoding, L2 word decoding was an important predictor of overall L2 reading comprehension. These results point to transfer of literacy skills from L1 to L2 (Sparks, Patton, Ganschow, Humbach and Javorsky, 2008).

Initially the research related only to people who had visible difficulties in both L1 and L2, but eventually it was seen that there were people who did not seem to have L1 problems and still manifested weak performance in L2. One possible inference from the above study could be that the people who do not seem to manifest L1

weaknesses are those whose linguistic coding differences are so subtle that they are not visible in L1 everyday language use, but surface in conditions of foreign phonological, orthographic and syntactic structures.

Recent research seems to be in line with these assumptions. It has been observed that some university students who struggle with the FL university requirements have never been diagnosed, since they were bright and never considered at risk. However, when diagnosed, they are often seen to have specific learning disabilities. These learning disabilities are specific to language processing, and range from the basic level of decoding, especially where the phonology is unfamiliar, to higher levels of comprehension which is often apparent in L1 as well (DiFino and Lombardino, 2004).

After having presented research which establishes links between language aptitude, FLA, L1 and L2, language will be broken into some of its building blocks and looked at vis-à-vis memory. DiFino and Lombardino, who have engaged in FLA research, asserted that:

> *"Memorization is an essential part of any form of learning at any level but is exceptionally significant in the learning, as well as mastery, of an L2. Almost every aspect of language learning, from the first to the last lesson in the L2 class, requires students to use their ability to memorize. The impact of poor memorization skills is devastating because it almost always means poor performance in the L2 class."*(DiFino and Lombardino, 2004, p. 395)

One of the basic components in any language is its vocabulary. The following section looks at the issue of vocabulary acquisition in L1 and L2.

2.3.1 Vocabulary acquisition

Words are small meaningful units within this sound system. One important question asked in this research is: Why is it that some have more words than others at their disposal in L1 as well as L2?

When children are initially exposed to a new word, a subconscious process of fast mapping is believed to take place as the word's semantic, phonemic and, later, visual form registers together with its contextual use. It may be stored in memory temporarily until meaning and use are strengthened by additional experience (Carey and Bartlett, 1978; Dickinson, 1984; Dollaghan, 1985; Taylor and Gelman, 1988 all in Gathercole and Baddeley, 1993). Individual differences in vocabulary knowledge

are already apparent in childhood, and one wonders what accounts for these differences. One possibility is that levels of exposure to vocabulary enhancing situations (parents, TV, books) make the difference. However, it is not likely that lack of appropriate exposure is the only reason. Another possibility is that children differ in some cognitive skills responsible for learning new words. This hypothesis is indeed supported by research which has established links between word learning and phonological working memory. This research derives from experimental, developmental and neuropsychological studies (Gathercole and Baddeley, 1993).

In experimental studies it was seen that in tests of PSTM (phonological short-term memory) and tests designed to simulate new word learning, subjects are sensitive to phonological similarity, word length and auditory suppression, which means that PSTM and vocabulary learning are implicated by some common denominators (Papagno & Vallar, 1992; Papagno, Valentine & Baddeley, 1992 all in Gathercole and Martin, 1996).

A series of studies by Gathercole, Service, Hitch and Martin (1997) set out to pursue the relationships between phonological short-term memory and new word learning (in L1) in a systematic experimental way. They tested 65 children, mean age 5 years and seven months (ranging from 5 years 1 month to 6 years 3 months). The children took all of the following tests: four word learning tasks, two phonological short-term memory tasks, vocabulary knowledge and non verbal ability. These were later correlated in a variety of statistical techniques in an attempt to single out patterns and relationships. Results suggest that the relationship between PSTM and vocabulary is multiform and that children's ability to learn new words is constrained both by current lexical knowledge and by their ability to hold phonological input in short-term memory (Gathercole et al., 1997). Further experimental research showed that correlations between PSTM and vocabulary knowledge were significant even when the subjects were teenagers. These experiments point to the fact that PSTM is important in early childhood and continues to constrain lexical knowledge in the teens (Gathercole et al., 1999).

Experimental research provides evidence for the role of phonological memory in the acquisition of vocabulary in a FL as well. Papagno et al. (1991) examined phonological loop functions in adults' learning of new words. The subjects were Italians who were presented (auditorily) with lists of eight word pairs to learn. One

list consisted of pairs of words in Italian (L1) and the other consisted of pairs of Italian – foreign (Russian) words. In the first trial subjects learned with no concurrent tasks, but in the next trial subjects were asked to learn words while engaging in an articulatory suppression task, which is known to disrupt phonological loop functions. Results showed that recall of foreign words learned with a factor of articulatory suppression was much lower than for all other trials. The explanation was that phonological loop involvement is bigger when newly learned vocabulary items have a strange phonological form and cannot lean on semantic ties (Papagno et al., 1991). Papagno and Vallar (1992) support these findings about phonological loop involvement in retaining FL vocabulary. They looked at two other elements known to influence phonological loop functions: phonological similarity and word length. In experiments similar to those described above, they experimented with word-word and word- non word (L1-L2) trials under conditions of varying phonological similarity and word length. Results showed no influence of either variable (phonological similarity or word length) in the word-word trial, but a big decrease in learning speed in the word-non word phase. Once again the phonological loop seems essential in long-term learning of new phonological material, especially when it cannot be supported semantically (Papagno & Vallar, 1992). Papagno and Vallar were also able to show that subjects who were exceptionally good at learning foreign languages, in general, and foreign language vocabulary, in particular, also had exceptionally high scores on tests of PSTM (Papagno and Vallar, 1995 in Gathercole and Martin, 1996).

A study carried out by Service (1992) shows that phonological memory skills are also predictors of FL acquisition. Service gave a non-word repetition test to a group of nine year old children in Finland just before they were about to start learning English as a foreign language. He then correlated their results with their grades in English two years later. The results correlated significantly and highly (r=.66). Non-word repetition did not correlate highly with results in arithmetic tested at the same time, indicating that what made the difference was something other than intellectual ability. Service claims that the mediator between phonological working memory and foreign language proficiency is vocabulary. Since phonological memory correlated so highly with vocabulary acquisition and vocabulary was a prominent factor in both receptive and productive tests in the battery, this may be the case (Service, 1992 in Gathercole and Baddeley, 1993).

Finally, neurological patients with impaired PSTM as a result of brain damage have also been seen to have great difficulties in long-term phonological learning as is needed in order to learn new words (Baddeley, Papagno, & Vallar, 1988; Baddeley & Wilson, 1993 all in Gathercole and Martin, 1996). One of the neurological patients tested was P.V, who had a severely impaired PSTM as a result of acquired brain damage. P.V. could learn associations between familiar words in L1 as well as the 14 controls, but could not learn any associations between familiar items (words in L1) and unfamiliar items (words in a foreign language) which functioned as non words. This inability to hold new phonological forms in short-term memory implicated long term learning of items which were phonologically unfamiliar. This supports former research which connects PSTM to new vocabulary learning (Brown and Hulme, 1996; Baddeley, Gathercole and Papagno, 1998).

Relationships between vocabulary learning and memory will be examined in my study as well.

Language, however, does not consist of random series of words. Words operate according to grammatical rules which determine their morphological form, their order, and additional grammatical elements which are part of any specific language. In order for us to be able to use language, several processing processes, facilitated by grammatical rules and enhanced by memory, must take place. These processes are not identical across language skills. The following sections present an account of memory as intrinsic to the various processing elements involved in speech perception, production and reading in L1 and L2.

2.3.2 Sentence processing: Speech Perception

This section looks at speech perception through sentence processing, which demands the integration of vocabulary, syntax and additional grammatical factors.

Doughty (2001) suggested a combination of Cowan's model of memory in language processing (Cowan, 1995 in Doughty, 2001), and Levelt's model of speech production (Levelt, 1993 in Doughty, 2001) as a basis for pedagogical intervention in L2 instruction. In doing so, Doughty stresses the importance of memory as the initial stage of L2 acquisition. In the combined model, a perceptual WM store absorbs acoustic incoming information. The information is then held in the WM store where it is instrumental for comprehension and learning. The following stages of processing

involve various processes of integration between world knowledge and linguistic knowledge, which serve as a basis for new learning (Doughty, 2001). Importantly, memory is at the basis of all this. A similar model of WM involvement in language comprehension was devised by Clark and Clarke (1977, in Gathercole and Baddeley, 1993). What exactly happens during these integration procedures still provokes academic debate.

There are three major approaches to sentence processing research: a principle-based approach, a constraint-based approach, and a referential-based approach. The principle-based approach claims that syntactic processing occurs prior to other sources of knowledge which take part in sentence comprehension, and that it functions independently. Semantics, context and other sources of knowledge are said to come into play later on (Frazier, 1987 in Harrington, 2001). The constraint-based approach maintains that all knowledge sources are activated simultaneously, and that each additional knowledge source constrains the final interpretation (Trueswell & Tanenhaus, 1994 in Harrington, 2001). The referential-based approach combines elements from the former two approaches. It asserts that syntactic processing is modular and independent, but also maintains that contextual information is highly important constraining the final interpretation (Crain & Steedman, 1985 in Harrington, 2001). A common denominator in these approaches is memory: information is held in memory awaiting further processing.

Theorists who advocate the principle based approach maintain that STM (short-term memory) plays an important role in the process of clause by clause parsing. They theorize that syntactic information is held in memory until semantic interpretations are applied (Frazier and Fodor, 1978 in Caplan, 1996). Constraint based approach theorists hold the view that lexical items are held in STM where they are utilized for further processing (Caramazza and Berndt, 1985; Vallar and Baddeley, 1984b; Baddeley at al 1987 all in Caplan, 1996). Referential based approach researchers claim that PSTM (phonological short-term memory) is not involved in parsing but affects post parsing processes such as checking sentence propositions against LTM (long-term memory), grammatical plausibility, and general knowledge (Caplan and Waters, 1990; McCarthy and Warrington, 1987a,b, 1990, all in Caplan, 1996).

Just and Carpenter emphasized the role of WM capacity with regard to the ability to cope with structural ambiguity in the framework of the principle based and

referential approaches, where syntactic processing is thought to be independent and modular. They found that individuals with a larger WM capacity are likely to consider more alternatives at points of ambiguity, a strength which will presumably give them an advantage in sentence comprehension (Just and Carpenter, 1992; MacDonald, Just and Carpenter, 1992 all in Harrington, 2001). Harrington adds that it is very likely that L2 learners are also constrained by WM capacity for sentence comprehension. Moreover, it may be that individual differences in WM capacity play a greater role in L2 sentence comprehension than they do in L1. Unfortunately, there are very few studies to date which research sentence processing in conjunction with FLA (Harrington, 2001).

Some researchers have turned to brain damaged patients in an attempt to gain insight into sentence processing. It was seen that sentence length affected STM patients' comprehension, and it was, therefore, postulated that STM could be involved in the parsing process. However, one STM patient, B.O, cast doubt on these assumptions. B.O, whose STM span is severely impaired (2-3 items), showed no difficulty in comprehending syntactically complex sentences (Waters, Caplan and Hildebrant, 1991 in Caplan, 1996). B.O's case strengthens the claim that STM is not involved in the process of parsing itself. Similar results were found by Martin in 1993 (Martin and Freedman, 2001).

The results showing that STM patients have overall speech perception difficulties but that the difficulty does not seem to be in the syntactic arena led Martin et al. to look into the semantic arena. Martin and Romani devised an experiment where the subjects were patients who suffered from semantic retention difficulties. They were presented with sentences where the number of adjectives **before** a noun or the number of nouns **before** a verb were manipulated. Each of these sentences was also presented so that the multiple adjectives appeared **after** the noun and the multiple nouns appeared **after** the verb. An example of multiple adjective sentences in the *before* phase is: *"The rusty, old, red swimsuit....."* and the matching *after* condition sentence would be: *"The swimsuit was old, red and rusty"*. (Martin and Freedman, 2001, p.337) An example of multiple noun sentences in the *before* phase is: *"The cloth, the vase, and the mirror cracked...."*whereas the same sentence in the *after* condition would be: *"The movers cracked the mirror, the vase, and the cloth."*(Martin and Freedman, 2001, p.337) Results of the subjects' comprehension

showed that in the *before* conditions the subjects made a large number of comprehension errors, whereas in the *after* conditions the number of errors was lower, and that the number of following nouns or adjectives did not make much of a difference. The researchers maintain that in the *before* conditions semantic information was delayed until all the adjectives could be integrated with the noun, or all of the nouns integrated with the verb. This pre-integration delay caused erratic comprehension in subjects with semantic retention deficits since their memory could not hold onto meaningless information for long. In the *after* conditions, where semantic integration was fast, the extraction of meaning was also fast and not prone to confusion and loss over time (Martin and Freedman, 2001).

The above models and experiments present situations where WM involvement is via the phonological loop retaining information for very short periods of time in order for it to be processed.

A somewhat different role of memory in text comprehension was suggested by Kintsch and Van Dijk (Kintsch and Van Dijk, 1978, 1983, in Gathercole and Baddeley, 1993). This model sees conveying messages as a cyclic process where the outcome of each cycle is a proposition. STM, according to this theory, holds these propositions in store whilst matching them with former and later ones. If there is a match, the information is considered coherent; if there is a mismatch, processes including LTM search are activated, which put heavy demands on memory capacity. In this model, memory is perceived as a coherence processing device, where the central executive component of WM seems to come into play as a general resource capacity coordinator (Gathercole and Badeley, 1993).

It has so far been seen that memory seems to play an important role in comprehension of speech. The following section looks at memory in speech production.

2.3.3 Sentence processing: Speech Production

In analysing speech production it is essential to look at processes which take place between our wanting to speak and the actual speech act, and to try and determine whether memory takes part in these processes. In Section 2.2 I presented Levelt's (1989) model of speech production. In this section I present Garret's speech production model which attempts to supply a simplified account of speech (depicted

in Gathercole and Baddeley, 1993), and discuss it in terms of memory.

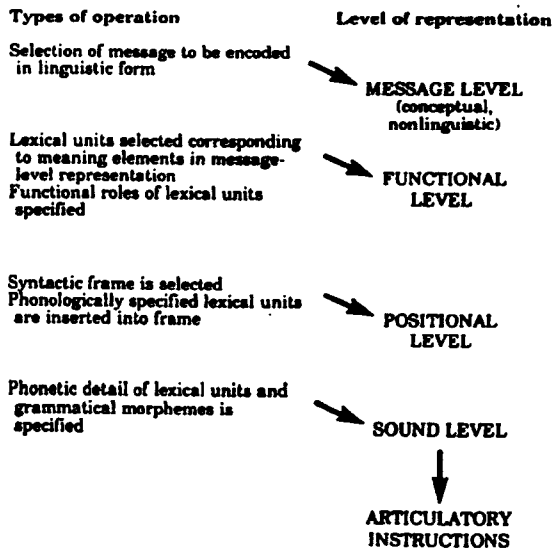

Illustration 2.5: Garrett's Model of Speech Production (Gathercole and Baddeley, 1993, p. 76)

In this model, each transition from one level to the next involves an element of storage and an element of processing, which are both functions of working memory. It is therefore logical to assume that working memory is involved in some stages of speech production.

It was hypothesized (Klapp, 1974, 1976 in Gathercole and Baddeley, 1993) that working memory has a role in speech production, and that phonological loop functions take the lead. Experiments run by Klapp were intended to establish links between the mechanisms involved in speech motor planning and the phonological loop element of working memory. However, the experiments could not establish such links. Apparently, the mechanism involved in speech motor planning was not sensitive to articulatory suppression, to articulatory duration of memory items, and to additional concurrent memory load, all of which are found to be very influential in phonological loop functions. Consequently, it was assumed that the phonological loop is not involved in speech motor planning (Gathercole and Baddeley, 1993). Neuropsychological research in the field of speech production has pointed to similar dissociations as well. P.V, the patient mentioned before, had substantial phonological loop deficits with an auditory memory span of two digits, but displayed no deficits in speech production. Another neuropsychological patient, who had suffered brain injury, J.B., manifested a very similar profile (Gathercole and Badeley, 1993). And

yet in Garrett's model of speech production above, the notion stands out that transition from one stage to the other demands storage of the earlier elements together with processing of the next stage. Since storage and processing concurrently are characteristic of the central executive, central executive functions in speech production were examined. Two studies indicated that such involvement is plausible.

The first study was conducted by Daneman and Green (Daneman and Green, 1986 in Gathercole and Baddeley, 1993). In this study the researchers devised a test which measured what they termed speaking span. Subjects were given a list of words and were asked to generate sentences with those words. For example: "A subject given *cabbage* and *judge* might generate the sentences: *Cabbage is my favorite vegetable,* and: *The judge condemned the innocent man to death".* (Gathercole and Baddeley, 1993 p. 91) Naturally, there is a limit to the number of words on a list that one can remember, so at a certain stage performance deteriorates. What is checked here is the ability to retain words on the list in memory (storage) whilst generating sentences with them (processing). Daneman and Green correlated the results of this speaking-span test with the ability to give synonyms to words in context, which also demands simultaneous storing and processing. The correlation was high (R=.60). In a sense, this speaking-span experiment imitates the on line processing and storage demands in Garrett's model. The researchers claim that speaking-span is a central executive function. They also maintain that the fact that people who have a high speaking span are able to manipulate vocabulary items more efficiently (as shown in the synonym test) links the central executive to speech production (Gathercole and Baddeley, 1993).

The second study attempting to link speech production to central executive function was performed in 1985 by Power. Links between storage, processing and speech production were tested. Subjects were presented with two words from which they were asked to generate sentences (e.g. *farmer – field*). Power's rationale was that if central executive functions were involved in speech production, a concurrent memory task which took resources from the limited resources available in the central executive would impair sentence production. Moreover, if this were the case, the more demanding the secondary memory task, the more impaired sentence production would be. The secondary memory task given to the subjects was three and then six digits which were provided before the words. Interestingly, performance of sentence

production was not impaired grammatically and neither was speech rate, but the sentences produced under heavy digit preload condition were very predictable, had a less interesting semantic structure and showed less creativity (Gathercole and Baddeley, 1993). It may be therefore that the central executive is involved in spontaneous speech, but its involvement is bigger in the earlier stages of cognitive, conceptual and functional processing where planning is needed (Gathercole and Baddeley, 1993).

It seems logical to assume that all memory functions involved in L1 sentence production are also a part of L2 sentence production and much more. The ***much more*** derives from the assumption that there are many elements in L1 speech production (such as vocabulary items and grammatical rules) which could be defined as native tongue linguistic knowledge for the L1 speaker, whereas for a non native speaker they demand conscious cognitive activity.

Schmidt (2001) maintains that attention is crucial for memory and for the language encoding process in FL sentence production. He goes as far as to claim that paying attention is a prerequisite for all FL learning (Schmidt, 2001). Doughty claims that in order for FL learning to take place, the learner must continuously *notice the gap* between what he/she has just uttered, and the way competent speakers convey the same message. The process of *noticing the gaps* requires memory resources. Doughty describes the theorized process of gap noticing as following: When a FL learner utters a sentence in the foreign language, or wishes to convey a message in the foreign language, but does not feel he/she is competent enough to do so, the target utterance needs to be compared with the *real thing*, namely, the same utterance produced by a competent speaker. If the FL learner has already uttered the sentence, he/she needs to look for differences between his/her performance and the *real thing*. If the speaker has not yet uttered the sentence due to lack of competence, he/she needs to be able to compare between the resources available and the resources needed in order to produce sentences in the target language. The ability to make these comparisons is essential for FL learning.

These processes of comparison require the activation of both STM and LTM in the FL learner, and the two are activated simultaneously. WM is activated for on-line speech acts whilst LTM is continuously activated for linguistic and world knowledge (Doughty, 2001). Unfortunately, there is not much FL literature to date which deals

with this issue.

The review, so far, has presented the relevant background dealing with oral language proficiencies. The following sections discuss the effect memory has on reading.

2.3.4 Reading

As opposed to understanding and speaking a mother tongue, the skill of reading does not happen automatically, so to speak. There is no area in the human brain which is the reading area. Reading is a learnt and taught skill which requires cognitive activity. Efficient reading involves low level skills such as visual and phonological discrimination, higher mediating elements such as visual and phonological processing and high level language skills (Gathercole and Baddeley, 1993).

This section sheds light on the reading process. It first presents influential reading models, then goes on to present FL reading theories and studies looking at reading impaired populations. It concludes with a broad account of the role of memory in reading.

One of the most influential developmental models of reading was developed by Frith (1985), who viewed reading as a developmental process consisting of three developmental stages: the logographic stage, the alphabetic stage and the orthographic stage. In the logographic stage children create associations between whole-word configuration and meaning. This stage depends on visual discrimination and visual memory skills. There is evidence that visual discrimination measures at the beginning stages of reading can predict reading skills in the first year of reading (Ellis and Large, 1988). Since words are perceived holistically at this stage depending on their salient features which are absorbed visually, spelling regularity does not influence readability and most of the children's reading repertoire is sight vocabulary. As children are exposed to reading experiences they begin to form correlations between letters and their sounds and begin to apply alphabetic strategies. According to Frith (1985), the child now enters the alphabetic stage. In this stage new knowledge of symbol sound correlations is utilized in order to read new words which are beyond the limits of the existing sight vocabulary. Reading experience and exposure are relevant at this stage as well, since the more a child engages in reading activities, the more vocabulary becomes sight vocabulary and the child does not need to decode each and every letter in order to read (Share, Jorm, MacLean & Mattews,

1984 in Gathercole and Baddeley, 1993). During the alphabetic stage the variance between languages makes a difference in its readability. In languages like English, where a large proportion of the words are not phonetic and are spelt in an irregular manner, reading can be quite erratic. Typical reading mistakes are characterized by phonetic reading of non-phonetic words, for example reading the word *was* as rhyming with *has* (Gathercole and Baddeley, 1993). In this stage, phonological processing has an important role, as will be discussed later. The next developmental stage in reading is defined by Frith (1985) as the orthographic stage. Here reading involves automatic parsing processes, namely, dividing written materials into units which connect with matching meaningful representations (morphemes or words) stored in LTM. In this stage segmented phonological decoding of symbol to sound is no longer necessary and reading becomes automatic. This orthographic stage of reading is actually the kind of reading practised by most normative adult readers.

Frith (1985) ties the transition between stages to a causal relationship between reading and spelling. In the logographic stage a good ability to identify words and their salient elements is what leads the reader to develop the letter–sound correlation characterizing the alphabetic stage. Initially, however, the child's alphabetic awareness serves more for writing (encoding) than for reading (decoding). It is only later on, when the child becomes more skilled in the sight-sound correlations, that these correlations lead to utilization of contextual and semantic knowledge which characterizes the transition to the orthographic stage. It is, therefore, writing which is the pacemaker between stage one and two. The pacemaker between stage two and three is reading (Frith, 1985).

A somewhat different approach to reading is an information processing approach. Adams (1994) suggests looking at reading as an information processing operation, where four processing systems operate in synchronization with one another.

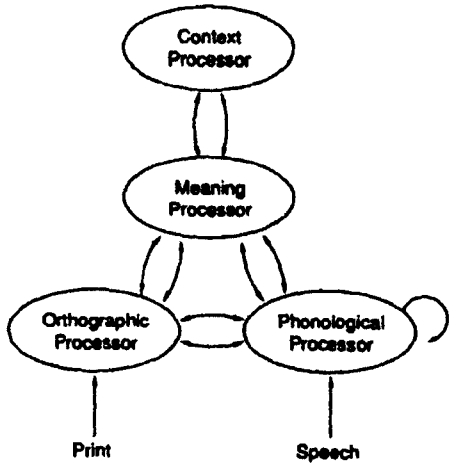

Illustration 2.6: Adams' reading model

(Adams, 1994 p. 158)

According to this model, visually absorbed information from the text undergoes orthographic and phonological processing. The information is simultaneously processed for linguistic meaning. These three processes lead to linguistic parsing. This information is now processed in conjunction with existing world knowledge to create text meaning (Adams, 1994). This model points to four distinct processing processes; however, meaningful reading depends on their operating together. When orthographic processing cannot take place, reading will be severely impaired or even impossible. For example, non Hebrew speaker would probably find it impossible to understand: האו אר יו although it is a very simple sentence (*How are you*), because orthographic processing could not take place. Likewise, a non Hebrew speaker would probably not understand *ma shlomcha* (which is: *How are you* in Hebrew) due to impossibility of processing meaning.

Both Frith's developmental model of reading and Adams' information processing model define the elements involved in reading in terms of the cognitive processes involved. Frith's logographic stages and Adams' orthographic processor rely on visual discrimination and memory; Frith's alphabetic stage and Adams' phonological processor incorporate phonological discrimination and memory; Frith's orthographic stage and Adams' processor of language and meaning comprise linguistic knowledge. Consequently, individual differences in the cognitive skills underlying these processes must come into play in any account of reading.

There are many cognitive factors which have been found to be associated with

reading. This research focuses on memory. A very comprehensive reading model was devised by Vellutino et al. in 2004.

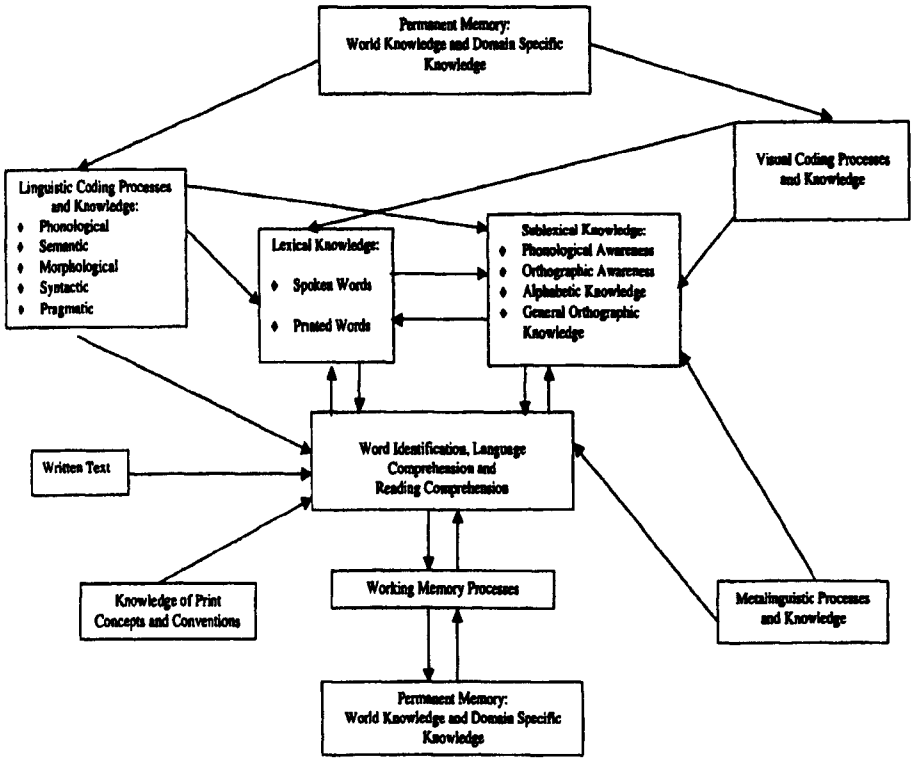

Illustration 2.7: Vellutino et al. Reading Model

(Vellutino et al. 2004 p. 4)

This model emphasizes the notion that written language is a reflection of the spoken language, and therefore, an adequate comprehension of the language is considered to be a prerequisite for meaningful reading (Vellutino et al., 2004).

If correct, this claim may account for differences between reading in L1 and L2, where adequate comprehension of the language cannot be taken for granted.

What stands out in this model is that memory seems to be essential for reading. All processes derive from and feed into permanent memory, which is comprised of world knowledge and knowledge which is domain specific. Visual coding processes and knowledge, together with linguistic coding processes, which are part of one's permanent memory, operate together in order to attain meaningful reading.

Visual coding processes and knowledge include: lexical knowledge of words (spoken and written), sub-lexical knowledge, which includes phonological, orthographic and alphabetic awareness, and general orthographic knowledge. Linguistic processing

coding and knowledge include phonological, semantic, morphological, syntactic and pragmatic knowledge.

All these elements interact in a reciprocal manner. The visual, linguistic, and lexical processes activated together serve to build a *sight* vocabulary, namely words which are recognized immediately and automatically, without any need for a decoding process. The process of recognizing words as *sight* words occurs when we see a configuration of a printed word and it immediately retrieves from our memory a linguistic unit which has meaning. However, there must be an additional route to reading since it is not logical to expect visual memory to store all the words in a language. Moreover, in the initial stages of learning literacy skills, there are no sight words in our store. This additional way to reading is via decoding. Here, reciprocal processes of alphabetic knowledge together with phonological and orthographic awareness continuously use available linguistic knowledge in order to build up word identification and reading comprehension.

As seen in the model, both working memory and long-term memory are involved in establishing connections between the components of spoken and written words, a process which is necessary for building *sight* vocabulary. Both types of memory are also needed in order to encode, store, decode and retrieve, all of which are needed for reading (Vellutino et al. 2004).

The above reading models do not specifically attempt to resolve the ongoing debate between bottom-up versus top-down routes to reading. Namely, is reading processed bottom-up as the reader decodes each letter until the sum total of the letters reach lexical meaning? Or, is it a top-down process where meaning is activated by overall word configuration and supported by semantic, syntactic, and contextual cues? This debate is beyond the scope and focus of this thesis, but the question is raised and is relevant to all reading theories.

How do these models relate to reading in L2? Bernhardt (2003) claims that the very fact that one reads in a language that is different from his/her spoken language renders reading in L2 different from that in L1. She points to the fact that in all reading theories, bottom-up, top-down, or integrative, phonological, visual, semantic and syntactic information needs to react with phonological, visual, semantic and syntactic representations from LTM. When reading in L1, input information from the text is the same as the representations stored in LTM. However, when reading in L2,

LTM representations are not necessarily the same. If L1 and L2 typology are the same, as is the case with English and Italian, for example, visual representations are the same, but phonological representations are not. In the case of a Hebrew speaker reading in English, visual, phonological, and syntactical representations are different. According to this view, the degree of similarity between L1 and L2 determines to what degree the reading process in L2 is similar to or different from the reading process in L1. Moreover, Bernhardt claims that there are many more issues to take into consideration when developing a theory of L2 reading. These are issues of the reader's cultural background, literacy in L1 and L2 and L2 language knowledge (Bernhardt, 2003).

Theories regarding reading in a foreign language represent two different approaches. One derives from the notion that language competence in the FL is the most significant factor in FL reading, whilst the other claims that reading skills in L1 predict reading in the FL.

Yorio maintains that difficulties in FL reading derive from language incompetence and native tongue interruptions. Yorio asserts that there are three main components to reading ability:

- language competence
- the ability to predict and engage in *intelligent guessing*
- the ability to remember former cues and make backward and forward associations, as in processes of inferring and referring

When it comes to reading in a foreign language, claims Yorio, incomplete knowledge of the FL might cause erratic comprehension of the cues, which could lead to wrong choices and erratic associations. Yorio also says that memory span in a FL is shorter than in the native tongue, which makes recollections of the cues more difficult (Yorio, 1971 in Alderson, 1984). However, although this theory seems perfectly logical, it still lacks empirical evidence (Alderson, 1984).

Clarke, on the other hand, claims that since the reading process is the same for all languages, it can be assumed that good readers in L1 will also do well in FL reading, and vice versa. He bases this on research showing that students with different native tongues had similar miscues in FL reading, which reduces the possibility of L1 interruptions in FL reading. He also relies on experiments pointing to the fact that

people who do not read well in L1 are poor readers in L2 as well (Clarke, 1979 in Alderson, 1984). These findings are supported by Segalowitz and Koda (both in Doughty, 2001). Segalowitz showed that bilinguals who were fluent in L2, but did not have good word recognition skills in L1 had reduced reading ability in L2 (Segalowitz, 2000 in Doughty, 2001). Koda found that L1 word recognition skills and reading comprehension in L1 predicted those in the FL (Koda, 1996 in Doughty, 2001).

Alderson attempts to resolve the disagreement between the two approaches (one pointing to L1 reading as the most significant factor in FL reading and the other pointing to competence in the FL as the most important factor in FL reading) and suggests that before reaching some threshold level in FL knowledge, FL reading difficulties may derive from inadequate language facility. However, beyond this threshold level reading ability in L1 could be a predictor of reading ability in the FL (Alderson, 1984). The threshold theory was later supported by Schoonen, Hulstijn and Bossers who provided empirical evidence for the claim that reading strategies could only apply where sufficient language was available (Schoonen, Hulstijn and Bossers, 1998 in Doughty, 2001).

The threshold theory seems to fit into all of the reading models brought forth, since all models build on linguistic knowledge as a prerequisite to reading.

It has already been pointed out that memory is an essential factor in most reading theories. It becomes quite clear that without memory, this complicated process could not take place in L1 as well as in L2, and that although memory is not always singled out as a research parameter, it is always there.

Research looking specifically at points where memory implicates reading comprehension has found that there is a connection between WM tasks which demand storing and processing of words, sentences or numbers simultaneously (central executive functions), and reading comprehension (de Beni, Palladino, Pazzaglia, & Cornoldi, 1998; Seigneuric, Ehrlich, Oakhill, & Yuill, 2000; Yuill et al., 1989 all in Cain et al., 2004), but not between reading comprehension and visual spatial tasks (Nation, Adams, Bower-Crane, & Snowling, 1999; Seigneuric et al., 2000 all in Cain et al., 2004).

Research by Cain et al. (2004) checked the involvement of language skills and WM

in reading comprehension. They distinguished between lower level language skills and higher level language skills. Lower level skills include word recognition, semantic skills and reading accuracy. Higher level language skills include inference making, comprehension monitoring, and understanding text structure.

Inference making is the ability to integrate between different parts of the text, or between the text and world knowledge. WM is assumed to be the work place where these integrations are made by way of storing and processing.

Comprehension monitoring is the ability to detect text inconsistencies. Such inconsistencies relate to erratic word order, contradictory sentence content, or sentences which are illogical in the framework of the reader's knowledge. It has been seen that children with poor reading comprehension find it difficult to detect such inconsistencies, especially when the contradicting pieces are situated far from each other in the text. This led to the assumption that the information did not survive long enough in memory for it to be manipulated later (Ehrlich, 1996; Ehrlich, Remond, & Tardieu, 1999; Yuill et al., 1989 all in Cain et al., 2004).

Understanding text structure refers to utilizing structural information such as introductions, first sentences in paragraphs, or summaries, for text comprehension. Lack of such knowledge has been found to reduce reading comprehension (Cain, 2003; Cain and Oakhill, 1996 in Cain et al. 2004). Cain et al. (2004) assumed that if such information could be learned, it would facilitate retrieval and limit the effects of processing capacity on reading comprehension.

The conclusion from their study was that WM, lower and higher level language skills make independent contributions to reading comprehension, but none of the variables, by itself, suffices to account for good reading comprehension. Further research is needed to unravel the complexity of reading comprehension (Cain et al. 2004).

Similar results were reported by Nassaji, who also studied the contribution of lower and higher level language skills in reading comprehension. Nassaji checked reading comprehension in L2 as well as in L1. He found that semantic processing (a higher skill) correlated highly with reading comprehension, as did lower level skills such as word recognition, and orthographic and phonological processing. Lower level skills could discriminate between poor and good L1 and L2 readers (Nassaji, 2003).

A completely different direction of research was taken by Calvo (2001). Calvo

studied the relationship between the ability to make inferences and working memory by measuring eye fixations during reading. Calvo based his study on research which had established connections between working memory and eye behaviour (Reichle, Pollatsek, Fisher & Rayner 1998 in Calvo, 2001). Reichle et al. divided eye fixation behaviour into fixation location and fixation duration. Fixation location was found to be sensitive to low level visual orthographic information such as word length. Fixation duration was sensitive to cognitive processes such as lexical access, lexical storing and lexical integration, all needed for on-line text comprehension. Since working memory capacity had been known to control the number of items which could be stored and processed simultaneously, as needed for lexical access, storing and integration, WM was believed to influence eye fixation duration (Reichle, Pollatsek, Fisher & Rayner 1998 in Calvo, 2001).

Calvo took these findings a step further in order to understand better the involvement of WM in higher level text comprehension as reflected by eye fixation duration. The specific research question asked was whether WM capacity influences the ability to make inferences and consequently predict future events in the text during reading, and at what stage of reading the text are the effects of inferring ability most influential.

The subjects of this research were 20 high WM span undergraduate psychology students and 20 low span students. WM was tested by the 1980 Daneman and Carpenter reading span task (computerized and translated into Spanish). Subjects were also given a vocabulary test in order to account for the element of vocabulary knowledge in inferring ability. Inferring ability was tested by short reading comprehension passages consisting of base-line sentences continued by sentences which were either logical and predictive or illogical according to the predicting information. There were also control sentences which were neither predictive nor contradictory according to the context. Results showed that: subjects with high reading span used the predicting context to facilitate reading. This was not true of low span readers.

The predictive effect was apparent in the final stages of text integration when sentence continuations were in line with the preceding data. This realization was achieved by measuring movement of the eyes. These measures showed that the subjects spent less time gazing at the final regions of the text and fewer regressions

were made to earlier parts of the text.

These results support the belief that WM capacity influences the ability to make on-line inferences during reading. Moreover, it helps to single out the late stages of reading as the stages where WM has the most impact in facilitating text integration. The study also points to a general pattern where high span readers need shorter fixation times and low span readers manifest higher fixation times. This suggests that low WM capacity affects even lower processing of single words (Calvo, 2001).

In investigating reading processes it is helpful to look into difficulties encountered by the population of dyslexic people. In relating to dyslexic children, Vellutino et al. (2004) defined them as:

"Children who have at least average intelligence, who do not have general learning difficulties, and whose reading problems are not due to extraneous factors such as sensory acuity deficits, socioeconomic disadvantage, and like factors. Reading problems in such children are manifested in extreme difficulties in acquiring basic reading sub-skills such as word identification and phonological (letter-sound) decoding." (Vellutino et al., 2004)

Vellutino et al. (2004) present a comprehensive account of the research into the hypothesized causes of dyslexia in the last four decades. The dominant factor pointed out is a deficit in phonological coding. This is contrary to early theories which attributed reading difficulties to visual deficiencies (Morgan, 1896; Hinshelwood, 1917 all in Vellutino et al., 2004). These early theories include Orton's theory of optical reversibility (Orton, 1925 in Vellutino et al., 2004) and Herman's theory of spatial confusion (Herman, 1959, in Vellutino et al., 2004), as well as others which pointed to visual sequencing and memory as reasons for dyslexia. However, it has since been established that when elements of verbal coding are controlled for statistically, or minimized in the test itself, visual factors could not account for differences between good and poor readers (Vellutino et al., 2004). Whether or not these findings hold for reading in a foreign language remains to be seen.

In their survey, Vellutino et al. (2004) present the reading process as dependent on word identification and language comprehension. Language comprehension is the stage in reading where lexical, semantic and syntactic information from the text integrate with one another and result in reading comprehension. However, research has shown that word identification is a prerequisite to language comprehension since it is the recognition of the words that triggers lexical, semantic and syntactic

information. Dyslexic children who are at the early stages of reading seem to have difficulties in word identification. Attributes which have been associated with word identification are: phonological coding ability, phonological awareness, orthographic awareness, spelling ability, naming, and verbal memory. Deficits in one or more of the above factors may result in impaired word identification (Catts, Hogan, & Fey, 2003; Curtis, 1980; Foorman, Francis, Shaywitz, Shaywitz and Fletcher. 1997; Hoover and Gough, 1990; Vellutino Scanlon, Small & Tanzman, 1991; Vellutino et al., 1994, all in Vellutino et al., 2004).

Most of the factors mentioned above are linked to memory. Phonological coding difficulties derive from deficits in storage and retrieval of shapes, names and sounds of letters. Likewise, deficits in storage and retrieval of spoken words, together with their printed counterparts, reduce the ability to grasp words globally, which is an important element of fluent word identification. Fluent word identification is also essential in facilitating the higher level language skills of text integration which is dependent on information processing procedures in working memory.

Children's difficulties in reading may surface in different stages of reading development. Impaired phonological coding, which leads to impaired word identification, surfaces in the early stages of reading development, whereas difficulties in comprehension, due to weak integration, surface in the later stages of reading development (Vellutino et al., 2004).

Memory implicates both types of reading difficulty. Processes of storage in and retrieval from long-term memory are more influential in word identification; WM capacity, where processing and storage operate simultaneously, influences the integrative processes of reading comprehension.

Recent research has looked at factors which have been hypothesized to underlie developmental reading disabilities, in the framework of Baddeley's WM model (Kibby et al., 2004). The three factors specified were phonological processing, visual-spatial processing and, and the ability to integrate these sub-skills, which is thought to be controlled by the central executive. The participants in the research were 20 children with reading difficulties (RD) and a control group of 20 normative readers in grades three, four, five, six and seven. The children were tested on verbal WM, visual-spatial WM, central executive functions, and articulation rate. The results showed that RD children had a reduced verbal WM span in comparison to the

control group. Further analysis revealed that both groups were sensitive to word length effects when this was tested as a separate variable; namely, longer words were more difficult to recall for both groups. As mentioned before, phonological similarity of items for recall is believed to reduce memory for these items. There was a possibility that RD children, who were thought to have deficient phonological processing, would not be affected by phonological similarity, and that their recall would be similar for phonologically similar as well as phonologically different items. However, results varied across tasks. RD children were sensitive to phonological similarity when the words were short, but the effect diminished as the words grew longer. The significance of this finding is that RD children do not altogether lack phonological processing skills, but these skills become severely diminished when the load on the phonological store increases.

Results of the visual-spatial tests pointed to no differences in performance between the RD group and the controls. For both groups performance on visual-spatial memory tasks deteriorated as the number of items and central executive load increased (Kibby et al., 2004). This is in line with former research findings (Baddeley, 1990; Mann et al., 1989; McDougall & Hulme, 1994; Nation et al., 1999; Snowling, 1991; Torgesen, 1985, all in Kibby et al. 2004).

Findings from the dual task performance showed that central executive load affected the RD group and the control group in the same way, both when the task was visual and when it was verbal. The significance of this finding is in ruling out a central executive-general processing deficit as the cause of RD. In summary, this study suggests that the predominant cause of reading disabilities is domain specific, and is related to the phonological store (Kibby, 2004).

In summary, research to date has been able to establish that reading in L1 and L2 has much in common and that one of these common factors is memory. It is, therefore, easy to see why people who have difficulties in L1 reading also struggle with L2 literacy. Moreover, in light of the literature, it is understandable why some people do not perform well in L2 reading although there may not seem to be a problem in L1. This could be due to low L2 oral proficiency or due to minor processing weaknesses which surface only with the extra burden of a foreign language.

2.4 Summary of literature review

The literature displayed above presents three disciplines: memory theory, EFL research, and studies which examine the role of memory in EFL learning. The memory theory shows how memory is perceived in terms of time, modality, and processing. It introduces terms such as short-term and long-term memory, working memory and central executive function. EFL research concerns theories and models in second language acquisition. It includes some theories which adopt a linguistic approach to second language acquisition, some which adopt a cognitive approach to second language acquisition, and some which integrate between the two. The EFL section introduces terms such as proceduralization, automatization, incidental and intentional vocabulary learning, lexical priming, collocations, colligations and formulaic sequences. The third section in the literature review represents findings from numerous studies which correlate people's results on memory tests with results on EFL tests in order to establish relationships. Finding from the studies presented show that there are various relationships between memory and EFL. Phonological memory skills were seen to predict foreign language acquisition in general, and vocabulary and syntax, in particular. To the best of my knowledge, literature to date has not examined the impact of other memory functions such as visual memory or auditory verbal memory (along with auditory/phonological processing) on the acquisition of vocabulary and syntax. Research has found that speech perception and production is related to working memory and to long-term memory. The central executive function has not been specified as a factor involved in speech perception and auditory verbal memory has not been mentioned at all. Reading has however been found to be related to working memory phonological working memory and long-term memory both in higher and lower levels of reading. My research examines those memory factors which were not examined, or not specified yet as influencing the ability to acquire EFL. Importantly, research to date has utilized mainly quantitative research tools and relied on correlation studies and regression analyses in order to establish links between memory and EFL parameters. I utilized qualitative research tools in my research hoping that this research method would allow me to look at the processes which underlie the relationships found in the former studies, gain additional insight and offer explanations for those links.

Chapter 3: Methodology

3.1 Introduction

After having presented the theoretical background underlying my research, in this chapter I present the research questions. I explain the research paradigm chosen in order to tackle the research questions, data collection methods, methods for analysing the data and my methods for proposing generalizations.

3.2 Research questions

The literature research presented in the former chapter shows that although there is much research in each of the fields related to in this thesis, namely second language acquisition and memory, less research pertains to relationships between these subjects. Moreover, research which does relate to these relationships touches upon very specific issues in an isolated manner. In addition, research to date, that has sought relationships between memory and second language acquisition has utilized mainly quantitative research tools and has generally been interested in the presence or absence of relationships rather than in the processes underlying these links. In this research, I address issues relating to relationships between memory and EFL performance in a qualitative manner. The first research question is general and relates to the overall relationships between EFL performance and memory:

How might (level of) performance in EFL be explained in terms of memory?

I decided to tackle the issue by dividing the main question into three sub-questions, each relating to a different domain in EFL performance.

1. How might EFL vocabulary and syntactic knowledge be explained in terms of memory?
2. How might EFL sentence processing (specifically speech perception and speech production) be explained in terms of memory?
3. How might EFL reading be explained in terms of memory?

My research approach and research methods are described in the following sections.

3.3 Research approach

In the current research I am interested to understand how performance of EFL learners' might be explained in terms of memory. This could be done by applying a quantitative research design aimed at discovering correlational relationships between variables (Mertens, 2005) tested in large samples, or by adopting a qualitative research design. As a practising educationalist, I was more interested in analysing learning processes and attempting to provide explanations for *how* and *why* than in analysing the results of such processes alone and providing answers to questions pertaining to *what* or *how many.* I believed that a qualitative research strategy would surface additional issues, allow me to gain insight into the processes underlying performance and enable me to gain a more holistic view of the relationships.

My decision was, therefore, to extract data from a small number of cases in the hope that rich data would lead to explanations and interpretations of the processes involved in various aspects of EFL acquisition. Years of experience in teaching English as a FL to mainstream, as well as to learning disabled, pupils have caused me to want to draw upon my own experiences in the process of collecting and analyzing the data (Denzin and Lincoln, 1994; Corbin & Straus, 2008). Since my personal motivation in conducting this research was to gain a better understanding of processes underlying performance, my personal involvement as a researcher in interpreting the data is present throughout (Clough, 2002).

In conducting this research I had no pre-conceived hypotheses which I set out to support or refute. However, I did not start out by feeling my way in the dark. The questions I asked myself and the case-studies derived from the theoretical framework with which I approached the research (Miles and Huberman, 1994; Willing, 2001) and throughout the research process I allowed myself to "follow a path of discovery" (Denzin and Lincoln, 1994, p. 200). All of the above is aligned with the qualitative interpretive research approach which I adopted in conducting this study.

In addition, most of my data collection methods are aligned with the qualitative research approach and include interviews, conversations and role plays with cases, observations and oral protocols. Most of my data analysis is likewise qualitative. It involves an attempt to understand processes via discourse analysis, and to analyse the observations and protocols thematically and systematically. Notwithstanding, since

my aim was to gain a better understanding of processes underlying performance, there was a need to assess performance itself, hence a need to incorporate quantitative test results as a basis for the qualitative analysis.

3.4 Incorporating quantitative test results in qualitative analysis

Although this study stems from a qualitative research approach, the need to determine levels of performance at the outset led me to incorporate quantitative test results in the qualitative analysis.

The quantitative element in the research consists of a battery of EFL tests and a battery of memory tests which show the level of each case-study on each of the subjects. These test results serve as the basis for a deep qualitative analysis of the performance in an attempt to gain insight into the reasons for specific levels of performance.

My decision to use numerical results as a springboard for qualitative research is in line with some current research methods which advocate looking at both the final outcomes and the processes leading to them (Miles and Huberman, 1994). In terms of research methodology, they advocate combining qualitative and quantitative research tools rather than adopting one single method. Supporters of combined methods of data collection maintain that "...numbers and words are both needed if we are to understand the world" and that "...quantities are *of* qualities, and a measured quality *has* just the magnitude expressed in its measure" (Miles and Huberman, 1994, p. 40) (italics in the original).

3.5 Multiple case study approach

[A]" case study is the study of the particularity and the complexity of a single case..." (Stake, 1995, p. xi). A case study may be intrinsic and deal with one specific case in order to understand this case alone, or instrumental, where a case is studied for the sake of understanding a wider range of people. In the latter situation, one should use more than one case (Stake, 1995). The approach to case study in my research is instrumental and aims to gain a better understanding of a general issue. The choice of case studies, therefore, was not random, but according to what I believed would enhance a wider understanding. The enquiry is an example of what is generally known as multiple case study research (Miles and Huberman, 1994). I

hoped that focusing my attention on a small number of cases (six pupils) would enable me to capture some of the complexity underlying EFL performance of Israeli students in their last year of high school and that this focus would allow me to identify characteristics and similarities which would enable me to produce generalizations (Stake, 1995). My decision to use multiple case study research derives from my conviction that evidence from multiple cases is more compelling and permits safer generalizations (Miles and Huberman, 1994; Stake, 1995).

Notwithstanding, I acknowledge the fact that multiple case study research is not sampling research and that a number of cases cannot represent all other cases (Stake, 1995). However, I believe that multiple case study analysis has the ability to facilitate cross contextual generalizations (Mason, 2002, p. 8) and throw light on the issues researched.

3.6 Sampling considerations

"Every instance of a case or process bears the stamp of the general class of phenomena it belongs to. However, every given instance is likely to be particular and unique....For these reasons... researchers employ theoretical or purposive, not random, sampling models." (Denzin and Lincoln, 1994, P. 201-202)

The multiple-case sampling in this research is not random. Rather, it is purposive and guided by the research questions and conceptual framework driving the research (Miles and Huberman, 1994, p. 29; Mason, 2002). It was hoped that a theoretical purposive sample would help produce explanations which are generalizable and could be projected from these cases to a larger population (Silverman, 2000). It must be stressed however, that the ability to form generalizations from such a small sample is limited. Since the main research question concerns the ways in which EFL performance can be explained in terms of memory, the case studies were chosen so as to represent different levels of performance in EFL. Initially, three case-studies were chosen, each with a different level of class performance in EFL (strong, intermediate and weak). I hoped that this sample would enable me to test patterns developing in the process of investigation (Mason, 2002). However, when I started to analyse the test data produced by the three, I realized that the strong pupil's performance on the tests was so strong and the weak pupil's performance on the tests was so weak that lack of diversity within the pupils' performance made it difficult to follow processes underlying performance. On the other hand, the pupil who was

defined as intermediate provided much interesting data. My decision was to add three more pupils to the sample whose class performance in EFL was intermediate.

3.7 Participants

The participants were students at a comprehensive high school in their last year of school (aged between 17 and 18). All the case-studies came from a middle class socioeconomic background. This particular age group was chosen because they were towards the end of their EFL studies and would have had their proficiency tested after 9 years of studying English in the Israeli educational system. The level of English in this last year of high school is thought to be sufficient for students to be able to take the EFL matriculation exams, which are a major part of the research EFL tests. None of the case-studies had been defined as having specific learning difficulties (SpLD). They were chosen according to EFL class performance as defined by the class English teacher. EFL class performance was the only *known* element at the onset.

Case 1- Natalie

Natalie was a girl aged 17 years and 3 months. Her performance in English was defined by her teacher as intermediate. Her reading and writing skills were weak, whereas in the oral skills she did quite well. Natalie was referred to me by the class teacher as an intermediate student with a strange difficulty in reading comprehension. Natalie's grades in other school subjects were intermediate as well.

Case 2 – Aya

Aya was a girl aged 17 years and 8 months, whose performance in English was high intermediate. Aya's performance was varied, with strong reading skills, quite good writing skills, and difficulties in the oral productive skills. Aya was referred to me by the class teacher as a *good, but not superior,* student who would be willing to take part in research. Aya was doing very well in all other school subjects.

Case 3 – Ori

Ori was a girl aged 17 years and 4 months. Her performance in English was very low in all skills. She was referred to me by the class teacher as a *lost cause,* who would be willing to cooperate in return for private tutoring. Ori's achievements in other school subjects were intermediate. She was quite good in Mathematics.

Case 4 - Shandy

Shandy was a girl aged 17 years and 3 months, whose performance in English was low – intermediate. Shandy performed quite poorly in all skills, but speech was the most difficult for her. Shandy was referred to me with Ori (case 3), and she, too, received tutoring after taking part in the research. Shandy was a successful pupil in high-school. However she exhibited a weakness in EFL and Bible studies.

Case 5 – Omer

Omer was a boy aged 17 years and 7 months, whose performance in English was intermediate. Omer's performance did not vary much between the skills, but his teacher claimed he had difficulty with syntax. The teacher claimed that Omer's syntax did not improve although he had made an effort to overcome the difficulty. Omer's overall achievement in high school studies was high moderate.

Case 6 – Eli

Eli was a girl aged 17 years and 8 months. She was a high achiever in EFL, with grades rating from 90% to 100%. Eli performed very well in all skills of English, namely listening, speaking and reading. Eli was referred to me by the class teacher as a very good student who would be willing to cooperate. Eli was a high achiever in all subjects studied at school.

3.8 Ethical considerations

Qualitative researchers face several ethical issues which depend to a large extent on the nature of the research. Since five of the six participants in this research were referred to me by their EFL teacher one of the ethical considerations was to make sure there was no pressure put on them in asking them to participate. In order to make sure that their consent was "freely given" (Miles and Huberman, 1994, p. 290) and that they would not be under the impression that they were required to participate (BERA, 2005) I spoke to them and assured them that their participation in the research depended on their free will. In addition, I ensured that the subjects understood their part in the research and acquired their informed consent to participate (BERA, 2005) Moreover, I assured them that they were free to leave at any given moment and that their participation, non-participation, or any other information concerning themselves would not be reported to their teacher, or anyone

else. This I did in order to protect the subjects as far as possible against potentially harmful effects (BERA, 2005). Since the subjects were all under 18 years of age, I requested, and received, parent consent. Another ethical issue, relevant to this research, was that of privacy and anonymity (Miles and Huberman, 1994). In order to keep the participants' privacy, their names have been changed and I have done my best to ensure that additional personal information presented to the reader would not reveal their identity.

3.9 Data collection methods and tools

Table 3.1 gives an overview of my data collection methods and tools, as well as the way in which I incorporated quantitative research tools in this research in a manner which is aligned with my qualitative research approach as discussed in section 3.5 (adapted from Miles and Huberman, 1994, p. 41).

Table 3.1: Quantitative and qualitative data collection methods

Task	Quantitative	Qualitative
Interview in Hebrew	_____	Content analysis
EFL oral dialogue in English	Quantitative estimation of performance (according to categories)	Observation Content analysis Discourse / conversation analysis
EFL role play in English	Quantitative estimation of performance (according to categories)	Observation Discourse / conversation analysis
EFL reading comprehension passages	Quantitative estimation of performance according to the official matriculation test criteria	Observation Qualitative analysis of processes: observation, oral protocols (in Hebrew), reading aloud
Memory tests	Quantitative results	Observation

Table 3.1 shows that most tasks taken by the case-studies were given a quantification assessment and an in-depth qualitative analysis. "The case study relies on interviewing, observing and document analysis" (Denzin and Lincoln, 2005, p. 202). In this research, each stage or wave (Miles and Huberman, 1994) of data collection has a strong qualitative mark in addition to quantification.

3.9.1 Interview

The first stage consisted of semi-structured interviews with the case-studies in Hebrew. Stake (1995) maintains that forming the questions in interviews is a fundamental step and that the questions should be formed on the basis of what needs to be known. The case-studies were asked about the history of their studies in EFL, their attitude towards these studies, what they consider to be their strengths or weaknesses, their learning styles and habits and the extent of meta-cognitive awareness in their studies. My main consideration in directing the interview was the desire to gather data on issues which would later be looked for in their performance and gain various types of data on the same issue (Corbin and Strauss, (2008). This interview was conducted in Hebrew so that the participants would not be restricted by ability/inability to express themselves in English.

3.9.2 Dialogue

The second stage was a dialogue in English based on a learning styles chart (see appendix A) between me and each participant. The fact that the dialogue was conducted in English meant that it was possible to undertake a linguistic analysis of the discourse at the same time. The fact that the conversation related to learning styles enabled me to learn about their learning from a somewhat different angle. In other words, the dialogue was data for both content analysis and discourse/conversation analysis. The linguistic aspects of the discourse analysis were first quantified according to categories described in table 3.2 and then underwent a qualitative analysis which looked at performance in terms of the underlying processes. In addition to providing additional data, the oral dialogue provided a means of triangulation as it enabled me to support or modify information from the interview in Hebrew (Miles and Huberman, 1994).

3.9.3 Role play

The role play provided further data for discourse/conversation analysis. It served both as a means of triangulation and as a means of looking at a different kind of discourse with less academic content and faster interaction (see appendix B).

3.9.4 Reading comprehension passages

The participants' level of EFL reading was assessed according to their performance on three reading comprehension tasks. Each reading passage required a somewhat different type of reading as is explained in section 3.9.2. Level of performance was first assessed in a quantitative manner after which I engaged in an in-depth qualitative analysis of the performance. The participants were asked to try and follow their line of thought (especially where they were wrong) in a form of what are generally known as oral protocols or think aloud protocols, which are further methods available in qualitative research (Denzin and Lincoln, 1998). This enabled me to 'see through' their line of thought and gain a better understanding of the reasons for their performance. Where I thought it would be revealing, the participants were also asked to read aloud. I would like to emphasise that the numerical score was given before the think-aloud procedure and that any 'help' or prompts given by me in an attempt to see what influence these have on their thinking patterns had no influence on the numerical score.

3.9.5 Memory battery

Unlike the tests in EFL, assessment of the memory tests was mainly quantitative and according to standardized procedures. The qualitative elements in these tests consisted mainly of observing the participants while they engaged in the tasks.

Observation of the participants was built into the whole process described above. Observation is considered, by some, to be the most comprehensive of all types of research strategies since it enables the researcher to see things that are not revealed in other forms of data collection (Patton, 2002). There was much to be learnt from the way in which the case-studies tackled the various tasks from the point of view of body language, remarks, working speed, mumbling and posture.

As can be seen from the above account I have used multiple sources and methods of data collection. I am well aware that having multiple sources of data requires the researcher to utilize several methods of data analysis as well as mapping one set of data upon the other, which is a complicated task (Silverman, 2000). However, my conviction was that the use of rich, in-depth data (Denzin and Lincoln, 1998) would enable me to conduct a more comprehensive study.

3.10 EFL tests - usefulness

The purpose of the EFL tests in this research was to reveal the subjects' general proficiency in EFL in the light of the experience they had had with the English language so far. There are a number of criteria that have to be met to render a test useful. These include reliability, construct validity, authenticity and interactiveness (Bachman and Palmer, 1997). The EFL tests are looked at in the light of these criteria.

Most of the tests used had been administered by the Israeli ministry of education as the summer 2002 matriculation exams and are, therefore, thought to have undergone inner validation procedures as seen fit by the ministry.[1] The Israeli Ministry of Education has also devised a predictive matriculation mark system whereby the school provides the ministry with an internal assessment mark, which predicts the students' matriculation exam mark, and is calculated with the external exam to give the final mark (50% external, 50% internal). The internal mark is also a means of taking into account the pupils' accomplishments throughout the school year. The mean of the summer 2002 external matriculation mark was 67.1% and the mean of the internal assessments was 73.9%. A direct translation of what the internal mark is called in Hebrew is *the defence grade* and indeed many teachers tend to slightly tip the internal mark to the benefit of the students. Taking this into consideration, the difference between the internal mark and the external mark is fairly small, which means that the matriculation test seems to assess the students' achievements quite accurately.

The tests which were a part of the Israeli matriculation exams were dialogue, role-play and the reading passages.

3.10.1 EFL - Oral tests

As noted, the oral tests consisted of two tests: dialogue and role-play. In the dialogue, the subjects were asked to engage in a dialogue with me (as interlocutor) for approximately 10 minutes. The topic of the dialogue was *Learning Styles,* and it was prompted by a learning style chart which displayed pictures of various learning patterns as presented in appendix A.

[1] The Ministry was reluctant to give information.

The role-play assumed the roles of teenager and parent and was played out by the case-study and me for approximately 10 minutes. We dealt with, and argued about, topics which often lead to differences of opinion between parents and teenagers such as eating habits, friends, studies and future plans (see appendix B).

3.10.2 EFL - Reading

The reading section consisted of three parts: checking various degrees of search reading and careful reading. The first reading passage was an article of 211 words, dealing with children's museums. The text was followed by three questions asking the test takers to find information in specific parts of the text (search reading) (see appendix C).

The second reading passage was a brochure advertising a scientific magazine. The passage was 160 words long and was followed by questions necessitating both search and careful reading in order to integrate information from various parts of the text (see appendix D).

The third reading passage was a 306 word article dealing with the importance of English as a foreign language. This reading passage was followed by six questions necessitating both search and careful reading (see appendix E).

3.10.3 Authenticity of the EFL Tests

Authenticity has been defined as "...the degree of correspondence of the characteristics of a given language task to the features of the target language use (TLU) task" (Bachman and Palmer, 1997 p. 22). It must be acknowledged that although we can sometimes produce relatively authentic language tests, they can never be real (McNamara, 2000). The research EFL tests had a high degree of correspondence with the students' immediate TLU task at this point of their academic studies, which was passing the EFL matriculation test at the end of the school year. Using authentic materials from the former year's matriculation test added to the authenticity and construct validity of the research tests and created high motivation amongst the subjects. The fact that the test included oral, as well as literacy, tasks rendered it useful for examining non-academic requirements of English as a foreign language as well.

3.10.4 Interactiveness of the EFL Tests

Interactiveness has been defined as the extent to which test tasks correspond to, and bring about, the test takers' language abilities, topical knowledge and affective schemata (Bachman and Palmer, 1997). All the test types relate to these abilities. One must have the language ability in order to read, speak one's opinion, or understand what is said. Topical knowledge and affective schemata are also a part of all these and are bound to play a crucial part in a learner's performance on the EFL test tasks. It is for this reason that the topics chosen for the test tasks were from domains familiar to teenagers. It is also a type of test which the subjects will have been familiar with, due to the fact that similar tests are given as they approach the final matriculation exam.

3.10.5 The constructs to be measured

"Defining the construct involves being clear about what knowledge of language consists of, and how that knowledge is deployed in actual performance (language use)". (McNamara, 2000 p. 13)

The reading tests

Two sets of constructs are measured in the EFL reading tests. One, which derives from a theory of language ability that underpins the school curriculum requirements, is reading comprehension. The second derives from an in-depth qualitative analysis of the reading and looks at decoding ability, vocabulary knowledge and syntactic understanding. Together, these constructs pertain to the research questions which attempt to explain overall reading ability, and what are thought to be the building blocks of reading ability (decoding, vocabulary knowledge, and sentence processing) (See chapter 2), in terms of memory. In the context of reading, sentence processing was examined in the light of what the oral protocols revealed about the underlying reasons for reading comprehension (or lack of comprehension). In addition, when the qualitative analysis of the data surfaced additional constructs which were seen to be relevant to the study and relevant across case studies, these constructs were examined as well. The main constructs raised as result of the qualitative analysis were the

relationship between the modality of learning and that of performance, and the issue of strategizing.

Scoring procedures

The quantitative aspect of comprehension in the EFL reading tests was assessed according to the matriculation assessment. In questions that consist of several parts, the numerical score was weighted as in the original tests. The difference between the scoring for the purpose of this study and the original system is that in the original system the answers to the questions are supposed to be given in English and in this study the answers were given in Hebrew. I thought this was a better way of assessing reading comprehension alone (without possible interference from elements of production in the answers). Decoding, vocabulary knowledge, and sentence processing were given a qualitative assessment after an in-depth qualitative analysis of the reading which relied on the case studies' oral protocols.

The oral tests

"Many researchers and language practitioners believe that the constructs of L2 performance and L2 proficiency are multi-componential in nature, and that their principal dimensions can be adequately and comprehensively, captured by the notions of complexity, accuracy and fluency" (Housen & Kuiken, 2009, p. 1).

The criteria based rating scales devised by the Israeli Ministry of Education (table 3.2) seemed to fit the multi componential constructs suggested above very well. The first set of constructs relates to the case study's communicative ability and includes comprehension, fluency and language complexity. The second set of constructs pertains to ability to use the language accurately and looks at correctness, range, and complexity of vocabulary and syntax. Pronunciation is looked at as a part of the qualitative evaluation. Examining these constructs is also in line with the research questions which relate to vocabulary and syntax in general (research question 1) and to the ability to comprehend and produce speech (the oral aspects of sentence processing) which is addressed in research question 2. Like the constructs measured in the reading, these constructs also derive

from a theory of language ability that underpins the school curriculum requirements.

Scoring procedures

It was very important for me both as interlocutor and as the assessor of the oral proficiency tests to try and put the students at ease and to create a relaxed atmosphere. Therefore, during the conversations with the case studies I concentrated on my role as interlocutor and the scores were given later when I listened to the whole process recorded on tapes. In fact, I found that I could only assess one criterion at a time and this led me to listen to the tapes several times, each time with one specific criterion in mind. The decision to give an estimation of each parameter in percentage was taken following personal communications with Pickering (in 2006) who maintained that this kind of scoring would better reflect the qualitative aspects of the constructs (the original scoring is numerical and slightly different). Although the assessment of the (matriculation) rating scales relies solely on qualitative analyses and judgment, it was my decision to involve an element of quantification in the assessment of language accuracy (labeled – *incorrect/correct use of simple/complex language structures)* and vocabulary (labeled – *limited/basic/rich vocabulary*) as a means of triangulation (only). This procedure involved listening to the tapes and counting mistakes. At this point a few problems emerged. Since the quantification process involved counting mistakes, I first listened to the tapes and counted vocabulary mistakes only. However, I very soon realized that it was sometimes difficult to decide whether to count a mistake as a vocabulary error or a grammatical one. If a case study said bringed instead of brought, for example, what would it be? My decision was to consider all morpho-syntactic mistakes as syntactic mistakes and count them as incorrect use of language structures. Although this is not a perfect decision, I felt that consistency was highly important and that trying to work out the roots of every such error would be both too complicated and could lead to inconsistency. The counting itself was also problematic since there were slight differences in the length of time each case study spoke and even a minute more meant that there might be more mistakes. My decision was to

count the number of errors, count the minutes, calculate how many mistakes there were per minute and then give weight for the range of structures or of vocabulary used. For example, a case study who made 3 vocabulary mistakes, and spoke for 6 minutes had, in average, 0.5 vocabulary mistakes per minute. The range of vocabulary she used was high and therefore I assessed her performance to be very good. Another case study who made 17 mistakes in 5 minutes, had in average 3.4 vocabulary mistakes per minute and used only a moderate range of vocabulary. I assessed her performance to be low intermediate. The assessments given with some quantification tools and those given using merely qualitative judgment were very similar. I would like to make it clear that the quantification procedures were used for triangulation only and that the results presented in the thesis were given according to the matriculation assessment, namely according to a qualitative judgment. The table below shows the criteria and constructs evaluated in the oral proficiency tests.

Table 3.2: Criteria for assessment of speech

Communicative ability	Points	Accuracy	points	Final grade
Comprehension of questions		Incorrect/correct use of simple/complex language structures		
Non-fluent/fluent Interaction		Limited/basic/rich vocabulary		
Gives single word/simple sentence/extended answers		Poor/mostly comprehensible/comprehensible pronunciation		
Total communicative ability		Total accuracy		

3.10.6 Construct Validity of the EFL Tests

Construct validity has been defined as *"...the extent to which we can interpret a given test score as an indicator of the ability(ies), or construct(s), we want to measure."* (Bachman and Palmer, 1997 p. 21)

The EFL tests in this research are quite integrative. The reading tests test both lower and higher level reading skills. Text types and question types allow us to follow the subjects' knowledge of the texts' vocabulary and syntax, as well as strategies for

searching for specific information and the ability to relate different parts of the text to each other. The oral tests enable us to see all the mentioned constructs as they operate in reaction to an interlocutor's stimuli. Although the end result of the reading tests show whether the text was understood or not, use of oral protocols allows the tester to follow processes and gain a better understanding of what underlies the student's strengths or weaknesses. The fact that there are two different oral tests allows us to see how the constructs are manifested in a variety of contexts and to appreciate similarities or differences in performance.

3.11 The memory tests

Unlike the English tests, the memory tests used in my research do not have authenticity. In real life people never have to remember nonsense syllables or lists of words. However, all the memory tests used in this research have been standardized and validated and are used by neurologists, psychiatrists, psychologists and assessors of specific learning difficulties. Whilst preparing the participants for the memory tests they were told that they would be asked to perform some strange tasks that would eventually shed some light on their memory patterns. They were also told about the research in general and were very curious to know the results. The subjects were willing to do these strange tests and were very cooperative throughout.

3.11.1 Rey Auditory Verbal Learning Test (RAVLT)

The original version of the Rey Auditory Verbal Learning Test (Rey AVLT or RAVLT) was written by Rey in 1964 in English. It is used to extract information as to immediate and delayed recall, proactive and retroactive interference. The Rey AVLT is used both as a research tool and for clinical purposes (Hebrew version: Vakil and Blachstein, 1997; see appendix F).

The original English Rey AVLT was translated into Hebrew and standardized in a Hebrew version by Vakil and Blachstein (Bar Ilan University – Israel), testing 528 males and females aged 21 through 91. Vakil and Blachstein also developed norms for ages 8 – 17 working with a much smaller group (n=39), which were used in this research.

Test and procedure

The subject is read 15 common nouns at the rate of one per second, and is then asked to repeat the list. (The repeated words do not have to be in the same order as in the original list). This is done 5 times (trial 1-5) and on each occasion the subject is asked to repeat the same words. These trials check short- term auditory memory and give an indication as to the test taker's learning curve between trial 1 and trial 5. Immediately after trial 5, an interference list of 15 new common nouns is read, and the subject is asked to repeat what he/she remembers from the new list. Trial 6 checks proactive interference, namely, to what extent previously studied materials interfere with newly studied material. Trial 7 is done immediately after trial 6. and requires the subject to repeat the first list again. This trial checks retroactive interference, namely, to what extent newly studied material interferes with retaining materials which have been studied before.

At this stage there is a 20-minute break. After 20 minutes break, the subject is asked to repeat list number 1 (without being able to listen to it again). This is trial number 8 and it checks long-term auditory memory.

Immediately after trial 8, there is a 9th trial in which the subject is read 50 common nouns. 15 of these are from list 1, 15 are from list 2 and 20 are new common nouns. The subject is asked to say '*yes*' when he/she recognizes words from list 1. Trial 9 checks memory via the recognition route, as opposed to the recall route checked in all former trials.

The Rey AVLT was included in this battery as a tool for a better understanding of the auditory memory processes. Since many aspects of FL acquisition are auditory, it was hoped that the test would be able to establish a link between oral language constituents and auditory verbal memory. The Rey AVLT enables us to single out factors such as proactive and retroactive interference, thereby shedding light on one's ability to absorb new auditory information (vocabulary, syntax) in the light of existing information, and determine to what extent former information is still retained after new information is taught. It also allows us to look at long-term auditory memory, and recognition of formerly presented things, all of which are believed to be relevant to the acquisition of a foreign language. The strength of this test is that it allows both a global and an analytical observation of the auditory verbal memory.

3.11.2 Active Memory – Siegel and Ryan (1984, 1989)

The active memory test is a part of a battery intended to assess central executive skills which are believed to play an important part in the reading process. The Active Memory Test was translated into Hebrew and standardized by Shani, Ben-Dror, Zeiger and Ravid by testing 281 pupils from 10 age groups (males and females) aged 5 to adults (university students). The pupils were aged between 17 and 18 (as in the sample of this research) and numbered 29 (Shani, Zeiger and Ravid, 2001). These students study in a high school with a heterogenous student population, as do the subjects of my research. Active memory is considered an important factor in the development of reading skills and is measured in tasks that demand retention of verbal items whilst processing.

The basic model of active memory was presented by Gathercole and Baddeley in 1993. According to this model, as noted in the previous chapter, phonological information is stored and processed in a *phonological loop*, which is theoretically a system that specializes in the storage of verbal information according to its sound structure, and in sub-vocalization processes that help the language user hold on to the information in memory (Shani, Zeiger and Ravid, 2001). The theorized system which controls simultaneous storing and processing is the central executive.

'Active Memory- Complementing words': test and procedures

Active Memory – Complementing Words is the Hebrew version of *'Sentence Working Memory'* (Siegel and Ryan, 1984).

In this test the subject is read simple sentences about common knowledge subject matter, with the last word missing. The subject is asked to provide the missing last word. After being read a series of sentences, the subject is asked to repeat all the words he/she had provided, in the original order. For example: *A hen lays* ...(The word expected is – *eggs*), *An aeroplane flies high in the* ...(The word expected is – *sky*). Now the subject is expected to say: *egg, sky.*

The test consists of five levels of difficulty, two items in each level of difficulty. At each level one more sentence is added so that the 5th level consists of five sentences. The test ends when the subject cannot repeat all the words provided by him/her in two series of the same level of difficulty (see appendix G).

Standard scores were calculated for each subject on each trial separately and

measured on a seven rank scale (1=poor to 7=very superior).

An element of active memory was included in this battery in order to estimate the possibility of links between skills in EFL and this type of memory.

3.11.3 Detroit Tests of Learning Aptitude – Adult (DTLA-A)

The Detroit Tests of Learning Aptitude – Adult (DTLA-A) was designed to test aptitude, which is defined in the examiner's manual as "...the ability that a person must possess to achieve some purpose." (Hammill & Bryant, 1991, p.3)

"The DTLA-A is a battery of 12 subtests that measure different but interrelated mental abilities. The battery is designed for use with persons ages 16 through 79 and has empirically determined reliability and validity. The normative sample consists of 1254 persons residing in 31 states." (Hammill & Bryant, 1991, p. 9)

The DTLA is used to measure the relationship of certain abilities to academic proficiency. It was constructed to satisfy the rigorous criteria of the American Psychological Association concerning reliability, validity, normative data, and method for reporting scores (Hammill & Bryant 1991).

The DTLA-A Design Sequences – subtest 6 measures visual discrimination and memory for non-meaningful data. It is non-verbal with an emphasis on attention and short-term memory.

Test procedures

The subject is shown a picture depicting a series of designs for five seconds. After five seconds the picture is removed from view. The subject is given cubes with designs on each of their sides and is asked to arrange the cubes in the same manner as was displayed to him/her before. To do the task, the subject must manipulate each cube in order to find the correct design, and slip the cube into a slot in a rectangular block (see appendix H).

"Standard scores provide the clearest indication of an examinee's sub-test performance. Based on the distribution with a mean of ten and standard deviation of 3, sub-test standard scores are converted from raw scores." (Hammill & Bryant, 1991, p. 43)

Standard scores were calculated for each subject separately.

Table number 3.3 presents standard scores and ratings of the Design Sequences test.

Table 3.3: DTLA-A scoring procedures

Std. Scores	Rating
17-20	very superior
15-16	superior
13-14	Above average
8-12	average
6-7	Below average
4-5	poor
1-3	very poor

Scores and ratings are taken from the DTLA –A manual (Hammill & Bryant, 1991).

The reason this test was made part of this research was to determine whether there is a link between the subjects' performance with non-meaningful visual sequential data and EFL reading.

3.11.4 Rey Complex Figure Test (RCFT)

The *Complex Figure* was originally derived by Rey in 1941 to investigate visuo-spatial constructional ability and visual memory in brain-injured people (Lezak, 1995, in Meyers & Meyers, 1995). In more recent times the Complex Figure Test (CFT) has been frequently employed as a neuropsychological test of visuo-spatial memory (Butler, Retzlaff, & Vanderploeg, 1991; Lezak, 1995, both in Meyers & Meyers, 1995) (see appendix I). The newly developed recognition trial enables one to single out more specific visual memory profiles, as will be presented in the *Tests and Procedures* section.

RCFT normative data were derived by Rey from a group of 601 normal subjects aged 18 to 89. The first sample consisted of 134 students from various university settings; the second sample consisted of 74 people who were friends and family of head injured patients in a hospital; the third sample consisted of 393 people from suburban communities in western and mid-western United States and British Columbia, Canada. Normative data were also provided later for 16 and 17 year olds.

Tests and Procedures

A variety of administration procedures and scoring systems have been developed for the CFT. The testing procedures and materials used in this research are those used in

the original version referred to as RCFT (Rey Complex Figure Test). Administration of the RCFT involves a copy trial, a recall trial after 3 minutes, an additional recall trial given after 30 minutes and a newly developed recognition trial, which is administered immediately after the delayed recall trial. The recognition trial presents 12 of 18 scoring elements of the complex figure stimulus, along with 12 designs that serve as foils. The subject indicates which items are recognized from the earlier copy and recall trials. The subject is not told beforehand that there are going to be recall trials so that no conscious effort is made to remember.

Scoring procedures

The RCFT scoring in the research reported in this thesis is based on the original scoring criteria developed by Rey. This scoring system divides the complex figure into 18 units. Each unit is scored separately for accuracy of performance and placement of the figures. A score of – 0, 0.5, 1, 2 are given to each unit according to very detailed scoring criteria given in the RCFT manual (Meyers & Meyers, 1995) (see appendix I). Raw scores ranging from 0 to 36 may be obtained for each trial. The same scoring criteria apply to all three drawing trials.

For diagnostic purposes the RCFT manual provides a transformation of RCFT raw scores to normalized T scores and associated percentile scores. T scores have been constructed to have a mean of 50 and a standard deviation of 10.

Columns number 1 and 2 of table 3.4 present T score interpretations as presented in the RCFT manual.

Table 3.4: Interpretation of RCFT scores

T score range	Interpretation
>55	above average
45 –54	average
40 –44	below average
35 – 39	mildly impaired
30 – 34	mildly / moderately impaired
25 – 29	moderately impaired
20 – 24	moderately/severely impaired

Scores which are below average on the immediate recall and delayed recall trials indicate low visuo-spatial recall ability in the short term and the longer term

memory. The recognition trial points to the ability to retrieve visuo-spatial information when given retrieval cues. It enables one to single out memory profile patterns such as a reduced attention profile, a reduced encoding profile, a reduced storage profile, a reduced retrieval profile and a normal profile.

The RCFT was chosen as a part of this research in order to discern whether the ability to recall or recognize visual materials is linked to reading and writing skills.

3.11.5 Shatil Syllable Range Test

The Shatil Syllable Range Test is a part of a test battery developed by Shatil (Shatil, 2002) and is widely used in Israel. The goal of this battery was early identification of specific and general language impairments apparent in the acquisition of reading and spelling. The normative data were derived from 349 children, who were checked twice: the first time was towards the end of preschool, and the second time was at the end of first grade. It was found that the syllable range test was one of the best predictors of decoding.

Test and scoring procedure

In the syllable range test the subject is asked to repeat combinations of meaningless syllables. The test begins with one syllable and ends with five, with two items in each level of difficulty (see appendix J). With each correct answer the subject receives one point. The points are then counted to make a raw score. The raw score is converted into percentile ranks according to given instructions (Shatil, 2002). This test was chosen to be part of the research battery in order to examine whether there is a link between phonological working memory and reading skills in EFL. This kind of test must be administered in the subject's mother tongue; however, since there is no such test in Hebrew which had been standardized for teenagers or adults, I preferred to use a standardized test to using other tests that are in use but not standardized. Results were measured on a dichotomous scale of low/high levels of performance. Scores within the maximum range of this test (95% percentile) were classified as high, whereas scores below this were classified as low. I would like to add that in test batteries used in Israel phonological working memory tests use mainly digit span. My decision was to use syllables since I believe that memory for language units is more similar to memory for syllables than memory for digits. In using this test, I was well aware that while a low score on this test pointed to difficulty, a high score did

not necessarily point to strength since the test takers were much older than the age group for whom the test was originally devised.

3.12 Data analysis

An overall view of the conduct of the data analysis in this research is presented in table 3.5 in order to show the workings of the study.

Table 3.5: Overview of data analysis

Data sources for analysis Each of the following participants took a battery of EFL and memory tests analysed in a quantitative and qualitative manner. Case 1 – Natalie, Case 2 – Aya, Case 3 – Ori, Case 4 – Shandy, Case 5 – Omer, Case 6 – Eli.
Main analytical practices Making comments in the field Transcribing and translating data Arranging data for analysis: categorizing Triangulation practices
Procedures for generating findings Within-case decisions Thematic clustering and analysis Comparing, contrasting, interpreting Realizing patterns and new themes Suggesting generalizations
Confirming the findings

3.12.1 Comments in the field

My comments in the field were recorded in the form of field notes. Patton (2002, p. 302) states that field notes should contain everything that the observer believes to be worth noting. In the course of this study, taking field notes mainly involved observing the case-study while he/she engaged with the test tasks. I noted body language which I later interpreted in terms of attitude towards, or easiness/uneasiness with, the tasks. I noted pace and what I perceived to be concentration or lack of it. I noted tone/steadiness of voice, alertness versus tiredness etc. Most of the field notes were taken on the spot. In tasks which involved me, as interlocutor, I wrote my comments immediately after the session since I believed that stopping a conversation or role play in order to attend to writing notes would prevent a natural flow of speech and decrease authenticity. In addition, since all of the oral communication tasks were recorded on tape, many of the non-visual points I noticed in the course of the conversations or role plays surfaced again when I listened to the tapes. The field

notes later proved to be useful in interpreting the data. One example of this was when the performance of one of the case-studies on one of the memory tests did not seem to be in line with anything else she had previously performed. When I went back to look at my field notes I found that I had recorded that she had been annoyed by not being told she would have to recall things from memory and from that moment her whole attitude towards the test became negative and 'off-handed'. The field notes helped to explain what would have otherwise remained quite a mystery.

3.12.2 Transcribing and translating the data

As mentioned above, many parts of the EFL tasks were recorded on tapes and were then copied onto discs. These included the interview in Hebrew, the dialogue in English, the role play, the oral protocols following the reading comprehension tasks and the instances where the case-studies were asked to read aloud. Because transcribing the data was time consuming, I asked two colleagues to help me with this part of the work. I thought that this would both save time and assure me as to my own transcription practices. Two colleagues agreed to transcribe a small part of the data according to identical transcription conventions as a pilot transcription study. Unfortunately, when I checked the transcriptions against the discs I realized that the kind of detailed transcription which I was aiming at could only be done by myself and that I could not ask anyone else to listen time and again until all speech nuances were thoroughly captured and put in writing. However, their transcriptions helped me realize better the type of transcripts required for this study. In order for me to be able to utilize transcriptions in my research, every hesitation, repetition, mispronunciation or self-correction was of importance. Consequently, I decided to transcribe all the data by myself. (Transcriptions of the data are presented in a separate binding.)

Patton (2002) maintains that:

"Transcribing offers another point of transition between data collection and analysis as part of data management and preparation. Doing all or some of your own interview transcriptions (instead of having them done by a transcriber), for example, provides an opportunity to get immersed in the data, an experience that usually generates emergent insights." (Patton, 2002, p. 441)

As Patton predicted, quite a few ideas began forming in the process of transcription, ideas which were noted along with the transcriptions. Arranging the data for analysis by way of categorizing in light of these ideas seemed to emerge naturally from the

transcription process. Below are the transcription codes I used while transcribing the data.

Written in bold:	Stressed words
He speaks slowly:	Word stretched
(pause):	My remarks in brackets
<high tech devices>:	Read from the text by the pupil
***	Unclear speech
What does it mean?= :	Overlapping speech between me and the case-study
=no sorry I meant	
SABABA:	Words said in Hebrew (given in Hebrew phonetics)
..not eh DISTURB ME:	Words spoken in Hebrew but translated are capitalized.

Translation

Parts of the tests which were conducted in L1 were translated into English by me, in a form that kept as many of the speech features of the original as possible. In order to be more confident in my translation, I asked one of my colleagues to translate an episode. Since our independent translations turned out to be very similar, I went on in this manner.

3.12.3 Arranging data for analysis

"Codes are tags or labels for assigning units of meaning to the descriptive or inferential information complied during the study." (Miles and Huberman, 1994, p. 56)

Transcriptions: my assigning of meaning to the data began with coding the transcriptions. The transcriptions were colour coded according to the conceptual framework underlying the study, in light of the research questions and using my professional experience. For example, when a case-study committed a reading error which, in my experience, could have been attributed to phonological working memory, I shaded it purple. This was done because reading was one of the EFL aspects to be checked, and in the conceptual framework of the study phonological working memory was named as a factor related to reading. In addition, any remarks and field notes which seemed relevant were incorporated into the transcriptions. The coded transcriptions were put in a different computer file.

One such instance is exemplified below:

<What two tink s were people not (pause) always (pause) to do eh eh in in muss in mooessems in the past?>

{In the previous sitting, when she read the question she read the word "things" correctly but she probably still didn't understand what it meant. That time she read the word "allowed" as "alloed" whereas this time she reads it as "always". We see that there is no consistency in her mistakes. It is not that she thinks there is a word "alloed" or that she always reads /ow/ as /oe. What we see here is in line with what she says about how she tackles vocabulary in a text. Namely, she is driven by the beginning of the word and something in the overall configuration. Here she took the /al/ from the beginning and the /w/ from the middle and ended up with "always" which was also probably a familiar word for her.}

The writings in script font are my remarks and interpretations I attribute to things while reading through the transcripts. My interpretations are also colour coded so that when I say that she is driven by the beginning of the word and something in the overall configuration, I colour it in red which stands for the visual aspects of memory. These remarks served as notes to pay attention to when I engage in the deeper and more thorough analyses. The next step was to 'collect' all of the parts in a specific test which have the same colour coding and look for patterns. For example, I asked myself whether there were patterns to be seen across decoding errors. Did the case study say anything about reading difficulties that could fit into a hypothesised pattern? The next step was to look at the same colour codings across tests for the same case study and ask myself whether I could identify patterns across tests. What are the similarities or differences? Could there be a mutual primary source for the errors? The last step with the codings was to look at the codings across tasks and across cases and look for patterns with similar questions in mind.

Following is the full colour code for the transcriptions:

EFL

Elements relevant to EFL vocabulary

Elements relevant to the productive aspects of sentence and textual processing

Elements relevant to reading comprehension

grammar

strategies

Language skills in L1 or other languages

Phonology/phonetics/incoherent speech

decoding

hesitations

Memory

Phonological working memory

Auditory verbal short-term memory

Central executive

Visual spatial

Interference

Additional points of interest

personality

{My remarks for further analysis in different font}

Field notes: the field notes were classified according to each participant and according to each test. Where appropriate, field note remarks were incorporated into the *transcriptions for work* as in the example above. Other notes were filed with the tests and tasks of each case-study so that they could be revisited when necessary.

Test results: numerical test results (both EFL and memory) were put in table form and colour coded according to a rough estimation of weak, intermediate and high. This was done in order to give an initial idea of performances on both tasks before the qualitative analysis.

3.12.4 Triangulation practices

"Stripped to its basics, triangulation is supposed to support a finding by showing that independent measures of it agree with it or, at least, do not contradict it." (Miles and Huberman, 1994, p. 26)

As an individual researcher in this study which involved assessment of performance as a basis for further analysis, I felt the need to involve a second researcher in the pre-interpretative assessment processes in order to add confidence to my evaluations. The second researcher holds an Ed.D degree from a university in England, is a practicing EFL teacher in Israel and is an assessor of specific learning difficulties, and therefore seemed to be qualified for offering her expertise as second researcher in this study. The points where I felt the need to involve the second researcher were in preparing the transcriptions for analysis and in checking samples of the EFL tests. After transcribing the recordings and singling out the categories for analysis, I decided to ask the second researcher to read a few samples from the transcripts and colour-code according to these categories. Our colour-coding was very similar meaning that we both thought that certain aspects of EFL performance or certain things that the case studies said about their difficulties could be related to a a certain primary difficulty (See colour coding in 3.12.3). After I had checked the EFL tests I asked the second researcher to check the oral tests in the same way as I did namely, by listening to the tapes a few times each time listening for a specific criterion and rating the performance according to the same criteria that I used. Our ratings were very similar. I would like to add that both I and the second researcher have many years of experience in grading the Israeli oral matriculation tests according to the criteria used for the purpose of this study, a fact that added to our expertise in grading this kind of performance. The second researcher was involved in checking the reading as well.

As far as the EFL reading was concerned, I did not ask her to listen to all of the oral protocols which followed the reading tests, but she did check all of the parts which could be quantified and listened to some of the oral protocols vis-a-vis the parameters singled out by me. Our assessments of the case studies' reading were also very similar. Interestingly, we both pointed to similar qualitative aspects in the reading as being problematic and raised some similar possible explanations for the

difficulties. This may be due to the fact that in our everyday lives we both engage in similar qualitative analyses as a basis for building individual remedial teaching programmes.

In addition to involving the second researcher, there were some things I, myself, applied as means of triangulation. Firstly, I revisited most of the tests and checked them again a few weeks later. This I did specifically where the assessment was a qualitative one. This meant that I listened to the tapes again according to the same categories and rating criteria. My ratings were very similar the second time around and very similar to the second researcher's. In addition, as I listened to the tapes the second time I thought it necessary to try and quantify the elements of vocabulary and syntax in the oral tests as a further means of triangulation. This I did as explained in section 3.10.5.

3.12.5 Reliability

"The underlying issue here is whether the process of study is consistent, reasonably stable over time and across researchers and methods. We can, in effect, speak of "quality control" (Goetz & LeCompte, 1984; A. G. Smith & Robbins, 1984). Have things been done with reasonable care?" (Miles and Huberman, 1994, p. 278).

Miles and Huberman (1994) specify a number of factors which add to the reliability of qualitative research. The first question qualitative researchers need to ask themselves is whether the research questions are clear and whether the features of the study design are congruent with them. I believe that the research questions of the study reported in this thesis are clear. They seek to explore and explain relationships between the EFL performance of the case studies and their memory profile. The questions focus specifically on vocabulary and syntactic knowledge, sentence processing (which in the context of this study relates to both comprehension and production), and reading. The study was designed in a manner which was thought to provide insights into the issues addressed in the research questions. The EFL tests examined the EFL parameters specified in the questions with both quantitative and qualitative research tools a design which enabled me to maximize the usefulness of the data. For example the quantitative scores of the reading tests showed to what extent the text was understood and the qualitative analysis of the oral protocols pointed to specific aspects in the texts which may have accounted for levels of

comprehension. The qualitative analysis allowed me to see whether a text was misunderstood because of lack of vocabulary knowledge or inability to process the syntactic structures. The criteria in the oral proficiency rating scales are also in line with the research questions. For example, the construct of sentence processing (comprehension and production) in research question 2 is addressed by assessing the case studies' syntactic accuracy and range, as well as his/her ability to comprehend the interlocutor. Another question qualitative researchers should ask themselves is whether the analytic constructs are clearly specified and connected to the theory (Miles and Huberman, 1994). The analytic constructs of EFL are driven by the research questions and the EFL literature. The analytic constructs which pertain to memory derive from the memory literature and are presented schematically in illustration 11.1. The qualitative nature of the research enabled additional factors to surface. These are specified and analyzed in addition to the original constructs. Miles and Huberman (1994) point to a number of additional factors which may render qualitative research reliable. They advise researchers to check for meaningful parallelism across data sources, to apply means of triangulation and quality check to the study and try to involve a colleague in review processes. This could also serve as a means of triangulation. My research is in line with all of these steps (see 3.12.4).

3.12.6 Within-case sampling

Although the overall method of analysis in this research is multiple cross case analysis, I decided to provide an in-depth analysis of one of the case-studies before beginning the process of comparing participants to one another. The reason was that an in-depth analysis of one of the cases, chosen using purposive within-case sampling (Miles and Huberman, 1994), would help identify issues requiring more focus in the following analyses. Having looked at the EFL and memory test results and arranged the data for analysis by way of colour-coding the transcriptions, there seemed to be two case-studies who were a mirror image of one another both from the point of view of memory and from the point of view of EFL performance. It was felt that an in-depth analysis of two such case-studies who appeared to be complete opposites could yield interesting information. This is in line with Miles and Huberman (1994) who claim that within-case sampling should be theoretically driven.

3.12.7 Thematic clustering and analysis

The first stage in my analysis was to look at strengths and weaknesses in the EFL and memory tests, first in each case and then across cases. So, for example, when I saw that a participant who performed poorly on a specific EFL test also performed poorly on a specific memory test I looked to see whether other participants manifested the same pattern of performance. I engaged in the kind of qualitative analysis which I hoped would allow me to follow processes and help me find possible reasons for these manifestations. This was done for all case-studies and all tests, whether or not obvious relationships stood out in the test results, and according to the conceptual framework underlying the study.

After having decided which cases were to be analysed in more depth, I began a process of thematic clustering and analysis of the data (case by case). My decision was to analyse the data according to the research questions regarding memory factors and their relation to EFL derived from the conceptual framework underlying the study. In doing so I was helped by the colour coding of the transcriptions. So, for example, when the research question referred to EFL reading, and in the conceptual framework reading was related to PWM, I 'gathered' all instances from the case-study's reading and oral protocols which were marked in purple (see section 3.9.3 above) and 'gathered' all instances in the interview (in Hebrew) and dialogue (in English) which referred to reading which were marked in purple, and started to engage in an analytic interpretive process. The same process was carried out for each of the case studies and each of the issues. One limitation of this strategy is that it is time consuming, especially when there are many EFL issues and memory factors to be looked at. On the other hand, one of the advantages of this meticulous procedure is that it is very thorough and does not leave one with many overlooked issues.

Miles and Huberman (1994, p.91) maintain that analysis is progressive and moves from description to explanation in a process which starts with telling a story about what is studied, followed by constructing a 'map' and ending with building a theory. My research is very much in line with this. First the cases are introduced to the reader. Their story is told in a way that the reader can get a picture of each case-study nested (Mile and Huberman, 1994) in his/her overall academic achievements and attitudes. Quotations of what they say are woven into the text throughout so as to add

to the authenticity of the descriptions and enable the reader to see on what I based my interpretations (Bogdan and Bilken, 1998). A 'map' is constructed by formalizing the elements of the story and locating key variables according to my interpretations. A new theory is suggested by showing how the variables may be connected in a new conceptual framework (Miles and Huberan, p. 91). The process of analysis started with arranging the data for analysis and coding the transcriptions. This involved formalizing the elements of the story and locating the key variables, which initially derived from the conceptual framework underlying the research. In a sense, analysis and interpretation of the data are there from the first moment and throughout the whole research process in a cyclic manner.

3.12.8 Comparing, contrasting and interpreting

"Yin (1984) advocates a replication strategy: a theoretical framework is used to study one case in depth, and then successive cases are examined to see whether the pattern found matches that in previous cases" (Miles and Huberman, 1994, p. 174).

As mentioned above, I first analysed two very different cases in depth and then the successive cases were studied in comparison to these two. In the process of analysing the cases I looked for links between EFL and memory and attempted to provide qualitative explanations to some of the links seen in the data. The analysis of each of the within-case samples ended with an EFL profile, explained in terms of memory, which actually determined the direction of the following analyses.

The next four cases were analysed in a process of comparative multiple cross case analysis. In the process of multiple cross case analysis, I utilized a comparative method by using key variables and preserving their configuration case by case (Miles and Huberman, 1994, p. 208). I attempted to understand findings from a single case by specifying how, where and, if possible, why they carry on as they do (Miles and Huberman, 1994, p. 29). From the technical point of view, many of my analyses were of texts and could be labelled as text analysis where I used the text for exploratory and confirmatory purposes, identifying, describing and comparing themes across cases (Ryan and Russell, 2003, in Denzin and Lincoln, 2003). In addition, issues which emerged from the data analysis were analysed in the cases that followed. The implications of this for the research process was that there were more issues investigated in the latter cases than in the former cases.

Although my research is not in the anthropological/sociological arena, methodologically the process of analysis is similar to grounded theory which is "an iterative process by which the analyst becomes more and more 'grounded' in the data and develops increasingly richer concepts and models of how the phenomena being studied really works" (Ryan and Russell, 2003 in Denzin and Lincoln, 2003).

Throughout the research I combined "variable-oriented and case-oriented strategies... cycling back and forth between, or synthesizing, strategies aimed at understanding case dynamics and at seeing the effect of key variables" (Miles and Huberman, p. 208). I analyzed each case according to the memory variables apparent in the initial conceptual framework. For example, since phonological working memory had been pointed to in the conceptual framework as related to EFL reading, I decided to analyze all aspects of EFL performance (not only reading) in each case vis-à-vis phonological and phonological working memories using my professional experience in interpreting the data. In addition, I tried to understand *why* and *how* the phonological memories are related to reading. In fact, this is how I came to theorize the *inner voice* which I see as the main finding of my research. Throughout my study I analysed the data both from the point of view of memory and from the point of view of EFL performance. Each chapter which presents the findings from a specific case-study is summarised from the two vantage points: according to memory parameters and according to the EFL profile explained in terms of memory.

The final stage was to assemble the findings from all case-studies and to move from interrelations to constructs and from constructs to theories by tying the findings to overarching propositions that can account for the *how* and the *why* of the phenomena studied (Miles and Huberman, 1994, p. 261). In the framework of this research, after I raised the idea of *inner voice* as a possible theoretical factor underlying much of EFL performance and saw that it holds across the cases, I asked myself whether there are broader constructs which could put these facts together in the way that I do (Miles and Huberman, 1994, p. 261). In my case I pointed to constructs from linguistics - collocations and colligations- which could account for what I found. I believe that binding my propositions with existing and well established constructs renders more plausible the concept which is now empirically grounded in a new context (Miles and Huberman, 1994, p. 262).

3.12.9 Confirming the findings

In conducting this research, I followed conventional guidelines of qualitative research in an attempt to increase the validity of my findings. I checked for representativeness of the case-studies by making sure that they were all normative pupils in their schools and classes who had similar EFL instruction throughout the years. I checked for researcher effects which could have affected the data. Firstly, I wanted to make sure that the participants did not say what they thought would please me. Therefore, in the interviews and dialogues I touched upon issues of interest from different angles and the same issues were looked at via different methods (triangulation). Secondly, I tried to put the participants at ease so that they would not feel tense or stressed while performing the tests. Means of triangulation were built into the data collection and some of the clustering decisions as discussed in section 3.9.4. A replication of the findings was built into the data analysis as it was analysed in a comparative multiple cross case method. In addition, when certain aspects of the data did not tally with my expectations I tried to provide an explanation and considered whether the explanation was plausible or the theory should be revised.

In the following chapters I present my findings, case by case, according to the methods and rationale described above.

Chapter 4: The first within-case analysis - Natalie

Chapters 4 to 9 present the findings of the study. Chapters 4 and 5 present the within case analyses and. Chapters 6 to 9 present the multiple cross case analyses.

4.1 Introduction to case 1 - Natalie

I chose Natalie, a 17 year old girl in grade 12, as one of the two cases for within-case analysis because there appeared to be large variations in her performance across the sub-tests.

Natalie's EFL achievements at school place her in the intermediate band. In her interview she reported that she started learning English in grade four and has always liked learning English. She also reported that she liked to watch films and read books in English and that she had *"always been attracted to this language."* (Interview, 4- in Hebrew) Nevertheless, Natalie was, as noted, placed in an intermediate level EFL class. In her interview, she explained that: *"It was simply more convenient for me to be there."* (Interview, 16- in Hebrew) When asked to describe an English lesson in her class she said:

"... I just sit there. Because me, the way I see it, don't have any business sitting in a 4 point matriculation class ... I sit there sort of bored ... They study things that I know, more or less. I know this material already. It's boring." (Interview, 42-44- in Hebrew)

Natalie says about herself that she is impatient and will not spend too long on a learning task. This impatience leads to quite an impulsive working style which is not always to her benefit. When asked about this she remarked: *"That's the risk that I take!"* (Interview, 24- in Hebrew)

Natalie does not have much inner motivation to study. When questioned about motivation she smiled and said: *"I need **a lot** of motivation to study."* (Dialogue, 147- in English) To the question: *"What motivates you?"* Natalie replied:

"...if I study hard and then I get eh very low, so all my motivation will just go...I give up, I give up very fast" (Dialogue, 149-153- in English)

The above reveals a discrepancy between Natalie's positive feelings about the English language itself on the one hand and her relatively weak motivation and performance at school on the other hand. As I will show, this gap reflects her gaps in performance across different EFL skills.

In the next section I present a numerical overview of Natalie's results on the different tests (table 4.1). Next, I will qualitatively describe her performance across the different EFL tests and provide explanations and interpretations of her data in light of my conceptual framework of memory processes.

4.2 Natalie – test results

Natalie's EFL tests were taken from the Israeli 2002 (4 point) matriculation tests administered by the Ministry of Education. Therefore, the criteria for marking follows the criteria set by the ministry, albeit with some minor adjustments introduced in order to accommodate the specific purposes of this research (see section 3.9).

4.2.1 EFL oral and reading tests

Table 4.1: Natalie - Dialogue

Communicative ability	Points	Accuracy	points	Final grade
Comprehension of questions	95%	Incorrect/correct use of simple/complex language structures	50%	
Non-fluent/fluent Interaction	95%	Limited/basic/rich vocabulary	65%	
Gives single word/simple sentence/extended answers	85%	Poor/mostly comprehensive/comprehensible pronunciation	80%	
Total communicative ability	91.6%	Total accuracy	65%	**78.3%**

Table 4.1 gives a detailed account of the parameters considered in order to arrive at a final mark for Natalie's oral proficiency in the dialogue. Accuracy accounted for 50% of the final mark and communicative ability for the additional 50%. The table shows that there are large gaps between Natalie's communicative ability and her accuracy. Whereas Natalie's speech is characterized by a basic level of vocabulary and marked by numerous grammatical mistakes, it is still very fluent and surprisingly communicative.

Table 4.2: Natalie - Role Play

Communicative ability	Points	Accuracy	points	Final grade
Comprehension of questions	100%	Incorrect/correct use of simple/complex language structures	65%	
Non-fluent/fluent Interaction	100%	Limited/basic/rich vocabulary	65%	
Gives single word/simple sentence/extended answers	90%	Poor/mostly comprehensive/comprehensible pronunciation	80%	
Total communicative ability	96.6%	Total accuracy	70%	**83.3%**

Table 4.2 shows a pattern very similar to that seen in the dialogue. Once again there is a large gap between Natalie's very good communicative ability and her much weaker accuracy in speech. Since the nature of this role play is highly communicative and at times provocative, the element of fluency is even more pronounced; the chances for committing grammatical mistakes, however, is somewhat reduced due to the interactions being short.

Table 4.3: Natalie - EFL Reading

Name	Reading passage 1 (search reading)	Reading passage 2 (careful reading)	Reading passage 3 (mixed search and careful reading)
Natalie	52.7%	42%	54.3%

Table 4.3 points to the fact that Natalie's reading comprehension is very weak. It is also seen that there is no meaningful difference between her ability to handle one specific type of reading, presented in the tests, better than another.

4.2.2 Memory tests

As discussed in chapter 3, the following tests were used: Rey Auditory Verbal Learning Test (RAVLT) to assess auditory verbal memory and interference; Rey Complex Figure Test (RCFT) to test visual spatial memory; Shani, Ben Dror, Zeiger and Ravid Active Memory – Complementing Words test to evaluate central executive functions; Detroit Test of Learning Aptitude (DTLA-A) - Design Sequences to check visual sequential memory and The Shatil Syllable range test to check phonological working memory.

Table 4.4: Natalie - RAVLT

RAVLT trial 1	RAVLT trial 2	RAVLT trial 3	RAVLT trial 4	RAVLT trial 5	RAVLT 6 (proactive interference)	RAVLT 7 (retroactive interference)	RAVLT 8 (LTM)	RAVLT 9 (recognition)
+0.20 (SD=1.59)	-0.33 (SD=2.13)	+0.36 (SD=1.63)	+0.94 (SD=1.54)	+1.36 (SD=1.44)	-0.30 (SD=1.80)	+0.55 (SD=2.04)	+0.42 (SD=2.11)	+0.32 (SD=2.46)

Results are given in standard scores (Mean standard score = 0)

Table 4.4 indicates that, on the whole, Natalie's auditory verbal memory is within the average range of the norm. In trials 1-5, where the same list of words is read to the subject in order to see how much he/she can remember in the short term and estimate improvement between the trials, Natalie generally performs slightly above the average level of normative performance. The best improvement is in the 5th trial where she performs in the high range of normative performance. Natalie is not seen to be specifically prone to interference and her long term memory and memory via the recognition route are normative.

Table 4.5: Natalie - RCFT

Results are given in T scores and percentiles (mean T score=50; SD=10)

Copy trial	Time to copy (seconds)	RCFT immediate recall	RCFT delayed recall	RCFT recognition
Percentile= 11-16 Below average	125 Percentile>16 normative	42 (% score=21) Rating=below average	45 (%score=31) Rating=average	54(%score=66) Rating=average
Qualitative features of performance: Natalie worked very fast and in quite an impulsive manner, not paying much attention to detail.				

Table 4.5 indicates that, on the whole, Natalie's visual spatial memory is not very strong. Natalie's low copy scores could point to reduced visual perceptual and visuo-motor integration skills. They could also be related to her very impulsive working style. Natalie's weak performance on the immediate recall trial indicates reduced visual spatial recall ability in the short term. Interestingly, Natalie's ability to recall 30 minutes later is better and her ability to recall visuo-spatial material when given retrieval cues is even better.

Table 4.6: Natalie - DTLA-A - Design Sequences; Active Memory - Complementing Words; Shatil Syllable Range Test

DTLA-A Design Sequences	5 (% score=5) rating=poor
Active Memory-complementing words:	+0.50 Rating=average
Shatil syllable Range Test	Low

Table 4.6 shows Natalie's visual sequential memory as measured by the Design Sequences Test is poor, her central executive function as indicated by her score on the Active Memory–Complementing Words Test is within the normative range of performance, and her phonological working memory skills measured by the Shatil Syllable range test are weak. Natalie's poor performance on the Shatil Syllable Range Test shows that she has serious difficulties with phonological working memory. The fact that Natalie performed poorly on this test which was devised for younger children points to the severity of the problem.

Natalie's EFL test results show that there was a substantial gap between her reading skills and her speaking skills, the latter being much better than the former. Gaps are evident, though, even within her speaking skills where her communicative ability is good, but her accuracy is inferior.

Natalie's memory tests indicate gaps both within the auditory modality and within the visual modality. Whereas her phonological working memory is weak, her ability to remember meaningful words is normative from the first trial. It was also seen that the element of repetition facilitated memory. Interference does not seem to have a great impact on her memory in this test. Within the visual modality her visual spatial memory is normative both in the short term and in the long-term. Her ability to recognize visual spatial information is above average. On the other hand, her ability to recall visual sequences is poor.

The following sections analyse Natalie's EFL performance according to the memory parameters specified in the research questions.

4.3 Natalie: EFL performance in terms of phonological working memory

The first issue discussed is whether certain aspects of EFL performance can be explained in terms of phonological memory.

In the following I will engage in a qualitative analysis of Natalie's performance across the EFL sub-tests and try to follow the role of phonological memory underlying her performance. My intention is to see whether a qualitative analysis of the research data can support former quantitative findings (see chapter 2) and whether this type of analysis can surface additional aspects of the role of phonological and phonological working memories in EFL performance.

The first EFL skill to be addressed is reading. Reading comprehension passages at matriculation level is pointed out by Natalie as a major difficulty in her EFL studies. When asked to define her difficulty she says:

"If I sit on an unseen passage for an hour and go word by word as needed, eventually I understand." (Interview, 20- in Hebrew)

But why does she need to go word by word and look for its meaning? Is it because she has such a weak vocabulary or because she cannot decode the word properly and therefore has no idea what it sounds like? The following lines provide a partial answer to this question:

T: Does it sometimes happen that you read a word incorrectly and because of that you don't know its meaning?

N: Yes, lots of times. I once had in a test the word "cigarette" (a cognate: the same in Hebrew) and I didn't read it correctly. It took me ages to find it in the dictionary and at the end I see it's "cigarette". Funny!" (Interview, 51-52- in Hebrew)

This is very much in line with Vellutino et al (2004) who maintained that one element in the reading related to phonological working memory is decoding.

Natalie's oral protocols, following some of her reading comprehension difficulties, support the assumption that much of her reading comprehension difficulties derive from erratic decoding. Two main types of decoding errors emerged in Natalie's reading: erratic decoding and what I name laborious decoding through self-mediation which lead to either slow correct or completely incorrect reading. Excerpts follow from Natalie's oral protocols which portray various decoding errors. First are some

de-contextualised instances of wrong decoding followed by a more contextualized sample which emphasises the impact of erratic decoding on reading comprehension:

N: <technological eh adventure>
T: advances (Reading passage 2. Oral protocols-23-24 – in Hebrew)
In the above instance, Natalie decodes the first three letters correctly. She then replaces the /æ/ sound with the /e/ sound and correctly decodes /n/. Hereon it seems as if she abandons decoding and averts to guesswork stemming from an attempt to lean on the global configuration of the word and coming up with a word which is familiar to her. It could be that when she hears herself wrongly vocalizing */adven/,* adventure is her first choice. In this case, Natalie's erratic decoding of the vowel, together with the abandonment then of decoding altogether, leads to the wrong word. It should be noted that from the point of view of frequent collocations, *technological* is hardly ever followed by *adventures.* However, this does not seem to be a factor in Natalie's reading, presumably due to English being L2, and her not having developed sensitivity to such factors.

N: <With the same him in mind>
T: With the same?
N: < I'm?>
T: aim (Reading passage 1. Oral protocols- 95-98-in Hebrew)

In this second instance, the word "aim" is not familiar to Natalie so she adds aspiration to the /ă/, which results in a /hă/ sound and then combines with /im/ and arrives at the word *"him".* As with the former case, when Natalie does not immediately recognize the word, a combination of partial correct and partial erratic decoding together with guesswork leads her to the wrong word. Once more, *"with the same him in mind"* does not sound strange to her. Similar decoding processes are evident in the quotations below:

N:...<Get the role picture>
T: Get the **whole** picture. (Reading passage 2 Oral protocols- 65-66 – in Hebrew)

<N: Do Euro-pins who know English well (pause) have>? Ah (Meaning Europeans) (Reading passage 3 Oral protocols- 167- in Hebrew)
N: <Curators of the new museums often really>

T: Often, often what?

N: *<really really rely>*

T: What is rely?

N: (gives the correct translation). *<on high teach>*

T: On high?

N: <teach>

T: Not teach. High-tech

N: Ah high-tech. I didn't understand. I know that ch together make; /ch/" (Oral protocols following reading passage 1, 61-69 – in Hebrew)

What could Natalie understand from this last passage? It is quite possible that she now thinks that Curators of museums really depend on high teaching... The above excerpt shows how erratic decoding could lead Natalie to misunderstanding, if not to complete lack of understanding, of a reading passage. This last excerpt provides additional insights. First, Natalie is not unaware of sound/symbol correlation in the process of reading. In the first instance quoted, she actually corrects her reading of the word "rely" probably after realizing that it would make more sense. Then she mistakenly reads *"Teach"* instead of *"tech"* due to her knowingly applying the regular /tʃ/ sound where it should have been /ĸ/. Second, Natalie is familiar with both words (rely and high-tech). So why is the final outcome wrong? One possible answer could be that although Natalie does have most of the puzzle parts at her disposal, she lacks the ability to hold on to the sound of what is being read in order to logically combine with the following. Had she been able to do that, she may have realized that there is no such thing as "high-teach". Holding on to the "high" whilst seeing the coming "tech" might have triggered "high-tech" and even though she is not aware of /k/ ch sound, she could have applied a process of 'intelligent guessing' and read it correctly. In a sense, she isn't really hearing herself. This function could be attributed to phonological working memory. It could also have to do with visual aspects as will be discussed later.

Natalie's reduced ability to hear herself is puzzling. It would be interesting to see if it appears in any other case study. It seems that because she does not really hear herself, integration with oncoming information is difficult. Natalie's reduced ability to hear herself (covertly) is seen in her reading throughout. When she reads she has a way of taking in each word separately and unfamiliar words are treated as obstacles

to be overcome in order to proceed with the next. When she is provided with the translation of a word which is not understood, she does not go back in order to try and integrate the sentence parts. The following excerpt is a typical sample of Natalie's reading:

N: <*With the same him in mind*>

T: With the same?

N: I'm?

T: aim. What's aim?

N: Don't know.

T: aim: (gives the Hebrew word) with the same aim..

N: <*in mind, many of them offer exabations*> *(pause) what's this?*

T: Tammy gives the word in Hebrew)

N: <*on subjects that appeal*> *?!*

T: Tammy gives the word in Hebrew.

N: <*to a young eh eh*> *(can't decode)*

T: (reads the word): audience, what's "audience"?

N: Gives the correct word in Hebrew. <*such as comics, space flight or ecology*>.(Reading passage 1,95-107 – in Hebrew)

A relevant question to be asked at this point is whether Natalie's reading comprehension difficulties are apparent only in EFL, or whether they exist to a certain extent in Hebrew as well. It should be stressed that Natalie, who is now in the last year of high-school, had not been defined as having specific learning difficulties of any kind. However, when asked how she studies for a test in History she said:

N:= I need always someone that speak with me and eh and eh eh

T: and explain?

N: explain, ye

T: So for a History test, do you not study at home? Do you not read the material again or =

N: No, of course I I'm reading but with someone.....

.....

T: But for instance, in History I think, it's not always just to explain. It's a lot to remember.

N: I know, but I need someone that explain me in his words because the words that my teacher DICTATES?

T: the words that your teacher dictates?

N: Yes. So it's hard to me to to to

T: To understand?

N: O.K to understand. (Dialogue, 52-68 – in English)

And more:

T: And if you have a long chapter in History just to study from the book. Let's say the teacher says: "Take your books and read chapter 7".

*N: I never start to*** I never eh can eh study all by myself because I don't eh understand eh the language that they write. ****inistory special in History.*

T: So you have problems in, so you're saying actually that you have problems in reading comprehension; in understanding reading (question-like intonation).

N: Ye. Ye .(Dialogue, 87-90 – in English).

Natalie's describing her difficulties in coping with reading and understanding History texts or academic texts dictated by the teacher point to her not coping very well with high level reading skills in Hebrew. This is not to say that Natalie cannot decode in L1. This is highly unlikely due to the fact that she had never been suspected of having reading difficulties. Moreover, she asserted that she does read the material. Her difficulty is very likely to be in understanding academic texts which generally require much higher level reading skills.

Natalie's unconnected reading style in L2 as well as her difficulties in comprehending academic texts in L1 could be related to her weak phonological working memory as seen in the memory tests. I would like to raise the possibility that under certain circumstances, weak phonological working memory could have an impairing impact on L2 reading already from the lowest level reading skills, whereas in L1 its impact on reading surfaces as the complexity of reading materials increases depending both on the reader and on the languages.

The second type of decoding error which I have named 'self-mediated decoding' was also evident throughout Natalie's reading. The following reading strategy used by Natalie provides us with an interesting insight:

N: <needed to communicate with eh fo, for, forjin, forjiners>

T: Foreigners (Reading passage 3. 24-25-Read in English)

When trying to decipher the word "foreigners" (which she does not know), Natalie actually allows us a look into her mind, so to speak. First it is *fo*; then *fo+r=for*; then

for+gin=forjin etc. In the following sample she uses a very similar strategy:

N: <Before the 1980's, companies in Ye in Europe generally sold pr, pro, produc, products...(Reading passage 3. 36- Read in English)

Here she does the same with the word *products*: first *pr*; then *pr+o=pro*; then *pro+duc=produc* and finally *produc+ts=products.*

What is Natalie doing and why? Natalie is actually using a self-mediating strategy in order to arrive at her reading destination. But why does she need this kind of processing when she is familiar with each of the sound symbol correlations in the word? A reasonable answer might be: in order to assist her weak phonological working memory. In order to see how Natalie's self-mediation may assist phonological working memory functions it may be worthwhile to revisit the model of working memory devised by Baddeley and Hitch in 1974, and which is still the most accepted memory model to date (see section 2.1.1). One part of the theorized working memory model is the phonological loop which is responsible for auditory information. The phonological loop is assumed to consist of two components: a phonological store which has a very limited capacity (between 1.5 to 2 seconds) and an articulatory control process which helps delay the fading away of the sounds in the phonological store. This articulatory mechanism then feeds the rehearsed sounds into the phonological store for further processing. Natalie's self-mediating strategy in reading raises the possibility that she is applying a kind of vocalized articulatory control process to help her keep the sounds in the phonological store for further processing. In this sense, Natalie's self-mediating decoding strategy may be an attempt to assist phonological working memory.

Paradoxically, this type of decoding strategy, intuitively adopted by Natalie to boost phonological working memory in order to cope with reading words, provides an obstacle to phonological working memory on the sentence level since it causes the whole reading process to be fragmented and slow. This, in turn, makes processing of oncoming sentence information in the phonological loop even more difficult due to the phonological loop being limited in time. Natalie best expresses this in her own words:

N: ...*that, I can't because I read and I forget the first *** This kind of exercise is not good for me.* (Reading passage 2, 2- in Hebrew)

However, a further analysis of Natalie's reading reveals that erratic decoding is not

her only source of reading difficulty. In many instances even when she decodes a word correctly, or it is decoded for her, Natalie cannot understand the text for lack of vocabulary knowledge. Research has already pointed to associations between phonological working memory and the acquisition of vocabulary in L1 (Gathercole and Baddeley, 1993; Gathercole and Martin, 1996; Gathercole et al., 1997; Gathercole et al., 1999), and in L2 (Papagno et al., 1991; Service, 1992, in Gathercole and Baddeley, 1993; Baddeley and Gathercole, 1998). In the following lines I will look at Natalie's vocabulary performance and the processes underlying this performance and try to provide explanations in terms of phonological working memory.

In her interview, Natalie points to vocabulary knowledge as being a weak spot in her EFL performance and adds a remark which is interesting vis-à-vis memory.

T: So what you are saying is that vocabulary could be improved right?

N: Yes, but sometimes when they give me a word; ask me what a word means, it just suddenly disappears, but I know it; it just disappears. I have to think about it a bit..

T: You mean you can't say it in Hebrew.

N: Yes, but I can give you a sentence in English with it. (Interview, 25-28- in Hebrew)

Throughout our sessions together, Natalie had never given a sentence in English with a word she could not retrieve in Hebrew. However, at times, she was able to come up with a meaning of a word when contextualized, as shown below:

N: (reads) <English was already a dominant language in the fields of international fi, finance? (Pronounced with a short /I/ sound very similar to its Hebrew pronunciation)>

T: finance. What's "finance"?

N: I donknow. It reminds me of a word but it doesn't seem right. (Says the word as it is pronounced in Hebrew) FINNANCY?

T: Yes, of course it's financial. What's the meaning of FINNANCY?

N: Eh, I donknow.

T: If your FINNANCY situation is bad, what does it mean?

88. N: Ah, my money situation sort of. (Reading passage 3, 82-88- in Hebrew)

As we can see above there is something in the sound of "finance" that triggers familiar phonological markers. However, when she eventually comes up with the correct Hebrew word "FINANCY", she does not know, or cannot retrieve, the meaning of the word in L1. This could point to Natalie's having difficulties in word

retrieval in L1 as well as in L2. Eventually, meaning is triggered via contextualization. It is interesting to notice that the type of contextualization provided does not have anything to do with money and, therefore, could not have provided Natalie with direct semantic ties to trigger the meaning of the word. It seems that it is the **sound** of the word "FINANCY" embedded in the **sound-context** of the sentence that triggers meaning. It is very likely that one of the reasons for Natalie's phonological working memory weakness derives from her not having stable enough phonological representations of sounds. They come and go, so to speak, making it very difficult to retrieve, store and process something which is not completely there. My saying "bad FINANCY situation" may have reminded Natalie that these sounds put together have something to do with money. An additional way of viewing the interaction described above is via a linguistic analysis of the expression "financial situation". If we look at English language collocations, we will see that the word situation is very frequently preceded by the word financial. It seems logical to assume that there is a relationship between appropriate use of linguistic collocations and the degree of language acquisition (in both L1 and L2) and that sensitivity to collocations has to do with phonological and auditory verbal memory.

Natalie seems to have developed strategies to cope with her phonological difficulties. Below is an excerpt from the interview with Natalie where she describes her way of learning new vocabulary items for a test.

T: If the teacher gave you this word (Tammy writes down on a piece of paper the word 'scrupulous' which she assumes Natalie isn't familiar with). You need to learn this word for a test (Tammy gives Natalie the Hebrew translation. The situation now is that Natalie can see the word written down in English and knows what the word means in Hebrew).

*N: How do you say ** s c are uuu puuu luus? (tries to read it out loud)*

T: So first you would try to say it to yourself, would you?

*N: Of course so that ****

T: And if you couldn't work out what it sounds like?

N: I would go to the teacher and ask her.

T: So without hearing it you wouldn't even try to learn it.

N: No. Until I know what it sounds like I wouldn't start learning it.

T: Why is that?

*N: Cause without *** the word I won't be able to remember it. I have to know how it sounds.*

T: I understand. O.K so I am telling you now that the word is /scrupulous/ (Tammy says the word out loud).

N: (repeats the word after Tammy whilst dividing it to syllables) scru/pu/lous.

T: (repeats) scrupulous.

N: (repeats) scrupulous.

T: Do you say it to yourself every time you read it?...

N:... What? The meaning?

T: No, the word itself. Do you say to yourself in your heart (sub-vocalize): /scrupulous/?

N: Obviously! I do it several times.

T: Do you sometimes say it to yourself out loud?

N: Yes. I sometimes say it out loud because sometimes when I say it in my heart it disappears. The thought about the sound always helps me. (Interview, 61-88- in Hebrew)

Natalie's need to have a new word articulated loudly and clearly in order to learn it could be attributed to the fact that otherwise its phonological representations will not be clear enough. She cannot rely on her poor decoding abilities which would probably lead her to different pronunciations of the new word with every reading and, therefore, prefers to know the exact sound. However, as we can see, when the word is long and unfamiliar Natalie adopts an additional strategy: repeating the word and dividing it into syllables. In terms of phonology, she is clarifying the new word's phonological representations and strengthening them. Her need to do this may derive from not being sure of the exact sounds or sound-stream of the new word, and not being sure about how to read it. These uncertainties could derive from both weak phonological representations of sounds and weak phonological working memory. In fact, Natalie's last utterance above points to both possibilities.

It is worth noticing that this is a strategy adopted by Natalie in order to learn new English words in a formalistic context of school studies. Beforehand, when she thought she was asked where her knowledge of English words came from her answer was completely different as will be discussed later.

Analysis of Natalie's reading provides several instances which could indicate unstable phonological representations and weak phonological working memory. The first is an example of weak phonological representation.

T: What's subscribing?

N: I donknow. I knew but I forgot now. Sort of ...

T: (Tammy gives the word in Hebrew) Is this what you thought

N: No, I thought something else.(Reading passage 2, 7-10- in Hebrew)

Experimental research has shown that in tests of phonological working memory and tests designed to simulate new word learning, subjects were sensitive to phonological similarity, which means that phonological working memory and vocabulary learning are implicated by some common denominators (Papagno & Vallar, 1992; Papagno Valentine & Baddeley, 1992 all in Gathercole and Martin, 1996). One of these common denominators could be the effect of unstable phonological representations on both.

Below are some examples of phonological similarity leading to Natalie's inaccurate understanding.

N: (reads) <Their sa, salearies may be> *Ah, (says in Hebrew) 20% to 30% higher than*

T: What does the word "salaries" mean?

N: From the word sale. (Reading passage 3, 177-179)

T: What's "international"?

N: national

T: No.

N: Ah, ***international*** *is national.*

T: ***Inter****national, what is it? Is it national?*

N: Yes.

T: No.

N: international?

T: Yes. This is national (Tammy separates the ***national*** *from inter****national*** *to show the prefix and gives the Hebrew word for national) and what's* ***inter****national?*

N: (pause)

T: ***inter****national (gives the Hebrew word) between nations, not within one nation.*

N: Ah, Ah,

T: It's not the same thing!

N: Ye, I know. I just got stuck on this national. (Reading passage 3, 91-104 – in Hebrew)

The above could also have resulted from Natalie's thinking that *inter* and *national* are two separate words or from her not attributing any importance to the prefix. However, it is evident that the distinction between *international* and *national* was facilitated visually by my covering the prefix and showing her that there was a part in the word that she had not taken in. Hearing the word time and again in various intonations did not seem to help. This could be attributed to a phonological difficulty which inhibits differentiation between words which are phonologically similar to each other.

To summarize the analysis of the data so far, we have seen how weak phonological working memory has apparently caused erratic decoding in EFL which has lead to deficient reading. Further evidence of the involvement of phonological working memory in EFL reading was supplied by observations of Natalie's strategies to overcome these difficulties. Furthermore, it has been seen that Natalie has some difficulties in L1 reading as well, and I suggested that weak phonological working memory affects L1 and L2 in different stages of reading depending both on the reader and on the language.

In addition, we have seen how Natalie's reading was affected by apparent lack of vocabulary appropriate for matriculation level. This could be related to phonological difficulties where her inability to create stable phonological representations of the sounds building the words in the foreign language implicated her ability to learn new words and impaired phonological working memory functions where these new sound combinations were involved. A look into Natalie's learning strategies and reading processes enabled me to make such connections.

The second EFL skill addressed in this analysis is that of speech. Analysis of Natalie's EFL speech performance pointed to the fact that phonological working memory may influence speech through vocabulary knowledge which was again seen to be influenced by the unsteady phonological representations of less familiar sounds in EFL vocabulary. The speech samples below demonstrate Natalie's searching for the right sounds during speech:

*N: So I'll go to a ve veterinar and and he'll be hĕl hĕlt***(Role play, 32- in English)*

T: Look how dirty it is.

N: I clean him.

T: How?

*N: In Bă****

T: In your bath.

N: Ye

T: Not in mine!

N: No. In mine (Role play, 55-62-in English)

N: Because I don't have nŭ.. nŭth.. nŭthing else to do. (Dialogue, 121)

Natalie has a general idea of the sounds, especially beginnings of words and, at times, voices the part she knows will help her retrieve the rest of the word.

In her oral tests, this weakness took the form of a basic vocabulary range as seen in the quotation below:

T: When, at what time of day do you like studying best, or when is it most efficient for you to study?

N: No. I'm coming home, I do the regular things: eating eh, clean, stuff and eh if I have homework so I first of all I do my homework and ***then*** *I start to learn eh, afternoon. Something like that start in the afternoon and finishing in the evening. (Dialogue, 92-93- in English)*

Natalie didn't talk about preference, efficiency or concentration. She provided a very concrete description using "come" "do" "eating" "clean" "stuff" "start" and "finishing". It is interesting to notice that the word "stuff" was perhaps used to replace other vocabulary items which were not at her disposal.

The above shows that weak phonological working memory has some impact on speech production mainly via vocabulary range, but, on the whole, that the impact in Natalie's case was not very strong and her speech in EFL does not seem to be impaired by the phonological weakness shown in her memory tests. In fact, although Natalie's speech is not always accurate due to grammatical mistakes, it is very fluent, completely understandable and highly communicative. Below are some samples to illustrate this.

T: How do you like studying? Do you sit at your desk?

N: No. I donhve a desk.

T: You don't have a desk?

*N: I don't need a desk. I have my bed. It's perfect (both Tammy and Nataly laugh) **! Ah maybe, sometimes I learn in the garden *** do there and its *** good to my head; to clean my head.*

T: And if you need to write something?

N: I'm going to the garden.

T: To the garden. And if it rains,

N: So I go to the eh living room.

T: So in order to write, what do you do?

N: Sometimes in my bed,

T: You write in your bed?

N: If it's comfortable, in my bed, and if I need to sit so I sit in the living room.

T: In the kitchen?

N: No, in the living room.

T: In the living room?

N: Yes.

T: Do you consume more food when you study?

*N: **Of course.** (both laugh) I need a lot of food to study. (Dialogue, 100-117- in English)*

Next is an excerpt from the role play:

T: I want you to tell me what you are going to do with this dog everyday now from today to the end of the week.

N: I'm going to feedim.

T: Feed him?

N: Feed him, and to take care of him and to love him and to give him a lot of attention and

T: and then

N: and then he stay!

T: He can't stay. We have three other dogs.

N: So now we have 4! (Role play, 33-40 – in English)

It is quite clear from the above that there is a big gap between Natalie's poor performance in EFL reading, seemingly influenced by her weak phonological working memory, and her better speaking (notwithstanding her basic vocabulary range), which does not seem to be influenced much by this weakness. Natalie's fluency could be explained in terms of her good auditory verbal memory which has

to do with remembering verbal information presented orally (see section 3.11.1).

Second language learning theory points to vocabulary and syntax as two very significant elements in second/foreign language research (Mitchell & Myles, 2004). The weakest aspect of Natalie's speech is her syntax which does not affect her fluency, but affects accuracy significantly. Most syntactic mistakes apparent in her speech involve erratic use of tenses (as in the dialogue, 40, 50, 56, 58, 84, in English), erratic use of the verb *be* (as in the dialogue, 16, 24, 30, 95 in English) and word order (as in the dialogue 36, 60, in English). Literature has linked phonological working memory to sentence processing in speech which presumably involves syntax as well as vocabulary (see section 2.3.3). The data provided by Natalie seem to point in that direction as well, since she has both weak phonological working memory and poor syntax in her speech. The nature of Natalie's syntactic mistakes seems to be related to central executive skills as well as to phonological working memory and is therefore discussed later in section 4.6.

4.4 Natalie: EFL performance in terms of auditory verbal memory

The second issue discussed relates to auditory verbal memory in an attempt to see whether certain aspects of EFL performance can be explained in terms of auditory verbal memory.

As pointed out above, one of the most notable features in Natalie's EFL performance is the large discrepancy between her poor reading and her relatively good speech. To the best of my knowledge, memory literature to date has not attributed such uneven EFL performance to specific memory functions. An analysis of Natalie's test data pointed to what looked at first like contradictory patterns: on the one hand her phonological working memory was weak, a fact which seemed to impair her reading performance. On the other hand, it was quite obvious that her preferable and stronger modality was the auditory one which depends on phonological information. When asked about her preferable learning style she said:

N: No, someone is talking about it – better. If I read, so eh just go eh from my mind. (Dialogue, 50 – in English)

This preference was verified when in the oral protocol process she was given the choice to read to herself or aloud:

... Read the question again, you can read it silently if you want... =

N:= No, on the contrary. It's better for me to read it out loud. (Reading comprehension 3, 75-76,-in Hebrew)

She also refers specifically to the sound of the word as what makes a difference to her being able to remember it:

N: ...cause if I know the word (its sound), I'll remember the translation CHICK CHACK (a slang expression in Hebrew which means: real fast.) no problem. (Interview, 80 – in Hebrew)

A deeper look into Natalie's performance shows that there is a difference between her ability to remember nonsense phonological bits of information and her ability to remember verbal auditory information once it acquires semantic value. Whereas meaningless phonological information is very difficult for her to remember, meaningful information presented to her auditorily seems to stay in memory without great difficulty. This could account for the difference in her learning new vocabulary for tests and her acquiring new words for life. The former is described by her as a long painstaking process of reading the word with difficulty, asking to hear its sound, dividing into syllables, repeating, writing, sub-vocalizing and finally vocalizing. The latter is described as much more enjoyable and painless:

T: ...How do you learn new words in English?

N: Only by movies. (Interview, 47-48 – in Hebrew)

As mentioned above, I could not find reference in the literature to auditory verbal memory as accounting for good speech performance, but there is a widely used memory test which looks at auditory verbal memory underlying learning ability (see section 3.11.1). I decided to give this test to Natalie to see whether her performance on this kind of memory test was better than on the phonological memory test. Interestingly, Natalie's auditory verbal memory as seen in the RAVLT proved to be normative from the first trial.

Natalie's ability to remember verbal information presented auditorily can be seen in Natalie's performance across EFL tests. One such example is seen in her ability to immediately put to use a newly learned word which was acquired in course of speech in a meaningful context:

T: What about your room? Is it tidy? I mean do you study when your room is tidy or=

N: = No. Never! Never! Never!

T: Never what? Tell me about it.

N: Always my room will be clean.

T: It will be clean?

N: Ye. Because..

T: Tidy.

*N: Tidy – CLEAN O.K. I need the room always tidy because if will be mess in my room, so it will be mess in my mind. I can** eh **eh in my room eh and study when he eh when he eh not clean eh not tidy. (Dialogue in English, 33-40)*

The word 'tidy' is probably not the word Natalie herself would use to describe her room. She obviously understands its meaning in the context of the question, but prefers to use a more familiar word 'clean'. However, when I use the word tidy again she repeats it after me; reassures herself (in Hebrew) that tidy is another way of saying clean and goes on with the sentence using the word tidy twice as a part of her vocabulary in English.

Picking up words which are used by me as interlocutor and using them in her immediate reactions is seen quite often in Natalie's speech:

T: So what do you do about the noises that come from outside?

N: There is no noises in Shoham (The name of the city where she lives). (Dialogue in English, 15-16)

T: Do you consume more food when you study?

N: Of course. (both laugh) I need a lot of food to study. (Dialogue in English, 116-117)

T: What kind of things?

N: Candy.

T: Oh oh

N: cookies

T: sweets.

N: Ye, sweets. (Dialogue in English, 103-105)

It is interesting to see the difference between Natalie's disconnected reading, supposedly resulting from her not being in touch with the sounds she utters, and her being very much in touch with what is said by her interlocutor. Here, she remembers

what was said, reacts in real time and puts it to immediate use. It is suggested that this ability has to do with the fact that in the latter she is dealing with auditory information which has become meaningful and that her better performance could be attributed to her better auditory verbal memory.

Natalie's being able to remember meaningful auditory information is demonstrable in her interaction with me whilst attempting to lead her to an understanding of the reading passages via mediation. Due to her weakness in reading comprehension, Natalie was seen to have difficulties in understanding the comprehension questions. However, once she understood the question, it stayed in her memory without having to go back and check for details. In reading passage 1, for example, one of the questions was:

"Name TWO ways in which children's museums in America attract visitors."

Natalie started to read the question in turn 2 without understanding what was asked. She then went through a long and painstaking mediation process until she understood that "Name two ways" could be semantically replaced with "how" and that museums in America are not attracted to children, but attract children. Natalie finally understood the question in turn 49 and exclaimed:

N: Ah, How do museums eh children's museums attract visitors? (Reading passage 1, 49,- in Hebrew)

However, it took another long and laborious process until she came across the answer which was located far from the question itself: in turn 93. Natalie started to read the question in turn 1, understood what it meant in turn 49 and came across the correct answer in turn 93. It is worthwhile noticing that from turn 49 to turn 93 Natalie did not look back at the question again. It stayed in her memory throughout the bumpy reading comprehension process and when the answer was there she recognized it without hesitation:

This ability to remember the question (once it had been understood and vocalized) for considerable periods of time, notwithstanding the struggle to comprehend the text itself, does not seem to be incidental. It is apparent throughout the reading comprehension data.

Below is an example from reading passage number 2. The question was:

"Which of the six reasons specifically mentions the following? Write the numbers of

three reasons (one number in each space).

...a) The magazine offers many different options.

...b) The information is relevant to the readers' own lives.

...c) This magazine has an advantage over similar magazines.

Once Natalie had understood the question and said it out loud to herself, she could recognize the parts of the answer as they appeared in the text. One part was in Turn 39 as presented below:

N: <Read about the eh eh pra par eh>

T: practical

N: <practical application of scientific break t tr trough> what's this?

T: Gives the word in Hebrew.

N: <and their significance to you>. I think this? (Points to b)

T: What does this say?

N: The information relevant to the person himself. (Reading passage 2, 35-41,-in Hebrew).

Phrase b presented in the question is "The information is relevant to the readers' own lives." The minute Natalie read "...and their significance to you" it triggered the memory of the original question and she pointed to b.

The other part is in turn 80:

N: <giving you all sides of the story>. This can be- a.

T: Yes, it's a. (Reading passage 2, 79-80,-in Hebrew)

As before, Natalie did not need to go back to the question.

Below is an excerpt from reading passage number 3 which shows the same pattern. The question was:

"According to paragraph 2, before the 1980's European companies did not use English much because:

1.....

2.....

Natalie was lead by mediation to understand what she was looking for and say it out loud:

T: So what are you asked?

N: (pause, and then says in Hebrew) European companies didn't really use English.

T: Yes, so what are you asked?

N: Why didn't they use it? (Reading passage 3,7-10,-in Hebrew)

It was very difficult for her to grasp the complexities of this text, to the extent that by the time we were at turn 43 I doubted her ability to remember the question:

T: O.K Do you remember the question?

N: Eh (wants to look at the text)

T: Wait, don't look at the text yet. Do you remember the question?

N: Ah, Yes. Why they didn't use the language, sort of why they didn't use the English language.

T: when?

N: Before 1980... (Reading passage 3, 43-48,-in Hebrew)

To my surprise she remembered the question very well including the date.

The above excerpts all point to Natalie's ability to retain auditory verbal information in memory for remarkable periods of time which could be related to good auditory verbal memory as seen in her memory tests. This is quite opposite from her inability to retain phonological non-verbal bits of information in memory for much shorter periods of time which could be related to weak phonological working memory as seen in her memory tests.

At this point a question may be raised as to Natalie's quite basic range of vocabulary. It would have been thought that good auditory verbal memory as it presented itself above would have facilitated a much wider range of vocabulary. Two propositions may be suggested which working together could provide an explanation for this phenomenon. The first has to do with school practice and the second has to do with memory itself. As shown above, Natalie's favourable way of learning new vocabulary was in simulated, or real, life situations presented in meaningful context. Unfortunately, although this way of learning vocabulary is generally practised in the early stages of studying English as a foreign language in elementary schools, it is rarely practised during EFL lessons in high-schools. Most of the vocabulary taught in high-schools has to do with long lists of words following, or preceding, reading passages and then tested in a very formalistic manner. Having to learn lists of words which have not acquired meaning leads me to look at L2 vocabulary acquisition vis-à-vis issues of phonological memory versus auditory verbal memory. It seems quite

safe to assume that a new word in a foreign language being introduced out of context is, in a sense, a non-sense phonological unit from the point of view of memory. If this is the case, lists of new words in L2 resemble phonological working memory tests where subjects are asked to remember arbitrary combinations of sounds in order to estimate phonological working memory ability. Looking at new word learning in L2 via word lists as a phonological working memory task could provide a logical explanation for Natalie's small range of vocabulary in EFL given Natalie's weak phonological working memory. It may very well be that Natalie was able to acquire EFL vocabulary in elementary school as long as it was taught in a meaningful contextualized way. This could also account for the fact that the basis of her vocabulary is quite solid albeit being small. However, later on in the higher grades of Junior High and High School Natalie's vocabulary acquisition in EFL slowed down, presumably due to having to learn new vocabulary through lists. Looking at L2 vocabulary acquisition as a phonological working memory task could provide an additional explanation for the relationship between the two, a relationship which is independent of decoding. Taking this idea a step forward leads to the suggestion that once new words in L2 acquire meaning, they cease to be nonsense phonological units and function as meaningful verbal units. From the point of view of memory, remembering these items no longer depends on phonological working memory, but on verbal memory. This may account for Natalie's small range of vocabulary on the one hand, and for her considerable ability to function within this vocabulary range, on the other hand.

School practice and memory factors combined together could also be the underlying reason for Natalie's relatively inaccurate speech in English. A look at Natalie's grammatical mistakes in English shows that many of these mistakes have to do with using incorrect verb forms, specifically confusing present simple and present progressive as shown below:

N: No, someone is talking about it – better. (Dialogue in English, 50)

N: No, of course I I'm reading but with someone. (Dialogue in English, 56)

N: ...explain to me better eh and take care of me that I am not going to sleep. (Dialogue in English, 58)

T: And if you need to write something?
N: I'm going to the garden. (Dialogue in English, 104-105)

Sometimes these two verb forms get confused even within one sentence:

N: ... if I-I am tell them to be quiet... (Dialogue in English, 24)

N: ... I'm coming home, I do the regular things: eating eh, clean, stuff...(Dialogue in English, 93)

The memory function that seems relevant to this confusion is interference. The notion of interference refers to information (similar in nature to the target information) which is not a part of the target information and which inhibits the absorption of target information. Retroactive interference refers to disturbance caused by materials presented after the target information, whereas proactive interference refers to disturbance caused by items presented prior to the target information (Bower, 2000) (see section 2.1.10).

The suggestion that these errors could be explained in terms of interference derives from the fact that the present progressive is generally the first verb form to be taught in Israeli elementary schools and for quite some time everything that happens in the English classroom happens in the present progressive. This includes small class interactions asking: *"What are you doing?"*; describing pictures as in: *"The boy is riding a bike."*; and even reading elementary short stories told in this tense. The next verb form to be taught is the present simple which is, if I may say so, not present and not simple. This is where the confusion begins: first, it is presented to the pupils in its name which includes the word 'present'. Second, it is very difficult to describe the conditions of its use. Third, negative and interrogative forms include the additional verb 'do' or 'does'. Fourthly, and maybe most significantly from the interference point of view, all this is learnt via lists and formulae and generally tested through un-contextualized sentences such as: "I (go)_____ to school everyday." Hereon, every school year, generally up to the very last year of high-school, repeats these differences between present simple and present progressive. Most grammar books, even at matriculation level, also begin with this issue. Natalie's memory test results did not seem to point to her being particularly prone to interference. However, the fact that Natalie is not alone in this kind of confusion may point to the fact that even

students with normative levels of interference find it difficult to cope with foreign language elements which are similar and taught in sequence and in a very artificial list-like manner. It is interesting to notice that Natalie does not use present progressive instead of any verb form other than present simple.

An additional reason for Natalie's confusion between these two verb forms could lie in the fact that Hebrew does not distinguish between them and, therefore, she could not find anything in her L1 to map on to. This could have added to the similarity factor between them. The fact that Natalie was not seen to be particularly prone to interference could suggest that in general it takes an exceptionally good memory to be able to overcome these memory interference factors.

Instances where erratic performance in L2 can be explained in terms of conflicting L1 structures is called L1 interference. In fact most of Natalie's grammatical mistakes which were not due to verb form confusion could be attributed to L1 interference:

N: If the light will be weak, so I start to be tired. (Dialogue in English, 4)

N: ...if will be mess in my room, so it will be mess in my mind. (Dialogue in English, 40)

*N: If I'll be a very popular singer, so I'll *** money and then I'll get a rich guy... (Role play in English, 121)*

In Hebrew, conditional sentences include the future marker 'will' in both parts of the sentence unlike the English structure which does not usually have the future marker after the conditional 'if'. In her conditional sentences, Natalie follows the L1 structure.

Likewise, Hebrew does not have the auxiliary verbs 'be' or 'do' and therefore she often drops them from her speech:

N: ...but if it really hot...(Dialogue in English 30)

N: I not remember. (Dialogue in English, 84)

N: I can't in the night. Can't, cause I tired.(Dialogue in English, 95)
Although there are other grammatical mistakes in Natalie's speech, most of her mistakes derive either from specific verb form confusion between the present simple and present progressive or from her applying L1 structures to L2 sentences. The former could be explained in terms of memory interference and the latter in terms of mother tongue interference.

4.5 Natalie: EFL performance in terms of visual memory

The third issue discussed in this research relates to visual memory. In what follows I intend to look at visual memory and the way it in which certain aspects of EFL performance may be related to it. Naturally, the skill which most involves visual memory is reading (see section 2.3.4)

Natalie's preference of the auditory modality has already been discussed, the following being a small reminder of her words:

N: No, someone is talking about it – better. If I read, so eh just go eh from my mind. (Dialogue in English, 50)
Such preference could be seen as both a weakness and a strength.The analysis of Natalie's data indeed exhibited quite a few instances where a better visual memory might have prevented errors. When Natalie said "high teach" instead of "high tech" (Reading passage 1, 65), "him" instead of "aim" (Reading passage 1, 95), "role picture" for "whole picture" (Reading passage 2, 65) or "adventures" for "advantages" (Reading passage 3, 159), visual memory did not come to her help by directing her to the correct words as well as ruling out the possibility that she eventually chose. In three of these instances both the words she read incorrectly and the words which appeared in the text were familiar to her. Natalie had knowledge of the expression "high-tech", and yet she read "teach". 'Teach' is a word she had, undoubtedly, come across many times in the course of her EFL studies, as are 'whole' and 'advantage'. In the second instance, although she was not familiar with the word 'aim', the word 'him' is an extremely common word and yet, it was provided in an unfitting context. In all of these instances visual memory did not prevent the errors made.

Notwithstanding Natalie's above statement regarding reading, later on in our talking about learning styles Natalie pointed to the fact that when studying for a test in

History combining the auditory with the visual does actually boost her memory:

*N: No. I need the notebook eh *** when I eh eh study for for a test, so I need someone that explain me, but I need my notebook in front of me so I can look eh look it and hear explain me in the same time.*

T:. So what you are saying is that you need to combine=

N:=Ye

T: between the visual=

N:=Ye, O.K, Ye

T: and the auditory.

N: Yes.

T: Is this because otherwise you do not understand or because otherwise you do not remember?

N: I not remember. It's a lot of material to remember.

T: So you are saying that connecting the visual with the auditory helps you remember.

N: Ye, ye. (Dialogue in English, 76-86)

At this point it is useful to distinguish between the three aspects of visual memory related to this research: visual spatial memory, visual sequential memory and visual-spatial working memory, specifically the visuo-spatial sketchpad. In the framework of this research, visual spatial memory refers to the ability to remember the location of visual stimuli in a given space as well as the general configuration of things; visual spatial-sequential memory refers to the ability to remember sequences of visual spatial stimuli; the visual spatial sketchpad is the visual sub-system in working memory and is essentially a visual workspace where information perceived in real time or retrieved from long-term memory interacts with new oncoming visual information (see section 2.1.2). It is possible that when Natalie said that she needed to see things written in her notebook as well as listen to oral explanations, she was referring to her later being helped by visualizing the already meaningful information, or maybe even the configuration of the words and sentences on the page, in order to interact with new information or tasks such as test questions. In terms of memory this would mean retrieving visual spatial information from long-term memory, causing this information to surface onto the visual spatial sketchpad and utilizing it for oncoming tasks. Once Natalie understands the material in History she now needs to be able to see things written on the page so that she can remember the overall configuration and retrieve written information.

Evidence for this type of memory in EFL reading is provided in the following excerpt. Natalie was to answer the second question in a reading passage. By the time she got to question number 2 she had already been mediated through most of the reading text in order to answer question number 1 and was worried that she would have to read it all again:

N: Now I have to read them all again.

T: Not necessarily. Maybe you just have to read on. Let's see (goes back to the reasons that Natalie has already read, refers to the first one and asks) Does the text say how it is made easier to understand here?

N: Eh no.

T: and here? (refers to the second reason)

N: eh eh no.

T: What about here? (refers to the third reason)

N: This looks a bit eh could be.

T: Why?

N: Because they sort of write it especially for me so..

T: O.K so read this again and tell me if your suspicion is justified or not. (Natalie reads it silently partly vocalizes and partly not. After a few second she says very decisively)

N: Yes!

T: right. Why?

N: Because they say it's all written in an easy way to understand and clear.

T: right. Now here (points to the fourth reason) do they say anything about it? Do you remember?

N: No, they don't. (Reading passage 2, in Hebrew, 89-103)

Natalie, indeed, remembered most of the information from the first reading. What is interesting from the point of view of visual spatial memory is her ability to remember the location of the information on the page. She could remember that it wasn't here and it wasn't there and that maybe it was in the third place.

Following is an additional instance where visual spatial memory is probably the reason for her ability to comprehend a specific part of the text. In Turn 37 of the oral protocols following the second reading passage Natalie reads:

N: <practical application of scientific break t tr trough> what's this?

She does not understand the word "breakthrough", asks for its meaning and I tell her what it means. The next time she encounters the same word in the same context is in

turn 157. She reads:

N: Because they say <read about practical applications of scientific>

T: scientific what?

N: <breakthr ah> *(gives the word in Hebrew) (Reading passage 2, in Hebrew, 155-157)*

Although Natalie could not figure out how to pronounce the word "breakthrough", she remembered its meaning. What triggered her memory was the configuration of this long word with the help of visual spatial memory. Natalie's ability to do this would be in line with her visual spatial memory test. Natalie's short-term visual spatial memory was defined as somewhat below average; her long-term visual spatial memory was defined as average as was her ability to recall visual spatial information with the help of retrieval cues.

Natalie's performance on the visual sequential tests portrayed quite a different picture. In this test Natalie's performance was defined as poor.

It is plausible that poor visual spatial-sequential memory could also partially account for Natalie's weak orthographic awareness and could explain the difficulty in distinguishing between "tech" and "teach" or between "advantage" and "adventure". There are instances where, weak orthographic awareness could have added reasons for incorrect reading as seen in the following:

N: = <Read articles writin, written especially for you>. (Reading passage 2, 43, in Hebrew)

N: <recent scientific discoveries, all writin written in clear and simple...(Reading passage 2, 65, in Hebrew)

In both examples, Natalie saw the word "written" and started to read "writing". Both "written" and "writing" are words she had in all probability came across many times and yet, word constituents did not trigger correct reading. In both cases, it was only after she had heard herself reading the word, that she realized her mistake and reread it correctly.

It may be asked whether poor visual spatial-sequential memory would not impair reading on the sentence level as well as at the word level. The answer to this is that it would but only after a certain threshold level of reading. In Natalie's case her lower level reading skills were so weak that visual spatial-sequential memory at sentence

level could not be put to the test.

To summarize issues of visual memory as seen in Natalie's performance, an analysis of the data raises the possibility of explaining Natalie's weak orthographic awareness in terms of poor visual spatial-sequential memory, and her ability to utilize meaningful visual chunks of information in terms of her normative visual spatial memory.

Analysis of Natalie's data, so far, has related to each of the research memory functions in an isolated manner. It seems, however, logical to assume that EFL performance involves more complex memory processing and that successful integration between memory functions will also play an important role in EFL learning. This ability to integrate between all memory functions is attributed to the central executive.

4.6 Natalie: EFL performance in terms of central executive function

In what follows I look at central executive functions in an attempt to see whether certain aspects of Natalie's performance in EFL can be explained in terms of central executive function.

The central executive is a component of working memory which is believed to be responsible for coordinating the flow of auditory and visual information from the phonological loop and the visual spatial sketchpad, retrieving information from long-term memory for integration with new information and simultaneously processing and storing on-coming information. Like the other sub-systems of working memory, the central executive is believed to be limited in capacity (Baddeley, 1997; Andrade, 2001a).

Memory literature points to a relationship between central executive functions and high level reading skills (Cain et al., 2004). I would like to suggest the idea that the reading models discussed in the theoretical background to this research involve varying degrees of central executive functions due to their integrative nature.

Adams (1994) suggested an information processing reading model where an orthographic processor, a phonological processor, a meaning processor and a context processor all operate in a simultaneous manner in order to achieve meaningful reading (Adams, 1994). Vellutino et al. (2004) also suggested a model of reading

where visual coding processes and linguistic coding processes operate together in order to attain meaningful reading (Vellutino et al., 2004). According to Baddeley and Hitch (1974, 1986 in Baddeley, 1997), all these processes which need to operate simultaneously involve central executive functions.

Looking at Natalie's EFL performance vis-à-vis central executive functions seemed, at first, to point in contradictory directions. On the one hand, her performance on the central executive memory test is normative. On the other hand, her EFL performance on tasks which require integration is weak. Natalie herself explicitly points to this weakness in her interview when asked what she believes to be the most difficult thing in her EFL studies:

N: What's most difficult? (thinks a few seconds) Ahh grammar with cloze when they give you a number of possibilities. When they give me a story, it confuses me when they give me too many options. When there are separate sentences it's easier, when it's a story it's more difficult for me. (Interview, in Hebrew, 18)

It seems that Natalie speaks about two separate types of tasks, both of which require a large extent of integration. Grammar with cloze refers to a type of question which is intended to check the pupil's understanding of a text and is in the form of a mini-cloze. In the mini-cloze small parts of the reading passage are rewritten in a different way leaving gaps for the pupils to fill in so as to fit the newly written text without changing the original meaning. This kind of task requires the ability to understand the original text, supply synonymous vocabulary to replace the original, make syntactic & morpho-syntactic adjustments in order to fit the new structures and eventually coordinate all of the above in order to retain meaning, accuracy and coherence.

The second task Natalie refers to are types of grammatical exercises where the verb is given in brackets in its base form and the pupil is supposed to put it in the correct form. Here there are two possibilities: 1. separate sentences 2.passages where things are contextualized. The context could be a whole story where tenses need to be manipulated in varying forms so as to fit the context of the story. This type of exercise demands the ability to integrate the information provided before and after the tense-less verb as well as be familiar with the various structures and applications of tenses. All of the above are very difficult for Natalie, and all of the above are believed to be within the realm of the central executive function.

Natalie's performance in the reading comprehension tests also seemed at first to point

to difficulties in tasks which require integration and higher level reading skills. The question to be asked at this point is: how does this weakness concord with Natalie's normative performance on the central executive memory test?

One possible answer is that Natalie's difficulties in coping with higher level reading skills and with EFL reading tasks which require integration start long before the level of integration is required. Her inability to cope with higher level reading skills may have to do with her inability to cope with lower level reading skills and therefore the elements she brings to the integration process are inadequate. If this is the case, one cannot expect the end result of the process to be satisfactory. In other words, it may be that EFL performance can be explained in terms of central executive function only after the specific aspect of the foreign language under discussion has reached a certain threshold level. Natalie's inability to cope with low level reading skills in EFL may render irrelevant central executive function, which account for some of the higher level reading skills.

An analysis of the tasks which Natalie pointed out as being difficult, as well as an analysis of some of her EFL tests, supports this line of thought. In all of these tasks, varying degrees of knowledge are required prior to the integration process: The grammatical exercises which are so difficult for her involve the ability to understand the original text, an ability which she does not always have. They involve competence in supplying synonymous vocabulary, vocabulary which does not often exist in her lexicon, and they require the knowledge to make syntactic and morpho-syntactic adjustments, a knowledge which she frequently lacks. When these are the building blocks at her disposal, there is no wonder that coordinating everything does not lead to correct language output.

An analysis of Natalie's reading also seems to support this claim. Once she understands the questions and the text itself she can integrate parts of the text as well as hold the already meaningful information in memory until she comes across the next relevant bit of information in the text. Although, in Natalie's case, this has been attributed to auditory verbal memory as discussed above, it also requires central executive functions in order to be able to integrate the pieces of information.

Additional support for the suggestion that Natalie's difficulties in EFL reading comprehension tasks derive from weak lower level reading skills, rather than from weak central executive function, can be seen in the fact that her oral performance in

EFL was much better than her reading. Throughout the oral tests, Natalie did not seem to have any difficulty in understanding me as interlocutor; her speech was fluent and communicative albeit often grammatically inaccurate and, on the whole, her oral skills were much better than her literacy skills as discussed above. It seems that once she did not need to struggle with the building blocks of literacy, central executive skills could come into play. In this case normative central executive skills may have contributed to Natalie's better oral performance in EFL.

4.7 Natalie: general summary EFL profile vis-à-vis memory

Natalie's overall performance in EFL is weak. Her vocabulary range in reading is low, but in speech it is low intermediate. Her productive syntax is weak; her receptive syntax is difficult to assess due to other reading difficulties. Her reading in English is weak. Her oral comprehension is good; her speech is fluent but extremely inaccurate.[2] Natalie's overall vocabulary range is not high possibly due to her weak phonological working memory which impairs her decoding ability. This could reduce her ability to learn new words in English by lists as is often requested in the EFL classroom. Her low vocabulary range in reading may be explained in the light of her overall unimpressive vocabulary knowledge, as well as the possibility that some of the words in a written text are not deciphered correctly due to her erratic decoding. Once more, weak phonological working memory may be the initial source of difficulty. Her better vocabulary range in speech may be related both to the fact that no decoding is needed in speech as well as to the fact that, for Natalie, meaningful EFL vocabulary is acquired auditorily. Her normative auditory verbal memory may be related to her better vocabulary range in speech.

Natalie's weak productive syntax may be related to a number of factors. Firstly, the nature of mistakes point to a strong element of interference, both from L1 and memory interference. Moreover, inappropriate teaching policy facilitates the influence of interference factors by teaching similar syntactic rules in sequence and out of meaningful context. Secondly, weak phonological working memory may cause reduced quality of information coming from the phonological loop and feeding

[2] Although it is outside the scope of my research to define a pupil as having specific learning difficulties, the qualitative analysis of Natalie's data suggests that she might have a mild form of dyslexia. This does not disqualify her as a case study since many of the memory factors which have been found to be related to EFL weakness have also been found to be related to SpLD.

into central executive integration processes.

Natalie's poor reading could be explained in terms of weak phonological working memory which seems to be related to both her decoding ability and her small vocabulary range. Her difficulties in EFL reading could also be linked to her weak visual sequential memory resulting in reduced orthographic awareness. Her good oral comprehension, on the other hand, may be related to her normative auditory verbal recognition memory and to the fact that most of her EFL meaningful learning is via the auditory modality. In addition oral comprehension does not involve decoding (which strongly affects her reading comprehension).

Natalie's fluency in speech may have to do with her normative central executive skills which facilitate the process of integration itself. However, it may be that information coming from the phonological loop is inexact due to weak phonological working memory and, therefore, speech outcome is erratic. In addition, Natalie's weak syntactic knowledge undermines all speech acts. Fluency in speech may be related to her normative auditory verbal memory and to the fact that she learns much English via the auditory modality and therefore retrieval via this modality is better.

Chapter 5: The second within-case analysis - Aya

5.1 Introduction to case 2 – Aya

I chose Aya as the second case for within-case analysis because she appears to be a mirror image of Natalie. Whereas Natalie's speech is much stronger than her reading, Aya's performance is quite the opposite: Her reading comprehension is excellent whereas her oral skills are less so. Whereas Natalie's speech is very fluent albeit inaccurate, Aya's speech is quite accurate, albeit fragmented, hesitant and therefore much less fluent. On the other hand, Aya seems to have a much better memory than Natalie. In what follows, I provide a qualitative analysis of Aya's performance whilst comparing and contrasting with Natalie (case 1).

Aya is a 17 year old girl in the last year of high school. By the end of that school year, she will have taken the 5 point matriculation test in EFL which is the highest level of EFL tests. In addition to studying English as a foreign language, Aya studies French at a very high level (equivalent to the level of English) and finds it very easy. She reports that she has always been very good in English, but that in the last two years her grades have gone down a little. She attributes this decline both to the material which is getting more difficult and to the fact that since most English tests at this stage of high school consist of unseen passages and cloze tests, there is no way one can actually learn for a test.

Aya is a high achiever and considers herself as having a good memory. In her words:

"A:... It doesn't matter. I have a good memory so (pause) I can I can eh memorize eh just by looking at ah ah O.K" (Dialogue, 84, in English)

When asked which academic subjects are easy/difficult for her to study, she classifies Math and History as more difficult and English and French as easy. Her grades, however, are high in all subjects suggesting that the real difference is in the amount of effort needed in order to succeed. Aya relates to this and says:

*"A: Ye. With the subject eh eh for example eh Math eh kind of difficult f for me I I can't sstudy for a test with music *** eh eh*

T: What do you do when you study for a Math test?

A: eh eh exercise eh

T: practice?

A: yes, a lot of exercising eh eh"

T: So you can't listen to music while practising Math

A: No, no (long pause) eh eh

T: but

A: (laughs) eh eh eh for example, eh eh French. eh, the eh the material is very is very easy for me eh so I I can study I can eh eh while I am ssstudying I can putting music eh watching television eh doesn't bother me so." (Dialogue, 12-20, in English)

When asked about motivation Aya says that she is motivated by success and concludes:

"A: The <u>most difficult</u> (pause) I have a problem with vocabulary. There are many words that I don't have which makes it difficult with unseen passages. There usually I lose points in tests.

T: Where? In unseens?

A: In unseens. Yes, to understand, unless the passages are easy, but on the whole that's my biggest problem. Sometimes also to express myself, but usually I can manage with that." (Interview, 12-14, in Hebrew)

Interestingly, the pattern of strengths and difficulties seen in the tests administered for the purpose of this research does not point to difficulties with the vocabulary of the reading comprehension passages. In fact, she scored 100% on all three passages, whereas her speech was much less impressive. It is possible that the level of reading comprehension passages given in her class at school is higher than the level of the reading comprehension test administered for the purpose of this research and that speaking is less emphasized at school, which is often the case.

5.2 Aya – test results

The EFL and memory tests administered to Aya were identical to those administered to Natalie, as was the procedure for assessing achievement on these tests (see sections 3.9 and 3.10 for details of the tests).

5.2.1 EFL oral and reading tests

Table 5.1: Aya - Dialogue

Communicative ability	points	Accuracy	points	Final grade
Comprehension of questions	85%	Incorrect/correct use of simple/complex language structures	75%	
Non-fluent/fluent Interaction	65%	Limited/basic/rich vocabulary	75%	
Gives single word/simple sentence/extended answers	75%	Poor/mostly comprehensive/comprehensible pronunciation	80%	
Total communicative ability	75%	Total accuracy	76.6%	**75.8%**

Table 5.1 gives a detailed account of the parameters considered in order to arrive at a final mark for Aya's oral proficiency in the dialogue. Accuracy accounted for 50% of the final mark and communicative ability for the additional 50%. The table above shows that Aya's communicative ability is a somewhat mixed bag. She can understand me as her interlocutor with no great difficulty and she has the ability to provide reactions at a level above the level of very simple sentences. Her fluency of speech, however, is quite inadequate and marked by numerous hesitations, repetitions and even complete stops. From the point of view of accuracy, Aya generally uses simple language structures which are correct most of the time; her vocabulary in speech is satisfactory but not excellent and her pronunciation is mainly comprehensible although quite distinct from that of a native speaker.

Table 5.2: Aya - Role Play

Communicative ability	points	Accuracy	points	Final grade
Comprehension of questions	100%	Incorrect/correct use of simple/complex language structures	90%	
Non-fluent/fluent Interaction	70%	Limited/basic/rich vocabulary	75%	
Gives single word/simple sentence/extended answers	70%	Poor/mostly comprehensive/comprehensible pronunciation	80%	
Total communicative ability	80%	Total accuracy	81.6%	**80.8%**

Table 5.2 shows that Aya's performance in this task is similar to her performance in the dialogue. From the point of view of communicative ability, Aya has a perfect understanding of me as interlocutor. Her fluency is better on this task where the interaction consists of shorter and more spontaneous speech acts. Most of her reactions in this task are given in simple, mainly short, sentences. Accuracy on this task is very good; vocabulary range is intermediate and pronunciation is satisfactory.

Table 5.3: Aya - EFL Reading

Name	Reading passage 1 (search reading)	Reading passage 2 (careful reading)	Reading passage 3 (mixed search and careful reading)
Aya	100%	100%	100%

Table 5.3 shows that Aya performed perfectly on all three reading comprehension passages.

5.2.2 Memory tests

As detailed in chapter 3, the memory functions looked at in this research include phonological working memory, auditory verbal memory, visual memory and central executive functions.

Table 5.4: Aya - RAVLT

Results are given in standard scores. (Mean standard score = 0)

RAVLT trial 1	RAVLT trial 2	RAVLT trial 3	RAVLT trial 4	RAVLT trial 5	RAVLT trial 6 proactive interference	RAVLT trial 7 retroactive interference	RAVLT trial 8 (LTM)	RAVLT trial 9 recognition
-1.05 (SD= 1.59)	-1.27 (SD= 2.13)	+0.36 (SD= 1.63)	+0.94 (SD= 1.54)	+1.36 (SD= 1.44)	+1.36 (SD= 1.80)	+1.53 (SD= 2.04)	+1.37 (SD= 2.11)	+0.32 (SD= 2.46)

Table 5.4 shows that in all of the trials Aya's performance is within the standard deviation range. In trials 1-5 the same list of words is read and Aya is asked to repeat as many of the words she can remember. Her performance is the weakest in the first two trials, but there is an improvement with each additional trial. Notwithstanding this improvement, Aya's performance stays within the average range. Trials 6 and 7 show that Aya is not specifically prone to interference; trials 8 and 9 point to her long-term memory and memory via recognition, both being within average range of performance.

Table 5.5: Aya - RCFT

Copy trial	Time to copy (seconds)	RCFT immediate recall	RCFT delayed recall	RCFT recognition
Percentile= >16 normative	420 Percentile Between 2-5 low	61 (% score=88) Rating=above average	60 (%score=84) Rating=above average	47(%score=38) Rating=average
Qualitative features of performance: In the copy trial Aya worked in a very meticulous/perfectionist manner.				

Scores on table 5.5 show that, on the whole, Aya has a very good visual spatial memory. Aya's higher time to copy scores could point to slower speed in cognitive processing; however, given her working style on this task, it could be that her desire to come up with a perfect copy was responsible for her slow performance. Her ability to retrieve visuo-spatial material when given retrieval cues is normative.

Table 5.6: Aya - DTLA-A - design Sequences, Active Memory - Complementing Words, Shatil Syllable Range Test

DTLA-A Design Sequences	17(% score=98) rating=very superior
Active Memory-complementing words	1.49 Rating=above average
Shatil syllable Range Test	High

Aya's performance on the DTLA-A Design Sequences test points to her having a very good visual sequential memory. Her result on the active memory test shows that her central executive functions are very good and her performance on the Shatil Syllable range test shows that she does not have difficulties in phonological working memory. Since this test was originally devised for younger children, Aya's high performance on this test cannot point to outstanding strengths, but can rule out any serious weakness.

Aya's EFL test results show that there are gaps between her reading skills and her speaking skills. Whereas table 5.3 shows that Aya performed excellently on all three reading comprehension passages with a score of 100%, Tables 5.1 and 5.2 indicate that her speech is weaker and that the weakest aspect of her speech is fluency (65% out of 100%). Aya does not seem to have any difficulty with the receptive aspects of EFL: she understands me as interlocutor and comprehends reading texts which consist of high level vocabulary and advanced language structures. However, producing EFL in real time seems to be much more difficult for her. From the point

of view of fluency versus accuracy, her speech is more accurate and less fluent.

Aya's memory tests show that, on the whole, she has a good memory. Most aspects of visual spatial memory are above average (Table 5.5) and her visual sequential memory as seen in the DTLA-A Design Sequences test is defined as very superior (Table 5.6). In the phonological working memory test (where scores are in terms of high and low) Aya's score is high and her performance on the central executive test which coordinates all other memory aspects is also above average.

Aya's performance on the auditory verbal memory test (table 5.4) reveals an interesting picture. As pointed out previously, this test consists of nine trials and although the results on all nine trials are within the standard deviation, differences between scores on each trial may be meaningful. Performance on the first two trials, when Aya is not aware of the fact that she is going to be asked to repeat the word list again and again, is the weakest. In a sense, the first two trials show net auditory verbal memory because she does not yet have enough knowledge of the tests to use strategy. Aya's scores on the first two trials may point to the possibility that her immediate instinctive auditory verbal memory is not as strong as other memory functions. From the third trial on, Aya uses strategy: she counts the words and tries to categorize. Aya's strategy leads to higher scores, but she never passes the standard deviation. Although Aya's performance on the auditory verbal memory test is within the range of standard deviation on all trials, on the whole her performance on this test is the least impressive.

5.3 Aya: EFL performance in terms of phonological working memory

The research question of this thesis attempts to look at EFL performance in terms of phonological working memory, auditory/phonological processing, auditory verbal memory, visual memory and central executive function.

In what follows, I attempt to explain Aya's EFL performance in terms of phonological working memory along with phonological processing and compare it to Natalie's performance where it seems appropriate. Research has already pointed to associations between phonological working memory and reading (Vellutino et al., 2004; Cain et al., 2004). Results on the phonological working memory test

administered for the purpose of this research are defined in terms of high and low. Aya's performance on this test is defined as high. Aya's performance on the EFL reading comprehension tests is excellent with a score of 100%. It is difficult to engage in a detailed qualitative analysis of Aya's EFL reading due to the fact that her performance was perfect and therefore there are no oral protocols to go with the test. What I can say, however, from watching her working on the reading comprehension passages is that, for Aya, it was a very smooth and un-laboured process. Phonological working memory is believed to influence people's low level reading skills via phonological coding ability (Vellutino et al., 2004; Cain et al., 2004). Unlike Natalie, for whom decoding seems to be a continuous struggle, Aya does not seem to encounter difficulties with decoding while engaging in her reading comprehension tasks. Although she was not asked to read out loud, the pace and ease of her work does not suggest any such difficulty. Aya does not have difficulty with words like *subscribing* or *Tennessee* which are long but have a straightforward phonetic orthography, nor does she have difficulty with the words *technological* and *recent* which require a deeper knowledge of sound symbol correlation due to the various possibilities for pronouncing */ch/* and */c/*. The reading texts include words such as *breakthrough* and *viewpoint.* These words do not have a simple orthography: the /eI/ and /u:/in *breakthrough* as well as the /ju/ in *viewpoint* require broad decoding skills. Moreover, both are compound words which are quite long. It seems that reading such words requires phonological processing and phonological working memory resources in order to handle their decoding, length and complexity. For Aya, reading these words does not seem to pose a problem.

The way in which Aya tackles the reading comprehension tasks indicates that she does not encounter difficulties with low level reading skills, which require phonological working memory functions. Aya's excellent performance on the reading comprehension tests together with her not having difficulties with the phonological working memory test is in contrast to Natalie's laborious reading, poor comprehension and weak phonological working memory.

Phonological working memory has also been linked to vocabulary acquisition in L1 (Gathercole and Baddeley, 1993; Gathercole and Martin, 1996; Gathercole et al., 1997; Gathercole et al., 1999), and in L2 (Papagno et al., 1991; Service, 1992; Baddeley and Gathercole, 1998). Unlike Natalie, whose reading comprehension is

weak due to lack of vocabulary as well as poor decoding skills, Aya does not seem to have any problem with understanding the vocabulary used in the reading comprehension passages. The only word she was not sure of and therefore underlined was the word *curators*. Aya and Natalie's differences vis-à-vis vocabulary is seen at the initial stage of L2 vocabulary acquisition, namely with strategies for learning new words. Whereas Natalie needs to divide new words into syllables and vocalize them, presumably in order to clarify and strengthen their phonological representations, Aya's strategy for learning new words is different. When asked how she learns new vocabulary in L2 she says:

A: *Eh, I just write them down a few times eh, it's no problem to remember them. The problem is that afterwards, after some time I forget them. For one day, for a test, I can manage.* (Interview, 18, in Hebrew)

It seems that decoding (even of new words) is quite effortless for Aya and that writing the new words a number of times does not include laborious decoding processes as it does for Natalie. It looks as if, for Aya, her inability to remember the words is not due to unstable phonological representations of L2 sounds. Her claim about not being able to retain new words involves different issues, discussed later.

The following lines can give us additional insight as to Aya's coding abilities:

A: If you now give me a list of words,

T: That you aren't familiar with?

A: That I'm not familiar with, and you tell me to write them down, it's most likely that I'll succeed in writing all of them.

T: Do you mean correct spelling?

A: From the point of view of spelling; from the point of view of translation, everything... (Interview, 20-24, in Hebrew)

Reading and spelling both involve coding ability. Aya's ability to spell new words correctly just by the sound of them is similar in nature to her ability to read new words with ease and points to very good encoding ability which has also been seen to be related to phonological processing and phonological working memory (Kreiner, 1992; Kreiner and Gough, 1990; Stage and Wagner, 1992 all in Leong, 1999; Savage et al, 2005).

From the above, it seems that if she has difficulties in learning new words in L2, they are not related to phonological processing or phonological working memory as

appeared to be the case with Natalie.

Interestingly, although Aya can cope with the vocabulary in the reading comprehension passages very well, her ability to use vocabulary fluently in speech is less marked. In tackling the reading comprehension passages Aya does not seem to have any difficulty with understanding high level words or phrases such as: *comprehensive analyses, from cover to cover, subscribing, international finance,* or *considerable advantage.* In her speech, however, Aya does not manifest such a high vocabulary range, although her vocabulary is above the basic and words like *material* and *prefer* (dialogue, 11, in English), *concentrate* (dialogue, 24, in English) or *confused* (dialogue, 54, in English) are used frequently. It seems that the difficulty Aya has with vocabulary is not in being unfamiliar with words, but in retrieving words in real time. Natalie's difficulties with retrieval look as if they are related to unsteady phonological representations of less familiar sounds in L2 words and have therefore been related to auditory/phonological processing and the memory for sound. Unlike Natalie, when Aya cannot retrieve a word, it is not on the tip of her tongue; it is not sound traces she is looking for, but the whole word or phrase:

A: Ye, If I have to, to eh (long pause seven seconds) eh
T: Try. If you have to
A: eh (pause five seconds). If it is material that eh (pause 14 seconds!)
T: What's the difference between Math and History for you?
A: O.K eh History is eh about memory and I need to eh read and then I need to eh eh
T: to memorize?
A: Ye, to memorize... (dialogue, 24-31, in English)

It seems, therefore, that Aya's performance profile vis-à-vis vocabulary is the complete opposite from that of Natalie's who is lost for words when reading, but can use vocabulary fluently albeit drawing on a small vocabulary range.

My observations so far are also in line with research which has not found relationships between phonological working memory and speech production. The question to be asked is: are there other elements which could be considered as linked to differences between receptive and productive language skills in L2?

One factor pointed out by Henriksen (1999) as accounting for differences between receptive and productive aspects of lexical development is the factor of automaticity (see section 2.2). Interestingly, psychology literature holds a variety of viewpoints

regarding the nature of automaticity, many of which do not consider it to be a function of memory retrieval (DeKeyser, in Robinson, 2001). It may very well be that whereas Aya has mastered knowledge that is both precise enough and deep enough (Henriksen, 1999) to deal with receptive aspects of EFL, she lacks sufficient automaticity in order to speak fluently. In a sense, Aya's speech production would also be in line with Krashen's acquisition/learning hypothesis and with the monitor hypothesis (Krashen, 1982). In terms of Krashen's acquisition/learning hypothesis, much of Aya's EFL has not been acquired although it had been learnt. In terms of the monitor hypothesis, Aya could possibly be considered an over-user of the monitor (See section 2.2) Natalie, on the other hand, has not developed enough knowledge to cope with EFL reading, but has the automaticity required in order to utilize her little knowledge in fluent speech. I am reluctant to call Natalie an under-user of the monitor (in terms of Krashen's monitor hypothesis) because I suspect that she simply lacks the knowledge.

From the point of view of phonological processing and phonological working memory, although it seems safe to point to relationships between these and the ability to learn new L2 vocabulary, the ability to use this vocabulary productively and efficiently in speech acts has to do with automaticity rather than with memory in general and phonological factors of memory in particular.

Notwithstanding the observations above, there are some instances where Aya's fragmented speech seems as if it has less to do with automaticity and more to do with memory recall, especially in those instances where she cannot come up with a word, even after a very long pause:

T: What motivates you?

A: Ah eh (long pause) to (long pause) Idknow eh to get eh ah (long pause 18 seconds) when I know that eh (pause) this is a subject that I know very well and eh eh and I can get and I can get and I can get eh good notes so eh I try to study a little bit more so

T: So success motivates you.

A: Ye, success, ye. (Dialogue, 104-106, in English)

Although it is not very likely that this difficulty has to do with the phonological elements of memory as discussed above, it may be that this difficulty to recall words in speech is related to Aya's learning strategy for new vocabulary items, inefficient school practice and auditory verbal memory, all of which are discussed later.

Although Aya's speech is not as fluent as Natalie's, it is much more accurate. When asked about grammar Aya says:

A: *Grammar eh I think I'm more or less O.K.* (Dialogue, 15-16, in English)

Performance on the oral productive tests shows that Aya makes very few grammatical mistakes. The quotation below shows that she is not sure as to which formulation to use and she eventually uses the formulation less used in such texts:

A: eh, alone, because eh eh when I'm try to study with my friend eh we cannot concentrate so we talk all the time we are talking all the time... (Dialogue, 108, in English)

As mentioned earlier, this kind of grammatical mistake could be attributed to interference from L1 together with memory interference which might be due to the way tenses are taught at school. The fact that Aya does not seem prone to this confusion as a rule may point to it being more due to specific episodic L1 interference than to memory interference. This is also supported by the fact that Aya is not seen to be prone to interference in the RAVLT memory test discussed later.

Aya's performance on the phonological working memory test and her better accuracy in EFL are in line with research which pointed to relationships between phonological working memory and speech production (Gathercole and Baddeley, 1993).

To summarize issues of phonological aspects of memory and EFL speech, it may be suggested that although no meaningful relationships were found between these in former research, there may be some connections through knowledge of vocabulary and syntax both of which have been related to phonological working memory.

Phonological working memory has been seen to account for much foreign language learning aptitude (Ganschow et al., 1991; Ellis, 2001) (see section 2.3). Aya's L2 school achievements seem to be in line with this. Although within the Israeli school system it is only compulsory to matriculate in English, Aya chose to matriculate in French as well and seems to be doing very well in both. In her interview, Aya says:

T: How was your history with studying English at school?
A:... all and all I don't find it very difficult. (Interview, 7-8, in Hebrew)

And:

A: (laughs) eh eh eh for example, eh eh French. eh, the eh the material is very is very easy for me... (dialogue, 20, in English)

Qualitative analysis of the data so far supports former research which has found

relationships between phonological working memory, along with phonological processing, and reading. Aya, whose EFL reading and receptive vocabulary knowledge are excellent, does not seem to have any difficulty with the phonological working memory test administered for the purpose of this research, whereas Natalie, whose reading and vocabulary knowledge are weak, performs very poorly on the phonological working memory test. Observations of the case studies' reading and learning strategies seem to support these realizations. Fluent speech production was not seen to be implicated by phonological working memory and the notion of automaticity was suggested as playing a role in fluent speech. Phonological working memory may be linked to speech production to some extent via vocabulary and syntax.

The above analysis of Aya's speech suggests that her difficulty to recall words in speech may be related to a certain extent to additional memory functions which are discussed henceforth.

5.4 Aya: EFL performance in terms of auditory verbal memory

The second issue discussed relates to auditory verbal memory in an attempt to see whether certain aspects of EFL performance can be explained in terms of auditory verbal memory.

Auditory verbal memory was checked by the Rey Auditory Verbal Learning Test (RAVLT). Although all of Aya's test results have been presented above, results of the RAVLT are presented again below together with Natalie's results on this test as a basis for discussing and comparing relationships between auditory verbal memory and EFL performance.

Table 5.7: Aya and Natalie - RAVLT

Name	RAVLT 1	RAVLT 2	RAVLT 3	RAVLT 4	RAVLT 5	RAVLT 6	RAVLT 7	RAVLT 8	RAVLT 9
Aya	-1.05	-1.27	+0.36	+0.94	+1.36	+1.36	+1.53	+1.37	+0.32
Natalie	+0.20 SD= 1.59	-0.33 SD= 2.13	+0.36 SD= 1.63	+0.94 SD= 1.54	+1.36 SD= 1.44	-0.30 SD= 1.80	+0.55 SD= 2.04	+0.42 SD= 2.11	+0.32 SD= 2.46

Table 5.7 shows that both Aya and Natalie's performance on this memory test is within average range. Analysis of the learning curve, however, suggests that Aya's immediate memory for verbal information presented auditorily is less good than that of Natalie's. Aya's and Natalie's results on trials 3, 4, and 5 are exactly the same. A qualitative analysis of their performance, though, shows differences in the way each of the girls approach the task. As mentioned before, from this point onwards, Aya starts using strategy in order to remember the word lists. She counts the words, tries to categorize and makes signs for herself in order to remember as many words as possible. Natalie, on the other hand, does no such thing. When she is asked to recall the word list again, she does not put much cognitive effort into the task: she just smiles and throws out words she remembers. Interestingly, Aya's cognitive effort and Natalie's effortless retrieval yield similar results. From observing performance on trials 1-5, it is suggested that although the test results of both girls seem similar, Aya's natural auditory verbal memory is less good than that of Natalie's. This observation will soon be supported by the qualitative analysis of Aya's preferable modality for learning and her performance on the EFL tests.

Trials 6, 7 and 8 show that Aya is less prone to interference than Natalie and has a slightly better auditory verbal long term memory. It should be pointed out, however, that of all the memory tests administered for the purpose of this research, Aya's performance on the auditory verbal memory test is the least impressive. This observation is in accordance with what Aya says when asked about her preferable modality for learning:

T:... how do you think you study better? By listening to something or by reading something or by practising something or maybe some of these things together or , just try, let's say you have a chapter in History to study, how would you go about it and how would you study best?

A: O.K eh I think it's, eh I prefer reading the test eh the text, eh eh practising... (Dialogue, 69-70, in English)

And:

T: You come to a test and you want to remember, what is it that you remember? The sound of the teacher speaking

A: No! (forcefully)

T: The way it was written on the page?

A: Ye ye! The way it was written on the page.

(Dialogue, 79-81, n English)

From the above we see that as opposed to Natalie, who needs to hear things in order to remember them. Aya's preferred way of studying is via the visual modality. It may be for this reason that Aya prefers to study alone whereas Natalie benefits from studying with classmates.

When asked how she learns new words in English Aya says:

A: Eh, I just write them down a few times eh, it's no problem to remember them. The problem is that afterwards, after some time I forget them. For one day, for a test, I can manage

T: What do you mean when you say that you have no problem to remember them?

A: If you now give me a list of words,

T: That you aren't familiar with?

A: That I'm not familiar with, and you tell me to write them down, it's most likely that I'll succeed in writing all of them.

T: Do you mean correct spelling?

A: From the point of view of spelling; from the point of view of translation, everything. The next week, there's a chance I'll forget them. (Interview, 17-24, in Hebrew)

Aya refers to writing words and remembering their spelling and meaning. Sounding out the words does not seem to be a part of her learning process. Aya's observation that her real difficulty is in retaining vocabulary items for longer periods of time is discussed along with visual memory.

Later on I asked her to relate specifically to sounding out words in the process of learning:

T: When you study these words, do you memorize their sound? Let's say you have a new word: "supercalifredgilistiexpielidocious" for example, When you want to learn it do you just try to memorize the way it is written, or do you try to save and reconstruct the way it sounds as well; to memorize the way it is said?

A: Eh eh yes. If it's a long word then yes I do. It makes it easier to remember. I divide it= (Interview, 25-26, in Hebrew)

It is interesting to notice that Aya stresses that she only sounds out words if they are long, meaning that with most vocabulary items her first choice is not auditory but visual. When she continues to say:

T: You divide it? Don't you say it as a whole?

A: I do as a whole as well, but if I see it's difficult for me, I remember a bit from the beginning, them from the middle like that. (Interview, 27-28, in Hebrew)

It is possible that remembering a bit from the beginning and a bit from the middle may refer as much to the visual aspects of the word as to auditory ones.

Apparently, listening and speaking is not a part of Aya's overall way of studying English either:

T: and if it's not History, if it's English?

A: English, practising ye practising so

T: So how do you practise it?

A: I have my books eh so I do exercises so I eh (pause) that's it. (Dialogue, 71-74), in English)

From this analysis of Aya's learning strategies it seems that there is very little utilization of the auditory modality for learning in general and learning EFL in particular. This seems to be in line with Aya's auditory verbal memory being less strong than other aspects of her memory. It may be worthwhile considering the fact that both Aya and Natalie's preferred learning strategies coincide with their better memory modalities, an observation which may point to further directions of research.

The most relevant aspect of EFL performance to be looked at in relation to auditory verbal memory is speech. The most outstanding feature in Aya's speech is that it is marked with repetitions, hesitations and even complete stops after which I as interlocutor have to put her back on track again:

T: If you have to study for a test in History for instance?

A: Ah, so eh without eh without eh music or sound. I need to concentrate and (pause)

T: So, maybe this has to do with things that have to do with memory?

A: Ye, If I have to, to eh (long pause seven seconds) eh

T: Try. If you have to

A: eh (pause five seconds). If it is material that eh (pause 14 seconds!)

T: What's the difference between Math and History for you?

A: O.K eh History is eh about memory and I need to eh read and then I need to eh eh
T: to memorize?

A: Ye, to memorize the dates eh the events all this, and Math is just practising the exercises so= (Dialogue, 23-32, in English)

And:

T: What motivates you?

A: Ah eh (long pause) to (long pause) Idknow eh to get eh ah (long pause 18 seconds) when I know that eh (pause) this is a subject that I know very well and eh eh and I can get and I can get and I can get eh good notes so eh I try to study a little bit more so

T: So success motivates you.

A: Ye, success, ye. (Dialogue, 103-106, in English)

Aya seems to be lost for words; and not very difficult words either. Given Aya's performance on the reading comprehension it is quite safe to assume that she would not have any difficulty in recognizing and understanding these words receptively. It has been shown earlier that Aya's better phonological working memory does not empower her oral productive skills. Could it be that Aya's weaker auditory verbal memory has to do with her speech performance? If we were to analyse Aya as a separate case, this could have been considered as an immediate logical assumption. However, the fact that Natalie and Aya's results on the auditory verbal memory test are not all that different whilst their EFL performance is so distinct leads me to consider additionalexplanations. I would like to propose that there may be a connection between the context of learning EFL and later performance in EFL. Since Aya does not usually choose to learn via the auditory modality, her auditory functions may be less active, less practised and as a result her oral productive skills are less developed. It may even be that this could partially account for her lack of automaticity in oral productive skills. Aya's hesitant speech may be related to her learning strategies which, in turn seem to be linked to memory in general and auditory verbal memory in particular. On the other hand, Natalie, whose first choice for learning is via the auditory route, provides continuous practice for her auditory functions, keeping them very active, and as a result facilitates automaticity in her oral productive skills. One crucial issue in this explanation is the issue of causality. Is one's preferred learning strategy determined by his/her stronger memory modalities, or do certain aspects of memory become more efficient due to our activating them? The scope of this research does not allow me to engage further with these issues despite their obvious relevance.

When Aya says that she thinks that her grammar is fine, it is reasonable to assume that she refers to the way grammatical knowledge is acquired and tested at school, namely via grammatical exercises isolated from meaningful context as referred to in Natalie's analysis. Aya's way of learning for these tests is by learning the rules and practising. In her words:

A: I have my books eh so I do exercises so I eh (pause) that's it. (Dialogue, 71-74), in English)

When Aya relates to grammar there is no mention of things sounding right or wrong. In fact, when she wrongly uses the preposition */in/* instead of */on/* as in: *" It depends in the subject."* (Dialogue, 114, in English), there is no hesitation on her part, which could have indicated that there seemed to be something wrong in the way it sounded. It may be that because Aya does not instinctively rely on her auditory verbal memory, she is constantly trying to apply suitable grammatical rules while producing speech, a fact which renders her speech slow and hesitant. This is in line with Krashen's acquisition-learning hypothesis which claims that language knowledge acquired by rules only and not practised in natural situations cannot be effectively integrated into one's EFL performance (Krashen, and Scarella, 1978). This analysis suggests that Aya's hesitant speech may be related to both vocabulary retrieval difficulties and cognitive preoccupation with accuracy in the process of speech. Both of the above may be related to Aya's not utilizing auditory resources in the process of learning, which may have to do with auditory verbal memory. As opposed to Aya, Natalie's route to speech production seems to go directly via her auditory resources resulting in fluent albeit non-accurate speech.

Analysis of Aya's data points to the fact that her visual modality is stronger than the auditory one. The next issue relates to visual memory.

5.5 Aya: EFL performance in terms of visual memory

The third issue discussed in this research relates to visual memory. In what follows I intend to look at visual memory and the way in which certain aspects of EFL performance may be related to it.

In this research, visual spatial memory is checked by the Rey Complex Figure Test (RCFT). Aya's test results are presented below together with Natalie's results on this test as a basis for discussing and comparing relationships between visual spatial memory and EFL performance.

Table 5.8: Aya and Natalie - RCFT

	Copy trial	Time to copy (seconds)	RCFT immediate recall	RCFT delayed recall	RCFT recognition	Qualitative features of performance:
Aya	Percentile= >16 normative	420 Percentile Between 2-5 low	61 (% score=88) Rating=above average	60 %score=84 Rating=above average	47(%score=38) Rating= average	In the copy trial Aya worked in a very meticulous/ perfectionist manner.
Natalie	Percentile= 11-16 Below average	125 Percentile>16 normative	42 (% score=21) Rating=below average	45 (%score=31) Rating= average	54(%score=66) Rating= average	Natalie worked very fast and in quite an impulsive manner.

Results are given in T scores and percentiles. (Mean T score = 50; SD=10)

Table 5.8 shows that, on the whole, Aya's performance on this test is better than Natalie's. Aya's copying is much better than Natalie's. It should be noted, however, that Aya took a long time to copy whereas Natalie took little time. Aya's ability to recall visual spatial information in the short and longer term is above average ability and is better than Natalie's. In contrast, Natalie's ability to recall visuo-spatial material when given retrieval cues is somewhat better than Aya's.

A qualitative analysis of Aya's performance, presented below, attempts to unfold relationships between visual spatial memory and performance in EFL.

When Aya is asked about her preferred way of learning she asserts that when she sees things written down there is a much better chance of her remembering them:

T: All and all how do you remember things better by listening to them or by reading them?

A: Reading! reading, cause I see it eh (pause) front of me so eh.

T: So when you come to a test, how do you retrieve things; by what?

A: (pause)

T: You come to a test and you want to remember, what is it that you remember? The sound of the teacher speaking

*A: **No!***

T: The way it was written on the page

A: Ye ye! The way it was written on the page. Ye, actually.

T: and if you have a hundred pages?

A: It doesn't matter. I have a good memory so (pause) I can I can eh memorize eh just by looking at ah ah O.K (Dialogue, 75-84, in English)

From this we learn that Aya's preferred learning style is via the visual modality. It

seems that when Aya needs to remember material she can actually visualize what and how things were written on the page. The memory functions involved in this kind of visualization are mainly visual spatial memory and the visual spatial sketchpad (VSSP). Aya can remember the whole configuration of writing on the page and make it surface onto the VSSP for the purpose of direct use or for further processing. This ability is in line with Aya's performance on the visual spatial memory test which is very good.

Aya's strategy for learning new words in English is also via the visual route:

T: You said that you have a problem with vocabulary. Let's say you have studied a story and you have a list of new words to learn, how do you approach this task?

A: Eh, I just write them down a few times eh, it's no problem to remember them. The problem is that afterwards, after some time I forget them. For one day, for a test, I can manage. (Dialogue, 17-18 in English)

Aya seems to feel that writing a word repeatedly facilitates her memory. The question to be asked at this point is why the words "disappear" from her memory in the long term, notwithstanding the fact that her performance on the long-term visual spatial memory test is excellent. The attempt to explain this phenomenon leads me down three separate paths. First, it may very well be that Aya is too hard on herself when she says "I forget them" and while it is reasonable to believe that she does not remember all of the words, she probably still remembers quite a lot. This explanation is in line with Aya's very good performance on the reading comprehension passages which points to her having a high range of receptive vocabulary. The seeming contradiction between her forgetting words in the long term and her good performance on the memory test could be due to the fact that the memory tests administered for the purpose of this research do not check memory in such a long term, namely after a few days. However, once more, Aya's vocabulary knowledge in the reading passages administered for the purpose of this research suggests that her self- judgment may be too harsh. Second, it may be that when Aya says that she does not remember words, she refers to her ability to use those words in speech. This explanation would be in line with Aya's less good performance on the oral productive skills as seen in the EFL tests. It would also be in line with the suggestion that there may be a relationship between the context of learning language and the context of using it, namely, the fact that Aya learns words visually enhances her EFL reading more than her speaking. Third, current research has posed a question mark as

to the efficiency of writing new words in L2 as a learning strategy. It has been argued that writing new words in L2 without contextualizing them detracts from their learnability (Hoey, 2005). This kind of learning strategy was found to reduce the ability to retain words in long-term memory (two days later) for productive use (Barcroft, 2006).

Bearing in mind that Aya may not be able to remember all of the words she attempts to learn and the fact that writing new words in L2 may not be the best of strategies, it still seems that Aya's very good visual memory is related to her reading comprehension in general and to her large vocabulary range in the reading comprehension passages in particular. It is also reasonable to believe that Aya benefits from school practice which generally provides more possibilities for learning via the visual route (word lists, grammatical exercises and reading materials) than opportunities for learning via the auditory route. Visual memory, however, is not disconnected from other memory functions such as phonological working memory along with phonological processing. It may be that Aya's phonological working memory facilitates good decoding skills which in turn enhance L2 vocabulary learning. All of these factors provide a sound basis for the operation of her visual memory functions enabling her to retain a large number of receptive vocabulary items. Aya's good visual spatial memory also enables her to successfully engage in the complexity of higher level reading skills by providing a sound basis for the operation of central executive function. The above proposition actually means that, in this specific context, phonological working memory may be a prerequisite to visual memory in a sense that it enables the EFL learner to reach a threshold level where visual memory functions can facilitate learning.

So far, the qualitative analysis of the data vis-à-vis visual spatial memory is in line with suggestions in this research regarding relationships between the context of learning and the context of performing in L2. It is suggested that when the context of learning and the context of EFL performance are via the same modality, performance is much better than when the context of learning and the context of EFL performance are different, namely via different modalities. An additional proposal is suggested regarding a somewhat hierarchical relationship between phonological working memory and visual spatial memory in this context. It is suggested that phonological working memory enables the EFL learner to arrive at a certain threshold level in the

absence of which visual spatial memory cannot operate effectively.

A somewhat different aspect of visual memory is visual memory for sequences. In the DTLA-A test which tests visual sequential memory Aya's rating is above average whereas Natalie's rating is poor. The fact that Aya points to her ability to spell a list of new words in L2 correctly with no great difficulty could be related to her excellent visual sequential memory, especially when the target language is English. The reason for this is that although to some extent English spelling follows straight-forward phonetic patterns, it still has a high degree of phonetic irregularity. English vowels having more than one sound and vowel combinations and words which do not seem to follow any phonetic logic may render English spelling a matter of visual sequential memory. Consequently, the fact that Aya does not find English spelling difficult and the fact that she performed very well on the visual sequential memory test may be related. Natalie, on the other hand, does not mention anything about her spelling in English but the very fact that she confuses between words like /teach/ and /tech / (see section 4.3) could be related to her weak visual sequential memory as mentioned before. Therefore, analysis of the data suggests that visual sequential memory may be related to EFL performance via English spelling ability and through orthographic awareness as a part of the reading process.

All the memory functions discussed so far are coordinated by the central executive component of working memory. The next section considers the central executive.

5.6 Aya: EFL performance in terms of central executive function

The next issue discussed relates to central executive function. In the following lines I attempt to explain certain aspects of Aya's EFL profile in terms of central executive functions and see whether a comparison with Natalie can support suggestions as to relationships between EFL and the central executive component of working memory.

As presented previously, the central executive is known as the overall control system within working memory (see section 2.1.3) and is believed to be related to high level reading skills in L1 (Cain et al, 2004).

It seems logical to assume that since relationships were seen to exist between central executive function and high level reading skills in L1, such relationships will be apparent in L2 as well, maybe even to a larger extent. As far as reading in L2 is

concerned, long sentences, sentences with complex deep structures, morpho-syntactic manipulations, referencing and inferencing all require a large degree of central executive capacity especially when low level reading skills are not yet automatic.

To the best of my knowledge, research to date has not related specifically to the role of the central executive in L2 productive skills. However, given the broad range of responsibilities attributed to the central executive it seems that the central executive component of working memory is involved in productive aspects of L2 performance as well. Being a control system, it may be logical to assume that in stages prior to automaticity in L2, the central executive carries an extra load due to the need to correlate both content and form, namely what one wants to say with how things are actually said. Whereas in L1 manipulation of low level language skills such as word retrieval and sentence production does not require much cognitive capacity, doing the same in L2 requires varying degrees of cognitive effort. When the control system needs to orchestrate parts which are not yet completely stable, it is likely to require even larger degrees of capacity and control.

As mentioned in section 3.11.2 above, in this research, central executive function is checked by the Shani, Ben Dror, Zeiger and Ravid Active Memory - Complementing Words memory span test. Aya's performance on this test is above average whereas Natalie's performance is within average range. Does performance on this memory test have any relationship with the case studies' performance in EFL?

In order to gain insight as to possible relationships between the two, it is worthwhile to go back and look at some of the data again. When Aya is asked about her history with English studies at school she points to the fact that although it is not a problematic subject for her, there is a difference between her grades in the first years of studying English and her current grades:

A: All through elementary school I was very good. I was good at Junior High as well. Now in high school my grades have gone down a bit. The material is more difficult. This year, or even, it started two years ago, there is a deterioration. But all and all I don't find it very difficult.

T: Do you attribute it to the materials; to the teacher; to the effort you put in studying? What do you attribute this deterioration to?

A: To the effort I make, since there is no way I can study for the tests which consist of unseens and cloze tests; this year there is a problem of a teacher

and also the material, which is obviously getting more and more difficult. (Interview, 7-10, in Hebrew)

She also points to vocabulary as being partially responsible for this:

A: The <u>most difficult</u> (pause) I have a problem with vocabulary. There are many words that I don't have which makes it difficult with unseen passages. There usually I lose points in tests. (Interview, 12, in Hebrew)

When Aya says that part of the reason for her grades dropping in the past two years is due to the materials getting more and more difficult, at first sight it seems as if this could have to do with central executive function which is said to deal with higher level language skills. It seems even more so considering the fact that most of Aya's memory functions checked for the purpose of this research are high. However, this line of thought would not be consistent with Aya's very good performance on the central executive memory test. A deeper analysis of Aya's observations could lead us down a different path.

It has already been emphasized that although Aya points to unseen passages as a difficulty, this difficulty does not surface in the research reading comprehension tests as shown in the examples below. Aya can easily handle long sentences such as:

"Judging by the numbers, the strategy has succeeded: children's museums have become so popular that there are more than 300 of them in the USA today – twice as many as a decade ago." (Reading comprehension passage 1)

Aya does not seem to encounter difficulties with sentences which are both long and have more complex structures either:

"In Birmingham, Alabama, for example, kids who dream of becoming doctors can learn about anatomy by taking a plastic skeleton apart – and then trying to put it back together again." (Reading comprehension passage 1)

Aya does not even have to struggle with the high level careful reading in reading passage number 2 where in order to answer most of the questions she needs to collect information from different paragraphs in the text. Ability to cope with such questions requires high degrees of simultaneous storage and processing which are believed to be within the domain of central executive function.

Furthermore, Aya claims that she loses points on reading comprehension tasks due to lack of vocabulary. Since vocabulary acquisition is not considered to be within the domain of central executive function, her losing points due to lack of vocabulary does not conflict with her having strong central executive skills. It, therefore, seems

reasonable to say that Aya's receptive skills in EFL as reflected in her reading comprehension skills are still in line with her very good central executive function and that central executive function may be related to reading comprehension in EFL.

The second source of difficulty specified by Aya is handling cloze tests. A cloze test is a text where a certain percentage of words of the original text had been taken out and the test taker is asked to supply words to replace the missing ones. Unlike reading comprehension, which requires EFL receptive skills, filling in the missing elements in cloze tests requires the ability to recall words which is actually a productive language skill. In a way, cloze tests have much in common with speech. Moreover, although cloze tests are done in writing, it seems logical to assume that the modality of recall may be not visual but auditory. It is quite difficult to imagine the many word options to choose from surfacing on the visual spatial sketchpad and flashing in one's visual memory; it seems more logical to assume that various possibilities are sub-vocalized in a process of inner speech. I would like to stress that although it is covert speech I am relating to, cognitively it is still speech. This being the case, the kind of memory utilized when engaging in cloze tests is probably auditory verbal memory as is the case with overt speech. In light of the above analysis, I would like to suggest that although cloze tests are done in writing, the memory modality involved in these tasks is auditory, the mental context of performance is auditory and, on the whole, cloze tests have much in common with oral productive performance.

If the cognitive resources needed in order to cope with cloze test tasks have much in common with those required in order to perform oral productive tasks, it could explain why cloze tests are difficult for Aya. This could also show that this difficulty is not necessarily related to central executive function. Viewing a cloze test task as an auditory productive task allow the factors suggested as underlying Aya's weaker speech performance to come into play once again: According to this analysis, Aya's weaker auditory verbal memory along with her limited utilization of the auditory modality for learning are related to her weaker performance on productive skills needed to perform cloze test tasks. Once again, relationships between memory modality, the context of learning and the context of performing are suggested as a possible factor underlying EFL performance.

How is the above discussion related to central executive function? The explanations I

have offered suggest that although, on the face of things, the ability to cope with cloze tests requires integration skills, which are in the domain of the central executive function, there may be times where the source of difficulty is already in the information fed into the central executive by one of the slave systems. Aya's difficulties with cloze tests, therefore, are not necessarily related to her very good performance on the central executive tests. This supports the suggestion that the central executive function is related to high level reading skills as well as high level oral productive skills in EFL.

Analysis of Natalie's data seems to support these realizations (see chapter 4). Natalie's normative performance on the central executive memory test is not thought to be in contrast with her very weak EFL reading comprehension performance because the central executive function cannot come into play effectively below a certain threshold level of low level reading skills. In addition, normative central executive skills could account for Natalie's fluent speech (where low level reading skills are irrelevant).

Interestingly, a re-examination of Natalie's data for the purpose of comparing her with Aya points to the fact that Natalie's preferred modality for learning is auditory; her more effective context of learning is generally auditory and her better performance in EFL is in the oral productive domain, namely, speech. Once more there seems to emerge a relationship between memory modality, the context of learning and the context of performance.

Summary so far: A qualitative analysis of the data provided by Aya and compared to Natalie leads to a number of conclusions. The analysis supports former research which found relationships between phonological working memory, EFL reading, vocabulary, syntax and overall foreign language aptitude, but not with EFL speech. Aya, who performed well on the phonological working memory test, was seen to have very good EFL reading skills, a high vocabulary range, good syntax and an overall high foreign language aptitude. Her speech, however, was not as strong. Natalie, who performed poorly on the phonological working memory test, was seen to have weak EFL reading skills, a low range of vocabulary and weak syntax. Her speech, however, was much better than her reading.

To the best of my knowledge, research to date has not addressed specifically possible relationships between auditory verbal memory and performance in EFL. The analysis

above suggests that auditory verbal memory may be related to the oral productive aspects of EFL as seen in the research speech data. Aya, whose immediate auditory verbal memory is the least impressive of all her memory functions, presents hesitant and fragmented speech, whereas Natalie, whose immediate auditory verbal memory is stronger, speaks much more fluently. In addition, analysis of the case studies' EFL vis-à-vis auditory verbal memory leads me to propose possible links between memory modality, the context of learning and the context of performance. Aya, whose weaker memory modality is the auditory modality, does not chose to learn via this modality and performs less efficiently in oral productive tasks which involve auditory skills; Natalie, who prefers to study via the auditory modality, performs much better in oral productive tasks which involve auditory skills. A question left open at this point is the direction of causality between memory modality strength/weakness and preferred learning modality. Whereas in Aya's case one could assume that she avoids learning via the auditory modality due to it being weaker than the visual, in Natalie's case such an assumption cannot be made. In Natalie's case, both visual spatial memory and auditory verbal memory are within the normative range and, therefore, her learning via the auditory modality cannot be attributed only to strength or weakness. It may be, however, that her using the auditory modality for learning keeps it constantly active and facilitates a kind of specialization for learning via this modality. It seems, therefore, that performance is better in the modality/context in which new learning takes place, but a direction of causality between these and memory modality strength is yet to be established.

Analysis of the data vis-à-vis visual spatial memory points to relationships amongst visual spatial memory, receptive vocabulary range and reading comprehension. In this context, phonological working memory evolves as a prerequisite for visual spatial memory to come into play. Aya, whose visual spatial memory is above average, has a large receptive vocabulary range. Her good visual spatial memory enables her to remember many words just by the sight of them and develop an orthographic lexicon. It also helps her to remember units of information via visualization. Strangely, Natalie, whose visual spatial memory is in the average range, has a small receptive vocabulary range and weak reading comprehension. It is suggested that Natalie's normative visual spatial memory cannot assist her in EFL reading or vocabulary since weak phonological working memory impairs Natalie's ability to acquire the low level reading skills needed in order to acquire an

orthographic lexicon. She therefore does not reach the level where visual spatial memory can facilitate memory for written words or parts of texts. Analysis of the data in terms of visual spatial memory also supports the notion of possible relationships amongst memory modality, the context of learning and the context of performance. Aya, whose visual spatial memory is above average, always prefers to study via the visual modality. It is suggested that since her context of learning is visual, her performance is better where the visual route can come into play, namely reading. Natalie, whose visual spatial memory is normative, prefers not to study via the visual route and therefore performance on tasks involving the visual modality such as reading and building a lexical orthography is weak.

As far as visual sequential memory is concerned, possible links are suggested between this kind of memory and orthographic knowledge as reflected in reading. Aya, whose visual sequential memory is very good, also has a very good orthographic knowledge whereas Natalie, whose visual sequential memory is weak, has very poor orthographic awareness and knowledge.

Analysis of the data vis-à-vis the central executive function suggests that the central executive function may be related to high level language skills in L2, but that there needs to be a minimum threshold level in L2 in order to enable the central executive to operate effectively. In this context as well, phonological working memory could be viewed as a prerequisite for the central executive function to come into play. In Aya's case, her high level reading skills are in line with her superior central executive function. Her difficulties with cloze tests and with oral productive skills could be due to information fed into the central executive by the phonological loop. In Natalie's case, better oral productive skills are in line with her normative central executive function. Her weak receptive skills, as seen in the reading, are not necessarily in contrast with her normative central executive skill, but may be due to her not reaching the threshold level of low level reading skills where the central executive can come into play. Her not reaching this threshold level may be due to her very weak phonological working memory skills, which once more evolve as a prerequisite, this time for the central executive function to come into play.

5.7 Aya: general summary of EFL profile vis-à-vis memory

Aya's overall EFL performance is good particularly as regards the receptive aspects

of language over the productive ones. Aya's vocabulary range in reading is high, but in speech it is only intermediate; her syntactic understanding is excellent, but her syntax in speech is not as good. Aya's overall reading and oral comprehension are excellent; however, her speech performance is less impressive.

Aya's high vocabulary range in the reading may be related to her adequate phonological working memory via decoding. This enables her to learn much of the vocabulary by lists as is often demanded in the EFL lessons. Aya's good reading vocabulary could also be linked to her good visual memory (spatial and sequential) which enables her to absorb orthographies and general configurations of words in English. Aya's visual strategies for new word learning may be connected to her wide range of reading vocabulary as well. Aya's less impressive vocabulary range in speech may be linked to this very strategy and to evidence suggesting that most of her new vocabulary learning is absorbed via the visual modality and that she does not consciously utilize phonological strategies or the auditory modality for new word learning. Aya's learning most of her new words in English by lists in a de-contextualized manner may cause lower availability of vocabulary for speech purposes. Aya's good receptive syntax may be related to her good phonological working memory and executive function. However, the fact that her productive syntax is less good may be explained by the fact that Aya learns most of her EFL visually and in quite a de-contextualized manner which may impair her ability to utilize English syntax orally as well. It seems that there is a link between the context of learning and the context of performance (modality-wise). A similar pattern was seen with Natalie whose erratic syntax was attributed to interference boosted by inappropriate teaching policy. Aya's excellent low level reading skills may be due to her phonological working memory which facilitates good decoding skills, and to her excellent visual spatial and visual sequential memory which enhances global word recognition. Her impressive higher level reading skills may be related to her good visual spatial memory via global word recognition and visual sequential memory via orthographic awareness, both of which enhance word recognition processes while reading. Aya's search reading may be enhanced by her good visual memory; her careful reading seems to be facilitated by her excellent central executive function which successfully integrates information from visual and phonological modalities. Aya's oral skills are a mixed bag. Her good comprehension may be due to her good receptive vocabulary and syntax as well as to her normative auditory verbal

recognition memory. Aya's less good speech may be related to her intermediate productive vocabulary and syntax and to the fact that of all memory factors, Aya's auditory verbal memory is the weakest (although still normative). It may be that because of this Aya prefers the visual route to learning; she does not expose herself much to the auditory aspects of the English language and does not intentionally learn via the auditory modality. This may somewhat slow down and damage retrieval processes in speech.

The next chapter presents a qualitative cross case analysis of the other four case studies. Each subject is analyzed according to parameters similar to those referred to in Natalie and Aya's within-case analyses which are used to shape discussion of the case studies. The first of these subjects to be analysed is Ori.

Chapter 6: Case Study 3 – Ori

6.1 Introduction to case 3 – Ori

In the previous chapters I have provided an in-depth analysis of two cases (Natalie and Aya) in light of the theoretical framework presented in chapter 2. In the following four chapters I examine findings derived from four more cases in an attempt to see whether the patterns found match those in the previous ones (Yin, 1984) or whether there is diversity which could lead to an additional "well grounded set of explanations." (Miles and Huberman, 1994, p. 208) I am aware of the fact that cross case analysis, by definition, cannot illuminate all aspects of each individual case. Taking this into consideration, I attempt to bring to the surface features which seem most relevant to the research.

Ori is a 17 year old girl studying in the last year of high school. At the end of the school year Ori is about to take the 4 point matriculation test in EFL (which is the second level of difficulty). Of the six subjects, Ori has the poorest achievements in EFL and was chosen as a case study in order to see whether the difficulties she encounters in studying English as a foreign language might be explained in terms of memory. When asked about EFL she pulls a face and says:

...I never really connected well to English; since a young age I hate; I never; I find it sort of difficult to = (Interview, 20, in Hebrew)

Her school achievements in EFL are very low and according to her teacher there is very little chance of her passing the matriculation test. In fact, the only reason for her agreeing to take part in this research was that I agreed to help her with her EFL studies after she had taken the research tests.

When asked about her history with EFL Ori says:

O: I started in 4th grade like everyone else until in the middle I quit and I was disconnected from English I quit *** (Interview, 16, in Hebrew)

Two things are worthwhile paying attention to in Ori's above statement. First, the fact that at the beginning things seemed to be fine and the difficulties started after approximately three years of studying. Second, Ori's use of the word *quit*. When I revisited both of these issues and asked why she thought the beginning was easier and what she meant by *quit*, Ori says:

O: ... cause it was the beginning; there were just small things (interview, 22, in Hebrew)

And

T: What do you mean when you say you quit?

O: I didn't connect with anything in the lessons; I don't understand anything. (Interview, 44-45, in Hebrew)

Apparently, when Ori says that she quit, she does not mean that she stopped attending EFL classes, but that she disconnected mentally from this subject. Ori sits in the lessons, never participates, is not even expected to do her homework and understands only partially what goes on in class. It seems that even her teacher has given up on her. In the following lines Ori describes a typical English lesson:

O: The teacher enters the class; starts speaking "Take out your homework", which I don't do because I can never succeed in preparing it. She is used to it. She knows I am not a part of the lesson. We do clozes; sometimes she reads a story from the literature to us and then she gives class work: to answer questions about the text. Again I fail to do this because I don't understand the text. That's it.

T: So English lessons are quite a nightmare for you.

O: Yes. Sometimes I do my own thing and then I sit and instead of listening to her, I look for words from the text in the dictionary and then I understand better. There will never be a situation where I will actually participate actively in English. (Interview, 165-167, in Hebrew)

Notwithstanding the fact that Ori was fine at the beginning and is now very weak in English, her performance in EFL is not a one-direction downward slope. From 4th grade, when she started studying English, to 9th grade there were fluctuations in her performance depending to a large extent on the teacher and the interaction between them. Ori's relationship with the teacher seems to play an important part in her motivation across all school subjects as will be shown later. In 9th grade two seemingly contrasting factors took place. On the one hand, the material in EFL started to get increasingly more difficult, but on the other hand this was exactly the stage when Ori was most motivated to get high grades. This was necessary in order to be accepted to the academic (as opposed to vocational) classes in high school. At this stage Ori and her family made an extra effort and managed to raise the money for private lessons in English. Ori managed to get into the first level academic class, but:

Then I stayed in the first level because I really wanted to get into the academic classes in high school (first level English was a prerequisite for this). At the

beginning it was O.K but then it started getting really really hard. In 10th grade it was too difficult and I couldn't stay in first level anymore. (Interview, 24, in Hebrew)

It seems that the private tutoring was enough to get her into the academic class, but at a certain stage it was not effective any more.

O: ... it didn't really help, I mean it helped, but not really. (Interview, 41, in Hebrew)

When asked to point to the most difficult aspect of EFL Ori says:

O: I think, lack of vocabulary. If I read a text, about 1/4 of the words I know. The rest I am not familiar with and then it drags onto English, the grammar because you have to be able to understand in order to cope with the. If you have to insert a verb in its correct form you have to understand the sentence. (Interview, 26, in Hebrew)

Ori does not see reading in EFL as difficult:

O: No, not difficult. There are words that are difficult, but generally it's O.K. (Interview, 35, in Hebrew)

This observation of hers is much too optimistic and is certainly not in line with her very weak performance on the reading comprehension tasks of the research tests.

When asked about her overall school performance Ori states:

O: O.K, not brilliant but O.K. (Interview, 51, in Hebrew)

The details of Ori's overall school profile show a pupil with middling school performance influenced to a large extent by her interaction with the teachers. Interestingly, Ori's best mark in the report card is Mathematics. Her final grade is 100%, although she only took the 3 point matriculation test (third level of difficulty). Ori reports that she was only 2 points short of being allowed to take the 4 point, but that here, also, she couldn't *"connect"* with the teacher and, therefore, didn't put much effort into studying. Ori is very much annoyed with her having to take the 3 point tests and says: *"Whereas I was always bad in English, I was always very good in Math"* (Interview, 59, in Hebrew). Ori's final grade in Hebrew language is 70%; in History she *"quit"* because she couldn't *"connect"* with the teacher. Ori actually stopped coming to History classes and took a summer course instead. (Here, when she says *"quit"* she actually means it in the literal sense of the word, as opposed to other times where her quitting is mental). Her final grade in the matriculation test after this course was 70%. In Bible lessons the picture was different. Her final grade is 65%. Here, Ori claims that the teacher gave her a good final mark, but that the Matriculation test was very difficult: "*all the pupils said it was a very difficult test.*" (Interview, 69, in Hebrew). (All final grades are calculated as the mathematical

average between a final grade given by the teacher and the grade in the matriculation test given by the Ministry of Education.)

My impression from this conversation with Ori is that her language skills in Hebrew (L1) are less than perfect. Ori's speech is characterized by simple vocabulary with a considerable amount of slang and it seems that she does not find it easy to express herself when she needs to convey more complicated ideas. In fact, the longer the utterance, the more difficult it becomes for her to stay on track. When asked about spelling mistakes Ori says that she used to have spelling mistakes in Hebrew for many years, but that nowadays it happens quite rarely and only in unfamiliar words. It must be said here that the fact that there are actually words in L1 that are unfamiliar could itself point to a problem. In addition, as opposed to English, Hebrew spelling is quite regular and therefore, even just a few spelling mistakes in the last year of high school could indicate difficulties in L1 language skills. It seems, therefore, that Ori's speech and writing in L1 are not strong.

6.2 Ori – test results

In the next section I will present a numerical overview of Ori's results on the different tests along with my interpretation of these results. Then I will analyse the data provided by Ori vis-à-vis the within-case analyses of Natalie and Aya in an attempt to support or modify former findings.

6.2.1 EFL oral and reading tests

Table 6.1: Ori - Dialogue

Communicative ability	**points**	**Accuracy**	**points**	**Final grade**
Comprehension of questions	50%	Incorrect/correct use of simple/complex language structures	40%	
Non-fluent/fluent Interaction	50%	Limited/basic/rich vocabulary	40%	
Gives single word/simple sentence/extended answers	40%	Poor/mostly comprehensive/comprehensible pronunciation	60%	
Total communicative ability	46.6%	Total accuracy	46.6%	**46.6%**

Table 6.1 points to weakness in all categories. Ori can hardly understand me as

interlocutor (in English); she gives very short, sometimes one word, reactions in a very hesitant manner; her syntax is very weak and her speech often consists of unconnected nouns and verbs. Ori's vocabulary is very limited and she often uses words in Hebrew. Her pronunciation is quite poor, sometimes to the extent of my having to guess what she meant.

Table 6.2: Ori - Role Play

Communicative ability	points	Accuracy	points	Final grade
Comprehension of questions	60%	Incorrect/correct use of simple/complex language structures	40%	
Non-fluent/fluent Interaction	60%	Limited/basic/rich vocabulary	40%	
Gives single word/simple sentence/extended answers	50%	Poor/mostly comprehensive/comprehensible pronunciation	60%	
Total communicative ability	56.6%	Total accuracy	46.6%	**51.6%**

Table 6.2 presents a picture very similar to table 6.1. Ori's communicative ability is somewhat better in the role play due to her better understanding of the questions and a slightly better fluency.

Table 6.3: Ori - EFL Reading

Name	Reading passage 1 (search reading)	Reading passage 2 (careful reading)	Reading passage 3 (mixed search and careful reading)
Ori	0%	0%	58.6%

Table 6.3 shows that Ori's overall reading comprehension is very weak. There is a difference, however, between the first two reading passages where she cannot answer any of the questions, and the third passage where her performance is somewhat better.

6.2.2 Memory tests

Table 6.4: Ori - RAVLT

RAVLT trial 1	RAVLT trial 2	RAVLT trial 3	RAVLT trial 4	RAVLT trial 5	RAVLT trial 6 (proactive interference)	RAVLT trial 7 (retroactive interference)	RAVLT trial 8 (LTM)	RAVLT trial 9 (recognition)
-1.05 (SD= 1.59)	-0.80 (SD= 2.13)	-0.86 (SD= 1.63)	-1 (SD= 1.54)	-2.79 (SD= 1.44)	-0.3 (SD= 1.80)	-1.89 (SD= 2.04)	-2.41 (SD= 2.11)	+0.32 (SD= 2.46)

Table 6.4 shows that Ori's overall performance on the auditory verbal memory test is not strong and although most of the results are within the standard deviation, they are in the lower range of normative performance. Ori's learning curve from trial 1 to 5 indicates that although there is a slight improvement between the first and second trial, the third, fourth and fifth trial slope downwards to the extent that her performance on trial 5 is much below the standard deviation. Such a pattern often points to difficulties in attention and concentration (and probably does not have to do with Ori's pattern of quitting). It also shows that additional exposure is not always helpful for Ori. Ori does not seem to be particularly prone to pro-active interference (trial 6). In fact, her performance on trial number 6 is better than on all former trials. She does, however, seem to be more prone to retroactive interference (trial 7); namely, exposure to new information reduces her ability to remember things she had been exposed to before. Ori's ability to remember auditory information for longer periods of time is weak as seen in trial 8; however, it seems that Ori's ability to remember when given auditory retrieval cues (trial 9) is slightly better than via the recall route.

Visual spatial memory

Table 6.5: Ori - RCFT

Copy trial	Time to copy (seconds)	RCFT immediate recall	RCFT delayed recall	RCFT recognition
Percentile= >16 normative	360 Percentile 11-16	37(% score=10) Rating=mildly impaired	37(%score=10) Rating=mildly impaired	22%score=<1) Rating=moderately to severely impaired
Qualitative features of performance: Ori worked on the copy trial very attentively and with great concentration. Ori copied the figure correctly, but she worked very slowly. In the recall trials Ori worked faster. She could recall the general configuration of the figure, but the difficulty was with the details. Some items were remembered correctly but placed wrongly in the figure and some mistakes had to do with directionality. Interestingly, there were details that Ori remembered in the delayed recall, but could not retrieve in the immediate recall and vice versa. Ori did not seem to be able to remember better with retrieval cues. Here the most confusing element was the element of directionality where Ori thought that the element in the original figure appeared in the opposite direction.				

Table 6.5 shows that, on the whole, Ori's visual spatial memory is weak. The quality of this copy trial suggests that Ori 's visual perceptual and visuo-motor integration skills are intact. Ori's time to copy, which is between 11 and 16 percentile, indicates a somewhat slow speed of cognitive processing; her weak performance on the immediate and delayed recall trials indicates reduced visuo-spatial recall ability and her very weak performance on the recognition trial shows that the ability to retrieve visuo-spatial material when given retrieval keys does not improve. On the contrary, it is even worse. Ori's overall memory profile, as seen in the RCFT test, points to a pattern of difficulty in storing visual spatial information.

Visual sequential memory, Central executive functions and phonological working memory

Table 6.6: Ori - DTLA-A - design Sequences, Active Memory - Complementing Words, Shatil Syllable Range Test

DTLA-A Design Sequences	11(% score=63) rating= average
Active Memory-complementing words	-1.64 Rating=below average
Shatil syllable Range Test	Low

Table 6.6 indicates that Ori's visual sequential memory is normative but her central executive skills and her phonological working memory skills are weak.

6.3 Ori – Data analysis vis-à-vis Aya and Natalie

"It's possible and usually desirable to combine or integrate case-oriented and variable oriented approaches." (Miles and Huberman, 1994, p. 176)

In the following sections I present a qualitative analysis of the data provided by Ori's EFL tests, whilst looking at the patterns found in the within case analysis of Natalie and Aya's tests, in order to illuminate similarities and explain differences across and between cases. In doing so, I use key variables relating to memory which emerge from the conceptual framework underlying the theoretical background to this research. The first variable discussed is phonological working memory along with auditory/phonological processing.

6.3.1 Phonological memory and phonological working memory along with auditory/phonological processing and EFL reading

Research has shown that accurate phonological processing of speech sounds, as well as phonological working memory, is related to reading in L1 and L2 (see section 2.3.4). In addition, the qualitative analysis of this research data provided by Natalie and Aya is in line with former research and points to possible aspects of reading which could be related to phonological processing and the phonological working memory. In what follows I point to aspects in Ori's reading which might be explained by strong or weak phonological processing and phonological working memory skills and try to discern whether these findings confirm or challenge my findings in connection with Natalie and Aya.

In order to provide a clear basis for analysis I present the results of the phonological working memory test and EFL reading tests of Ori (case 3) along with those of Natalie (case 1) and Aya (case 2) who were chosen as cases for the within case analysis.

Table 6.7: Ori, Natalie and Aya - Shatil Syllable Range Test

Ori	Natalie	Aya
Low	Low	high

Table 6.7 shows that both Ori and Natalie have a significant weakness in phonological working memory, especially when taking into consideration the fact that this test was originally devised for much younger children (see section 3.11.5).

Table 6.8: Ori, Natalie and Aya - EFL Reading

Name	Reading passage 1 (search reading)	Reading passage 2 (careful reading)	Reading passage 3 (mixed search and careful reading)
Ori	0%	0%	58.6%
Natalie	52.7%	42%	54.3%
Aya	100%	100%	100%

Table 6.8 shows that whereas Aya's reading in English at matriculation level is very good, Ori's reading, at this level, like Natalie's is very weak. It is worthwhile noticing the gap within Ori's performance between the first two reading passages and the third one. I would like to suggest that the main reason for this difference is in the nature of the questions (rather than in the reading passage itself) and has to do with central executive skills (see section 7.3.1, 7.3.7)

The following discussion relates mainly to Ori and Natalie since Aya does not have any visible difficulties in the reading.

Lower level reading skills were seen in the literature to be affected by phonological working memory via decoding (see section 2.3.4). Like Natalie (see section 4.3) Ori seems to be aware of her decoding difficulties and when asked to elaborate on this she says:

O: O.K but there are things that I can't pronounce. I can read, but not pronounce it correctly.

T: You mean you don't read the word correctly. Do you refer to words than don't look like what they sound?

O: Yes. They are not supposed to sound like they do (meaning non-phonetic words).

T: Words like 'dangerous', for instance?

O: yes, exactly. I can read it 'dunggerus'.

T: Even if you know the word 'dangerous', is it possible that when you see it written, you will read it as 'dunggerus'?

O: Yes. And then I don't understand what it is. (Interview, 141-147, in Hebrew)

Decoding

A closer look at the type of decoding difficulties reveals both similarities and some differences between Ori and Natalie's decoding errors. It is my suggestion that the origin of some of their similar errors is erratic auditory/phonological processing and some originate from weak phonological working memory. In addition, erratic

auditory/phonological processing in itself seems to have an impact on phonological working memory.

Erratic auditory/phonological processing seems to contribute to Natalie's erratically reading *technological adventure* instead of *Technological advances* (Reading passage 2. oral protocols–23-24) and Ori's reading *"What two tink s"* instead of *"What two things..."* (Reading passage 1. oral protocols - 72). In both cases erratic decoding affects reading comprehension and Ori, who reads *tink s,* now understands the question to be related to thoughts.

How are these errors related to erratic processing of speech sounds? It is possible that Natalie's decoding error stems from her unstable processing of the /ɑ:/and /e/ sounds; her replacing the /ɑ:/ sound by the /e/ sound and then turning to guesswork (see section 4.3). Likewise, Ori's decoding error could stem from her not distinguishing between the sounds of /θ/ and /t/ and between the sounds /g/ and /k/. Interestingly, Hebrew (the case studies' L1) does not have an /ɑ:/sound, or a /θ/ sound, a fact which could provide a partial explanation to the difficulty.

Erratic processing of speech sounds could also be the underlying reason for unnecessarily adding aspiration to vowel sounds. This was evident in Natalie's reading (as discussed in section 4.3) and is even more pronounced in Ori's reading as presented below:

O: <Hands hoff>

T: (corrects her): "Hands off"

O: (Doesn't seem to take in the correction and in the following doesn't pay any attention to punctuation.) <Hands Hoff no hands won.>(Reading passage 1. oral protocols, 64-66)

And also:

O: <They hall had> =

T: all, not hall=

O: <They hall>=

T: all

O: <all ad the same rules keep your voice down and your hand in your poocket.>(Reading passage 1. oral protocols, 106-110)

In the example above, not only does Ori add aspiration to the vowels, but she is also unable to correct herself when I say the word and ask her to repeat. When she

eventually succeeds in taking the aspiration off the word *all* she automatically and wrongly applies it to the word *had* and reads it as *ad.*

It seems, therefore, that erratic phonological processing inhibits the stabilization of L2 sound representations. This, in turn, interrupts a consistent sound-symbol correlation which underlies decoding processes.

Decoding difficulties might also be related to reduced vocabulary learning as is discussed later in this chapter. The above findings from Ori (case 3) seem to support the findings which emerged from Natalie's (case 1) data on this issue.

Strategy

Although initially strategy was not defined as a construct to be related to in this thesis, the qualitative aspects of the research surfaced strategy as a relevant factor. In the context of this study, the term strategy is used to describe the learners' conscious utilization of processes and actions in order to tackle tasks successfully. Strategizing may be related to learning, reading and remembering as well as to a variety of other cognitive activities (Gass and Selinker 2001). The case studies' strategizing is surfaced in their oral protocols and their reading aloud. Their strategies are not measured but described as part of the qualitative analysis of the data.

Unlike Natalie, Ori does not engage in a self-mediated decoding technique to facilitate reading. By not using such a technique Ori does not benefit from helping the sounds anchor in phonological memory as a basis for further processing. Instead, she either throws a wild guess, or continues to decode erratically as she does when she reads */ekspera:es/* instead of *experiences.* (Reading passage 1. oral protocols, 124, read in English). Natalie's benefit from this strategy is limited due to reduced reading speed. Ori does not benefit from her slightly faster pace because the outcome of her erratic decoding is meaningless reading which does not lead to comprehension. Ori's strategy being different from that of Natalie points to the fact that erratic decoding does not always result in similar compensatory strategies.

Inner voice

There is one interesting respect in which Ori's reading is very much like Natalie's. Ori, like Natalie, seems to have a reduced ability to hear, or be tuned to, her own internal voice while reading (for Natalie see section 4.4). The fact that two of the

case studies whose EFL reading is far less than satisfactory manifest this similar and puzzling phenomenon led me to introduce the term **inner voice** in conjunction to phonological working memory. At this point I would like to make it clear that both the term and the idea of an internal form of speech has been introduced in different contexts and different disciplines as far back as the 19th century. The German Philosopher Husserl, who is known as the founder of phenomenology, claimed that inner speech brings about an existential state of consciousness (Husserl, 2001 [1900]). The Soviet psychologist Vygotzky used the term inner speech as he maintained that the constitution of an inner life depends on internalization of speech (Vigotzky, 1962 [1934]). Inner speech has also been perceived as a state of self awareness (Morian and Everett, 1990). I, however, use the concept in a very different respect and look at it in a view of how language processing works. Inner voice, as it is used in the context of my research (here vis-a-vis reading), is the reader's ability to hear inside his/her head what has been read and hold it for split seconds in memory in order to, meaningfully, combine it with on-coming information. It seems logical to assume that this kind of ability is a prerequisite for meaningful reading; otherwise letters could not be assembled into words, words would not form meaningful sentences and sentences could not express ideas. Reduced inner voice may be the reason why Natalie cannot comprehend a sentence, or idea, even when given word meanings, and why she treats words as obstacles rather than stepping stones to meaningful reading (See section 4.4).

Ori does not seem to have an inner voice when reading either. Just as Natalie reads *high teach* instead of *high tech* (4.3) Ori reads parts of a sentence as if they are completely disconnected items:

O: <A desade> (stressing the /sade/)=
T: Decade. What's /decade/?
O: I don't know.
T: Gives her the word.
O:<visiting a children eh children's mooessem> =
T: = museum
O: <was not very different from visiting any other muesment>(Reading passage 1, Oral protocols-92-98-in Hebrew)

When Ori is corrected and told how to pronounce a word, she does not repeat it in order to strengthen its sound and stabilize it for later integration. When I correct her

reading of the word *museum* (which is a cognate- the same in L1), not only does she not repeat it after me, she actually reads it differently and wrongly as *muesment* a few words later. It may be that both Ori and Natalie do not repeat the words because, subconsciously, they do not feel that the sound representations will register. This is obviously a vicious circle because by not repeating they indeed reduce the chances of remembering. Ori's inability to remember any echo of the word *museum* after approximately two seconds may very well be indicative of her poor phonological working memory, even more so taking into account the fact that the context of the two phrases is similar. These findings seem to be in line with findings from Natalie's data on the issue of phonological working memory and lack of inner voice in the reading process.

The view of an inner voice as a voice which a person hears and hangs on to for integration with oncoming phonological data means that there is a relationship between phonological working memory and inner voice because phonological data held in memory for seconds for further processing is held in phonological working memory. The relationships between reading, inner voice, and phonological working memory as described above may provide a qualitative explanation for the well established quantitative relationships between phonological working memory and reading in L1 and L2 (See section 2.3)

Reading/language in L1

Weak phonological working memory has been related to difficulties in L1 language skills in general and L1 reading skills in particular. It has been shown in section 4.3 that Natalie's L1 reading comprehension is problematic. Ori does not point to specific difficulties in L1; however, her overall school record could be indicative of a problem. Ori's final grade in Hebrew language studies is 70% which is unimpressive. The very fact that there are, as we saw earlier, words in L1 that Ori is not familiar with, and that in unfamiliar words there is a possibility of her committing spelling mistakes, suggests less than perfect language skills in L1.These findings as to possible relationships between weak phonological working memory and difficulties in some L1 language skills confirm findings from Natalie's data.

Foreign language aptitude

An additional factor worth noticing in Ori's school record is her final grade in Bible studies which is 65%. Bible studies (in Israel) have much in common with foreign language studies since biblical Hebrew is quite different from the modern Hebrew language in everyday use. Moreover, some of the tests administered at matriculation level are actually unseen passages in biblical Hebrew. Therefore, such a low grade in both EFL and Bible studies could point to an overall difficulty with non-native languages. This kind of difficulty has also been seen to be related to weak phonological working memory (see section 2.3).

Phonological working memory's relationships with lower/higher level reading skills in L1/L2

The suggestion that there may be cases where weak phonological working memory starts to affect L2 from the lowest level reading skills but could become apparent in L1 only in the higher level reading skills seems to be confirmed by Ori as well. When asked about L1 literacy acquisition, Ori claims that she acquired L1 reading skills at a normative pace (see interview, 76- 79 and also 138-139, in Hebrew). The fact that she was never referred for assessment of specific learning difficulties seems to confirm this. It seems, therefore, that Ori's weak phonological working memory is not related to her ability to acquire low level reading skills in L1, but may be related to her difficulties in acquiring those skills in L2 (English in this case) and may also have to do with some of her mediocre achievements in subjects which require advanced high level reading skills in her L1.

Summary

So far analysis of the reading related data provided by Ori strengthens findings from Natalie in the following issues:

1. Weak auditory and phonological processing resulting in unstable representations of speech sounds may be an underlying reason for erratic decoding resulting in L2 reading difficulties.

2. Weak phonological working memory might be related to reduced ability to utilize an inner voice while reading, resulting in reduced semantic connectivity and reduced

reading comprehension.

3. Weak phonological working memory may be related to L2 reading at the basic low level reading skills, whereas difficulties in L1 may surface only with the higher level reading skills.

Analysis of the data points to differences between the two cases on strategy issues.

Although both Natalie and Ori were both seen to have weak phonological working memory along with weak auditory and phonological processing, and both case studies were seen to have similar reading difficulties, each developed different reading strategies which do not have much in common. Similar difficulties are thus not seen to lead to similar strategies.

6.3.2 Phonological memory and phonological working memory along with auditory/phonological processing and EFL vocabulary

Research has also found links between phonological working memory/phonological processing and vocabulary acquisition in L1 and in L2 (see section 2.3.1).

In order to provide a clear basis for analysis and comparison of vocabulary knowledge between the cases, I present test results showing vocabulary scores in the oral proficiency tests and an estimation of vocabulary knowledge in the reading comprehension passages based on the case studies' oral protocols.

Table 6.9: Ori, Natalie and Aya - vocabulary knowledge

Vocabulary knowledge	Oral dialogue	Oral role play	Reading passages
Ori	40%	40%	Very low
Natalie	65%	65%	low
Aya	75%	75%	Very high

Table 6.9 presents an estimation of vocabulary knowledge based on the oral tests and oral protocols following the reading tests. The table shows that the Ori has the weakest vocabulary both in her oral performance and when asked for word meanings during the oral protocols following the reading comprehension tests. In fact, Ori is not familiar with vocabulary items above the very basic level of sixth grade. Natalie's vocabulary is not strong either, but it is better than Ori's. Natalie's vocabulary knowledge in speech is better than that in the reading comprehension passages,

presumably due to the fact that although her vocabulary range is not big, it still enables her to converse in English. The reading passages, however, use many words which are above the range of her knowledge and expose her weakness. Aya's knowledge of vocabulary in the reading passages is very high. However, as we have seen, when it comes to speaking Aya generally uses a much smaller vocabulary range, a fact which we have noted could point to difficulties in on-line retrieval rather than lack of vocabulary knowledge.

Ori, like Natalie, points to vocabulary as a substantial difficulty in her EFL studies. When asked what the most difficult aspect of EFL is for her she says:

"*I think, lack of vocabulary. If I read a text, about 1/4 of the words I know. The rest I am not familiar with...*"(Interview, 26, in Hebrew).

Could this difficulty to learn L2 vocabulary be related to auditory/phonological processing and phonological working memory? Ori claims that at the beginning stages of EFL studies she did not find it difficult because... *there were just small things...* (Interview, 22, in Hebrew). This statement is interesting in terms of the notion of inner voice which I suggested in the context of reading. Vocabulary-wise *small things* may refer to simple short words which are often learnt as individual items. As EFL studies progress, students are required to learn longer words, word sequences and chunks, and their familiarity with word collocations serves to promote vocabulary knowledge (See section 2.2). It may be that in this stage of the learning the existence of such an inner voice would facilitate vocabulary learning. According to this explanation, a reduced inner voice may be the reason for Ori's weak vocabulary knowledge. The notion of inner voice would then be relevant to vocabulary knowledge as well as to reading. A view of phonological memory as being related to the theorised notion of inner voice (See section 6.3.1) implies that the difficulty to learn vocabulary in a second language may be connected to phonological memory.

Ori's difficulty to learn new words in English could also be connected to phonological memory via decoding. Unfortunately, as it is today, a large percentage of new L2 vocabulary learning is done via lists of new words, as Ori complains: "*...we now had a test in English and the teacher gave us 62 new words in English to learn. We had to learn their meanings.*" (Interview, 89, in Hebrew)

When this is the case, learning many new words in mass practice would depend to a

large extent on the learner's ability to decode unfamiliar words correctly in order to facilitate the storage/retrieval process. If weak phonological skills impair decoding ability as proposed in section 4.3, this weakness could also be an underlying reason for difficulties in L2 vocabulary acquisition. This being the case, both Ori and Natalie's weak vocabulary in English could be related to weak phonological skills.

Words as unstable sounds for storage and retrieval

It has been seen before that weak auditory/phonological processing seems to affect Natalie's ability to retrieve words in speech as well when she says */ba***/* for bath (Role play, 58, in English) or */heal healt***/ for healed* (Role play, 32, in English). Likewise, Ori's difficulties with the word *museum* (See section 6.3.1) suggest

that the ability to register the accurate sound representations of new L2 vocabulary items in the first place may determine the ability to retrieve those words for later use.

Although both case studies have difficulties with acquiring new L2 vocabulary items, possibly due to weak phonological skills, the strategies they develop to overcome this difficulty are very different. Natalie develops strategies which assist her phonological memory by dividing the words into syllables, sub-vocalizing and even vocalizing (Interview, 61-88, in Hebrew) (see section 6.3.1), whereas Ori attempts to remember visual aspects of the word:

"I recognize words by the structure of the word. For example, if there is a long word, I remember its beginning and that's how I remember." (Interview, 89, in Hebrew)

When there are many words with the same memorized beginning, she doesn't look for alternative ways:

T: But then what happens if there are other words with the same beginning like 'comprehension', for example?

O: So I get mixed up. (Interview, 98-99, in Hebrew)

It seems that Natalie's phonological strategies yield better results than Ori's visual ones since her vocabulary knowledge is better than Ori's. Interestingly, Natalie's phonological strategies for vocabulary learning are more helpful in the oral skills than in the reading, but Ori's visual route does not seem to be helpful in reading via the word recognition route. This may be due to the fact that her visual memory is also weak and she is only able to remember small bits at the beginnings of words rather than whole units of word configurations.

In addition, Ori's ultimate solution of *"Then I quit"* (Interview, 43, in Hebrew) which evolves as a recurring motive in her learning is not very helpful as a coping strategy.

The reasons for strategy choice as well as for one strategy yielding better results than the other are uncertain. They may have to do with the fact that each case study turns to what she believes to be a stronger memory route for her (Natalie seems to be helped by sound contextualization – see section 4.3), or it may be that, on the whole, the phonological route is a better choice for vocabulary learning. Whatever the reason, once more we see that similar difficulties lead to very different learning strategies with varying degree of success.

Context of learning - context of performance

The suggestion (in sections 4.7 and 5.7), that there are links between the context of learning and the context of performance cannot be strengthened or weakened by Ori's data. Ori uses a visual route for vocabulary learning, but does so in a partial/ineffective way that does not even provide a visual basis for storage, let alone for retrieval.

Memory literature points to word length and phonological similarity as factors which affect phonological working memory. Natalie's EFL vocabulary knowledge is affected by phonological similarity (see section 2.1.1). Ori's EFL vocabulary seems to be related to both word length and to phonological similarity:

T: So is the length of the word a factor?
O: Yes. (Interview, 128-129, in Hebrew)

O: You mean "hair"?
T: No, I mean 'air' (I give the Hebrew word).
O: 'air', 'hair'? No, I don't think there's a difference. (Interview, 133-135, in Hebrew)

When Ori herself speaks, phonological similarity between *after* and *other* results in her using the wrong word:

Yes. In the day I eh I sleep (pause) other the school. (meaning after the school) Other eh I study. (Dialogue, 98, in English)

It seems, therefore, that findings from Ori (case 3) confirm findings from Natalie (case 1) which show that phonological similarity may affect L2 vocabulary learning.

Ori's ability to learn new L2 vocabulary items seems to be influenced by word length as well. Since both factors have been pointed to as affecting phonological working memory (see section 2.1.1), L2 vocabulary knowledge also seems to be linked to phonological working memory.

Summary

So far analysis of the vocabulary related data provided by Ori (case 3), and Natalie (case 1) vis-à-vis phonological working memory along with auditory/phonological processing leads to the following conclusions:

- In both cases weak auditory/phonological processing and weak phonological working memory is thought to be related to new L2 vocabulary via decoding ability due to the school policy of teaching vocabulary through word lists.
- In both cases unstable representations of L2 sounds are seen to contribute to difficulties in storage and retrieval of new words.
- In both cases, factors such as phonological similarity and/or word length, which are believed to influence phonological working memory, are seen to affect vocabulary knowledge as well, thus creating a link between vocabulary knowledge and the phonological working memory.

Ori (case 3) differs greatly from Natalie (case 1) on strategy issues which confirms the previous conclusion that similar difficulties do not necessarily result in similar strategies. Reasons for strategy choice and strategy failure or success remain open at this point. They will be partially referred to later in this research and are indeed suggested as issues for further research.

6.3.3 Phonological working memory and EFL speech performance

To the best of my knowledge, research to date has not found links between phonological working memory and speech in L2. In order to provide a clear basis for analysis and comparison of speech performance between the cases, I present test results showing the scores of the three cases on the chosen parameters in the oral proficiency tests.

Table 6.10: Ori, Natalie and Aya - Dialogue

Communicative ability	name	points	Accuracy	name	points	Final grade
Comprehension of questions	Ori	50%	Incorrect/correct use of simple/complex language structures	Ori	40%	
	Natalie	95%		Natalie	50%	
	Aya	85%		Aya	75%	
Non-fluent/fluent Interaction	Ori	50%	Limited/basic/rich vocabulary	Ori	40%	
	Natalie	95%		Natalie	65%	
	Aya	65%		Aya	75%	
Gives single word/simple sentence/ extended answers	Ori	40%	Poor/mostly comprehensive/ comprehensible pronunciation	Ori	60%	
	Natalie	85%		Natalie	80%	
	Aya	75%		Aya	80%	
Total communicative ability	Ori	46.6%	Total accuracy	Ori	46.6%	**46.6%**
	Natalie	91.6%		Natalie	65%	**78.3%**
	Aya	75%		Aya	76.6%	**75.8%**

Table 6.10 provides a comparison between Ori's speech performance and that of Natalie and Aya. All aspects of Ori's speech are very weak. She can hardly understand her interlocutor and her own speech is so erratic that communication hardly takes place. Both Natalie and Aya's speech is much better than Ori's. That said, table 6.10 shows that both Ori and Natalie have weak syntax, though Ori's syntax is somewhat weaker than Natalie's and a qualitative analysis of Ori's speech data reveals very different speech patterns: whereas Natalie's syntactic mistakes seem to stem from not remembering exactly where to apply certain syntactic rules along with not being able to integrate various elements of syntactic knowledge in order to produce accurate speech, Ori's mistakes seem to stem from lack of basic knowledge. Ori almost automatically adds */ing/* to verbs regardless of tense (see dialogue 14, 42, 58, 64, in English), and seems to think that all negation requires */didn't/* regardless of tense (see dialogue 40, 46, 104, and role play 28, 58, 60, in English). Ori's lack of vocabulary, together with her haphazard syntax, result in fragmented speech which is often not communicative.

The research question looks at possible relationships amongst phonological processing, phonological working memory and performance in EFL. The numerical

table presented above, along with a qualitative analysis of the data, indicates that notwithstanding the fact that phonological working memory may impact speech through vocabulary knowledge, once a basic level of vocabulary has been mastered it may not have a big impact on speech. Ori who has very weak phonological working memory has great difficulty in speech, but then Aya, who does not have difficulties with phonological working memory, also manifests very unimpressive speech, whereas Natalie speaks fluently and very communicatively notwithstanding weakness in phonological working memory.

6.3.4 Visual memory and EFL reading

Research has shown that there is a relationship between spatial perception and reading via the direct lexical route (Mendez, in Pickering, 2001a) and between reading and the ability to store and process passive visual and visuo-spatial information (Kyttala, 2008).

In order to provide a clear basis for analysis I present results of both visual memory tests of Ori (case 3) along with those of Natalie (case 1) and Aya (case 2) who were chosen as cases for the within case analysis. Visual spatial memory was checked by the Rey Complex Figure Test.

Table 6.11: Ori, Aya and Natalie - RCFT

	Copy trial	Time to copy (seconds)	RCFT immediate recall	RCFT delayed recall	RCFT recognition
Ori	Percentile= >16 normative	360 Percentile 11-16	37(% score=10) Rating=mildly impaired	37(%score=10) Rating=mildly impaired	22%score=<1) Rating=moderately to severely impaired
Aya	Percentile= >16 normative	420 Percentile Between 2-5 Low	61 (% score=88) Rating=above average	60 (%score=84) Rating=above average	47(%score=38) Rating=average
Natalie	Percentile= 11-16 Below average	125 Percentile>16 normative	42 (% score=21) Rating=below average	45 (%score=31) Rating=average	54(%score=66) Rating=average

(For qualitative features of performance see tables 4.5, 5.5, 6.5)

Table 6.11 shows that of the three case-studies, Ori's visual memory is the worst. All phases of Ori's visual memory are weak and, as opposed to the other case-studies, there does not seem to be any compensatory factor she can lean on within visual spatial memory.

Table 6.12: Ori, Aya and Natalie - DTLA-A - Design Sequences

DTLA-A Design Sequences	
Ori	11(% score=63) rating= average
Aya	17(% score=98) rating=very superior
Natalie	5 (% score=5) rating=poor

Table 6.12 shows that Ori's visual sequential memory is better than her visual spatial memory and is rated as average. Her visual sequential memory is much lower than Aya's, but much better than Natalie's.

Table 6.13: Ori Natalie and Aya - EFL Reading

Name	Reading passage 1 (search reading)	Reading passage 2 (careful reading)	Reading passage 3 (mixed search and careful reading)
Ori	0%	0%	58.6%
Aya	100%	100%	100%
Natalie	52.7%	42%	54.3%

Reading

In section 4.5 above, visual sequential memory was related to orthographic awareness which accounts for positive recognition of familiar words as well as negative recognition, namely, not being able to rule out an illogical choice of word. A link between visual spatial-sequential memory, orthographic awareness and word recognition in reading was suggested and supported by the data provided by Aya and Natalie: Aya, who has good visual sequential memory, has good word recognition ability, whereas Natalie, who has weak visual sequential memory, has weak word recognition ability (both positive and negative). When looking at Ori's data it seems, at first, that she does not fit into this theory, since, although she has normative visual sequential memory, her ability to recognize words which are both familiar to her and are frequently used is poor. Ori herself points to this when she refers to her inability to recognize words in a text even when their spoken form is familiar to her (see 6.3.1)

This inability to recognize familiar words in a text seems to be incompatible with Ori's normative visual sequential memory. This could suggest that either visual sequential memory is not related to this ability, which is not very likely, or that there is an additional explanation.

One such explanation for this could concern Ori's weak phonological working memory. It could be that although Ori's visual spatial-sequential memory is normative, her weak phonological working memory serves as an inhibiting factor preventing visual memory from coming into play by not providing visual memory with anything productive to hook onto in the process of word recognition. This would be in line with reading models which claim that in the course of meaningful reading, top down and bottom up processes operate in a simultaneous manner (see section 2.3.4). It would also be in line with Pavio, (1971, in Logie, 1995) who claims that retention of information is better when both visual and phonological representations are available. When Ori's starts reading the word *museum* as *muss* or *moos* (Reading passage 1, 16, in English), erratic decoding at the onset might lessen, confuse and interfere with visual memory and not allow her to depend on this memory with any great confidence.

In addition, there may be a further explanation: Ori's inability to utilize normative visual sequential memory in word recognition processes may also be explained in terms of long-term visuo-spatial knowledge (Pickering, 2001). Pickering maintains that visual information which has become an integral part of one's overall world knowledge and is readily recognized as familiar patterns has a better retention rate in visual spatial working memory tasks. In the context of reading, familiar patterns which are part of one's overall world knowledge may be familiar patterns which carry semantic meaning, namely words which are accessed globally via the direct route while reading. For example, if one is shown these figures /בית/ and told that they mean */house/* in Hebrew, it seems logical to assume that it will be easier to recognize them when seen again than if there were no semantic label to go with the shapes. How does this relate to Ori? If we take into consideration that Ori's knowledge of the spoken form of words in English is very poor and that, to a large extent, the sound representations of the words she encounters while reading are unfamiliar to her, it may be much more difficult for these patterns to become familiar. It may be that lack of spoken representations of L2 words prevents Ori's normative visual sequential memory from coming into play in word recognition processes whilst reading. If this is the case, Ori's normative visual sequential memory is not necessarily in contrast to her weak L2 word recognition and orthographic awareness while reading.

In light of these explanations, it is proposed that Ori's visual sequential memory cannot be activated efficiently in L2 reading both due to weak phonological working memory which does not provide visual sequential memory with any phonological hooks to hold on to, and due to lack of semantic knowledge which does not provide any semantic hooks to hold on to.

Word recognition processes vis-à-vis visual spatial memory

As opposed to visual spatial-sequential memory, which is thought to account for the ability to remember sequences of visual information, visual spatial memory, as used here, is thought to account for the ability to remember geometric shapes as well as where and how they are located in a given space. From the point of view of reading, the ability to recognize an overall configuration of a word may be attributed to this type of memory. In an extreme example, a person who sees the word *presumptuous*, for example, would not think that it looks anything like the word *on* (even if he/she is not familiar with the alphabet or with all sound symbol correlations) and recognize it as such (see section 2.3.4). When Ori reads *no* for *now* (Reading passage 1, 50, oral protocols in English) or *one* for *on* (Reading passage 1, 66, oral protocols in English), it seems that she cannot recognize the overall word configuration (notwithstanding the fact that both words are very common and probably familiar to her). Although the examples from Ori's reading are not as extreme as the example I give above, it looks as if the whole word configuration is not stored in memory for her to recognize when seen. This could be attributed to her weak visual spatial memory. This finding is in line with research which points to relationships between spatial perception and reading via the direct lexical route (Mendez, in Pickering, 2001a). It also supports previous findings from Aya who has good visual spatial memory and also good word recognition ability (see section 5.5). Where visual spatial memory is concerned, Natalie is the one who does not completely fit into the theory in that her normative visual spatial memory, did not seem to help her overall word recognition ability which is weak. It was suggested (see section 4.5) that Natalie's inability to utilize her better visual spatial memory for word recognition could also be due to her weak phonological working memory which does not provide a sound basis for visual memory to operate on. This is also in line with Logie (1995) who maintains that generation of an image in visual spatial working memory needs access to long-term memory representations other than the sheer visual image. It may

be that in the context of reading these properties have to do with the phonological representation of the word. This approach is somewhat different from that of Pickering (2001) who maintains that in contrast to young children who tend to encode visually presented material visually, older children are able to use both phonological and visual codes when dealing with visually presented material. The difference in approach may be due both to the fact that the visually presented material is foreign language script which might not always carry semantic meaning, and to the element of individual differences (other than age) in the ability to utilize phonological codes. Similar to Ori's inability to utilize normative visuo-spatial sequential memory in word recognition processes while reading, Natalie's inability to utilize normative visuo-spatial memory in word recognition could also be explained in terms of long term visuo-spatial knowledge (Pickering, 2001). It may be that here, as well, reduced knowledge of the spoken forms of L2 words reduces the chance of whole word configurations becoming familiar patterns stored in long-term memory due to the fact that they lack semantic properties which could facilitate these processes.

Strategy

Analysis of Ori's strategy relates to vocabulary learning strategies alone, since her reading is so poor that she very seldom gets beyond the level of word reading. It was seen that, on the whole, Ori prefers visual strategies to phonological strategies in order to learn new words in English..

When asked how she studies vocabulary in English, Ori says:

I recognize words by the structure of the word. For example, if there is a long word, I remember its beginning and that's how I remember. That's my way. (Interview, 89, in Hebrew)

In terms of memory, what Ori seems to do is to get a mental picture of the word and then try to recognize it when it appears in a written text. However, Ori's visual memory does not seem capable of taking in big chunks of information and, therefore, when a word is too long for her to remember, she tries to remember at least the beginning. Since this seemed to be such a strange strategy I wanted to make sure, and asked her again if she doesn't even attempt to grasp the whole word. To this Ori says: *"I learn the whole word, but I don't remember the whole word."* (Interview, 103, in Hebrew)

Later in the interview, Ori relates to word length as well as her ability to pronounce a word as a factor in retention ability:

O: Less complicated words, sort of. It also depends on how the word is read. If I can't read the word correctly, it's more difficult for me to learn.

T: So is the length of the word a factor?

O: Yes. (Interview, 127-129, in Hebrew)

From the excerpt above it seems that Ori does not exclude the phonological representations of new words. Rather than that, it seems that Ori is not helped by the spoken form of new words when she cannot decode them. Since Ori's decoding skills are quite poor, there are many instances where she cannot read words (as seen in her oral protocols of the reading passages). When this is the case, Ori turns to visual strategies for new word learning. However, this strategy does not seem to be very helpful either. Ori is unable to take in longer stretches of visual information and it seems that she cannot take in word configuration when it is longer and has more complicated features. This may be due to her weak visual spatial memory. In terms of memory, Ori's weak visual spatial memory coupled with her weak phonological working memory render new word learning in L2 a very difficult task. The following excerpt shows the extent of inefficiency in Ori's learning new words in English:

T: Let's say the word 'composition'.

O: Ye, composition.

T: So how do you remember it?

O: I remember the beginning eh com

T: So you remember the 'com'?

O: Ye. 'com'

T: But then what happens if there are other words with the same beginning like 'comprehension', for example?

O: So I get mixed up. (Interview, 92-99, in Hebrew)

When asked whether she tries to put the words in any kind of context Ori answers: "*No, just like that.*" (Interview, 118-119, in Hebrew)

When Ori elaborates on her way of learning, we see how inefficient it is: it is disconnected from the rest of its visual environment because she cannot remember more; it is disconnected from its phonological match because she cannot decode accurately and it is also disconnected from its meaning because there are so many possibilities for confusion. It should be noted that while this is a very inefficient way

for learning vocabulary in any language, it is particularly poor for the English language which uses affixation in morphology, meaning that many completely different words begin with the same affix.

Surprisingly, Ori can sometimes, probably after putting in much effort, remember words in the shorter term for a few hours or a day, but not for more than that:

O: But sometimes we have to study a set of words for a test and I study and do well, and then some of those words appear later in another test as well; it happened not long ago and I didn't remember them very well. It didn't go as well as in the former test.

T: So you say that you remembered them well in the short term, but not permanently. (Interview, 115-116, in Hebrew)

To summarize Ori's strategy, the only way she learns new words in L2 is via word lists according to school requirements. In her attempt to learn these new words, Ori abandons phonological strategies due to weak decoding ability and turns to visual strategies which are not very effective. In instances where Ori does manage to remember some new words, it is only for short periods of time. This could be because, on the whole, visual strategies are less efficient for learning new words, but the following may also be factors.

Ori tries to learn visually, but her visual spatial memory is weak.

Ori cannot utilize a full enough phonological representation of the word while learning, which might otherwise have helped visual memory.

Ori studies new words in English in a completely de-contextualized manner.

Aya, like Ori, utilizes more visual strategies for new word learning in L2. However, in Aya's case these strategies prove to be much more effective and her vocabulary range in reading is very high, as opposed to Ori's which is very low. This could be due to the fact that Aya's visual memory (both spatial and spatial sequential) is very good, whereas Ori's visual memory is between weak (visual spatial) to normative (visual sequential). Interestingly, Aya also complains that many of the new words she learns are prone to decay within a number of days. In addition, Aya's visual strategies for word learning seem to be more effective in reading than in speech and the decay which she refers to seems to be more apparent when she needs to recall the words in speech acts than when she needs to recognize them in reading.

Ori's data analysis supports former suggestions as to relationships between both

visual spatial and visual sequential memory and reading mediated by visual word recognition via the direct lexical route. However, weak phonological working memory (which inhibits decoding) and lack of semantic knowledge (in this context- L2 vocabulary knowledge) may reduce the effect of visual memory in word recognition processes while reading.

It may be that a combination of visual spatial and visual sequential memory is needed for efficient word recognition processes in reading to take place, since the visual spatial memory could assist in the immediate recognition of word configuration and the visual sequential memory could assist in identifying words as familiar visual patterns.

Phonological strategies seem effective, to a certain extent, for Natalie, whose auditory memory is, on the whole, better than her visual memory, but neither memory modality is high. However, as opposed to Ori and Aya, Natalie's phonologically acquired vocabulary does not seem as prone to decay, especially when it is learnt in a meaningful way.

Data analysis seems to point to a relationship between the context of learning and the context of performance; namely, vocabulary learnt via the auditory modality is better utilized in speech, whereas vocabulary learnt via the visual modality is better utilized in the reading.

6.3.5 Auditory verbal memory and EFL performance

Below, I point to aspects in Ori's EFL performance which could possibly be explained by strong or weak auditory verbal memory and try to discern whether these findings support, modify, or add to former findings from Natalie and Aya.

To the best of my knowledge, research to date has not linked specific EFL performance to auditory verbal memory. One of the purposes of this research is to see whether certain aspects in EFL performance can be explained in terms of auditory verbal memory.

Results of the three case studies on the RAVLT memory test are presented together below for the sake of convenience.

Table 6.14: Ori, Natalie and Aya - RAVLT

RAVLT 1	RAVLT 2	RAVLT 3	RAVLT 4	RAVLT 5	RAVLT 6 proactive interference	RAVLT 7 retroactive interference	RAVLT 8 LTM	RAVLT 9 recognition
(SD= 1.59)	(SD= 2.13)	(SD= 1.63)	(SD= 1.54)	(SD= 1.44)	(SD= 1.80)	(SD= 2.04)	(SD= 2.11)	(SD= 2.46)
Ori -1.05	-0.80	-0.86	-1	-2.79	-0.3	-1.89	-2.41	+0.32
Natalie +0.20	-0.33	+0.36	+0.94	+1.36	-0.30	+0.55	0.42	+0.32
Aya -1.05	-1.27	+0.36	+0.94	+1.36	+1.36	+1.53	+1.37	+0.32

Table 6.14 shows that Ori's immediate auditory verbal short term memory is in the low range of the norm and resembles that of Aya. Her results on trial number 5 indicate that, as opposed to Natalie and Aya, who benefit from repetition, Ori does not benefit from this kind of rote repetition. On the contrary, her performance after five repetitions is worse than before. Ori is more prone to retroactive interference than Natalie and Aya and her ability to remember orally presented information in the longer term is much worse than theirs. In fact, it is below the standard deviation. Ori's recognition ability is like Natalie's and Aya's and is defined as average although they have separate abilities.

Research suggests that the basis for knowing any language is vocabulary knowledge of that language, and that when vocabulary knowledge is insufficient, additional processing cannot occur, or is very limited. Pienemann (1998, Mitchell and Myles, 2004) claims that a second language is processed in a hierarchical manner and that:

"...each lower level is a prerequisite for the functioning of the higher level: a word needs to be added to the L2 lexicon before its grammatical category can be assigned." (Pienemann, 1998, p. 80)

Although the claim that grammatical category is always added to the foreign language after having learnt L2 words may be too categorical, Ori feels that, in her case, deficient vocabulary interferes with her ability to acquire additional layers of L2.

"...and then it drags onto English, the grammar because you have to be able to understand in order to cope with the... If you have to insert a verb in its correct form

you have to understand the sentence." (Interview, 26, in Hebrew)

In the following lines, Ori relates to tests in grammar:

"...I can't study for them because there are always words to insert in sentences; add 'ing' or 'ed'. Although I know the rules I don't succeed because I don't understand the sentence itself. And in cloze tests, if I don't understand the passage I don't know what word to put in." (Interview, 151, in Hebrew)

It seems, therefore, that most of Ori's additional language factors are restricted by her weak vocabulary in English. Immediately below, I attempt to see whether the fact that Ori has such low vocabulary knowledge is linked to her auditory verbal memory and whether these findings are in line with those from Natalie and Aya.

A qualitative analysis of Ori's oral protocols shows how Ori's memory for word translations, supplied by the interlocutor during the oral protocols, may be related to her auditory verbal memory.

As opposed to Natalie, who, throughout the reading passages, remembers things presented via the auditory modality, and who presents normative performance on all trials of the RAVLT, Ori cannot remember the chunk "Children's museums" even though these words have been vocalized and explained a number of times whilst tackling the former question and whilst reading the passage. When Ori encounters the words "children's museums" again, a few seconds after this has happened, this is what occures:

O: O.K Two examples of experiences offered by children in the Museum.

T: Not by children in the museums. What's children's museums?

O: (Hesitates + pause) Museum of children?(Oral protocols, reading passage 1, 134-136, reading in English, conversing in Hebrew)

In addition, Ori cannot remember the Hebrew translations of words provided just seconds earlier as in the excerpt below:

O: <now encourage (stressed wrongly) young visitor (no /s/) to handle exhibitis> =

T: "To handle exhibits" What does it mean?

O: I don't know/

T: (gives the word for handle in Hebrew)

O: <and intruckt with them.> What's "to handle"? (Oral protocols, reading passage 1, 150-154, reading in English, conversing in Hebrew)

It is possible that this kind of performance is reflected in the various trials of the RAVLT memory test. Ori's inability to recall the meaning of "to handle", a second after being told what it is, reflects her low-average performance on the RAVLT immediate memory trial (trial 1). Repetition of the chunk "children's museums" does not seem to help either and may reflect her weak performance on trial 5. Ori's inability to remember "children's museums" may also be reflected in trial number 8 (LTM) since we actually started reading this passage a few days earlier and went over this expression. When Ori encounters it again in turn 134, it is after seeing it a few days before as well as having had it explained to her a few minutes earlier. Nevertheless, when Ori encounters the same expression again (auditorily), it does not trigger the right meaning. It may very well be that trial 8 also reflects Ori's overall very weak knowledge of vocabulary. Interestingly, Ori's performance on trial number 7 which tests retroactive interference is also in the low range of normative performance. It may be that Ori's difficulty in recalling word meanings after short or longer periods of time has to do with the fact that during the intervening time Ori has been dealing with additional information which may interfere with her ability to recall the information presented before.

It is not possible to compare Ori's ability to utilize words provided along the reading to Aya, since Aya is already familiar with all the reading vocabulary. However under similar circumstances, Natalie, whose results on the RAVLT are normative on all trials, remembers word translations and uses them for later integration.

This analysis shows how weak auditory verbal memory may be reflected in the ability to remember auditorily presented meanings of new words or chunks which occur in reading passages.

Auditory word recognition

Ori finds it very difficult to comprehend EFL speech:

O: When the teacher talks, I only understand small things.
T: Why is this? Is it because of her flow of speech?
O: Yes. The speed and also what she says.
T: The words?
O: Yes. (Interview, 159-163, in Hebrew)

In previous chapters, we saw that both Natalie and Aya scored high on the

comprehension aspects in the oral dialogue and the role play (Natalie-95%, Aya-85%). A qualitative analysis of their performance shows that both case studies have a good understanding of the vocabulary used by the interlocutor. Likewise, both Natalie and Aya present normative performance on the recognition trial of the RAVLT. This may point to there being links between auditory word recognition in speech and auditory verbal memory. However, Ori, who has the same score on the recognition phase of the memory test, scored low on the comprehension aspects in the oral dialogue and role play (50%), and a qualitative analysis of her performance shows that she has very little understanding of the vocabulary used by the interlocutor. At first sight, this may lead to the conclusion that word recognition in speech and auditory verbal memory are not related. However, a deeper analysis may point to a different direction.

The very fact that a well recognized memory test as the RAVLT distinguishes between memory via recognition and memory via recall points to there being a difference between the two. It is thought that memory via recognition is less demanding than memory via recall, or in other words requires a lower level of knowledge/storage. Nevertheless, self-evidently, one will not be able to recognize information that is totally unfamiliar. It is my suggestion that Ori is not able to recognize words in English used by the interlocutor because this information is unfamiliar to her. There may be a number of reasons for this: First, as mentioned above, part of Ori's difficulty in understanding EFL speech is due to her inability to follow the flow of English speech. This kind of difficulty may stem from Ori's erratic phonological processing (see section 6.3.2) resulting in her not being able to segment speech sounds into words. It is logical to assume that if Ori is not able to segment sentences into words properly, these words will be very difficult for her to recognize. Second, from Ori's account of her English lessons at school, it seems that she is quite disconnected from what goes on in class (see section 6.1).

This low level of engagement with EFL lessons at school may mean that the base of stored information available for recognition is quite narrow.

If this is the case, the findings that Ori has such weak EFL auditory word recognition but a normative score on the RAVLT recognition are not contradictory with one another and Ori's data do not rule out suggestions as to relationships between word recognition in EFL and auditory verbal recognition memory.

In summary, Ori's data analysis somewhat modifies findings from Natalie and Aya as to possible relationships between auditory verbal memory and word recognition in EFL and points to the fact that such links can only be possible after a certain minimal threshold level of EFL has been reached. In addition it is suggested that auditory verbal memory cannot come into play in EFL auditory word recognition processes before a certain level of meaningful exposure to and engagement with EFL vocabulary has been attained. It is also suggested that, unfortunately, under certain circumstances, it is possible for a 12th grade student who is physically present in EFL classes not to reach this level of exposure and engagement.

Word retrieval in speech

When Ori is asked about her ability to speak in English she laughs and says:

"... I can't talk at all. Through all school, I have never spoken in the lessons; maybe at the very beginning. (Interview, 36, in Hebrew)

Ori's difficulty to retrieve words is seen throughout the oral tests. Often, when she does not repeat words used by the interlocutor, Ori simply inserts words in Hebrew. It is worthwhile noticing that the words Ori uses in Hebrew are at quite a low level and point to her low level of productive vocabulary: *floor* (Dialogue, 48), *sit* (Dialogue, 54), *weak,* (Role play, 68), *meat* (Role play, 66) and more.

Ori's claim that she cannot speak in English is verified by her performance on all oral parts of the EFL tests. The level of Ori's vocabulary in the oral dialogue is very weak and estimated as 40%. Ori's difficulty with retrieving words in English and using them in speech may be attributed to weak auditory verbal long-term memory as measured by the RAVLT (trial 8). This kind of relationship is also suggested in Natalie and Aya's data. Their level of productive vocabulary in the oral dialogue is 65% (for both) and both have normative scores on the RAVLT long-term memory recall test (trial 8).

Interestingly, a qualitative analysis of the data provided by Natalie and Aya seems to suggest that where L2 is concerned, the difference between auditory verbal word recognition and auditory verbal word recall is even more pronounced. The difference derives from the fact that, within this research, auditory word recognition requires recognition of vocabulary chosen by the interlocutor, which may be unfamiliar to the case study, whereas L2 word retrieval requires the ability to retrieve vocabulary from

one's own repertoire. Both Natalie and Aya are able to comprehend/recognize the high level vocabulary used by the interlocutor, but can only use/recall a much smaller vocabulary repertoire in their speech. The suggestion that auditory verbal memory via recall is more difficult in L2 cannot be verified or modified by Ori's data since there is no way of knowing whether her weak ability to retrieve L2 vocabulary in speech is due to her difficulty in retrieving vocabulary that is stored (and maybe could have been recognized), or due to not having anything stored for potential recall.

Of course the circumstances in the RAVLT memory test are not identical to the circumstances of EFL utilization in day to day life, as is the case with most laboratory tests which attempt to simulate real life situations. In this case, the most outstanding difference is in the period of time defined as long-term. Whereas in the test, long-term memory relates to approximately half an hour, in real life it could be a much longer period of time. On the other hand, the level of exposure to many vocabulary items is probably higher in real life and may serve to compensate for the time factor.

In summary, Ori's data analysis seems not to rule out the suggestion that there may be links between auditory verbal memory and the ability to comprehend L2 vocabulary in speech since it is suggested that as far as L2 vocabulary is concerned, auditory verbal memory via recognition and recall cannot come into play before a certain threshold level of L2 knowledge has been reached and that Ori may not have reached this threshold level.

One must bear in mind, however, that the level of vocabulary in itself does not account for overall speech performance. Additional parameters should be taken into account, among them syntactic knowledge and fluency. Both syntactic knowledge and fluency are not discussed separately in this analysis of Ori's performance since Ori's limited knowledge of vocabulary restricts higher levels of knowledge, let alone fluency in production. However, the very fact that Ori finds it difficult at times to correctly segment sound streams into words points to syntactic weakness as well as phonological difficulties. Additional parameters which are excluded from this analysis are the context of learning and context of performance. Although Ori does not learn via the auditory modality, her very weak performance in all modalities does not shed light on this issue either.

6.3.6 Central executive function and EFL performance

One of the aims of this research is to understand whether certain aspects of EFL performance can be explained in terms of the central executive function. The central executive component of working memory is theorized as an integrating system which coordinates flow of auditory information from the phonological loop, visual information from the visual spatial sketchpad and information retrieved from long-term memory with new on-coming information. Memory literature points to a relationship between the central executive function and high level reading skills (Cain et al. 2004) (see section 2.3.4). In section 4.6, when discussing Natalie, I also noted that the central executive function seems to be an essential part of various reading models presented in this research.

Analysis of the data presented by Natalie and Aya pointed to possible relationships of high level reading skills and high level oral productive skills with the central executive function. In addition, it was suggested that since the central executive is a coordinating system, the end result of the coordinating process depends on the quality of the information fed into the integration process from the slave systems of working memory.

The memory test administered to the case-studies in order to check central executive skill is the Active Memory (complementing words) Test (see section 3.11.2 for details.)

Table 6.15 shows that Ori's score for active memory is the weakest of the three cases under consideration.

Table 6.15: Ori, Aya and Natalie - Active Memory - Complementing Words Test

Ori	-1.64 (Rating=below average)
Aya	1.49 (Rating=above average)
Natalie	+0.50 (rating average)

When Ori refers to her EFL study history, she says that at the beginning she felt that she could cope with English because "*it was the beginning; there were just small things* (Interview, 22, in Hebrew)". As mentioned before, it is logical to assume that *small things* refers to basic vocabulary and maybe short chunks which do not require much integration for receptive or productive use and that therefore Ori's weak central

executive function do not yet have any impact on the low level skills required at this stage. Interestingly, although Ori's syntactic abilities presented in the EFL tests are very weak, when she refers to grammar she adds: "*But grammar, I know that if I study, I know it because it's all about rules*= (Interview, 27, in Hebrew). It is reasonable to presume that when Ori talks about grammar, she is thinking about grammatical exercises which focus on specific language items in a very isolated manner which do not yet require integration with the natural flow of language. As such, these exercises do not seem to require much central executive function and Ori's weak central executive skill does not prevent her from coping with these drills. However, when Ori needs to integrate the grammatical rules into real language, she cannot cope. Her difficulties may at this point be aggravated by her weak central executive skill. This is in line with findings from Natalie and Aya suggesting that central executive skills are involved more in higher level language skills than in lower level.

However, Ori's difficulties in higher level language skills in EFL cannot be attributed to a weak central executive function alone. As mentioned above, being a coordinating system, the central executive depends on the information fed into the process. In Ori's case, integration between weak vocabulary and weak syntax could not be expected to result in good language even if the integration process itself were intact (which is probably not the case with Ori). From the point of view of memory, when both slave systems are weak, one cannot expect the integration process to give good results. In this instance, information in the phonological loop is reduced due to weak phonological and auditory memory, and information in the visual spatial sketchpad is reduced due to weak visual memory, and therefore the final mix results in an impaired product. Below is an excerpt from Ori's speech:

T: But this dog may be sick.
O: What the question?
T: It may be sick. Do you understand /sick/?
O: No
T: (Gives the word in Hebrew.) What will you do to make sure?
O: I eh WILL TAKE CARE OF THE DOG.
T: What will you do?
O: I taked him to the eh(pause) the doctor to the dog.
T: When will you do this?

O: In eh (long pause) so I forget it (meaning the word /vet/). Doctor in eh

T: To the vet; and then what?

O: And then I (long pause) eh

T: O.K. You take the dog to the vet. Now what? After that, what will happen?

(Role play, 35-47, in English)

When Ori speaks in English, it is obvious that she lacks basic vocabulary and syntax. However, it also seems that she has difficulty with the integration itself. Ori needs to be put on track again and again by mediating questions. She seems to need a "restart" apparatus in order to collect information from long-term memory and from short-term memory (what she has just uttered), and integrate it with on-coming information (my questions) and her intentions.

Some of Ori's difficulties in reading are similar to her difficulties in speech. In the first reading comprehension passage it takes Ori from turn 84 to 122 with mediation to be able to answer one question. She seems to need constant reminders of the question and the text even after she has understood both. In addition to deciphering difficulties and lack of vocabulary, Ori does not seem to be able to hold onto the information she has already acquired through my mediation and integrate it with the new parts as shown below:

O: O.K <What two things were people always> =

T: (corrects) allowed.

O: What does this mean?

T: (Gives the word in Hebrew.) So what are you asked?
O: (Translates quietly to herself word by word.)

T: Try to understand what you are asked, not just to translate the words.

O: What couldn't people do in the past in museums?

T: Yes, what weren't they allowed to do in museums? Right?

O: Yes.

T: and you wrote:

1. to lower their voice.

2. to put their hands in the pocket.

*What **weren't** they allowed to do? Why isn't it correct what you wrote?*

O: Ah, exactly the opposite.

T: Right. So let's read the text.

O: <A desade> (stressing the /sade/)=

T: Decade. What's /decade/?

O: I don't know.

T: [Gives her the word].

O:<visiting a children eh children's mooessem> =

T: = museum

O: <was not very different from visiting any other muesment>

T: Do you understand what you read?

O: Yes. A visit of children to a museum wasn't... Is "different" like "the same"?

T: No, the opposite. (Gives her the Hebrew word for different.)

O: (Goes on translating) Wasn't different from visiting another museum?

T: Yes

O: Did the children visit the museum or

T: No. A visit to a children's museum: a museum especially aimed at children visitors.

O: <They hall had> =

T: all, not hall=

O: <They hall>=

T: all

O: <all ad the same rules keep your voice down and your hand in your poocket.>

T: So if we look at the question again you are looking for two things that were forbidden, right?

O: Yes.

T: So what was forbidden?

O: Eh sort of to shout; to talk loudly.

T: right, and what else was forbidden?

O: (hesitates and reads to herself) to put the hands in the pockets.

T: No=

O: = Eh, sort of

T: Why did they want people to keep their hands in their pockets? Because it was not allowed to

O: To touch the exhibits.

T: Exactly, So what two things were forbidden?

O: To touch exhibits in the museum and to talk loudly. (Reading passage 1, 80-122, reading in English, mediation italicized in Hebrew)

Analysis, so far, suggests that the end result of language integration processes is erratic due to both bad quality of information at the pre-integration stage and due to the integration process itself. However, the distinction between these two sources of difficulty is not simple since the end result does not always allow us to differentiate between impaired information and impaired integration. In order to be able to understand Ori's integration ability without the extra burden of having to perform in a foreign language, I looked into Ori's interview in Hebrew and saw that her conversation skills in L1 are also less than perfect. It seems that even when vocabulary and syntactic knowledge do not pose a problem, Ori's speech is far from being organized and coherent. She goes back and forth, skips some things, repeats others and gets confused with the sequence of events:

T: Let's go back to the beginning. It's 4th grade; you start studying English, and =

O: = Good. It was good because it was the beginning. 5th grade also; 6th grade eh not really; 7th grade eh (pause) it was also good, sort of O.K eh =

= Why did you say "not really" about 6th grade? What there anything specific?

O: The teacher. The teacher was not really, apart from the fact that as a subject, I never really connected well to English; since a young age I hate; I never; I find it sort of difficult to=

T: but you said that in 4th grade it was O.K?

O: Yes, cause it was the beginning; there were just small things and also in 5th; and then in 6th, the teacher didn't teach well and she was eh sort of and then in 7th it started to affect things.

T: But you said that in 7th grade things were good?

O: Yes, because the teacher was excellent. 8th Grade was more or less O.K. We were split into levels and I was put in second level (not top level) at first and then I got good grades and was transferred into the first level. Oh sorry, that was in 9th grade the levels and the transfer. I started 9th grade in second level and was transferred into the first. Then I stayed in the first level because I really wanted to get into the academic classes in high school. At the beginning it was O.K but then it started getting really really hard. In 10th grade it was too difficult and I couldn't stay in first level anymore. (Interview, 17-24, in Hebrew)

The above quotation from Ori's interview points to the fact that Ori finds it difficult to integrate information stored in long-term memory with things she has just uttered, and to maintain the right sequence of events.In other words, it seems that Ori can not handle large bits of information in L1 as well. These findings strengthen the notion that Ori's difficulties in higher level language skills in EFL derive both from the quality of information fed into the integration process and from weak integration ability in itself. These findings support suggestions from Natalie's data analysis as

well.

In summary, findings from Ori are in line with findings from Natalie and Aya proposing that the central executive component of working memory is involved in higher level language skills in EFL. However, analysis of the data points to the difficulty of determining between weak EFL performance, which derives from weakness in central executive integration ability, and weak EFL performance which derives from faulty ingredients fed into the integration process, especially when performance is so weak.

6.4 Ori – general summary of EFL performance vis-à-vis memory profile

Of the six case studies presented in this research, Ori's EFL performance is the weakest. Her vocabulary, syntax, reading, speech and even oral comprehension are weak to the extent that it is very difficult to achieve communication with her in English. Ori's performance on most of the memory tests is also weak which points to possible links between the two.[3] Ori's very low vocabulary range in English could be linked to her weak phonological processing causing unstable sound representations in English. Ori's inability to learn and remember new words in English could also be related to her very weak auditory verbal memory which reduces the possibility of remembering meanings of new vocabulary items or short chunks when presented auditorily. Ori, unsuccessfully, utilizes a visual strategy to learn new vocabulary. This strategy may be unsuccessful due to her weak visual spatial memory which decreases the possibility of learning via a more direct visual-lexical route. In addition, her weak phonological working memory and weak decoding ability reduces learning via the phonological route. Ori's very weak syntax may be due to her very weak vocabulary (including morpho-syntax). It might also be related (independently) to weak phonological processing and working memory via reduced inner voice and reduced sensitivity for the right sound of EFL elements. Ori's poor low level reading skills in EFL may be related to her poor phonological processing resulting in unstable sound representations, her poor phonological working memory leading to poor decoding ability and reduced inner voice. Ori's weak reading may also be related to her weak visual spatial memory which reduces word recognition processes

[3] It might be the case that Ori, like Natalie, has a mild form of dyslexia (See section 4.8)

in a more global manner. In addition, Ori's low vocabulary range adds to the difficulty of global word recognition. Apparently, Ori's normative visual sequential memory is not enough to compensate for all her other language and memory weaknesses and does not help her EFL reading much. Ori's oral skills are very weak, presumably due to her not reaching a threshold level in EFL vocabulary or syntax which would enable her to comprehend or produce speech at a satisfactory level.

None of Ori's EFL weaknesses has been specifically attributed to the central executive function (although her central executive function is weak) due to the difficulty of determining whether weak EFL performance derives from weakness in her central executive integration ability or from faulty ingredients fed into the integration process.

The next subject analyzed is Shandy, who considers EFL to be the most difficult of all school subjects. In the following section her EFL and memory data are analyzed in an attempt to see whether they point to similar patterns as those suggested by some/any of the former cases.

Chapter 7: case 4 - Shandy

7.1 Introduction to case 4 – Shandy

In this chapter I present Shandy (case 4) and analyse her data vis-à-vis the former cases in order to see whether patterns found match those found in the previous cases and watching for new observations which may evolve in the course of analysis.

Shandy is a 17 year old girl in her final year of high school. At the time of the research tests, it had not yet been decided whether Shandy would take the 5 point or 4 point matriculation test in English because her grades were borderline. According to Shandy, English is not one of her favourite subjects at school:

SH: =Bible and English. ***These*** *are the subjects that I specifically hate. Hate because I don't succeed in them.* (Interview, 85, in Hebrew)

Shandy's mark on a recent English test at school was 63% and her final grade in the previous year was 70%. Possible reasons for this deterioration are discussed with Shandy below:

T: ...What do you think is the difference between the end of last year and the beginning of this year that could have made the difference?

SH: I think that the teacher. Last year's teacher gave easier tests than this years' teacher.

T: I understand. So actually the material is more difficult.

SH: right.

T: The material this year focuses on reading comprehension doesn't it?

SH: Yes it does.

T: So the reading comprehension tests are more difficult this year than last year. Is this what you're saying?

SH: Yes. (Interview, 32-39, in Hebrew)

In contrast to Shandy's current achievements in EFL, her first years of studying English looked quite promising. When she was in first grade, a friend of the family, who is an English teacher, used to come in and teach her English. By the time Shandy started to learn English at school, in third grade, she was already familiar with some of the basics. Up to the 8th grade Shandy's grades in English were always around 90%. The decline started in 8th grade but Shandy cannot point to any specific factor responsible for this deterioration:

SH: In 8th/9th grade the ability to study English stopped. It is sort of difficult for me to learn this language. (Interview, 57, in Hebrew)

And:

T: =What was after this that wasn't there before?

SH: I don't know. That's what I also don't know!

T: Was there a different teacher or a different school or?

SH: No. In 10th grade I started high school=

T: I mean at that point where you say it was difficult for you to study English.

SH: No, the same teacher. It was just difficult for me. I simply don't know why.

T: You have no... =

SH:= ye I don't know. All of a sudden grades started to drop to 80% and from 80%

dropped to 70% just like this. (Interview, 60-67, in Hebrew)

Shandy's overall school performance is good and she seems to be quite a strong student. She also seems to be a motivated student and is very much annoyed by her grades in EFL:

SH: ..I'll tell you something: It's the only subject that spoils my report-card! (Interview, 57, in Hebrew)

Shandy's final grade in Hebrew language was 90% and so was her final grade in History. In mathematics her final grade was 100% on the 4 point matriculation test. In Bible Shandy got 80% which she considers to be low. Shandy classifies English and Bible as subjects she dislikes whereas History and Literature are *"okay"*. Given Shandy's achievements, it appears that English is really the only subject that *"ruins"* her otherwise quite impressive report card. Notwithstanding Shandy's worthy achievements at school, my impression from our conversation is that she is not very comfortable with conversing and although her speech in Hebrew is generally accurate, most of her answers are short and ungenerous. Whether or not this laconic style of speech in L1 has to do with the fact that speech is the most difficult aspect for Shandy in English remains to be seen.

In the next section I present a numerical overview of Shandy's results on the different tests along with my interpretation of these results.

7.2 Shandy – test results

7.2.1 EFL oral and reading tests

Table 7.1: Shandy - Dialogue

Communicative ability	points	Accuracy	points	Final grade
Comprehension of questions	90%	Incorrect/correct use of simple/complex language structures	50%	
Non-fluent/fluent Interaction	65%	Limited/basic/rich vocabulary	65%	
Gives single word/simple sentence/extended answers	65%	Poor/mostly comprehensive/comprehensible pronunciation	65%	
Total communicative ability	73.3%	Total accuracy	60%	**66.65%**

Table 7.1 shows that there is a large gap between Shandy's good ability to understand speech and her poor ability to speak in English. When Shandy speaks, she has a very basic range of vocabulary at her disposal used erratically because of weak syntax. Her answers are short, not fluent and often poorly pronounced. The strongest aspect of Shandy's dialogue is her comprehension whereas the weakest aspect is her syntax. All other parameters are in the low intermediate range.

Table 7.2: Shandy - Role Play

Communicative ability	Points	Accuracy	points	Final grade
Comprehension of questions	90%	Incorrect/correct use of simple/complex language structures	50%	
Non-fluent/fluent Interaction	70%	Limited/basic/rich vocabulary	65%	
Gives single word/simple sentence/extended answers	65%	Poor/mostly comprehensive/comprehensible pronunciation	70%	
Total communicative ability	75%	Total accuracy	61.6%	**68.3%**

Table 7.2 indicates that Shandy's performance in the role play is similar to, but slightly better than, her performance in the dialogue. Shandy's fluency of interaction is better in the role play than it was in the dialogue and so is her pronunciation. Use of syntax, however, is very erratic. As in the dialogue, Shandy's strongest aspect is comprehension and her weakest aspect is syntax.

Table 7.3: Shandy - EFL Reading

Name	Reading passage 1 (search reading)	Reading passage 2 (careful reading)	Reading passage 3 (mixed search and careful reading)
Shandy	66.6%	26.3%	100%

Table 7.3 points to the fact that there are very large gaps between Shandy's performance on the different reading passages, the differences in performance ranging from perfect performance in the third reading passage to low ability to cope with the second. Performance on the first reading passage is also quite weak.

7.2.2 Memory tests

Auditory verbal memory

Table 7.4: Shandy - RAVLT

RAVLT trial 1	RAVLT trial 2	RAVLT trial 3	RAVLT trial 4	RAVLT trial 5	RAVLT trial 6 (proactive interference)	RAVLT trial 7 (retroactive interference)	RAVLT trial 8 (LTM)	RAVLT trial 9 (reco-gnition)
+2.72 (SD= 1.59)	+0.60 (SD= 2.13)	+0.36 (SD= 1.63)	-1 (SD= 1.54)	0.67 (SD= 1.44)	-0.85 (SD= 1.80)	+1.04 (SD= 2.04)	+0.42 (SD= 2.11)	+0.32 (SD= 2.46)

Table 7.4 shows that Shandy's immediate short term auditory verbal memory is very high. However, from the second trial on, Shandy's performance is only within average range of the standard deviation. Whereas it is generally the case that in trials 1-5 where the same list of words is read again and again, there is a learning curve of improvement from trial to trial, Shandy's scores on these trials decline from trial to trial. This kind of performance could point to difficulties in maintaining attention and concentration. It may be that when Shandy is fully attentive and concentrated, her score is very high, but she cannot hold onto this level of concentration for long. Trials 6 and 7 indicate that Shandy is not especially prone to interference; trials 8 and 9 show that her auditory verbal long term memory from recall and recognition are normative.

Visual spatial memory

Table 7.5: Shandy - RCFT

Copy trial	Time to copy (seconds)	RCFT immediate recall	RCFT delayed recall	RCFT recognition
Percentile= >16	Percentile 240 >16	40(% score=16) Rating=below average	36(%score=8) Rating=mildly impaired	54(%score=66) Rating=average
Qualitative features of performance: Shandy works in an organized way. She sees the global picture well, but when she gets to the inner details she seems to arrive at the end result by adding up small parts. For example instead of two long diagonal lines across the figure which make the shape of an X, she draws > and < and combines them to ><.The end result is fine, but the way is unconventional. In the immediate recall, she initially gets mixed up with the diagonal lines. Eventually she corrects them as they interfere with other elements and she realizes her mistake. Shandy does not seem to be able to hold her initial concentration for a long time, which is apparent from her body language that becomes restless.				

Table 7.5 shows that, on the whole, Shandy's visual spatial memory is weak. Copy scores suggest intact visual perceptual and visual motor integration skills; her time to copy which falls in the >16 percentile range indicates adequate cognitive processing speed; Shandy's immediate and delayed recall point to reduced visuo-spatial recall ability but her recognition ability is better and is defined as normative. Shandy's overall memory profile, as seen in the RCFT test, points to a pattern of difficulty in retrieval which can be improved significantly when given retrieval cues.

Visual sequential memory, Central executive functions and phonological working memory

Table 7.6: Shandy - DTLA-A - Design Sequences; Active Memory-Complementing Words; Shatil Syllable Range Test

DTLA-A Design Sequences	9 (% score=37) rating=average
Active Memory-complementing words	-1.64 Rating=low
Shatil syllable Range Test	Low

Table 7.6 indicates that Shandy's ability to remember visually presented sequences is normative. This may strengthen the findings in table 7.5 which suggest that although

Shandy's ability to recall visual items which had been presented to her is weak, her ability to recognize which items had been presented is better. The additional information provided by this test is that Shandy's ability to recognize the sequences in which items are presented is also normative. This is in line with the visual spatial test pointing to Shandy's better ability to recall when given retrieval cues. Shandy's low score on the Active Memory-complementing words test points to the fact that she may have difficulties with integration between various memory modalities as well as with tasks which require simultaneous storage and processing of information and retrieval from long term memory. Shandy's performance on the test which checks phonological working memory is classified as low since she did not score within the maximum range of the test.

7.3 Shandy – Data analysis vis-à-vis Ori, Aya and Natalie

In the following sections I present Shandy's test results along with those of Ori, Natalie and Aya along similar lines to those used when looking at Ori.

7.3.1 Phonological memory and phonological working memory along with auditory/phonological processing and EFL reading

In order to provide a clear basis for analysis I present results of the phonological working memory test and EFL reading tests of Shandy (case 4), along with those of Ori (case 3), Natalie (case 1) and Aya (case 2).

Table 7.7: Shandy, Ori, Aya and Natalie - Shatil Syllable Range Test

Shandy (case 4)	Ori (case 3)	Aya (case 2)	Natalie (case 1)
Low	Low	high	low

Table 7.8: Shandy, Ori, Aya and Natalie - EFL Reading

Name	Reading passage 1 (search reading)	Reading passage 2 (careful reading)	Reading passage 3 (mixed search and careful reading)
Shandy	66.6%	26.3%	100%
Ori	0%	0%	58.6%
Aya	100%	100%	100%
Natalie	52.7%	42%	63%

Table 7.8 shows patterns of different performance between the reading passages as well as differences between cases. All three case-studies who have difficulties in reading perform better on reading passage number 3 than on the other two reading passages. The reasons for these differences may be twofold. The first reason has to do with the questions following the reading passages. In reading passage 3 the sentence structure of the questions is more linear, and less complicated, making the task clear. In addition, the questions send the reader exactly to the paragraph, or even to the lines, where he/she can find the answers. On the other hand, in reading passage 1, one question out of three is phrased in the negative form (which may confuse), the sentence structures of the questions are more complex, and they do not focus the readers on specific parts within the text where they are likely to find answers. Questions following reading passage number 2 are structurally complex and answers to these questions require a great deal of text integration.

The second reason for different performances on the reading passages may have to do with the text itself. The structures of passage 3 sentences where the reader is sent in order to find answers are generally quite simple, whereas in reading passages 1 and 2 this is not the case. Reading passage 2 is the most difficult from the point of view of levels of integration required. The different nature of the reading passages may require different memory functions. Reading passage number 2, for example, requires more central executive function, due to its integrative nature as discussed in analysing the earlier cases.

The discussion, following, relates to Shandy, Ori and Natalie since Aya does not have any visible difficulties in the reading.

When asked about things that are more, or less, difficult in EFL, Shandy does not immediately name reading as a factor. When I name advanced reading comprehension as a possible reason for her difficulty that year, Shady agrees.

"T: The material this year focuses on reading comprehension doesn't it?
SH: Yes it does.
T: So the reading comprehension tests are more difficult this year than last year. Is this what you're saying?
SH: Yes" (Interview, 36-39, in Hebrew)

However, Shandy's feeling that reading is not her biggest difficulty in EFL performance seems to be justified by the EFL tests. One should not conclude,

though, that Shandy's reading is good. It is not! But her difficulties are somewhat different from Natalie's and Ori's and result in great variance across reading passages (26.3% in reading passage 2 versus 100% in reading passage 3).

As with Natalie and Ori, some of Shandy's reading errors stem from decoding. However, it seems that Shandy's decoding difficulties are of a different nature. Shandy's reading does not manifest unstable sound representations: Whereas Natalie and Ori decode some letters and phonemes differently each time (see sections 4.3, 6.3.1), Shandy is generally consistent with her decoding, be it right or wrong. For example, Shandy does not seem to be familiar with the/*i- consonant e/* rule and decodes the vowel as /e/.The result is that she reads */deves/ (deveese)* instead of /dIvaIs/*(device),* (reading passage 1, 40, oral protocols, in English) and */hvZ/* (lives with short /i/ sound), instead of /laIves/ (with long */i/* sound) (reading passage 2, 20, oral protocols, in English). In addition, aspiration errors, which pointed to the direction of erratic auditory/phonological processing in Natalie's and Ori's reading, do not exist in Shandy's reading. Many of Shandy's low level reading errors derive from letter transportation followed by guesswork as seen when she reads */aaapeals/* for */applies/* (reading passage 2, 36, oral protocols, in English) or */particular/* for */practical/* (reading passage 2, 44, oral protocols, in English). This type of reading error, observed in Shandy's reading, is not due to unstable sound representation and does not seem to be related to auditory/phonological processing. Examination of Shandy's data therefore, modifies earlier findings from Natalie and Ori on issues of auditory/phonological processing and suggest that additional factors may be involved.

Strategy

As opposed to Natalie's self-mediation strategy (see section 4.3), Shandy does not provide herself with phonological crutches on the word level in order to facilitate the decoding process. Her strategy is more like Ori's: she either turns to guess-work (see above), or engages in very slow and laborious decoding as seen in the following:

<*Which of the six reasons specifically...*> *{slowly in a decoding style}*
(reading passage 2, 6, oral protocols, in English)

<... *appe eh lications* ...> (reading passage 2, 46, oral protocols, in English)

<... *sssig n ifi cance*> (reading passage 2, 48, oral protocols, in English)

Although Shandy's strategy is similar to Ori's the results of applying this strategy are better in Shandy's case than in Ori's, presumably due to her having a larger vocabulary range and a better ability to utilize contextual cues for comprehension.

Once more it is seen that the nature of the reading difficulty does not necessarily drive strategy choice. Also, similar strategy choices result in varying degrees of success.

Inner voice

Like Natalie and Ori, Shandy does not always seem to have an inner voice when reading. In fact both Shandy and Natalie read the following text with the same errors:

SH: <...of the new museum often really>

T: rely
SH: (repeats) <rely on high teach elec>
T: high tech
(Reading passage 1, 36-39, oral protocols, In English)
An additional example is:

<The information is relevant to the readers own lives (/ɪv Z)/. {***pronounced with a short /i/***}> (reading passage 2, 20, oral protocols, in English)
However, as opposed to Natalie and Ori, Shandy's lack of inner voice in the reading is not apparent throughout. There are many times where she does manifest an inner voice, especially when she exhibits an overall contextual understanding. In addition, it seems that Shandy's behaviour is designed to help her inner voice boost her comprehension in reading. Consequently, as opposed to Natalie and to Ori, Shandy does tend to repeat words that I provide. Interestingly, when Shandy repeats the words after me the inner voice which I am theorizing becomes an outer voice which allows us a glimpse into some of her processing processes. It seems that Shandy's building an inner (or in this case outer) voice is necessary for further integration of sentence parts. In my view, the inner voice which I am theorizing underlies phonological working memory can either be inner (sub-vocalized) or outer (vocalized), as it is when Shandy repeats after me, so long as it is a voice heard by the reader and utilized by him/her, for integration with and comprehension of what comes next.

SH: Ah, <high tech electronic deveese>

T: devices

SH: <devices to attract children and hold their interest.> (Reading passage 1. Oral protocols, 39-42.)

SH: <Understand how science aaapeals to you >

T: Applies

SH: applies to you (reading passage 2, 36-38, oral protocols, in English)

SH: <Read about the particular>

T: practical

SH: <practical appe eh lications to sc..> (Reading passage 2, 44-46, oral protocols, in English)

The fact that Shandy's reading does not always lack an inner voice modifies my former suggestion regarding the possibility that weak phonological working memory causes lack of an inner voice while reading. However, Shandy's reading verifies my former suggestion as to possible relationships between inner voice and stable/unstable representations of sounds. It was suggested before (see section 6.3.1) that Natalie and Ori do not repeat the words that I give them due to inexact sound perception of those words, presumably resulting from erratic auditory/phonological processing. Shandy, who seems to have better sound representations of words, almost always does repeat words given to her, thereby strengthening their sound representations and providing a voice which serves as a sounder basis for integration and comprehension. In fact, it may very well be that the relationship between phonological working memory and inner voice is a reciprocal one, mediated by auditory/phonological processing: weak phonological working memory is related to lack of inner voice; inner voice can be strengthened by repetition which occurs more when auditory/phonological processing is intact and sound representations are stable; repetition facilitates phonological working memory by serving as rehearsal processes in the phonological loop and strengthening sound representations. Improved phonological working memory facilitates inner voice, and strengthened inner voice facilitates phonological working memory.

Lack of, or reduced, inner voice in the course of reading may be more affected by phonological working memory in L2 than in L1 since in L1 the words read acquire

semantic value quite automatically when bottom-up processing meets top-down processing. Once semantic value is acquired, the memory is more verbal and less phonological. In contrast, in L2 reading the process of words acquiring semantic value is slower depending on vocabulary range, retrieval skills and morpho-syntactic knowledge. Throughout this procedure and until semantic value is acquired, the memory burden is that of the phonological working memory.

Strategy

Shandy's way of repeating words given to her as described above could indeed be considered as a phonological strategy to facilitate reading comprehension. This strategy seems to be quite helpful since in many cases Shandy's repetition is seen to lead to better comprehension.

This is the second case where phonological strategy seems to facilitate reading. The first was that of Natalie's self-mediating decoding which was applied at the level of the word. Here Shandy's repetition strategy is helpful at the sentential level.

Foreign language aptitude

Shandy, as opposed to Natalie and Ori, does not seem to have any difficulties in L1 language skills (including reading). In her words: *"..I'll tell you something: It's the only subject that spoils my report-card!"* (Interview, 57, in Hebrew). However, like Ori, Shandy struggles with Bible studies:

*"Bible and English: **These** are the subjects that I specifically hate. Hate because I don't succeed in them."* (Interview, 85, in Hebrew)

It is interesting to notice that some characteristics of what has become to be known as *foreign language aptitude* (specified in 2.3) have much in common with those of Bible studies at matriculation level. It could be that Shandy's difficulties with EFL as well as Bible studies may point to reduced foreign language aptitude.

Shandy's not having difficulties in L1 but struggling with Bible studies and with L2 modifies my suggestion as to phonological working memory affecting L2 in lower level reading skills and L1 in higher level reading skills. In Shandy's case, only L2 and Bible study (which could be considered as pseudo L2 as regards language) are affected.

Summary

So far analysis of the reading-related data provided by Shandy, Ori and Natalie vis-à-vis phonological working memory along with auditory/phonological processing leads to the following conclusions:

Erratic decoding which is evident in Natalie, Ori and Shandy does not seem to be related to erratic auditory/phonological processing in Shandy as it is in Natalie and Ori, a fact which modifies former suggestions as to relationships between the two.

The suggestion that lack of inner voice, evident in Natalie's and Ori's reading, stems from weak phonological working memory is somewhat modified by Shandy whose inner voice is uneven (not always weak) across reading although her phonological working memory is weak.

Shandy's, at times successful, attempt to utilize an inner voice while reading together with her seemingly intact auditory/phonological processing supports the suggestion that lack of inner voice while reading may be related to erratic auditory/phonological processing (as seen in Natalie and Ori's reading) by inhibiting covert or overt word repetition.

Point 1, along with point 2, and 3, above, may suggest that lack of, or reduced, inner voice while reading may stem from some combination of weak phonological working memory with weak auditory/phonological processing.

The suggestion that weak phonological working memory may result in weak low level reading skills in L2 and weak high level reading skills in L1 is somewhat modified since Shandy does not have any evident difficulties in L1.

From the point of view of strategy Shandy's data analysis supports former findings as to different reading strategies stemming from similar reading difficulties and with varying degrees of success.

Phonological reading strategies seem to facilitate reading in both Natalie and Shandy.

I would like to add two additional suggestions in light of Shandy's data analysis.

Firstly, Shandy's data analysis, following Natalie and Ori's data analysis, seems to suggest a reciprocal relationship between phonological working memory and inner

voice when reading is mediated by auditory/phonological processing. Repetition, which occurs more when auditory/phonological processing is intact, serves to strengthen both inner voice and phonological working memory and also to trigger a process where phonological working memory boosts inner voice which in turn enhances phonological working memory and so on.

Secondly, lack of, or reduced, inner voice could be more affected by weak phonological working memory in L2 than in L1 due to the slower acquisition processes of semantic value.

7.3.2 Phonological memory and phonological working memory along with auditory/phonological processing and EFL vocabulary

As stated earlier, research has found links between phonological working memory/phonological processing and vocabulary acquisition in L1 and in L2 (see section2.3.1). Below are the test results showing vocabulary scores in the oral proficiency tests and an estimation of vocabulary knowledge in the reading comprehension passages based on the case studies' oral protocols.

Table 7.9: Shandy, Ori, Aya and Natalie - vocabulary knowledge

Vocabulary knowledge	Oral dialogue	Oral role play	Reading passages
Shandy	65%	65%	low
Ori	40%	40%	Very low
Aya	75%	75%	Very high
Natalie	65%	65%	low

Table 7.9 shows that Shandy's vocabulary profile is lower than Aya's, better than Ori's and very similar to that of Natalie's. Her vocabulary range in the oral tasks is low intermediate and in the reading tasks it is estimated as low.

The discussion that follows excludes Aya and proceeds to discuss Shandy's vocabulary profile vis-à-vis Natalie's and Ori's in light of phonological working memory (which is weak in these three case-studies) along with auditory/phonological processing.

Shandy, like Ori and Natalie, admits that the vocabulary factor reduces her reading comprehension. In the oral protocols following reading passage 2 she says:

"...the words were difficult for me." (Reading passage 2, 4, oral protocols, in Hebrew)

School practice/list learning

Notwithstanding the fact that Shandy does not mention learning new words via lists, it seems reasonable to assume that since Shandy, Ori, and Natalie go to the same school and have the same EFL teacher, Shandy is also required to learn lists of new words in English. It seems, therefore, that the harming impact of weak phonological working memory on Shandy's new word learning in EFL through lists is likely to be similar to its impact on Ori and Natalie: successful studying of new words by lists depends to a large extent on decoding ability, which is believed to be erratic when phonological working memory is weak.

Words as unstable sounds for storage and retrieval

Shandy's reading does not manifest unstable representations of L2 phonemes and I therefore assumed that Shandy's auditory/phonological processing was intact. Data analysis of Shandy's speech performance seems however to modify this observation. In the instance below, Shandy cannot repeat the word after me:

SH: to HOW DO YOU SAY TO CONCENTRATE? (in Hebrew)
T: concentrate
SH: (can't say the word) in the class. (Dialogue, 76-78, in English)

In the following instances Shandy repeats after me, incorrectly. It actually seems as if she hears something else:

T: line
SH: lie
T: line (Dialogue, 99-101, in English)

T: appetite
SH: appety, I don't have. (Role play, 76-77, in English)

In the next example Shandy uses the very common word *afraid* erratically:

*"Because he's very miserable *** and fraid..."* (Role play, 26, in English)

And in the next case Shandy says the same word in two different ways. Once her performance is correct, and once incorrect:

"Its not matter." (Dialogue, 48, in English)

"Eh don't, not manner to me I eat when I hungry." (Dialogue, 120, in English)

From the aspect of Shandy's general auditory/phonological processing, I suggest that when this processing is related to a visual sign, as it is in the case of reading, it is not problematic. Shandy's auditory/visual correlation ability may be good and the visual cues may serve to stabilize the related auditory representations of sounds. However, in the absence of a visual anchor to stabilize sounds, Shandy's auditory/phonological processing is not as good and results in speech errors.

As for relationships between erratic auditory/phonological processing and EFL vocabulary knowledge, Shandy's speech performance seems to support the conclusions that the ability to register accurate sound representations of L2 vocabulary items in the first place may determine the ability to retrieve those words for later use and therefore limits vocabulary range.

Strategy

Unfortunately, whilst analyzing Shandy's data I was somewhat carried away by the dynamics of the conversation and did not ask her specifically about her strategy for vocabulary learning. Therefore, there is no specific information as to how she learns new vocabulary items in English. However, her overall preference in learning is via the visual route and by writing things down and it seems reasonable to presume that this is how she learns EFL vocabulary as well. The example below serves to support this assumption as it illustrates how Shandy reads a word correctly, does not recognize the word's phonology, reads it again, this time incorrectly, and recognizes the meaning presumably by going from visual word configuration to its semantics. The semantic value of the word *advantage* is triggered visually and this probably derives from visual storage while learning:

<This magazine has an advantage aadvitage over similar magazines.>

T: What is the meaning of this?
SH: That it has an advantage over other magazines. (Reading passage 2, 54-56, oral

protocols-text read in English; explanations in Hebrew)

Shandy's data present low vocabulary knowledge. If my assumption as to Shandy's L2 word learning strategy is correct, namely, that her L2 vocabulary learning is visual, this might point to the visual route as not being an effective route for vocabulary learning. This conclusion could support findings from Ori's data analysis showing that her visual route for learning new L2 vocabulary items is not effective either. One reason could be that excluding the phonological route from vocabulary learning may lead to reduced inner voice while reading, and having to turn to the visual route (via the visual spatial sketchpad) while speaking would be unnatural, very slow, and probably erratic. Indeed, an additional explanation could have to do with the fact that neither Shandy nor Ori has strong visual spatial memory. In fact, Ori's visual spatial memory is extremely weak (as discussed in section 6.3.4). However, having said this, the fact that Natalie combines the visual and the phonological route for list learning and is yet unsuccessful may also lead to the suggestion that word learning via lists does not yield good results.

Context of learning-context of performance

Links between the context of learning and the context of performance are somewhat modified by Shandy's data analysis. Although on the face of things Shandy's visual learning could fit her claim that the most difficult aspect of EFL studies is speech, performance on the EFL tests shows that her vocabulary knowledge in the reading is not better than her vocabulary knowledge in speech.

Word length and phonological similarity

Memory literature points to word length and phonological similarity as factors which influence phonological working memory,and to phonological working memory as having an impact on vocabulary knowledge (see section 2.3.1). As shown above (section 6.3.2) Natalie's EFL vocabulary seems to be affected by phonological similarity and Ori's EFL vocabulary seems to be affected by both phonological similarity and word length. Although Shandy does not identify these factors as having an impact on her vocabulary, data analysis shows that word length and phonological similarity seem to be a factor in Shandy's vocabulary knowledge as

well. When Shandy says: *"about eh silence."* (Dialogue, 30, in English) instead of *without silence* and *"in the lïsen"*(Dialogue, 66, in English) instead of *in the lesson,* it seems safe to assume that phonological similarity between the intended word and the uttered word caused the confusion. Interestingly, there also seems to be a relationship between phonological similarity and the stability of sound representations. The more similar the words, the less stable are the sound representations of each and the more difficult the auditory/phonological processing task.

In some of the examples above word length seems to be a factor in Shandy's vocabulary acquisition. The fact that Shandy's vocabulary knowledge in EFL seems to be affected by phonological similarity and word length supports findings from Natalie and Ori on this issue and suggests that phonological working memory may be linked to EFL vocabulary knowledge via these two factors.

Summary

So far analysis of the vocabulary related data provided by Shandy, Ori and Natalie vis-à-vis phonological working memory along with auditory/phonological processing leads to the following conclusions:

Assuming that Shandy, like Ori and Natalie, is made to learn EFL vocabulary via lists, findings from Shandy support those from Ori and Natalie suggesting that vocabulary knowledge may be related to phonological working memory via decoding ability.

Shandy's speech manifesting unstable L2 sound representations is very similar to the situation for Ori and Natalie and seems to strengthen the notion of unstable sound representations being one of the underlying reasons for difficulties in storage and retrieval of new words.

Like Ori and Natalie, Shandy's vocabulary knowledge is seen to be related to phonological similarity and word length which are believed to have impact on phonological working memory. These findings support former findings from Ori and Natalie on this issue suggesting that phonological working memory may be related to EFL vocabulary via phonological similarity and word length.

Again, assuming Shandy's new L2 vocabulary learning is by lists and via the visual

route alone, the fact that her L2 vocabulary learning is unsuccessful could support former findings from Ori who is also unsuccessful at new L2 word learning via the visual route. This conclusion suggests that the visual route is a less efficient route for new vocabulary learning, or it could be related to the fact the Shandy and Ori have an overall weak visual memory and that therefore their failure to acquire sufficient vocabulary via the visual route is a matter of individual differences. However, given that Natalie's strategy for new list-word learning combines the visual route with the phonological route, and that her word learning is also unsuccessful, it may be that word learning via lists is altogether an inefficient way of acquiring new vocabulary in L2.

Links between the context of learning and context of performance are somewhat modified by Shandy's data.

7.3.3 Phonological memory, phonological working memory and EFL speech performance

In order to provide a clear basis for analysis and comparison of speech performance between the cases, I present test results showing scores on the chosen parameters in the dialogue, excluding the role play since the results are very similar to those for the dialogue.

Table 7.10: Shandy, Ori, Aya, and Natalie - Dialogue

Communicative ability	name	points	Accuracy	name	points	Final grade
Comprehension of questions	Shandy	90%	Incorrect/correct use of simple/complex language structures	Shandy	50%	
	Ori	50%		Ori	40%	
	Aya	85%		Aya	75%	
	Natalie	95%		Natalie	50%	
Non-fluent/fluent Interaction	Shandy	65%	Limited/basic/rich vocabulary	Shandy	65%	
	Ori	50%		Ori	40%	
	Aya	65%		Aya	75%	
	Natalie	95%		Natalie	65%	
Gives single word/simple sentence/ extended answers	Shandy	65%	Poor/mostly comprehensive/ comprehensible pronunciation	Shandy	65%	
	Ori	40%		Ori	60%	
	Aya	75%		Aya	80%	
	Natalie	85%		Natalie	80%	
Total communicative ability	Shandy	73.3%	Total accuracy	Shandy	60%	**66.65%**
	Ori	46.6%		Ori	46.6%	**46.6%**
	Aya	75%		Aya	76.6%	**75.8%**
	Natalie	91.6%		Natalie	65%	**78.3%**

Table 7.10 shows that Shandy's overall communicative ability is better than her accuracy. In this respect her profile resembles Natalie's. However, whereas Natalie has good oral productive skills as well as receptive ones, Shandy's oral productive skills are much lower than her receptive ability. Like Natalie, Shandy's weakest aspect of EFL oral proficiency is syntax.

The speech performance of Shandy and the other case studies vis-à-vis phonological working memory does not seem to point to systematic relationships between the two; Shandy, Ori and Natalie, who all have weak phonological working memory, have low speech performance, low-intermediate speech performance and good speech performance respectively. Aya, who does not have weak phonological working memory, has high-intermediate speech performance.

7.3.4 Phonological memory and phonological working memory along with phonological processing

Some provisional findings in this research are verified by Shandy's data analysis and others are modified. The basic dichotomy remains between Aya (who has very good EFL reading skills and does not have phonological working memory weakness) and the other three case studies (who have low phonological working memory and low EFL reading skills). However, Shandy, Ori and Natalie, who have weak phonological working memory, present varying degrees of weak reading among themselves and between the reading passages.

Reading - All three case studies' reading is marked by erratic decoding. In addition, all have weak phonological working memory. However, whereas Natalie's and Ori's decoding errors seem to be related to unstable auditory/phonological processing, Shandy's decoding errors do not, suggesting that there are additional factors involved in decoding ability. Given that the case studies all have weak phonological working memory which has been seen in former research to be related to weak decoding ability (see section 2.3.4), one of these additional factors could be phonological working memory. Consequently, in light of Shandy's data analysis it is proposed that erratic decoding may stem from a mixture of unstable auditory/phonological processing and weak phonological working memory.

Natalie and Ori's reading is marked by complete lack of inner voice, whereas Shandy manifests varying degrees of inner voice while reading. A qualitative analysis of the

data shows how lack of inner voice could be related to both phonological working memory and to auditory/phonological processing. In addition, given that phonological working memory is weak in all three case studies and auditory/ phonological processing varies among the three, it is suggested that lack of, or reduced, inner voice while reading may also stem from some combination of weak phonological working memory with weak auditory/phonological processing. In light of the research data analysis together with my personal experience with L2 language learners, I would like to suggest that lack of, or reduced, inner voice while reading could be more affected by the above phonological factors in L2 than in L1 due to slower acquisition processes of semantic value.

From the point of view of reading strategies Shandy's data support former conclusions that similar reading difficulties lead to different strategies with varying degrees of success. Phonological strategies were seen to facilitate reading in Natalie and Shandy.

In light of Shandy's data analysis following the former case studies' analyses, there seems to be a reciprocal relationship between phonological working memory and inner voice during reading mediated by auditory/phonological processing.

Vocabulary - Findings from Shandy verify some former findings from Natalie and Ori suggesting links between phonological working memory and L2 vocabulary knowledge. It is suggested that where vocabulary learning is done by word lists the very need to decode words brings phonological working memory into the equation. Phonological similarity and word length also seem to have an impact on all three case studies' L2 vocabulary knowledge, a fact which serves to link phonological working memory with L2 vocabulary knowledge.

Shandy's data analysis surfaces the possibility of manifesting unstable L2 sound representations in speech alone (as opposed to stable sounds in the reading). Shandy's speech, like Natalie's and Ori's, suggest that inconsistent L2 sound representations obstructs accurate storage of words which results in inaccurate retrieval.

From the point of view of a strategy for vocabulary learning (by lists), analysis of Shandy's data seems to give rise to questions rather than conclusions. Data provided by Ori and Shandy could suggest that the visual route to such learning is inefficient

or that it is inefficient only when the visual memory is weak. Natalie's data suggest that a combination of the visual and phonological route for this type of learning is inefficient as well. These, together with the fact that Natalie herself claims to have actually acquired vocabulary only by movies (Interview, 48, in Hebrew), could suggest that list learning is not the best of ways to acquire new L2 vocabulary.

Links between the context of learning and context of performance are somewhat modified by Shandy's data.

Speech performance – Shandy's data seem to support former conclusions as to there being no visible links between phonological working memory and speech production, especially after a certain threshold of vocabulary has been acquired.

7.3.5 visual memory and EFL performance

As stated earlier, research has shown that there is a relationship between some aspects of visual memory and reading (Mendez in Pickering, 2001a; Kyttala, 2008). The qualitative analysis of this research data relating to Natalie, Aya and Ori is in line with former research and points to possible aspects of reading which could be related to visual memory. In the framework of this research, two visual memory functions were looked at and were tested by different visual memory tests: visual spatial memory and visual sequential memory (see sections 3.11.3, 3.11.4).

In order to provide a clear basis for analysis I present Shandy's results on the visual memory tests and on the reading tests immediately below.

Table 7.11: Shandy - RCFT

Copy trial	Time to copy (seconds)	RCFT immediate recall	RCFT delayed recall	RCFT recognition
Percentile= >16	Percentile 240>16	40(% score=16) Rating=below average	36(%score=8) Rating=mildly impaired	54(%score=66) Rating=average

Table 7.12: Shandy - DTLA-A - Design Sequences

DTLA-A Design Sequences	
Shandy	9(% score=37) rating=average

Table 7.13: Shandy -EFL Reading

Name	Reading passage 1 (search reading)	Reading passage 2 (careful reading)	Reading passage 3 (mixed search and careful reading)
Shandy	66.6%	26.3%	100%

Reading

Word recognition processes vis-à-vis visual sequential memory

In section 6.3.4 it was suggested that there may be relationships between visual sequential memory and reading mediated by visual word recognition via the direct lexical route, and that visual word recognition was related to orthographic awareness. Shandy's visual sequential memory in the test I administered is defined as normative. However, Shandy's orthographic awareness and visual word recognition seems to vary across reading tasks. At times, her visual word recognition seems to be good, resulting in fluent reading and good comprehension, as demonstrated by her performance on reading passage number 3 and in various parts of the other reading passages, as seen below, where her reading is quite fluent and does not seem to require great effort:

SH: "<The information is relevant to the readers own lives.>" (Reading passage 2, 20, in English)

However, at times, Shandy's word recognition skills are much weaker and result in erratic reading and reduced comprehension as in the following:

SH: <Understand how science aaapeals to you >
T: Applies
SH: applies to you
T: What's "applies"?
SH: I don't know. (Reading passage 2, 36-40, the reading in English, the conversation in Hebrew)

One question to be asked is whether there are specific factors which account for Shandy's visual word recognition. Shandy's data analysis shows that she seems to have good visual word recognition via the direct lexical route when she has enough knowledge of the spoken language and good contextual understanding (as seen in the

first example and indeed in most of reading passage number 3). Shandy's visual word recognition is erratic when there is reduced L2 spoken language knowledge and contextual understanding. In addition, it seems that in many cases, Shandy's visual word recognition is erratic due to confusion between the target word and another word which is visually similar to it as seen in the example above and elsewhere.

Shandy's normative visual sequential memory may facilitate her orthographic awareness when her spoken language and contextual knowledge are adequate. When this is the case, similar distracting words have a less potential to confuse. In other words, normative visual sequential memory cannot operate as effectively and facilitate orthographic awareness, resulting in good visual word recognition, in conditions of reduced knowledge of the spoken language and understanding of the context. When this is the case similar distracting words have a much greater potential to confuse.

The above suggestion seems specifically relevant when reading is in L2, and knowledge of the spoken forms cannot be taken for granted. This actually means that the effect of visual sequential memory on L2 reading depends on the overall level of target language knowledge and that visual sequential memory is impeded in L2 reading before a certain threshold level has been acquired.

A qualitative analysis of Shandy's reading also suggests that, on the whole, her reading style is more global than phonetic. Shandy's natural inclination is to take in the whole word as a sequence of letters (top-down process) rather than to engage in decoding (bottom up process). This may be due to her visual sequential memory being better than her phonological working memory. However, Shandy does not always have enough knowledge of the spoken language to depend solely on a global reading style which requires visual word recognition. When this is the case, Shandy needs to turn to decoding for help, but Shandy's decoding skills are less than perfect and, therefore, sometimes result in her reading a word which bears resemblance to the target word instead of the target word itself.

In summary, Shandy's data analysis supports former suggestions as to relationships between visual sequential memory and reading mediated by orthographic awareness and visual word recognition, but also modifies them by proposing that there should be a certain threshold level of L2 spoken language as a basis for visual word recognition.

Shandy's data also support the notion of relationships between visual sequential memory and phonological working memory via decoding. However, the nature of the relationship is somewhat different from that observed in Natalie (See 4.3 and 4.5) and Ori (See 6.3.1 and 6.3.4). Whereas the data provided by Natalie and Ori show that erratic decoding ability at the onset inhibits visual word recognition because there is no phonological hook to initiate the process, data provided by Shandy show that, at times, good decoding skills are required in mid-process in order to prevent visual word recognition errors which may occur due to reduced knowledge of the spoken language.

Word recognition processes vis-à-vis visual spatial memory

Visual spatial memory, as used here, is thought to account for the ability to recognize the overall configurations of words. This is why the recognition phase of the Rey Complex Figure Test (which looks at the ability to recall visual stimuli with the help of retrieval cues) is very relevant in the context of reading. Shandy's performance on the recognition phase of the visual spatial memory test is normative.

A qualitative analysis of Shandy's reading shows that her reading errors do not stem from an inability to identify overall word configurations: she does not tend to confuse long words for short ones or vice versa. Rather than that, the confusion often derives from her transforming and replacing letters within words, a confusion which has been attributed to visual sequential memory, as discussed above.

In addition, visual spatial memory may also account for the ability to remember where specific bits of information are located in a written text whether via direct perception when the text is in front of the reader (recognition) or by means of surfacing it on to the visual spatial sketchpad (recall). When Shandy is asked how she learns for a test in History, she relates to what can be viewed as her visual spatial memory:

SH: I can eh I have eh A VISUAL MEMORY How do you say?
T: a visual memory...

.....

T: So you can remember by heart 500 pages?
SH: <u>Not 500</u>, but I can in a test I can remember where this LINE

.....

SH: line in the paper and I can really see while I write. (Dialogue, 90-102, in English)

It must be said that although Shandy claims to have an overall good visual memory, especially when she learns for tests in History, her memory tests do not confirm this observation of hers. Her ability to recall in the immediate and the delayed phase is weak, and only her ability to recall with the aid of retrieval cues is normative. I could not account for this dissonance in the framework of this research, nor is it the focus of this research. However, Shandy's ability to cope with higher level reading skills in reading passage 3, skills which demand the ability to locate specific bits of information in a written text in a reasonable amount of time, are in line with Shandy's normative performance on the recognition phase.

In section 5.5 it was suggested that a combination of visual sequential memory and visual spatial memory is needed in order to enhance good visual word recognition skills. This was suggested since only Aya who scored high on both visual memory tests presented good visual word recognition. Analysis of Shandy's data somewhat modifies this suggestion since Shandy seems to have normative visual sequential memory and normative visual spatial memory in the recognition phase which is relevant to reading, and yet her visual word recognition is not always good and varies across reading tasks. This observation, however, strengthens the suggestion that knowledge of the spoken language (in this case L2), contextual knowledge and good decoding skills, which require intact phonological working memory, are needed in order to enhance visual word recognition which requires intact visual spatial and visual sequential memory.

In summary, Shandy's data analysis supports suggestions as to possible relationships between visual spatial memory and reading mediated by visual recognition of overall word configuration and the ability to locate specific information in a given text. Shandy's data also support the idea that visual spatial memory alone will not suffice to achieve good reading. Moreover, it is suggested that even when visual sequential memory and visual spatial memory in the recognition phase are normative, adequate decoding skills (which depend on phonological working memory), adequate knowledge of the spoken language and an adequate understanding of the context are required in order for visual spatial and visual sequential memory to come into play effectively via visual word recognition.

Strategy

Shandy's way of learning vocabulary is not stated directly. However, Shandy does tell us that she started learning English with a friend of her mother's in first grade and that no reading and writing was involved. It is, therefore, assumed that in the initial stage of EFL learning Shandy acquired vocabulary auditorily and not visually. It seems that Shandy's EFL learning at this stage was effective since in the interview she maintains that *"I came to school, I already knew everything (pause) in English."* (Interview, 49, in Hebrew) In fact, Shandy's decline in EFL starts only in the 8th grade and although she can not point to any specific reason *"... I don't know. That's what I also don't know!"*(Interview, 61, in Hebrew), it may be that Shandy, like Natalie and Ori, finds it more difficult to acquire EFL in general, and EFL vocabulary in particular, when teaching becomes more rule and list oriented and less meaningful (as it often does at this stage). Shandy's vocabulary knowledge as seen in the research tests (low in the reading and 65% in the oral tasks) points to the fact that this kind of learning is not very effective for her. The fact that Shandy's vocabulary is better in the oral tasks than in the reading tasks may also serve to strengthen the notion that there are links between the context of learning (auditory) and the context of performance (oral).

How do these strategies compare with strategies utilized by the other case studies?

Visual strategies for vocabulary learning are successful for Aya who has a good visual memory, although she also complains that words are prone to decay over time (probably when not in use). Visual strategies for new word learning are unsuccessful for Ori who has weak visual memory. Likewise, visual strategies seem less successful for Natalie and Shandy in the advanced stages of EFL learning when words are generally studied by lists of vocabulary. Phonological strategies for new word learning are more effective for Natalie and Shandy: these strategies, applied mainly in the earlier stages of EFL learning, seem to have created a stable elementary vocabulary basis. Both Natalie and Shandy present better vocabulary knowledge in speech than in the reading.

The large variation in Shandy's performance across the reading passages points to the possibility that the strategies which Shandy utilizes for reading comprehension in English work well for specific text types, but are not enough for other text types. In reading passages 1 and 3, most of the tasks require search reading and involve

locating a specific bit of information in a specific part of the text. It may be that Shandy's normative visual spatial memory with the help of retrieval cues facilitates her spatial orientation within the text and enables her to cope with such tasks successfully. On the other hand, the tasks in reading passage number 2 require the ability to locate several pieces of information from several parts of the text and to integrate the information. It seems logical to assume that although both text types and question types require a strategy which involves visual spatial memory, more than this is required in order to cope with texts like reading passage number 2.

Summary

Shandy's data analysis supports former suggestions as to relationships between visual sequential memory and reading mediated by visual word recognition and confirms that a certain threshold of the spoken language (in this case L2) is needed as a basis for the visual process. It also supports the notion that a certain level of decoding is needed in order to trigger effective visual word recognition both at the onset and in mid process as seen here. This could suggest that in the context of reading, adequate phonological working memory is needed for visual sequential memory processes to operate effectively.

In addition, analysis of Shandy's data supports former proposals as to a relationship between visual spatial memory and the ability to identify overall word configuration and is in line with former suggestions as to there being a need for both visual spatial and visual sequential memory for good visual word recognition. However, it was seen that even this will not suffice when L2 is concerned. Here, adequate knowledge of the spoken language, adequate decoding skills and an understanding of the context are all required as a basis for the visual skills to operate effectively in visual word recognition processes.

Shandy's data analysis supports former findings as to visual strategies not being very effective for vocabulary learning especially when visual memory is not specifically strong. It also supports findings which point to phonological strategies for new word learning as being more effective and less prone to decay when applied (although phonological strategies are rarely applied in the more advanced stages of L2 learning).

Shandy's data are in line with former findings which suggested that visual spatial

memory is related to the ability to apply effective reading comprehension strategies when the tasks involve search reading, but not when higher integration skills are required.

The suggestion as to a relationship between the modality context of vocabulary learning and the modality context of performance (reading or speech) seems to apply to Shandy as well.

7.3.6 Auditory verbal memory and EFL performance

Analysis of the data provided by Natalie and Aya suggested possible links between certain aspects of EFL performance and auditory verbal memory. Analysis of the data provided by Ori modified this suggestion by proposing that such links could only be established after a certain minimal threshold level of EFL has been reached.

Shandy's results on the Rey Auditory Verbal Learning Test (RAVLT) which was administered in order to check auditory verbal memory are presented below in table 7.14.

Table 7.14: Shandy - RAVLT

RAVLT 1	RAVLT 2	RAVLT 3	RAVLT 4	RAVLT 5	RAVLT 6 proactive interference	RAVLT 7 retroactive interference	RAVLT 8 LTM	RAVLT 9 recognition
(SD=1.59)	(SD= 2.13)	(SD= 1.63)	(SD= 1.54)	(SD= 1.44)	(SD= 1.80)	(SD= 2.04)	(SD= 2.11)	(SD= 2.46)
+2.72	+0.60	+0.36	-1	0.67	-0.85	+1.04	+0.42	+0.32

Table 7.14 shows that Shandy's immediate auditory verbal memory is very good. In fact Shandy scored higher on this trial than did the former case studies (Natalie-table 4.4, Aya-5.4, Ori-6.4). Shandy's results on trials 2-5, however, show that rote repetition has a negative effect on her memory (although her scores are still considered normative). This kind of decline in memory from trial to trial resembles Ori's performance on these trials and could reflect fluctuation in concentration. Shandy does not seem to be specifically prone to interference and has normative long-term auditory verbal memory as well as normative auditory verbal recognition ability. Shandy's scores on LTM and recognition are like Natalie's.

In what follows, I attempt to see whether specific aspects of Shandy's performance in

the EFL tests are reflected in specific aspects of her auditory verbal memory. This is done by a qualitative analysis of the EFL data vis-à-vis the different trials of the RAVLT memory test.

When asked about difficulties in EFL, Shandy says:

SH: The grammar.
T: The grammar? And what about vocabulary?
SH: Also, but here I can use a dictionary so it's better. (Interview, 5-7, in Hebrew)

And:

SH: Speaking is the most difficult thing for me. (Interview, 23, in Hebrew)

Shandy's low score (50%) on productive syntax (in the oral tests) and her low score on reading vocabulary confirm this observation. Shandy's score on productive vocabulary (65%) and her overall score on accuracy in speech (60%) are within the low intermediate range.

Shandy's score on the first trial of the RAVLT memory test, which checks immediate auditory verbal short-term memory, is high. Given such good immediate auditory verbal short-term memory ability, one would expect Shandy to be able to remember words used by me as interlocutor, or translations provided in the course of on-line conversation. However, Shandy's ability to remember in these situations varies across the oral tests. At times, she uses the given word in the next sentence, as seen below when she uses the words *consider* and *save*:

SH: O.K but you need to (HOW DO YOU SAY TO CONSIDER)
T: consider
SH: You need to consider the environment we don't have a lot of water and we need to (HOW DO YOU SAY SAVE?)
T: save
SH: We need to save the water that we have. (Role play, 10-14, in English)

At times she can even remember words given to her at an earlier stage and use them again as happens with the word *clean* which is first given to her in turn 54 of the dialogue:

SH: It's eh HOW DO YOU SAY CLEAN?
T: Clean.
SH: clean?

T: clean

SH: It's clean now eh and eh most of the time it's clean but sometime I eh I don't have power to clean and I do (meaning /don't/) like this and eh maybe my mother come and clean my desk. (Dialogue, 54-58, in English)

Shandy remembers this word and uses it later in the role play:

*SH: So we clean him and *** he smell good.* (Role play, 36, in English)

This ability to remember the word may also have to do with the fact that in the first instance Shandy actually uses the word a number of times in the sentence. The fact that Shandy is able to remember this word in spite of her being engaged in cognitive activity in the time gap between turn 54 (dialogue) and turn 36 (role play) may be reflected in the 6th and 7th trials of the RAVLT which indicate that Shandy is not specifically prone to proactive or retroactive interference.

However, at times, Shandy cannot remember a word given to her one second before, as seen below:

SH: I can eh I have eh A VISUAL MEMORY How do you say?
T: a visual memory. So say that
SH: I don't remember
T: Visual memory. Say that: I have
SH: I have
T: a visual memory
SH: a visual memory. (Dialogue, 90-96, in English)
(Also see dialogue, 76-78, on the next page)

How can this uneven memory be explained? I would like to propose that Shandy's occasional difficulty with remembering EFL words in the short-term has to do with her difficulty with auditory/phonological processing in L2. When Shandy has a stable phonological representation of the word in her mind, she can remember it in the short term; however, when the phonological representation of the word is not stabilized, Shandy's otherwise good auditory verbal short-term memory cannot come into play. Therefore, the occasional drops in Shandy's ability to remember EFL words in the short term does not contradict her good performance on the first trial on the memory test pointing to good auditory verbal short-term memory but suggests that auditory verbal short-term memory might be impaired by erratic phonological processing.

Surprisingly, despite Shandy's good auditory verbal short term memory as reflected in RAVLT 1 and her normative performance on all other trials of this test, Shandy asserts that she cannot remember things learnt via the auditory modality:

SH: Writing and summarize and sometimes I need to read it and I understand. But to listen eh no! It's not work.

T: It doesn't work when you listen?

SH: No. Most of the case I learn alone not with teacher...(Dialogue, 64-66, in English)

How can this contradiction be resolved? It is possible that Shandy cannot learn via the auditory modality in class due to her not being able to focus her attention on what is said. Shandy herself points to her lack of concentration in class:

SH: I talk. I can't learn in the class.

T: But let's say if you were concentrated; if you tried to concentrate in the lesson and listen?

SH: ***Just*** *for 5 seconds something like that. I can't; I can't. It's a bad thing because I need to learn *** but I can't.*

T: So I don't understand now if you don't remember things that you listen to because your memory from hearing is less good or you never gave it a chance.

SH: No, I give it a chance. I give, but I can't I

T: What do you mean you give it a chance?

SH: I'm try all the time.

T: Try what?

SH: to HOW DO YOU SAY TO CONCENTRATE?

T: concentrate

SH: (can't say the word) in the class. I can't eh I can't. I'm try but I can't. (Dialogue, 68-78, in English)

An anecdote which may indicate Shandy's poor concentration is presented below:

SH: So, he cute.

T: who's cute?

SH: the cat.

T: the dog...

SH: (laughs) the dog. (Role play, 28-32, in English)

After discussing the poor dog for some time, Shandy is not focused enough to realize

we are talking about a dog, not a cat.

Interestingly, Shandy's inability to concentrate may be reflected in her performance on trials 2-5 on the memory test. As mentioned before, instead of improving from trial to trial as a result of repetition of the words in the list, Shandy's performance decreases from trial 2 to trial 4, and only improves on the 5th trial. These fluctuations may have to do with fluctuations in concentration ability.

So far, in the light of this discussion, Shandy's data analysis does not contradict former findings that point to possible links between auditory verbal memory and the ability to remember auditorily presented meanings of new words and utilize them in the short term. Erratic auditory phonological processing might interfere with this ability. In addition, proneness to interference as reflected in RAVLT 6 and 7 may be related to the ability to remember auditorily presented information in the longer term.

Auditory recognition in speech

When Shandy is asked about EFL performance, she says that, for her, the least difficult thing in EFL is comprehending speech (see interview, 14-15). This observation is confirmed by her score on the comprehension factors in the dialogue and role play which are both rated 90%. Shandy's good comprehension in EFL may be reflected in her normative score on the recognition phase of the RAVLT memory test. It must be said, however, that Shandy's comprehension score in the EFL tests reflects more than her ability to recognize vocabulary, since this kind of performance necessitates syntactic comprehension as well. Therefore, the RAVLT may only partially account for the comprehension score. This finding supports findings from Natalie and Aya as to possible links between speech comprehension and auditory verbal memory via recognition. Ori's findings somewhat modified this suggestion and added the suggestion that this relationship cannot occur before a minimal threshold level of L2.

Retrieval in Speech

According to Shandy, for her, speaking in English is the most difficult skill, more difficult than listening comprehension, reading and even writing (see interview, 23). Shandy's scores on the EFL oral tests show that her main weakness in EFL is in the domain of syntax, rather than vocabulary. Shandy's score on the syntactic aspects of

EFL speech is 50%, whereas her score on the use of vocabulary in speech is 65%. Shandy's normative ability to use vocabulary in speech may be reflected in her normative performance on the 8th trial of the RAVLT memory test which checks auditory verbal long-term memory. The reason that the RAVLT memory test does not reflect Shandy's ability to use vocabulary in a grammatical way may have to do with the fact that the RAVLT memory test uses single words as stimuli and measures the subject's ability to retrieve words, whereas the ability to build sentences in a grammatical way involves the ability to remember the way in which a number of words are chunked together, in addition to the underlying rules which are the basis for constructing an infinite number of sentences. In addition, it may be that the ability to remember chunked words or morpho-syntactic word manipulations may be connected to phonological processing ability. This would be in line with data from Natalie and Aya; like Shandy, Natalie, who is seen to commit errors due to erratic phonological processing, has normative auditory verbal long-term memory and normative productive vocabulary but weak productive syntax. Aya, whose phonological processing is intact, has normative auditory verbal long-term memory, normative productive vocabulary and normative syntax.

In conclusion, data from Shandy's transcriptions support former suggestions as to there being relationships between auditory verbal long term memory and word retrieval in EFL speech. Auditory verbal long term memory, as measured by the RAVLT trial 8, seems to be less linked to memory for longer chunks, due to phonological processing factors and grammatical rules.

Although Shandy's productive vocabulary scores 65%, the level of words Shandy can comprehend when used by the interlocutor is much higher than that she can produce herself and the level of syntax Shandy can understand is much higher than the level of syntax she can produce. It may be that the ability to retrieve words on-line in speech as well as the ability to remember short sentences as chunks has to do with the modality context in which these elements have been acquired. The elementary level of English, which Shandy studied orally in her pre-reading era, is retrieved easily and put to use in speech whereas the higher levels, which are studied visually, are more easily recognized than retrieved. The following quotation serves to illustrate my point:

T: O.K, let's say that you don't understand something, what do you do with it?

SH: Eh, call a friend. (said it unclearly)
T: You
SH: Calling to my friend. (Dialogue, 137-140)

Shandy's initial instinct (which may be due to auditory memory) is correct. However, she is insecure and starts thinking. Paradoxically, it is her thinking that leads her to the erratic outcome. Shandy's thinking probably involves the modality through which she had originally learnt. It is reasonable to assume that in this instance Shandy's application of various grammatical rules, studied visually, results in erratic syntax. These finding verify findings from Natalie and Aya as to there being links between the modality of learning and the modality of performance and adds a suggestion that retrieval is more sensitive to the modality factor of learning than recognition.

Summary

Findings from Shandy support former findings as to possible links between auditory verbal short-term memory and the ability to utilize words or translations provided on-line in the course of speech.

Suggestions as to possible links between auditory verbal memory via recognition and vocabulary recognition in speech are supported by Shandy's performance.

Findings from Shandy strengthen former proposals as to there being relationships between auditory verbal long-term memory and word retrieval in speech. These links do not seem to exist when the elements retrieved are longer chunks or grammatical rules.

The notion of possible relationships between the modality of learning certain aspects in EFL and the modality of performance is supported by Shandy's data. In addition, it is proposed that retrieval is more prone to the factor of acquisition modality than recognition.

7.3.7 Central executive function and EFL performance

Analyses of the former case studies on issues of EFL performance vis-à-vis the central executive function, point to the probability of there being links between the central executive function and higher level language skills in EFL.

A qualitative analysis of Shandy's data is presented in an attempt to see whether this analysis leads to suggestions compatible with this position. Shandy's results on the Active Memory – Complementing Words test which was administered to the subjects in order to check the central executive function is -1.64. The rating is below average and resembles that of Ori.

When Shandy points to difficulties in EFL she says:

Speaking is the most difficult thing for me. (Interview, 23, in Hebrew)

Theoretically speaking, it seems logical to assume that weak central executive skill is related to L2 speech difficulties since, when a foreign language is concerned, of the four language skills (reading, writing, listening and speaking), speaking seems to require the most on-line integration ability.

A qualitative analysis of Shandy's speech shows that when she speaks it is usually in very short phrases or sentences. She manages to avoid long speech acts even when asked questions which require longer descriptions:

T: So what happens? Just describe if you were studying for a test in History and the tape recorder were on. What would have happened?

SH: I can't eh=

T:=You can't what

SH: I can't learn.

T: Describe what goes on in your brain.

SH: Nothing.

T: (laughs)

SH: I can't.

T: When did you find this out?

*SH: ***long time.* (Dialogue, 15-24, in English)

Or:

T: When you sit to study, is your room can you study in a messy room or does it have to be organized or Describe your room when you study.

SH: It's not matter.

T: Its

SH: Its not matter.

T: Ahha. Describe your desk. (She looks as if she doesn't understand what I want) Describe it. Just now, can you remember what's on your desk.

SH: Now? Nothing.

T: Nothing? It's clean? And usually?

SH: Yes.

T: What yes?

SH: It's eh HOW DO YOU SAY CLEAN?

T: Clean.

SH: clean?

*T: clean (*Dialogue, 45-57, in English)

Although Shandy's short staccato style could be due to lack of vocabulary, as discussed in former sections, it could also be due to her finding it difficult to integrate the elements which may be in turn due to a weak central executive function.

When Shandy actually does try to develop an idea, her speech is erratic to the point of not making herself understood:

T: What motivates you?

SH: to succeed. I want to succeed. Not if I look to another man how he succeed. I want to succeed by myself eh; I want to get to the higher level than I can. I'm not looking for someone else eh want to get to eh want to get (pause) to where he go eh he get. (Dialogue, 121-122, in English)

It seems here that the need to integrate thoughts, words and syntax is too difficult. Shandy herself points to the grammar as being the most difficult element in EFL for her to acquire. By this stage of their EFL studies, the case studies have learnt most of the grammatical rules of the English language. However, there is a big difference between being able to quote the rules and being able to apply them in speech. It seems that the ability to apply grammatical rules in on-line speech requires much integration ability. Once more, therefore, weak central executive skill may be partially responsible for erratic output.

These findings support findings from former case studies which suggest that central executive skill is involved in higher level speech skills in general and the grammatical aspects of speech in particular, (on the level of the sentence and above) in EFL.

An interesting issue which seems relevant at this point is the distinction between the central executive function in speech and automaticity in speech, or rather, to what extent does the central executive function require conscious cognitive effort and

when and to what extent is the integration automatic and requires no conscious cognitive effort. This issue is discussed in more detail in chapter 11.

Shandy claims that reading comprehension passages have become more difficult in this final year of high school (see interview, 38-39), and that, more generally, at a certain stage EFL studies became difficult:

In 8th/9th grade the ability to study English stopped. It is sort of difficult for me to learn this language. (Interview, 57, in Hebrew)

When asked to pinpoint the reason for this, Shandy is at a loss. I would like to suggest that the reading comprehension texts in the final year of high school are longer and involve more complicated syntax and, therefore, require more integration ability. It seems logical to assume that both length and grammatical complexity count independently as factors which might burden the central executive which is limited in capacity. Length counts because the more elements there are to store in memory while processing on-coming information and retrieving additional elements from long-term memory, the more difficult it is to integrate; grammatical complexity counts because of the difficulty of processing the on-coming information itself. Shandy's performance on the research reading tests may suggest how the differences in text types affect reading comprehension ability.

One of the most striking features in Shandy's reading comprehension tests is the large gap between her ability to deal with reading passage 3 (in which she scored 100%) and her inability to cope with reading passage 2 (in which she scored 26.3%). The main difference between these two passages may lie in the fact that both the questions and the text in reading passage 2 require a greater deal of integration ability than those in reading passage 3. For example, the second question in reading passage 3 asks:

"According to paragraph 2, before the 1980s, European companies did not use much English because:

1.....

2....."

The answer to this answer can be easily found by scanning the text and looking for the figure *1980*. The text reads:

"Before the 1980s, companies in Europe generally sold products in their own countries, and hired workers locally."

On the other hand, the first question in reading passage 2 reads:

"Which of the six reasons specifically mentions the following?
WRITE NUMBERS OF <u>THREE</u> REASONS (<u>ONE</u> NUMBER IN EACH SPACE.)
.....a) The magazine offers many different options.
.....b) The information is relevant to the readers' own lives.
.....c) This magazine has an advantage over similar magazines."

This question seems to require integration ability in order to understand the task. The question is phrased such that it conflates what needs to be found out, where this information should be taken from and how to write the answer. There may also be vocabulary comprehension issues involved. All these burden the integration processes required in order to understand the question. The task itself also requires a large degree of integration. First, the information is spread all over the text and cannot be located by search reading alone. Second, one must be able to juggle pieces of information from the question and the text in order to tackle this task. Shandy's weak performance on this task may be related to weak central executive skills. The oral protocols following this question show that although Shandy was able to understand the question parts, the whole picture became completely clear only after my mediation:

T: What do they want to know?

SH: To read all the three and each is related to, sort of what is the main idea of each paragraph.

T: I don't understand; explain it to me again.

SH: I read this, this and this (points to a) b) and c) and see in which paragraph they talked about it.

T: O.K so you have understood. And where do you find your answers? Can you take them all from one paragraph or not?

SH: No. There are other things as well.

T: No, I mean to emphasis that you are asked to take your answer from three different reasons.

SH: Yes.

T: namely you can't take all three from the same reason even if the text allows it.

SH: Yes. (Reading passage 2, oral protocols, 7-16)

The following excerpt also shows that although Shandy is able to understand separate question parts, her understanding of the complete task is erratic:

SH: <Copy two (hesitates) p eh (pause)>

T: phrases. Phrases are parts of sentences, right?

SH: Ye <that show that the magazine deals with new developments?{Intonation of not understanding}.

T: What's "new developments"?

SH: (gives the correct word in Hebrew)

T: So the emphasis is that you have to copy parts of sentences that show that it deals with?

SH: The newest latest developments.

T: Right. And again you have to take it from?

SH: Two=

T:=Two of the six reasons. You didn't do it correctly. Both things you wrote are incorrect. "Giving you all sides of the story" is what you wrote. Where does it say something about new developments?

SH: It doesn't.

T: "Presents a variety of viewpoints" (was the second thing she wrote).

SH: No, I probably didn't understand the question right. (Reading passage 2, oral protocols, 94-106)

Shandy's better ability to cope with small parts of the text along with her difficulty in comprehending the whole picture may again point to the correctness of assuming the involvement of central executive skill in higher levels of reading comprehension.

One of the difficulties in looking for relationships between EFL performance and central executive skill is that of distinguishing between weak performance due to difficulties in the integration process itself and weak performance due to errors in the components fed into the integration. When the separate components are very erratic the distinction is problematic. One of the ways to distinguish between the two is to look at language performance in L1 where it is less likely that vocabulary and syntax pose a problem. Ori's data analysis showed that she has difficulties in language integration in L1 as well. This led me to suggest that her difficulties in EFL derive from erratic integration as well as erratic information fed into the integration process. Shandy, on the other hand, does not seem to have difficulties in L1. However, when asked about her performance at school she names Bible studies as problematic:

*Bible and English. **These** are the subjects that I specifically hate. Hate because I don't succeed in them.* (Interview, 85, in Hebrew)

Interestingly a part of the matriculation test in Bible includes unseen passages for the students to analyze. Since the vocabulary and syntax of biblical Hebrew are

somewhat different (although not completely different) from the everyday language, coping with biblical reading resembles, to a certain extent, coping with reading in a foreign language. Shandy's difficulties in Bible lessons could have to do with weakness in the auditory/ phonological modality, as discussed in section 7.3.1. However, difficulties in biblical reading comprehension in Hebrew may be similar to difficulties in L2 reading comprehension due to difficulties in integration as well. First, the components for integration (vocabulary and syntax) may not be completely clear to the reader. Second, the integration process itself may be burdened by this lack of clarity. If on top of this, the central executive function is weak, the end result of the integration process might be quite erratic. Therefore, Shandy's difficulty in Bible lessons may be another indication of the involvement of central executive skill in L2 written language integration.

These findings are also in line with former findings suggesting that the central executive function is involved in higher level reading skills in EFL.

In summary, findings from Shandy are in line with findings from the former case studies and suggest that the central executive function is involved in higher level speaking skills and higher level reading skills in English as a foreign language.

7.4 Shandy - general summary EFL performance vis-à-vis memory profile

Shandy's EFL school achievement is between intermediate to low intermediate. Her oral vocabulary is low intermediate and her vocabulary in the reading is low. Shandy's syntax in speech is weak. Shandy's performance on the EFL reading tests is characterized by a large variance across the reading passages. Her difficulties in reading are partially due to low-level reading errors and partially due to problems in higher-level comprehension. Shandy's speech comprehension is good, but speech production is much weaker and could be described as low intermediate. Shandy's low intermediate oral vocabulary range and low vocabulary range in the reading may be related to her weak phonological working memory; weak phonological working memory may be the reason for her erratic decoding which reduces the effectiveness of learning new vocabulary by lists. In addition, Shandy's vocabulary knowledge was seen to be affected by phonological similarity and word length, which have both been related in memory literature to phonological working memory. Shandy's

difficulty with correct storage of new vocabulary items seems to be linked as well to a difficulty in maintaining stable representations of English sounds. This may be related to erratic phonological processing in speech. Shandy's list learning strategy for vocabulary learning may also be affected by the fact that her visual spatial memory (via recall) is weak and the global lexical route cannot be utilized effectively for new word learning. Syntax is the weakest aspect of Shandy's EFL performance. This may be related to her weak phonological working memory resulting in reduced inner voice in speech which decreases the correct triggering of chunks and collocations. It may also be related to her weak central executive function which impairs the process of integration of separate words/chunks into coherent sentences and longer spoken texts. Shandy's reading ability is a mixed bag. Some of Shandy's low-level reading difficulties derive from erratic decoding which may be related to her weak phonological working memory. When Shandy encounters low level reading difficulties, she utilizes phonological strategies such as self-mediating decoding and word repetition, which seem to be helpful. Shandy's low level reading is better when she is familiar with the spoken language. When this is the case, her normative visual sequential memory and visual memory via recognition may facilitate her orthographic awareness, which, in turn, boosts visual word recognition. Shandy's successful search reading may also be attributed to her normative visual spatial recognition memory as well as normative visual sequential memory. Shandy's difficulty with careful reading which requires a high degree of integration may be related to a weak central executive function. Shandy's receptive and productive oral skills are very different from each other. Her good speech comprehension may be partially attributed to her good immediate auditory verbal memory and overall normative auditory verbal memory. Shandy's better ability to retrieve single words may also be related to her normative auditory verbal memory. However, Shandy's overall speech performance is much weaker than her comprehension and seems to be connected to a number of factors. First, weakness in the building blocks (vocabulary range and syntax) undoubtedly restricts her speech performance in English. Second, Shandy's difficulty with the production of complex sentences and longer spoken texts seems, like her difficulty with careful reading, to be related to a weak central executive function.

Chapter 8: case 5 – Omer

8.1 Introduction to case 5 – Omer

In this chapter I examine the data provided by Omer (case 5), once more looking to justify or modify former findings. In addition, as before, I attempt to detect possible additional patterns which may emerge in the course of the analysis.

Omer is a 17 and a half year old boy in the final year of High school. At the end of the year Omer would take the 5 point matriculation test in English. When asked about his present and past performance in EFL Omer says:

...Average. I was never a great success but I never failed. I never scored less than 70%. I think that it's the same now: average, that's it. (Interview, 10, in Hebrew)

Omer has not had private tutoring in English on a regular basis, but at the end of 9th grade, when EFL grades could determine whether a pupil is accepted into the academic (as opposed to vocational) classes in high school, Omer decided to take some private lessons. When asked whether or not these lessons had been helpful Omer says:

O: Ye, sort of, especially where technique was needed cause English is all about technique in exams.

T: Do you mean strategies for reading comprehension questions?

O: Ye, reading comprehension and all sorts of small things like in the clozes there are always things that are repeated and in unseen passages. (Interview, 14-16, in Hebrew)

Omer makes a distinction between reading in English for fun or personal interest, which he does occasionally, and the kind of reading comprehension needed in order to succeed in EFL tests at matriculation level. Omer claims that the latter is much more difficult to cope with since he does not have enough strategic knowledge. His difficulty with strategy on reading comprehension tests stands out even more as he claims that the easiest aspect of English for him is reading books:

T: What is the easiest thing in English for you?

O: I read books... (Interview, 23-24, in Hebrew)

When asked what aspect in EFL is most difficult for him, Omer says:

O: Grammar, grammar and obviously also to express yourself. It's a foreign language and you need to think ahead. It's not a native tongue so you think in Hebrew and then you translate it in your head to English so that you don't say

complete nonsense so it always takes more time. (Interview, 18, in Hebrew)

Omer relates to vocabulary in English and adds:

Apart from that eh vocabulary, vocabulary is O.K but also sometimes you get stuck for a word so you can't express yourself fluently and it's English. What can you do, a foreign language; what can one do? (Interview, 18, in Hebrew)

Apparently, Omer had spent between three to four months in the United States in the previous year. I asked him about the experience as far as language was concerned:

T: How was it there from the point of view of English?

O: When I came back from there my level was O.K, actually really fine.

T: Did people understand you?

O: O yes.

T: How old were you?

O: It was last year, about 16.5. I was understood, yes. I had friends; I still keep in touch with them.

T: In English?

O: My accent is bad. I have a difficult accent; a very Israeli accent. I still have.

T: So they found it difficult to understand you?

O: Ye

T: Did you find it difficult to understand them?

O: No, not really, apart from the slang that you acquire with time. (Interview, 27-38, in Hebrew)

Omer reported that all foreign students in the American school he attended were given extra help with English language in what they call ESL classes. Omer was placed in the highest level ESL class which he claims was quite difficult for him.

Omer's attitude towards school (back in Israel) is a mixed bag. On one hand he is very much aware of the fact that he needs to do well in school in order to secure an academic future. On the other hand he does not think very highly of school and he claims that school has not really been able to get him interested. When asked about motivation he says he is motivated by success, but does not seem to be willing to facilitate success by studying at home and does not seem to be bothered by his overall middling achievements:

*O: *** I'm not a very good student but=*

T: =But you're a motivated student?

O: Yes, I think so.

T: Do you think that you should get better grades in relation to the time you put in studying?

O: No, I put like eh 3 hours a week study something like that and af just just before tests... (Dialogue, 112-116, in English)

And:

T: If you don't succeed in something, what do you do with this?

O: Nothing (smiles), I mean I If I just failed in a English test so next time I do eh I do my best, but it's not so it's not so critical I mean it's just eh it's just eh studies and Idunno it's not my important thing in my life. (Dialogue, 131-132, in English)

Although Omer does not have any idea as to what he would like to do in the future, he says that he certainly knows what not:

O: Yes, I know what not. The elimination eh eh the elimination O.K, so I know that I 'll not gonna study Geography or eh eh History or something like that. I like Math or eh *** (Interview, 130, in English)

Interestingly, Omer is an avid player of chess. It seems that he finds chess much more cognitively challenging than what he does at school.

In the next section I present a numerical overview of Omer's results on the different tests along with my interpretation of these results.

8.2 Omer – test results

8.2.1 EFL oral and reading tests

Table 8.1: Omer - Dialogue

Communicative ability	points	Accuracy	points	Final grade
Comprehension of questions	95%	Incorrect/correct use of simple/complex language structures	50%	
Non-fluent/fluent Interaction	65%	Limited/basic/rich vocabulary	80%	
Gives single word/simple sentence/extended answers	80%	Poor/mostly comprehensive/comprehensible pronunciation	70%	
Total communicative ability	80%	Total accuracy	66%	**73.3%**

Table 8.1 shows that there is a large gap between Omer's communicative ability and his accuracy. Omer can communicate in English, he understands his interlocutor very

well and the level of elaboration in his reactions is quite suited to the nature of interaction. However, his speech is not fluent and is characterized by numerous hesitations and repetitions. Omer's weakest point is syntax which is erratic throughout. This is in contrast to a much higher vocabulary range. His pronunciation is generally comprehensible, but marked with a very strong foreign accent.

Table 8.2: Omer - Role Play

Communicative ability	points	Accuracy	points	Final grade
Comprehension of questions	95%	Incorrect/correct use of simple/complex language structures	50%	
Non-fluent/fluent Interaction	60%	Limited/basic/rich vocabulary	75%	
Gives single word/simple sentence/extended answers	80%	Poor/mostly comprehensive/comprehensible pronunciation	70%	
Total communicative ability	78.3%	Total accuracy	65%	**71.65%**

Table 8.2 shows that Omer's performance on the role play is similar to, but slightly weaker than, that on the dialogue. His fluency, which is weak in the dialogue, is even weaker in the role play and his vocabulary, which is quite good in the dialogue, is less so in the role play.

Table 8.3: Omer - EFL Reading

Name	Reading passage 1 (search reading)	Reading passage 2 (careful reading)	Reading passage 3 (mixed search and careful reading)
Omer	100%	73.6%	82.6%

Table 8.3 points to the fact that, on the whole, Omer has a good reading comprehension. His weakest performance is on the passage which involves much careful reading and integration between text parts and his best performance is on the passage which requires mainly search reading.

8.2.2. Memory tests

Table 8.4: Omer - RAVLT

RAVLT trial 1	RAVLT trial 2	RAVLT trial 3	RAVLT trial 4	RAVLT trial 5	RAVLT trial 6 (proactive interference)	RAVLT trial 7 (retroactive interference)	RAVLT trial 8 (LTM)	RAVLT trial 9 (recognition)
+1.49 (SD=1.59)	+1.47 (SD=2.13)	+0.84 (SD=1.63)	-0.92 (SD=1.54)	+1 (SD=1.44)	+0.32 (SD=1.80)	+0.40 (SD=2.04)	+0.47 (SD=2.11)	-0.13 (SD=2.46)

Table 8.4 indicates that Omer's auditory verbal memory is normative. Somewhat reduced scores on trial 3 and 4 could point to a certain drop in concentration; however, the decrease is not very meaningful and is no longer apparent in trial number 5.

Table 8.5: Omer - Rey Complex Figure Test (RCFT)

Copy trial	Time to copy (seconds)	RCFT immediate recall	RCFT delayed recall	RCFT recognition
Percentile= >16 normative	600 Percentile</1 Very low	<20(% score=<1) Rating=severely impaired	24(%score=<1) Rating=moderately to severely impaired	54(%score=66) Rating=average
Qualitative features of performance: In the copy tria,l does not seem to grasp the whole picture. He copies each detail as an individual entity and works very slowly. In the memory, sees the complete picture, but misses many details.				

Table 8.5 shows that, on the whole, Omer's visual spatial memory is weak. The quality of his copy trial suggests that his visual perceptual and visuo-motor integration skills are intact. The fact that it took him a long time to copy may indicate reduced speed of cognitive processing. Omer's weak performance on the immediate and delayed recall trials points to reduced visuo-spatial recall ability, but his recognition ability is better and is defined as normative. Omer's overall memory profile, as seen in the RCFT test, points to a pattern of difficulty in retrieval which can be improved significantly when given retrieval cues.

Table 8.6: Omer - DTLA-A - design Sequences, Active Memory - Complementing Words, Shatil Syllable Range Test

DTLA-A Design Sequences	6(% score=9) rating= below average
Active Memory-complementing words	1.09 Rating= above average
Shatil syllable Range Test	High

Omer's low score on the Design Sequences test points to a difficulty in remembering visual sequences, but his high score on the Active Memory test points to strong central executive skills which involve the ability to deal simultaneously with processing, storage, retrieval from long-term memory and correlating between oncoming information from both modalities and his performance on the Shatil Syllable range test indicates that he does not have difficulties in phonological working memory.

8.3 Omer – Data analysis Data analysis vis-à-vis Shandy, Ori, Aya and Natalie

8.3.1 Phonological memory and phonological working memory along with auditory/phonological processing and EFL reading

Omer's performance on the phonological working memory test was high.
Omer is quite a good reader (See table 8.3). Reading passage 2, which requires high level reading skills and good integration ability, is more difficult for him, whereas passages 1 and 3 are easier for him. In comparison to the other case studies, Omer's reading is more like Aya's (See table 5.3) than Shandy's , Ori's or Natalie's (See tables 7.3, 6.3, 4.3).

The analysis below has to do mainly with phonological working memory since Omer's reading comprehension was basically good and he was not asked to read aloud. The assumption is, therefore, that his phonological processing of sounds in the reading process is not problematic.

Research has shown that there are links between phonological working memory and reading in L1 and in L2 (see section 2.3.4). On the whole, the fact that Omer is an overall good reader in EFL and does not have visible weakness in phonological working memory supports former research on this issue. However, the fact that Omer's overall good reading varies between the reading passages may suggest some further distinctions. Omer's performance on the reading tests shows that he does not have difficulty with decoding or comprehending sentences which have a logical progression. This is also apparent from his interview when he says that he reads books in English (Interview, 23-24, in Hebrew). His difficulty seems to be related to reading that requires a high degree of integration. This distinction may point to the possibilities that phonological working memory is linked more to low level reading skills in L2, including decoding and comprehension on the intra-sentential level, and that higher level reading skills in L2 may involve additional memory factors. These suggestions are also in line with findings from Shandy, Ori and Natalie who have weak phonological memory and varying degrees of weak L2 low level reading skills. It could also be partially supported by Aya, who, like Omer, does not have weak phonological working memory and has strong L2 reading skills. However, unlike

Omer, Aya has both strong L2 low level and high level reading skills. The reason for Omer's being less successful with higher level reading skills may have to do with the strategy he uses and which is discussed in the next section.

Strategy for reading

As mentioned above, Omer does not seem to have difficulty with decoding or with understanding sentences. Neither does he seem to have difficulty with comprehending stories which have a straightforward logical progression as in novels. Therefore, Omer does not need to turn to any additional strategies to help him cope with these aspects of reading. However, when it comes to higher level academic reading, Omer finds it much more difficult, and it is then that he turns to other strategies for help. In his interview, Omer says that he had taken some private lessons "*especially where technique was needed cause English is all about technique in exams.*" (Interview, 14, in Hebrew). The kind of strategy usually taught in order to help students cope with reading comprehension passages teaches them to look for cue words in the questions and in the text. Omer seems to have benefited from this strategy which actually builds on an ability to recognize surface visual cues, especially when the questions require search reading. From the point of view of memory, visual recognition memory now takes the lead.

This finding points to an additional direction. When visual strategies are less helpful as is the case when high degrees of integration are required, Omer turns to a self taught strategy: the strategy of translation. In his interview, Omer repeatedly mentions translation as a major strategy when dealing with EFL.

"It's a foreign language and you need to think ahead. It's not a native tongue so you think in Hebrew and then you translate it in your head to English so that you don't say complete nonsense so it always takes more time". (Interview, 18, in Hebrew)

Although in the quotation above Omer relates to speech, translation strategy is apparent in his reading as well. I observed Omer while he was dealing with the reading passages and it was quite clear that when he encountered difficulty (especially in reading passage 2), he mumbled to himself in Hebrew as if he were building a security link between the question, the text and the answer. Interestingly, Omer did not do this when he could go straight from the question to the answer via visual cues, but only when complete comprehension was needed as a basis for further integration, and when simple scanning or search strategy was not enough.

Taking into consideration that translation ability initially depends on the ability to read the word in L2, phonological working memory has a role insofar as decoding is concerned. However, from this point onwards, it seems that Omer's reading strategy excludes phonological working memory from the equation. There is no possibility for L2 inner voice since L2 sounds are converted to L1 words. In fact, in some respects, Omer excludes L2 altogether thus turning the task to an L1 verbal task. The degree of success in Omer's translation strategy when dealing with L2 reading, which demands high levels of integration, is limited. In fact, it may be that his translation strategy interferes with integration ability and that the translation process burdens simultaneous storage and processing procedures in the central executive by taking up more time and capacity. This could explain why Omer, who scored well on the central executive test, had difficulty in L2 reading which demanded integration. (Omer's EFL performance vis-à-vis central executive function is discussed in section 8.3.7).

Summary

Findings from Omer's reading support findings from Shandy, Ori, Aya and Natalie as to possible links between phonological working memory and reading. Omer's relative difficulty with integration-oriented reading suggest that phonological working memory may be related more to L2 lower level reading skills and that additional memory factors are involved in higher level reading skills which require integration.

From the point of view of strategy, Omer's acquired visual strategy for dealing with L2 higher level reading skills (specifically search reading) is effective, whereas Ori's visual strategy for dealing with low level reading skills is not. Shandy and Natalie, on the other hand, do benefit from phonological strategies for dealing with low level reading skills. Omer alone uses translation strategy for dealing with high level integration oriented reading with a limited degree of success.

8.3.2 Phonological memory and phonological working memory along with auditory/phonological processing and EFL vocabulary

Below are the test results showing vocabulary scores in the oral proficiency tests and an estimation of vocabulary knowledge in the reading comprehension passages based

on the case studies' oral protocols.

Table 8.7: Omer, Shandy, Ori, Aya and Natalie - vocabulary knowledge

Vocabulary knowledge	Oral dialogue	Oral role play	Reading passages
Omer	80%	75%	Very high
Shandy	65%	65%	Low
Ori	40%	40%	Very low
Aya	75%	75%	Very high
Natalie	65%	65%	Low

Table 8.7 shows that Omer/s vocabulary knowledge in the reading is much better than in speech and that his vocabulary in the dialogue is slightly better than in the role play. Of all the case studies, Omer's vocabulary profile is very similar to Aya's.

School practice/list learning

In former chapters I raised the possibility that one way in which L2 vocabulary may be related to phonological working memory relates to the fact that EFL teachers often require pupils to study L2 vocabulary via word lists. When this is the case, decoding ability, which has been seen to be related to phonological working memory, becomes a factor in EFL vocabulary acquisition. Omer's data seem to support this since his vocabulary knowledge (especially in reading) is high. Omer and Aya's memory profiles and vocabulary profiles are very similar. They both have normative phonological working memory and high vocabulary in the reading but a less impressive vocabulary in speech. This suggests that there are factors which distinguish between the ability to comprehend vocabulary in reading and the ability to utilize vocabulary in speech. This also suggests that whereas a good phonological working memory may facilitate list learning vocabulary, this kind of vocabulary knowledge may be more utilized in reading than in speech. In fact, list learning vocabulary may have a detrimental effect on speech as is discussed in section 5.4.
In addition, it seems logical to assume that when it comes to vocabulary use in speech there are other factors involved. Possible factors are auditory retrieval ability and automaticity. One factor suggested as underlying retrieval ability is L2 sound stability.

Words as unstable sounds for storage and retrieval

Although Omer does not seem to have unstable sound representations in the reading, when he speaks he does not seem to be walking on safe ground. In the following example Omer remembers the beginning sounds of the word, but cannot retrieve the rest. The fact that I supply the second part of the word does not help:

O: Idunno it's just if I read something so I have to be very eh con con con

T: cen

O: concen (pause)

T: concentrated?

O: Ye O.K and if someone eh call me or my mother is eh eh cooking so eh I can't eh study very well. (Dialogue, 8-12, in English)

In this case, Omer does not even repeat the word after me. Instead of repeating the word, he says "*Ye O.K*" and continues with the sentence. In the following example, Omer, again, can retrieve the beginning of *civil studies* but is not sure whether it is *ci* or *ce*, *vil* or *vial*. This time, however, he does repeat after me, perhaps because the word is less complicated:

O:...But in History and eh ci ce civial s

T: civil studies

O: Ye civil studies... (Dialogue, 72-74, in English)

In the next example, Omer knows that the word includes */ch/* and he wrongly starts with this sound. Although there is an immediate self correction, this kind of slip may indicate problematic sound processing:

O: Ye, Ye. If I'm learning in the ch kitchen and she is cooking so... (Dialogue, 14, in English)

The last example has to do with vowel aspiration as was seen with Natalie and Ori:

O: No. eh O.K I'm heating and while I'm studying at at in the same time. (Dialogue, 36, in English)

The fact that Omer does not seem to manifest sound confusion in reading, but presents many sound confusions in speech, may derive from his successfully using the letters in order to anchor the sounds. This could be due to his normative visual recognition ability which is discussed in section 8.4. However, when left to

auditory/phonological processing alone, his sound representations are shaky. Unstable L2 sound representations may cause erratic storage resulting in erratic retrieval of words. It might also cause a level of insecurity in using words as discussed in section 7.3.7. Omer's lower vocabulary scores in speech may, therefore, be a result of erratic auditory/phonological processing of L2 sounds along with insecurity in using L2 words. It may be that Omer's difficulty with English pronunciation also stems from this erratic auditory phonological processing.

These findings add to former findings regarding links between erratic L2 sound representations and L2 vocabulary knowledge. Unstable L2 sound representations manifested in Ori and Natalie's reading and speech seem to affect vocabulary knowledge in both. Unstable L2 sound representations manifested by Omer seem to affect Omer's vocabulary in speech alone.

Strategy for learning vocabulary

Omer's strategy for learning new material is visual. He claims that he must read things in order to remember and that listening alone will not suffice:

T: So you think that you remember better by seeing things than by hearing them.

O: Yes, undoubtedly so! (Dialogue, 21-22, in English)

T: Let's talk about perception. Some people like to read things for themselves, others can just listen to the teacher and it's enough for them; others like things to be said to them. How about you?

*O: I like to read the material, I mean my preferal*** to read the material and then remember it alone and then after I read it and I and I eh can remember it so I can talk with someone.* (Dialogue, 69-70, in English)

Omer's overall visual strategy for learning along with schools' list-learning practice leads me to assume that most of Omer's vocabulary learning is visual list learning (Links between Omer's visual memory and his EFL performance are discussed in section 8.4). The fact that Omer's total immersion in an English speaking country for a number of months the previous year did not boost his vocabulary in speech also serves to strengthen this point. As mentioned above, list-learning vocabulary strategy seems to be more effective in reading than in speech. The fact that Omer's oral comprehension is high may derive from his total immersion, but it could also suggest that visual list learning has a stronger effect on the receptive skills: reading and

listening. The fact that all other case studies, who presumably engage in list learning, have better L2 receptive skills than productive skills serves to support this suggestion.

How does Omer's vocabulary learning compare with the other case studies and what do these have to do with phonological working memory along with auditory/phonological processing?

Of all the case studies, only Natalie learns EFL vocabulary via the auditory route and boosts her phonological working memory by self mediation techniques, and even Natalie turns to list learning in preparation for EFL tests. Natalie's phonological strategy for vocabulary learning seems to be more successful in speech than in the reading. All the other case studies seem to use the visual route for vocabulary learning. The visual route for vocabulary learning is not seen to be effective for Ori and Shandy. Visual strategies for vocabulary learning seem to have a better effect on reading than on speech. The visual route for vocabulary learning is more effective for Omer and Aya, but has a better effect on reading than on speech, a fact which points once more to links between the context of learning and the context of performance.

Context of learning - context of performance

Omer's data analysis seems to support findings regarding relationships between the context of learning and the context of performance (modality-wise). Omer and Aya, who acquire most of their vocabulary visually, utilize their vocabulary knowledge better in reading than in speech; Natalie, who claims that the only way for her to really acquire EFL vocabulary is by meaningful exposure to the spoken language, utilizes vocabulary much better in speech than in reading; Shandy and Ori's performances somewhat modify these findings. Both Shandy and Ori learn vocabulary visually, but do not seem to have better vocabulary knowledge in the reading tests. However, this could also be related to their difficulties in decoding rather than the context of learning.

Summary

Findings from Omer's data support former suggestions as to possible relationships between phonological working memory and vocabulary knowledge mainly as a result of list learning and adds a suggestion that it may be related more to vocabulary

knowledge in reading than in speech. Omer's data analysis seems to support proposals as to links between auditory/phonological processing and L2 vocabulary knowledge and adds a suggestion that auditory/phonological processing in the reading may be related more to vocabulary knowledge in the reading, as opposed to listening, whereas auditory/phonological processing in speech may be related more to vocabulary utilization in speech and listening, as opposed to the utilization of written words.

Most of the case studies do not utilize phonological strategies for vocabulary learning. One subject who does use phonological strategies in order to acquire vocabulary utilizes vocabulary better in speech than in reading. All the other subjects use visual strategies for word learning. The visual strategies for word learning seem to be more effective in reading (providing that a certain threshold level of decoding had been reached), but do not seem to be as effective when it comes to utilizing vocabulary in speech.

Omer's data analysis appears to support the notion of links between the context of learning and the context of performance. Once more this relationship requires a certain threshold of decoding in order to enable meaningful utilization of visually learnt vocabulary in reading.

8.3.3 Phonological memory and phonological working memory along with auditory/phonological processing and EFL speech performance

In order to provide a clear basis for analysis and comparison of speech performance between the cases, I present Omer's test results showing scores on the chosen parameters in the oral proficiency tests.

Table 8.8: Omer's test results on the EFL dialogue

Communicative ability	name	points	Accuracy	name	points	Final grade
Comprehension of questions	Omer	95%	Incorrect/correct use of simple/complex language structures	Omer	50%	
Non-fluent/fluent Interaction	Omer	65%	Limited/basic/rich vocabulary	Omer	80%	
Gives single word/simple sentence/extended answers	Omer	80%	Poor/mostly comprehensive/comprehensible pronunciation	Omer	70%	
Total communicative ability	Omer	80%	Total accuracy	Omer	66%	**73.3%**

Table 8.8 shows that Omer's oral performance is a mixed bag. On one hand, he completely comprehends me as interlocutor and provides full extended answers. On the other hand, although the vocabulary he uses in his answers is not bad, his syntax is very bad and his speech is not fluent and marked with a strong foreign accent. Omer's communicative ability is similar to Aya's, but his accuracy is much weaker than hers (See tables 5.1, 5.2). On the whole, Omer's speech profile is quite distinct from all other case studies.

Omer's speech data seemed, at first, to support the notion of there not being relationships between phonological working memory and speech performance. However, incorporating into the analysis collocation and colligation theory served to surface possible relationships between phonological and phonological working memories and L2 speech production. Most words in a language are regularly situated in similar lexical environments known as collocations and in similar syntactic environments known as colligations (Sinclair, 2004; Hoey, 2005) (see chapter 11). Collocation theory could serve to link phonological memory and vocabulary utilization in speech, since learning words in their linguistic environments allows phonological and phonological working memories to take part in the speech process by enhancing an inner voice which hears the word/words just uttered and triggers the word/words to come. Over all, phonological memory facilitates an inner voice for L2 sounds (words, chunks, phrases, sentences) and phonological working memory facilitates a context-specific inner voice. If one strips words of their linguistic environment and learns words as separate entities via word lists, phonological memory and inner voice can no longer be a significant part of the L2 speech process. Table 8.9 presents the case studies' phonological working memory and their vocabulary knowledge in speech.

Table 8.9: Omer, Shandy, Ori, Aya and Natalie - phonological working memory and speech vocabulary

Name	PWM	Speech vocabulary
Omer	high	80%
Shandy	low	65%
Ori	low	40%
Aya	high	75%
Natalie	low	65%

Table 8.9 shows that the subjects who have low phonological working memory have low to low intermediate speech vocabulary. The subjects, who have high phonological working memory, have high intermediate to high speech vocabulary, but not as high as expected in light of their reading vocabulary. This could now be explained in terms of collocation theory: since Omer and Aya presumably learn vocabulary by lists, their good phonological working memory, which would have triggered neighbouring words via inner voice, is not utilized since there are no linguistic neighbours in memory to trigger. Furthermore, although I have formerly not established relationships between phonological working memory and syntax, colligation theory, claiming that each word is characteristically associated with specific syntactic environments, could serve to link phonological and phonological working memories and utilizing syntax in speech performance. The theorized inner voice which presumably hears the uttered words and triggers their linguistic neighbours, triggers them in their L2 syntactic environments as well. Since the theorized inner voice is related to phonological memory as well as to syntactic utilization in speech, phonological memory and phonological working memory may be related to syntactic utilization in speech. Shandy, Ori and Natalie, who have low phonological working memory, also have low command of syntax in speech. Aya and Omer do not have weak phonological working memory. Aya has high intermediate syntax in speech, but Omer has weak syntax in speech. How can Omer's weak syntax in speech be explained in light of his phonological working memory? The explanation could include the effect of word list learning which deprives words of their syntactic environment as well as of their lexical environment. This could also have to do with the fact that syntax is also often taught and studied in a de-contextualized rule-governed manner.

Strategy in speech

Speech, by definition, requires on-line performance and leaves a smaller margin for strategy. None of the other case studies are seen to utilize specific strategy in their speech, and although it is logical to assume that there are times when they translate from L1, it does not appear to be a systematic factor in their speech. Omer, on the other hand, utilizes translation strategy throughout, which, instead of assisting, has a damaging effect. When Omer says "*...you think in Hebrew and then you translate it in your head to English*" (Interview, 18, in Hebrew) he describes exactly the way he

speaks. The following examples show some typical speech acts:

O: Eh generally I like I like to beee with myself alone eh without any sound eh around eh I like eh (Dialogue, 2, in English)

O: Right. Eh ..But eh....ok ...eh I saw this dog and he ....very....very...cold outside, and he's very dirty and ...you know ..es eh Imean youknow he's (pause).....so (pause)...so (pause)...I...he look at me like , you know, like he does he doesn't have a house (Role play, 18, in English)

O: Ok so you care about your eh garden and eh your flower and eh and the beautiful garden but I care about eh the world eh, I think eh I think I think that eh eh the eh human eh health is eh better is is i i important than your eh than your flower and eh I care and I I don't I don't agree to do it.... (Role play, 8, in English)

Omer's translation strategy does not seem to be restricted to word retrieval and is apparent on the sentential and even inter-sentential level as well. He seems to be jumping between languages, thinking in Hebrew, translating words or phrases, speaking in English, going back to the idea in Hebrew etc. Omer's translation strategy raises the issue of causality. On one hand it may be that Omer's translation strategy is a primary factor and that translation causes lack of fluency. On the other hand, it may be that Omer translates due to the fact that visual strategies and list learning deprive him of collocations and colligations which would presumably enhance his fluency. If this is the case it may be that lack of fluency causes the need for translation. It may also be that there is a reciprocal relationship between translation strategy and fluency and that translation inhibits fluency which causes the need for yet additional translation. Translation strategy may be a barrier between phonological working memory and inner voice: jumping between languages does not allow an L2 inner voice to develop. Any inner voice would also be fluctuating between languages thereby continuously obstructing phonological working memory processes. In Omer's case, excluding phonological working memory means that he cannot utilize a memory function which otherwise would have probably been helpful. Furthermore, it may be that translation technique could actually be triggering L1 collocations and colligations which would be likely to result in erratic L2 speech.

Unstable sounds and speech

As discussed above, Omer's ability to retrieve vocabulary seems to be influenced by unstable L2 sound representations which may stem from erratic auditory/phonological processing. Below is an additional example where Omer is not sure of how a word works:

O: Ok we can s take it to the eh to the veter ve vet vetinary? (not sure how to say the word) (Role play, 40, in English)

Interestingly, Omer seems to be aiming at the written form of the word *vet* rather than at its spoken form, which may support the notion that written forms of words are more stabilized in his mind than the spoken ones.

The next example shows how even a very simple word like *house* is not stable in his lexicon:

O:...maybe your heise house is dirty (Role play, 18, in English)

This kind of instability of the L2 sound system could cause insecurity in using even simple words as *house,* let alone more complicated ones. It may be that Omer's unstable L2 sounds resulting in reduced vocabulary range and insecurity in speech production lead him to his consistent translation strategy.

Omer's erratic auditory/phonological processing could also be the underlying reason for his problematic accent in English to the extent of not always being able to make himself understood by his American peers (although it is my observation that his accent is not as bad as he feels it to be):

O: My accent is bad. I have a difficult accent; a very Israeli accent. I still have.
T: So they found it difficult to understand you?
O: Ye (Interview, 34-36, in Hebrew)

Omer's erratic auditory/phonological processing may affect speech performance by limiting L2 vocabulary range, generating problematic L2 pronunciation and bringing about an overall insecurity in speech.

Summary

Omer's distinct speech performance led me to analyze his speech in a different way from that necessary for the former case studies. Therefore, whereas there are

additional suggestions, there are no comparisons presented in the summary.

Looking at Omer's speech in terms of collocation and colligation theory led me to suggest links between phonological and phonological working memories and speech production. These links could be obstructed when L2 vocabulary is learnt via word lists and when translation strategy is utilized systematically in speech.

Erratic auditory/phonological processing seems to affect speech production via reduced vocabulary, pronunciation difficulties and overall insecure speech. These factors in Omer's speech are more pronounced in comparison to his overall good reading comprehension in general and good vocabulary in reading in particular.

8.3.4 Phonological memory along with auditory/phonological processing

Reading – Findings from Omer support findings from Shandy, Ori, Natalie and Aya as to possible relationships between phonological working memory and L2 reading and add the suggestion that higher level reading skills which require a high degree of integration may involve additional memory factors.

Omer's visual reading strategy is seen to facilitate search reading, but does not seem to be effective enough for dealing with reading which requires high degrees of integration.

Vocabulary – Findings from Omer support findings relating to links between phonological working memory, auditory/phonological processing and L2 vocabulary knowledge. It is suggested that phonological processing while reading may be more related to vocabulary knowledge in reading whereas phonological processing in speech may be more related to vocabulary knowledge in speech.

Phonological strategies for vocabulary learning seem to yield better results in speech whereas visual strategies for vocabulary learning yield better results in reading, providing that a certain threshold level of decoding had been reached.

These findings seem to strengthen the notion of links between the context of learning and the context of performance. As far as reading is concerned, such a relationship is only possible after a certain level of decoding has been reached.

Speech performance - Omer's speech profile, being so distinct from and weaker than his reading, led me to look at his speech performance in light of collocation and colligation linguistic theory. In the light of this theory I suggest links between

phonological and phonological working memories and L2 speech performance mediated by *inner voice* which hears the uttered word/words and triggers the next in its morphological and syntactic environments. These links could be obscured when L2 vocabulary is learnt via word lists and when translation strategy is utilized systematically in speech.

Auditory/phonological processing seems to be related to overall speech production via reduced vocabulary in speech, problematic pronunciation and lack of security in producing speech.

8.3.5 Visual memory and EFL reading

In order to provide a clear basis for analysis I present Omer's results of both visual memory tests and those of his EFL reading tests.

Table 8.10: Omer - RCFT

Copy trial Omer	Time to copy (seconds)	RCFT immediate recall	RCFT delayed recall	RCFT recognition
Percentile= >16 normative	600 Percentile<1 Very low	<20(% score=<1) Rating=severely impaired	24(%score=<1) Rating=moderately to severely impaired	54(%score=66) Rating=average

(For qualitative features of performance see table 8.5)

Table 8.10 shows that, on the whole, Omer's visual memory is weak. However, although his memory vis-a-vis recall is weak, his memory vis-a-vis recognition, which is more relevant to reading, is normative. Omer's visual spatial memory profile, as seen in the RCFT, is similar to Shandy's (See table 7.5). Omer and Natalie (See table 4.5) share a weak immediate recall and average recognition.

Table 8.11: Omer - DTLA-A - Design Sequences

DTLA-A Design Sequences	
Omer	6(% score=9) rating= below average

Table 8.11 shows that Omer's performance on this visual sequential memory test is weak and resembles Natalie's (See table 4.6).

Table 8.12: Omer , Shandy, Ori, Aya and Natalie - EFL Reading

Name	Reading passage 1 (search reading)	Reading passage 2 (careful reading)		Reading passage 3 (mixed search and careful reading)
Omer	100%	73.6%		82.6%

Reading

Table 8.12 shows that, on the whole, Omer's reading in English is good. Like the other case studies, his performance on reading passage 2 is weakest but, unlike the other case studies, he performed best on reading passage 1.

Not only is Omer's EFL reading good, but he also seems to enjoy it and claims that it is "easy":

T: What is the easiest thing in English for you?

O: I read books. (Interview, 23-24, in Hebrew)

When asked whether he prefers to read or be read to Omer replies:

O: To read by myself! In Hebrew as well, by the way. If I study for a test and I am read to, I don't absorb everything, even in Hebrew where I understand everything, I don't absorb everything. If I read it myself, I am more focused. Even more so in English.

T: So you think that you remember better by seeing things than by hearing them.

O: Yes, undoubtedly so! (Interview, 20-21, in Hebrew)

There appear to be two contradictions emerging from the data. First, a contradiction between Omer's claim that his visual memory is better than other memory modalities while the visual memory tests do not support this claim. Second, a contradiction between former findings suggesting that good reading is enhanced by good visual spatial and visual sequential memory while Omer's reading is good in spite of his weak visual memory.

The first contradiction may be explained by Omer himself pointing to the fact that after reading the material by himself he actually discusses it with his friends:

*I like to read the material, I mean my preferal*** to read the material and then remember it alone and then after I read it and I and I eh can remember it so I can talk with someone. So I study to a test, I reading alone like two days the material then I'm meeting with my friends and I'm talked about it *** the material.* (Dialogue, 70, in English)

It may be that the very act of discussing the material with friends serves as a processing mechanism and that it is due to this deeper processing that the material is anchored better in memory. Omer himself may not be aware of this and therefore attributes his success in remembering the material to visual memory alone. The second contradiction is more fundamental. In the following, visual spatial and visual

sequential memories are discussed together in a unified manner and related to the sentential and inter-sentential levels, since Omer had no difficulty in coping with individual words. This may be partially attributed to his normative visual spatial recognition.

Reading processes vis-à-vis visual spatial and visual sequential memory

Table 8.13 below presents the results of Omer and Natalie on both visual memory tests as a basis for comparison between the two.

Table 8.13: Omer and Natalie RCFT and DTLA-A Design Sequences

RCFT immediate recall	RCFT delayed recall	RCFT recognition	DTLA-A Design Sequences
Omer <20(% score=<1) severely impaired	**Omer** 24(%score=<1) moderately to severely impaired	**Omer** 54(%score=66) average	**Omer** 6(% score=9) below average
Natalie 42 (% score=21) average	**Natalie** 45 (%score=31) Average	**Natalie** 54(%score=66) average	**Natalie** 5 (% score=5) poor

Table 8.13 shows that Omer and Natalie both have average visual spatial recognition memory and below average visual sequential memory. Natalie has an advantage over Omer because her visual spatial recall memory is better. Nevertheless, Omer's reading in EFL is better than Natalie's. This may suggest the existence of factors which enhance Omer's reading but inhibit Natalie's. In section 5.5 it was suggested that in the course of reading, both visual memory processes interact with each other, are related to the level of L2 spoken language, and are also linked to the level of L2 decoding ability. Omer's overall L2 spoken language is weaker than Natalie's as seen in table 8.14. The only factor in L2 where Omer has a big advantage over Natalie is in L2 spoken vocabulary knowledge. This requires me to modify my former proposal which suggested that in L2 reading, visual memory processes are facilitated by L2 spoken language, and suggest instead that in L2 reading, visual memory processes are enhanced most by L2 spoken **vocabulary** level. The fact that L2 vocabulary level, as opposed to overall L2 spoken language, may support visual memory processes while reading, is strengthened by the fact that Omer's vocabulary

knowledge in the reading is rated "very high", whereas Natalie's vocabulary knowledge in the reading is rated "low".

Table 8.14: Omer and Natalie's test results of the oral dialogue, side by side

Communicative ability	**Points**	**Accuracy**	**points**	**Final grade**
Comprehension of questions	Natalie: 95%	Incorrect/correct use of simple/complex language structures	Natalie:50%	
	Omer: 95%		Omer: 50%	
Non-fluent/fluent Interaction	Natalie: 95%	Limited/basic/rich vocabulary	Natalie: 65%	
	Omer: 65%		Omer: 80%	
Gives single word/simple sentence/extended answers	Natalie: 85%	Poor/mostly comprehensive/comprehensible pronunciation	Natalie:80%	
	Omer: 80%		Omer: 70%	
Total communicative ability	**Natalie: 91.6%**	**Total accuracy**	**Natalie:65%**	**78.3%**
	Omer: 80%		**Omer: 66%**	**73.3%**

A qualitative analysis of Omer and Natalie's reading serves to surface an additional factor which distinguishes between the two. Omer does not seem to have any difficulty with comprehension of the syntactic structures as they appear in the reading comprehension texts. Natalie, on the other hand, often struggles with syntactic structures, to the extent of not being able to comprehend the overall meaning of a sentence even when each word separately is familiar to her.
An example of this can be seen when it takes Natalie 48 turns in the oral protocols to comprehend the question: *"Name TWO ways in which children's museums in America attract visitors."* (see transcriptions- Oral protocols, reading passage 1, 1-49). It seems logical to assume that when one cannot make sense of a sentence due to inability to decipher the syntax, visual memory cannot come into play effectively in the process of reading, and conversely, good syntactic understanding and sentential comprehension may make it easier for information to surface onto the visual spatial sketchpad for further processing. This may be one of the reasons why, while both Omer and Natalie do not have a strong visual memory profile, Omer can utilize whatever visual memory he has better than Natalie. It is important to make the distinction between productive syntax in speech and receptive syntax in reading. It seems that the relevant factor for reading is receptive syntax which Omer can cope

with very well, as opposed to productive syntax which is as weak for Omer as it is for Natalie. This is also in line with Omer's normative visual spatial memory via recognition as opposed to his weak visual spatial memory via recall. In the light of the analysis above, it seems that both L2 spoken vocabulary and L2 receptive syntactic comprehension facilitate visual memory in the process of reading.

Interestingly, in his interview, Omer seems to relate to these two aspects in EFL reading when he talks about his short schooling experience in the United States:

"There were all sorts of... for example they had Shakespeare that I can hardly read in Hebrew, let alone in English." (Interview, 40, in Hebrew)

It is logical to assume that what prevents Omer from dealing successfully with Shakespearean texts, even in Hebrew (when the translation is into old, heavy Hebrew- language), is his reduced ability to comprehend old English/Hebrew vocabulary and syntax which is somewhat different from the modern version. When this is the case, reading becomes difficult as visual memory processes cannot operate effectively in conditions of reduced syntactic understanding and vocabulary knowledge.

In conclusion, although, at first, Omer's good reading in EFL and his visual memory profile seem to be in contrast to former findings as to relationships between the two, it may be that Omer's weak visual sequential memory is compensated for by normative visual spatial memory via recognition (which facilitates recognition of word configurations), good decoding skills, a high range of EFL spoken vocabulary and good receptive syntactic comprehension, all of which facilitate the utilization visual memory in the process of reading. Omer's data analysis suggests that not only are these additional factors necessary when visual memory is intact, but that they can also serve as compensatory and enhancing factors when some aspects of visual memory are weak. Omer's data analysis modifies former findings in that it narrows the term L2 spoken language and points to L2 spoken vocabulary and receptive syntax as being the relevant factors which facilitate visual memory while reading.

Strategy

Omer's reading for academic purposes is handled as "strategy" mainly due to the fact that he himself relates to this as strategy, as opposed to reading in English for fun, which does not seem to require any conscious effort on his part. Omer relates to this

when he is asked whether he had any private lessons in EFL.

O: Ye, sort of. Especially where technique was needed cause English is all about technique in exams.

T: Do you mean strategies for reading comprehension questions?

O: Ye, reading comprehension and all sorts of small things like in the clozes there are always things that are repeated and in unseens. (Interview, 14-16, in Hebrew)

As mentioned before, the kind of techniques Omer refers to are looking for cue words in the questions, scanning the text for identical, or similar, cue words in the text, holding on to this location in memory, going back to the question etc. The ability to utilize these strategy tips effectively requires an ability to recognize surface visual cues. Omer seems to have benefited from these strategic tips as is seen in the way he deals with the questions in the reading comprehension passages. Omer's ability to utilize reading strategy tips well may be attributed to his visual spatial recognition memory which is thought to facilitate the ability to locate specific bits of information in the text. These reading strategy tips do not seem enough in dealing with reading passage number 2 which requires more than surface visual cues and visual recognition memory. This point is strengthened by my observation of Omer while dealing with the reading comprehension passages. In reading passages 1 and 3 Omer went straight from the questions to the approximate areas where he could find the answers, probably relying on where he saw this or that in the first reading. This kind of ability seems to be related to the ability to recognize text configuration where specific bits of information are located. In reading passage number 2 Omer went back and forth from questions to the text and from one paragraph to another and muttered to himself in Hebrew.

When Omer is asked about his strategies for learning new material in the various subjects he says that in History he needs to read the material first and then discuss it with friends; in Maths he needs to solve questions and practise exercises, and in English:

O: ...English you need to talk. (Dialogue, 74, in English)

This may indicate that much of Omer's good EFL vocabulary knowledge had been acquired hands on through practice. As opposed to the other case studies, Omer had speech experience as well as reading experience on a daily basis while attending school in the United States. Interestingly, Omer's vocabulary level in speech is not as

high as in the reading and he encounters clear retrieval difficulties which affect fluency in speech. Since Omer was probably exposed to both modalities (via conversing and reading), it seems that his better vocabulary in reading has less to do with links between the modality context of learning/performance and more to do with an individual ability/difficulty. It should also be recognized that until Omer went to the States and since he came back, his main exposure to EFL was to EFL texts at school, which may account for his better performance in literacy. It may be that Omer's overall high vocabulary level is due to his being exposed to both visual and auditory EFL vocabulary in a meaningful way and in a condition of total immersion for a number of months. This may point to a combination of both visual and auditory learning in a meaningful context as being effective in EFL vocabulary learning.

As opposed to an overall high vocabulary level in English, Omer's data present a huge gap between his good syntactic understanding in the reading and his weak syntactic utilization in speech. It seems that Omer's total immersion in the language did not have such a positive effect on his productive syntax.

Summary

Omer's data analysis suggests that visual spatial recognition memory and visual sequential memory operate together in order to facilitate visual word recognition in L2 reading.

Fluent and meaningful reading in L2 requires more than visual spatial and visual sequential memory: it requires intact L2 decoding skills and good knowledge of L2 spoken vocabulary and L2 receptive syntax.

Very good L2 vocabulary knowledge, L2 receptive syntax and good decoding skills can serve as compensatory factors for weaker visual sequential memory when reading in L2.

Visual spatial recognition memory facilitates reading strategies for search reading. However, this kind of memory does not always suffice for higher level reading which requires integration between text parts.

Exposure to new vocabulary via both visual and auditory modalities in meaningful contexts seems to be very effective for vocabulary learning.

The same exposure to meaningful syntactic structures via both modalities seems effective for receptive syntax in reading, but not for productive syntax in speech.

It is not possible to support or modify links between the context of learning and the context of performance on the basis of Omer's data because of his being exposed to the language both via regular school procedures and via total emersion for a short period of time and then again at school in Israel.

8.3.6 Auditory verbal memory and EFL performance

Analyses of the former case studies, on issues of EFL performance vis-à-vis auditory verbal memory, point to possible links between auditory verbal memory and performance in EFL.

Omer's results on the Rey Auditory Verbal Learning Test (RAVLT) are presented in table 8.15.

Table 8.15: Omer - RAVLT

RAVLT 1	RAVLT 2	RAVLT 3	RAVLT 4	RAVLT 5	RAVLT 6 proactive interference	RAVLT 7 retroactive interference	RAVLT 8 LTM	RAVLT 9 recognition
(SD= 1.59)	(SD= 2.13)	(SD= 1.63)	(SD= 1.54)	(SD= 1.44)	(SD= 1.80)	(SD= 2.04)	(SD= 2.11)	(SD= 2.46)
Omer +1.49	+1.47	+0.84	-0.92	+1	+0.32	+0.40	+0.47	-0.13

Table 8.15 shows that Omer's immediate auditory verbal short-term memory is within the high range of normative performance. Like Shandy (See table 7.4), Omer seems to lose some of his concentration in the 3rd and 4th trial but recovers in the fifth. After Shandy, Omer presents the best performance on the 1st trial. However, Omer's performance on the recognition trial is weaker than the others' (although still within normative range). Omer does not seem to be specifically prone to interference.

When asked about difficulties in EFL studies, Omer, like Shandy, names grammar as the most difficult factor and speech as the most difficult skill:

Grammar, grammar and obviously also to express yourself. It's a foreign language and you need to think ahead. It's not a native tongue so you think in Hebrew and then

you translate it in your head to English so that you don't say complete nonsense so it always takes more time. Apart from that eh vocabulary, vocabulary is O.K but also, sometimes you get stuck for a word so you can't express yourself fluently and it's English. What can you do, a foreign language; what can one do? (Interview, 18, in Hebrew)

Omer's low scores on productive syntax (50%) and good scores on vocabulary (dialogue - 80%, role play-75%, reading vocabulary – very high) confirm this observation.

Given Omer's score on the short-term memory test, which is within high range of normative performance, it is expected that he would be able to utilize words provided by me, as interlocutor, in the course of speech and use them in his own speech. However, Omer's ability to do this varies. At times he is able to make use of these words, as in the following:

O: =Sit down, I can't lie because I'm fell asleep

T: You fall asleep

O: Ye, I fall asleep. (Dialogue, 94-96, in English)

Or:

T: kennel?

O: Kennel O.K, yes, he can sleep in my; he can sleep in my eh bed. (Role play, 33-34, in English)

However, at times Omer avoids repeating the provided word:

O: Idknow it's just if I read something so I have to be very eh con con con

T:cen

O: concen (pause)

T: concentrated?

O: Ye O.K and if someone eh call me or my mother is eh eh cooking so eh I can't eh study very well. (Interview, 8-12, in English)

Some time later, it becomes apparent that he finds it difficult to pronounce the word:

T: O.K Does this not break your concentration?

O: No, it's help, I mean it's helps my conce con-cen-tration... (Dialogue, 101-102, in English)

Omer's ability to use words given by his interlocutor in the course of speech has to do with their phonology. Words with a short and simple phonology are easier for him to use, whereas longer words which have a more complicated phonology are utilized by Omer with difficulty. This could be due to Omer's having difficulties with

phonological processing as seen below:

Ye, Ye. If I'm learning in the ch kitchen (Dialogue, 14, in English)

A few minutes later we see that the difficulty with *kitchen* is not accidental. When Omer utters the word again, he does it very slowly:

...probably in the kitchen... (Dialogue, 30, in English)

Also:

Yes, but it's, this cow has eh has, has soil (probably meaning soul)... (Role play, 82, in English)

Like Natalie and Ori, Omer also adds aspiration to vowel sounds:

No. eh O.K I'm heating... (meaning eating) (Dialogue, 36, in English)

Omer points to his overall bad accent in English as a weak spot (see 8.1- interview, 34-38)

Omer's inability to acquire a better pronunciation in English, notwithstanding his complete immersion in the language for a few months, may be attributed to his difficulties in phonological processing. It seems that, like Shandy, Omer is able to remember words in the short term and utilize them for immediate use when their phonological representation is stabilized in his mind, but when phonological representations are unstable this is not always the case. This finding may have further, and more meaningful, implications, since it seems logical to assume that words which do not have stable phonological representations and cannot be repeated by the speaker on-line will not be available for retrieval from long-term memory either. This may take form of reduced vocabulary range, as in Shandy's case, or hesitant, repetitive and insecure retrieval, as in Omer's case. Omer's higher vocabulary range, in spite of his erratic phonological processing, may be explained by his total immersion in the language, and his bumpy retrieval may be explained by his erratic auditory phonological processing. These findings support former findings in this thesis suggesting that the ability to utilize vocabulary supplied in the course of on-line speech is related to auditory verbal short-term memory, but also requires intact phonological processing in order for both auditory verbal short-term memory and auditory verbal long-term memory to function.

Interestingly, like Shandy, Omer can not remember things studied via the auditory modality, although his auditory memory seems to be better than his visual memory:

O: To read by myself! In Hebrew as well, by the way. If I study for a test and I am read to, I don't absorb everything, even in Hebrew where I understand everything, I don't absorb everything. If I read it myself, I am more focused. Even more so in English.

T: So you think that you remember better by seeing things than by hearing them.

O: Yes, undoubtedly so! (Interview, 20-22, in Hebrew)

Omer's reduced ability to learn via the auditory modality may have to do with issues of concentration. In the following, Omer describes the process of learning by himself when he can choose the time and place. One can assume that when Omer does not take an active part in the studying process (as may be the case in class), his ability to control his concentration is even worse:

O.K so each 15 minutes I have <u>tooo</u> eh get up and I walking or eh eating or eh talking talking with someone eh eh THORNS IN MY BUTT {like the English expression ants in my pants.} (Dialogue, 98, in English)

This explanation is also in line with Omer's performance on trials 2-5 in the RAVLT memory test. Omer's reduced ability to repeat the same list of words read to him three and four times could certainly be an indication of fluctuations in concentration. It seems that when he pulls himself together again, in trial 5, his performance improves.

The fact that Omer, Shandy and Ori, whose performance on the RAVLT trials 1-5 suggest fluctuations in concentration, prefer to study via the visual modality, even when auditory memory is stronger than visual memory, may point to auditory memory being more prone to drops in attention and concentration.

Auditory recognition in speech

When Omer talks about his performance in EFL, he claims that he can understand EFL speech with no difficulty. Omer's score on the comprehension factors in the dialogue and role play (95%) confirms this observation. His performance on the recognition trial of the RAVLT is normative and may reflect ability to comprehend vocabulary aspects of EFL speech.

This finding supports findings from Natalie, Aya and Shandy as to possible links between speech comprehension and auditory verbal memory via recognition (after a certain threshold level of EFL).

Retrieval in speech

Omer's speech is hesitant, repetitive, and erratic throughout, as in the excerpt below:

...and eh I just I met with those people who are eh 31, 32 and we got eh weave weav weav weav eh eh eh eh weave the same eh ideas to talk about; the same eh the same thoughts= (Role play, 84, in English)

At first, Omer's claim that it is difficult for him to express himself in speech is puzzling in light of his vocabulary in the oral dialogue (80%) and in the role play (75%). However, his syntactic performance (50% in both oral tests) and fluency (65% in the dialogue, 60% in the role play) seem to account for his difficulty. We therefore need to look at whether auditory verbal memory is related to syntactic and fluency factors as well. Below are examples of Omer's syntactic errors:

O.K I'll explain myself. In my room it's very quiet. I mean it's like eh silent and I can't, I can't. I need to see people I need to you know I need to be I need to be near my mother she will give me food something like that, but if I'm in the kitchen and she cooking I can't study because it's very very loudly, but in the other hand I can be in the kitchen when she is read books something like that so I can= Dialogue. 48, in English)

Also:

In Math I just eh you just just eh you solve problems. You can't talked about it; it's science, I mean it's just numbers. (Dialogue, 72, in English)

Or:

=*Sit down, I can't lie because I'm fell asleep* (Dialogue, 94, in English)

And:

...I can talk with someone. So I study to a test... (Dialogue, 70, in English)

From the point of view of memory it seems that tense and aspect related mistakes such as *I'm fell asleep* or *you can't talked about it* are more rule governed and have less to do with auditory verbal memory. When Omer commits these mistakes, he actually applies the wrong rule to the right verb. In addition, I would like to argue that morpho-syntactic errors and preposition related errors have to do more with phonological processing or phonological working memory (via inner voice) than with auditory verbal memory since they generally have to do with empty morphemes which do not carry semantic value on their own. Their semantic value is only acquired via specific collocations which I have previously linked to phonological working memory (see section 8.3.3).

In the light of this analysis, it is suggested that neither rule governed syntactic knowledge nor errors deriving from mistaken morpho-syntax, prepositions, phrasal verbs and other inflexible chunks are related to auditory verbal memory per se. This finding from Omer's data supports former findings from Natalie and Shandy. All three case studies who have normative auditory verbal memory but erratic auditory/ phonological processing have weak productive syntax.

The analyses above support former suggestions as to relationships between auditory verbal long-term memory and productive vocabulary. Productive syntax seems to be more related to auditory phonological processing, phonological working memory and additional cognitive factors.

8.3.7 Central executive function and EFL performance

In former chapters of this research, it has been suggested that the central executive function is involved in higher level EFL language skills, starting from the sentential level.

Omer scored highly on the Active Memory-Complementing Words test which was administered to the subjects in order to test central executive skill. His result was 1.09 (which is above average rating).

So far, the only other case-study whose performance was above average was Aya.

Omer points to grammar being the most difficult aspect of EFL (see 8.1- interview, 18)

The following excerpts from Omer's speech show that his grammar is indeed very weak. One of Omer's typical mistakes is confusing between present simple and present progressive as seen below:

O: No, but eh I mean usually eh I'm learning eh in the kitchen. I don't know why. (Dialogue, 16, in English)

Although Omer has many other grammatical errors, his confusing these two grammatical choices and even mixing their parts as in *I'm start to study* (Dialogue, 30, in English) or *I'm eating while I studying all the time* (Dialogue, 36, in English) is consistent throughout his speech. There may be two explanations for such mistakes. The first is that Omer is not familiar with the theoretical rules underlying these grammatical structures and the second is that although Omer is familiar with the

theory, he is not able to apply this theoretical knowledge in on-line speech. In my opinion, the possibility of Omer's not being familiar with the rules is quite unlikely since the rules are taught and repeated in the EFL syllabus from grade six up to the last year of high school and Omer's overall academic profile does not suggest inability to remember two grammatical rules. Omer's consistent confusion between these two grammatical choices may however have to do with his inability to put theory into practice. In chapters 4, 6 and 7 it was proposed that weak central executive skill is one of the underlying reasons for the subjects' syntactic weakness. However, Omer's data seem to challenge this suggestion since although his central executive function is strong and his vocabulary is quite good (80% in the dialogue, 75% in the role-play), his syntax in speech is very erratic. Could it be that former suggestions as to those relationships are no longer relevant? In addition, Omer, too, performs poorer on reading passage number 2 which requires higher degrees of integration. Is it possible that those former proposals as to relationships between higher level reading skills and central executive functions are also questionable? Omer's higher level speaking skills and higher level reading skills are not only contradictory of former findings in this research, but also raise questions concerning the literature which points to links between these and the central executive function (see section 2.1.3). Once again, it may be that Omer's translation strategy has a negative effect on his EFL performance. Omer's applying a strategy of "*...you think in Hebrew and then you translate it in your head to English...*" may put too much of a burden on the central executive, which, by definition, has limited capacity. The process of working out what he wants to say in L1, translating L1 vocabulary by retrieval from long-term memory, trying to ascertain which tense in English suits a specific tense in Hebrew and what the inner rules of this tense are, is all too much. Moreover, where the present simple and present progressive are concerned, the very process of translation into L1 and back renders the end result a 50% chance of being wrong due to the fact that Hebrew does not distinguish between these two grammatical structures and therefore there can be no one-to-one translation. While acknowledging the possibility that, at least initially, all L2 learners utilize a certain degree of translation while speaking in L2, for Omer translation has become a strategy which is consciously and consistently used. The numerous stops and repetitions in his speech are most likely due to the translation processes described above:

I mean the the high school eh education is not so complicated. If you have a good brain and you have eh you have eh eh very good eh eh eh (pause) ifyousmart O.K ifyousmart so it's eh you don't need to to study a lot so it's comes comes comes along (Dialogue, 118, in English)

Or:

*Ok so you care about your eh garden and eh your flower and eh and the beautiful garden but I care about eh the world eh, I think eh I think I think that eh eh the eh human eh health is eh better is is i i important than your eh than your flower and eh I care and I I don't I don't agree to do it....(*Role play, 8, in English)

In the light of the above explanations, it is suggested that although Omer's data somewhat modify the suggestion that erratic syntax in EFL speech may be related to a weak central executive function, it does not rule out the possibility of there being links between the two. It is suggested that Omer's consistent translation strategy may burden the central executive to the extent of it not being able to cope with the long and complicated processes involved in consistent on-line translation.

It is also possible that Omer's reading comprehension is affected by his translation strategy. The nature of Omer's mistakes in the reading comprehension passages seems to support this. For example, the fourth question in reading passage number 1 reads:

"What do we learn about the English language from the last three lines of paragraph 2?"

Instead of reading the lines and arriving at a conclusion, Omer just gave a near exact translation of the last two lines, which led him to an incorrect answer.

Furthermore, Omer's data analysis points to the fact that, in addition to the translation strategy, Omer utilized search reading strategies, even when different reading strategies would have been a better choice. In answer to the first question in reading passage number 2, Omer wrongly used a strategy which is appropriate for search reading. He scanned the paragraph, found the word *information* which was used in the question and wrongly assumed that that was the paragraph which dealt with *"the information is relevant to the readers' own lives."*

The fact that Omer used a search reading strategy instead of reading the text carefully and utilizing his central executive skill to integrate text parts led him to the wrong answer. These explanations raise the possibility that although Omer's reading

comprehension data seem to challenge the notion of relationships between higher level reading skills and the central executive function, it is possible that his central executive function is less activated due to his applying a translation strategy and search reading techniques. Therefore, the suggestion as to there being relationships between higher level reading skills and the central executive function is not necessarily refuted.

In summary, it is suggested that although Omer's data somewhat modify the notion of there being links amongst the central executive function, EFL syntax in speech and higher level reading skills, further analyses do not rule out the possibility of connections between these factors. It is proposed that as far as speech is concerned, Omer's consistent translation strategy causes central executive overload to the extent that even a good central executive function is not able to cope with the amount of on-line integration needed for what looks like simultaneous translation processes. As far as higher level reading is concerned, it is suggested that although Omer has a good central executive skill, his translation strategy and his inappropriate application of a search reading strategy does not allow his central executive function to come into play. Therefore, suggestions as to relationships between high level reading skills and the central executive function still stand.

8.4 Omer – general summary of his EFL performance vis-à-vis memory profile

Omer's general EFL performance is difficult to characterize due to the large gaps across the parameters. His overall reading is quite good and his vocabulary range in the reading is very high. However, his performance on the research passages shows that he handles search reading much better than he handles careful reading. Omer's oral comprehension is very good, but his oral production is less so. His speech is hesitant, very erratic and marked with a strong foreign accent. His reasonable (but not excellent) vocabulary range in speech is undermined by numerous syntactic mistakes which occur when he puts words together. Omer's high vocabulary range in the reading may be related to his good phonological working memory which enables him to decode words correctly, learn them by lists and apply an inner voice while reading. In addition, it may be that Omer's visual strategy for learning new words in English is effective for written vocabulary, due to his normative visual spatial

recognition memory. Omer's excellent vocabulary range in the reading may also be due to his total immersion in the English language for a number of months in the previous year which seems to have boosted his overall receptive vocabulary. Omer's weaker vocabulary range in speech may be due to his unstable representations of speech sounds in English which cause erratic storage and difficult retrieval and obstruct inner voice processes. These unstable sounds may be due to erratic phonological processing. His productive syntax, which is the weakest aspect of Omer's EFL performance, does not seem to be affected by any specific memory factor. (The memory factors suggested in the literature, as well as in this research, as related to syntax are phonological working memory and central executive function, both of which are strong in Omer's memory profile). Instead, Omer's data analysis shows that his consistent and systematic translation strategy prevents these factors from coming into play and obstructs development of an inner voice which could otherwise be facilitated due to his good phonological working memory. Omer's receptive syntactic comprehension is good and does not seem to rely on translation. Omer's good low level reading skills in English may be connected to his good phonological working memory. In addition, Omer's data suggest that his EFL reading is facilitated by good knowledge of English vocabulary and receptive syntax which enhance visual memory while reading. Omer's successful search reading may be related to his normative visual spatial recognition memory. His less successful careful reading which requires integration of specific pieces of information located in various parts of the text may be linked to his translation strategy which causes overload to his otherwise good use of the central executive function. Omer's receptive oral skills are excellent. His good oral comprehension may be related to his receptive vocabulary and syntax, which were probably enhanced by his total immersion in the language, as mentioned above. Omer's good oral comprehension may also be related to his normative auditory verbal memory via recognition. Why Omer's total immersion in English does not seem to have helped his EFL speech remains puzzling. Omer's immersion in the English language makes his very erratic and hesitant speech difficult to explain. Yet it seems that Omer's weak speech performance cannot be explained in terms of memory. It may be explained, to a certain extent, in terms of faulty strategy. Firstly, most of Omer's formal and intentional learning of EFL vocabulary and syntax (in Israel) is de-contextualized and utilizes visual strategies. This kind of learning does not expose Omer to the

vocabulary's collocations and colligations in the English language and does not allow him to utilize his phonological and auditory memory in speech. This may point to the possibility that inappropriate teaching strategies might override the value brought by good memory. Secondly, Omer's poor speech may be attributed to his consistent translation strategy. Both his hesitance and his errors in speech may be due to central executive overload caused by systematic translation of words and sentences to and from L1.

Chapter 9: Case 6 – Eli

9.1 Introduction to case 6 – Eli

In this chapter I examine the data provided by Eli the final case study, (case 6), once more looking to support or modify former findings and to detect possible additional patterns which may emerge in the course of analysis.

Eli is a seventeen and a half year old girl studying in the final year of high school. At the end of the year Eli intends to take the 5 point (highest level) matriculation test in English.

Eli's EFL school achievements are high and have always been that way. The only time she felt a bit stuck was in the 9th grade, before high school. According to Eli, the teacher taught at an extremely high level in order to prepare them for high school and she needed to study very hard in order to keep up. Eli reports that, indeed, the first year of high school seemed to be very easy in comparison to the last year in Junior High. Eli reports that she does not seem to have any special difficulties as far as EFL is concerned. When asked about the easiest or most difficult aspect of EFL she says:

E: I think that there is no problem with reading. Sometimes when I read books, I bump into words that I don't understand, but I usually can understand them by the context. Listening comprehension, I don't really have much experience with that, but I don't think I have a problem with it.

T: When you hear people talking in English=

E:= If I hear people talking in English? Yes; I think I understand. As far as expressing myself, I am not sure I am so good. I don't think I have enough of the ah I am sure I will get stuck every now and then and also in the grammar when I speak because when you write it or you are given an exercise and you are told to fill in and you have to decide if it's future or past it's something you think about; you stop to think about it and it's easier, but in speech in a conversation I am sure I make mistakes. I don't, I don't feel that I have the fluency to conduct a completely fluent and accurate conversation. (Interview, 18-20, in Hebrew)

Eli's EFL performance throughout the tests was very impressive. In fact, it was so impressive that I raised the possibility of her being somehow exposed to the language more:

T: What is the level of exposure you have had to English? Were there times when you were more exposed to English?

E: I don't think so. The basic level of exposure: Television, films, programs, nothing special.

41. T: As a child did you watch many television series in English?

E: No.

T: What about reading in English?

E: I try, but I don't do it enough. During the summer vacation I always read a book, a big book, in English and during the school year one or two books: what is demanded at school. (Interview, 39-44, in Hebrew)

It seems that Eli has a good foreign language aptitude. Apart from English, she studies Arabic and knows some French:

E: I started studying English in the regular procedure in 4th grade. I didn't go to any pre English courses beforehand and I have always been good at it. I absorbed it well. All and all it seems that in our family we are good at learning languages. My sister always had it easy with languages, my parents as well. It's a sort of a thing that flows easily. It was also very easy for me to study Arabic and I know some French. (Interview, 16, in Hebrew)

Eli points to both memory and strategy as contributing to her success in EFL studies. Indeed, Eli's use of strategy is evident throughout. She uses different strategies depending both on the subject (i.e. EFL, mathematics, History etc) and on specific items within those subjects as is seen later in the data analysis.

Eli is a high achiever in all school subjects. She seems to have an internal drive for knowledge which is evident from the way she describes the process of her studying for a test:

E: ...when I study I, I always take lots of things I can't study just from my eh just from my notebook. I always need that book and that book and sometimes I use notes from other people...(Dialogue, 24, in English)

This drive for knowledge seems to be related to a process of change Eli reports to have been undergoing:

In the past I used to study much more but during the years I've learned that the less I learn to tests the more I succeed. (Dialogue, 47, in English)

When asked to elaborate upon this, Eli explains that she has come to realize that rote learning and memorizing is both less effective and more stressful than learning which is driven by a genuine understanding of subject matter. The process, in Eli words, is quoted below:

E: That's something that it's a big change in my life that made me eh HOW DO YOU SAY TO GET RID OF?

Tammy: Get rid of

E: To get rid of lots of pressure that I had in school. It changed my life completely

T: Oh, yes? So what did you do to get rid of that pressure?

E: eh (pause), What did I do? Eh it wasn't something eh that I did. It was a process of change, of understanding what I'm worth; that I'm good at school that I'm a good student that I can succeed without studying so much.

T: And now you feel much more self confident. And this is like a cycle.

E: You feel you don't have confidence you have to study more you don't know the material very well, you can keep on memorizing and studying and then you are very nervous on tests and it's a circle. (Dialogue, 52-56, in English)

And:

E: I think I used to be more analytic when I didn't have eh, when my studying skills weren't that good because I wasn't eh I didn't have enough self confidence so I used to learn more eh by the help of analytic side - by memorizing, by trying to remember, trying to understand a pattern of something, but today I, I I'm more, how to say it? I try to understand, I try to to to (pause) try to I try to get the eh the full picture of the material and then eh more thinking about it than memorizing. (Dialogue, 100, in English)

The subject Eli chose to major in at school is literature and it seems that she has very good language skills in her L1. When asked about future plans, Eli expresses her interest in writing and adds that, actually, she has been writing for some time:

E: I also want to write a book or two, just for eh

T: Really? And do you know exactly what you want to write about?

E: I'm writing right now.

*T: **Oh you are?** That's interesting, about yourself?*

E: Yes

T: Do you let anyone read this or is it deep, deep in your drawer

E: No, I publish, I write songs and short stories as well.

T: Yes?

E: So I publish it. There's an internet eh SITE=

T:= Site

E: New Stage, that eh that young people and eh, everyone can write so I publish it there and my friends, my close friends read it.

T: Do you get any comments?

E: Yes.

T: Good?

E: Everyone says good, good, but the real, the real thing is to hear it from people that are objective and have the authority to tell you if it's good or not, and I get this from my SUPERVISOR?

T: Supervisor

E: In. I am a group WRITING WORKSHOP

T: Writing workshop. (Dialogue, 64-82, in English)

However, writing is not Eli's only interest. Her future plans consist of highly demanding academic subjects as well:

E: Psychology (pronounces the p) I don't know what the future holds, but this is what I want to do.

T: Do you know what kind of psychology?

E: Clinical. (Dialogue, 60-62, in English)

There is no doubt that of all the case studies who took part in this research, Eli has presented the highest level of performance on all EFL tests. Following is an overview of Eli's results on the different tests along with my interpretation of these results.

9.2 Eli – test results

9.2.1 EFL oral and reading tests

Table 9.1: Eli's test results - Dialogue

Communicative ability	points	Accuracy	points	Final grade
Comprehension of questions	100%	Incorrect/correct use of simple/complex language structures	90%	
Non-fluent/fluent Interaction	95%	Limited/basic/rich vocabulary	95%	
Gives single word/simple sentence/extended answers	100%	Poor/mostly comprehensive/comprehensible pronunciation	95%	
Total communicative ability	98.3%	Total accuracy	93.3%	**95.8%**

Table 9.1 shows that Eli's EFL speech is very impressive both from the point of view of communicative ability and from the point of view of accuracy. Eli understands perfectly well and responds both fluently and accurately. Her range of vocabulary is considerable as is her ability to use appropriate syntactic and morpho-syntactic manipulations in her speech.

Table 9.2: Eli's test results - Role Play

Communicative ability	points	Accuracy	points	Final grade
Comprehension of questions	100%	Incorrect/correct use of simple/complex language structures	90%	
Non-fluent/fluent Interaction	95%	Limited/basic/rich vocabulary	90%	
Gives single word/simple sentence/extended answers	100%	Poor/mostly comprehensive/comprehensible pronunciation	95%	
Total communicative ability	98.3%	Total accuracy	91.6%	94.9%

Table 9.2 shows that Eli's speech performance in the role play is similar to that in the dialogue and that both her communicative ability and her accuracy are impressive.

Table 9.3: Eli - EFL Reading

Name	Reading passage 1 (search reading)	Reading passage 2 (careful reading)	Reading passage 3 (mixed search and careful reading)
Eli	100%	100%	100%

Table 9.3 shows that Eli's reading comprehension in English is very high regardless of the type of reading required.

9.2.2 Memory tests

Table 9.4: Eli - RAVLT

RAVLT 1	RAVLT 2	RAVLT 3	RAVLT 4	RAVLT 5	RAVLT 6 proactive interference	RAVLT 7 retroactive interference	RAVLT 8 LTM	RAVLT 9 recognition
0.83 (SD= 1.59)	1.53 (SD= 2.13)	0.97 (SD= 1.63)	0.29 (SD= 1.54)	-0.71 (SD= 1.44)	0.81 (SD= 1.80)	0.06 (SD= 2.04)	-0.52 (SD= 2.11)	+0.32 (SD= 2.46)

Table 9.4 shows that Eli's auditory verbal memory is normative with a slight improvement between the 1st and 2nd trial, and a slight decrease in memory between the second and 5th trial. This decrease could point to a decrease in concentration after the 2nd trial. Trials 6 and 7 indicate that Eli is not especially prone to interference. Trials 8 and 9 point to Eli's having a normative ability to retrieve from long term memory with and without retrieval cues.

Table 9.5: Eli - RCFT

Copy trial	Time to copy (seconds)	RCFT immediate recall	RCFT delayed recall	RCFT recognition
Percentile= >16 normative	180 Percentile>16 normative	42(% score=21) Rating=below average	42(%score=21) Rating=below average	35(%score=7) Rating=mildly impaired
Qualitative features of performance: Eli seemed to be annoyed by the fact that she was not told she would have to draw the figure from memory. From this minute on, her whole posture changed: she sat back in a nonchalant manner, held the pencil with a very light grip and tried to make the impression of one who is not really going to take this whole 'memory business' seriously. In addition, from that minute on Eli did not seem to be very concentrated on this task and she became less concentrated and attentive as the task progressed.				

Table 9.5 shows that Eli's performance on the copy trial both from the point of view of accuracy and time to draw is normative. However, when it comes to remembering the figure her performance drops. Eli's immediate and delayed recall of visuo-spatial materials is defined as below average and retrieval with the help of retrieval cues is even worse. In interpreting the results on this test it is worth taking into consideration my observation that Eli did not work seriously on the memory aspects of the test, as mentioned above in the qualitative description of the process. Such weak visuo-spatial memory is also in contrast to everything Eli says about her memory and learning styles in the interview, the dialogue and the oral protocols. However, the fact that putting Eli's visual memory to the test triggers such a reaction, may indicate that she does not feel very secure in her performance on this kind of task.

Table 9.6: Eli - DTLA-A - design Sequences, Active Memory - Complementing Words, Shatil Syllable Range Test

DTLA-A Design Sequences	9 (% score=37) rating= average
Active Memory-complementing words	+0.50 rating= average
Shatil syllable Range Test	high

Table 9.6 shows that Eli's visual memory for sequences is in the low range of average performance. Although this result is still within average performance, it supports the suggestion that Eli's act of indifference in the former visual spatial task could be due to her feeling that visual memory tasks are not easy for her. Eli's normative score on the Active Memory test indicates that her central executive skills are normative. Eli's performance on the Shatil Syllable range test shows that she does not have difficulties in phonological working memory.

9.3 Eli - Data analysis vis-à-vis Omer, Shandy, Ori, Aya and Natalie

In what follows I present Eli's test results and engage in a qualitative analysis of her performance vis-à-vis the other case studies according to the parameters singled out in the research questions, thereby supporting or questioning former findings.

9.3.1 Phonological memory and phonological working memory along with auditory/phonological processing and EFL reading

Eli's performance on the phonological working memory test was high.

Table 9.7: Eli - EFL Reading

Name	Reading passage 1 (search reading)	Reading passage 2 (careful reading)	Reading passage 3 (mixed search and careful reading)
Eli	100%	100%	100%

Eli's performance supports research which links phonological working memory to L2 reading. When asked about reading in English, Eli replies:

"I think that there is no problem with reading " (Interview, 18, in Hebrew).

In the former chapters I have shown how the case-studies, who have weak phonological memory, also have difficulties in decoding. Eli has no difficulty in decoding. When asked to read aloud a part of reading passage number 1, she reads fluently and accurately (see reading passage 1, 11, oral protocols.). Moreover, when presented with an unfamiliar word, which is both quite long and has a rather complicated spelling pattern, Eli decodes it systematically and accurately. She neither has difficulty with the sound/symbol correlation nor with integrating the decoded parts into a coherent word:

T: Let's say you had this word. (Shows her the word scrupulous), Do you know it?.....

E: So I see the /lous/ which is an ending that you meet sometimes, this is already helpful and I know the two first letters are consonants they are together, and then I have /ru/ and /pu/ It's a sort of visual thing so I will now sc and then on.

.....

T: How will you read it?

E: (reads /scrupulous/ correctly. (Dialogue, 30-34, in English)

These findings support former findings as to relationships between phonological

working memory and low level reading skills. All the case-studies who have weak phonological working memory have weak low level reading skills in EFL. Eli has no difficulty with high level reading skills either. She can deal with reading which demands high levels of integration with the same ease as she can deal with search reading. Her performance on the EFL reading tests and on the phonological working memory test resembles Aya's. Omer, who also did well on the phonological working memory test, did not perform as well on the second reading passage as we have discussed, presumably, due to his translation strategy.

Strategy for reading

When Eli talks about reading comprehension, she relates to reading articles, short stories and unseen passages. In the excerpt below Eli speaks about content articles:

T: How do you approach such text?

E: I start reading the text. If I see there are words that I don't know, I usually mark them.

T: Do you start by reading the text?

E: Yes, and say there are words that look to me as key words or important things, I write down points that look important. (Reading passage 1, 1-4, oral protocols, in Hebrew)

And also:

I read the article; there are always questions after it so I look at them and see I understand. What I have developed for myself lately, mainly thanks to the fact that I study literature as a major subject at school and work a lot with texts, is that I go paragraph by paragraph and write down next to the text a few lines with the main idea= (Interview, 32, in Hebrew)

Eli maintains that in this type of reading her strategies come from having developed strategies to deal with 20th century literature texts in L1. This could point to relations between high level reading in L1 and in L2. Eli's main strategy here is to mark key words in the text. From the point of view of memory, such a strategy has two advantages: it provides visual cues and reduces memory load. When the question is read, visual cues guide the reader to areas in which to find the answers. In addition, instead of having to remember large portions of information, marking key words provides landmarks for integrating information in order to answer open questions. From the point of view of modality, marking key words is mainly a visual strategy which can boost other forms of retrieval. In EFL unseen passages, Eli has different strategies for search reading and for careful reading, although they both involve

visual cues. The excerpt below relates to search reading:

T: So you say that you first read the passage. Then marked words that seemed important without even knowing the questions and then you read the questions and answered them. How did you know, when you read the question, where to go back to in the text?

E: Here, for example, which things are allowed or forbidden to do in Museums, I remembered it was right at the beginning.

T: So actually you could rely on your memory. You didn't have to go through the whole thing again and do a long search.

E: In all the questions my memory worked fine. It was not such a long passage. (Reading passage 1, 12-14, oral protocols in Hebrew)

Again Eli marks things that will later serve as visual cues and reduce the burden on memory. On the whole, my impression is that Eli's visual memory is intact, notwithstanding her results on the visual spatial memory test, which she took reluctantly (see section 9.2). Eli visual memory functions are discussed separately in section 9.4. Although Eli's memory tests do not point to memory difficulties, her performance on the tests is generally normative (not higher). Eli's success in academic studies may be due to her developing efficient strategies, which serve to reduce memory load:

E:...Usually in an unseen passage I do look first at the first question and if, for example, they write "paragraph 1" I read the paragraph, stop reading and answer the question. I find that it's easier when it's fresh in my head and not to have to go back at the end of the text. (Reading passage 1, 6, oral protocols, in Hebrew)

Eli's strategy for careful integrative reading as in reading passage 2 is somewhat different from her strategy for dealing with search reading. Here she reads the whole passage before looking at the questions, presumably due to the fact that the answers to the questions are spread all over the text and she recognizes that she will not be able to keep in memory so many details whilst scanning the text for answers. Eli's strategy for dealing with this type of text is presented below in her own words:

T: (referring to "Six Good Reasons to Subscribe to the 'Science Scene'")

This is a different kind of unseen. How do you approach it? Here you need to give three reasons when every reason is from a different paragraph.

E: Here I read the whole passage first.

T: You read all of it?

E: Yes, and then I just connected everyone to where it belongs.

T: Could you explain the process.

E: I read all the text and then looked at the question.

T: Let's say you read the question

(The question is: "Which of the six reasons specifically mentions the following? Write the numbers of <u>three</u> reasons (<u>one</u> number in each space.)

.....a) The magazine offers many different options.

.....b) The information is relevant to the readers' own lives.

.....c) This magazine has an advantage over similar magazines.

E: Here I saw "offers many different options" and here I remembered there was "a variety of viewpoints" so it gave me a hint it could be suitable. I read it again and saw that it's right. (Reading passage 2, 16-23, in Hebrew and English)

Although, technically, her strategy here is different, modality-wise, it is visual as before. When Eli says that she saw *"offers many different options"* and remembered *"a variety of viewpoints"* it seems that she remembers more of the visual surface features than the complete idea.

Summary

Findings from Eli support findings from all the other case-studies as to possible relationships between low level reading skills in EFL and phonological working memory. As far as high level reading skills are concerned, an intact phonological working memory seems to be a necessary condition, but not a sufficient one. Good strategy seems to make a difference when it comes to very high reading skills in EFL.

Findings from Eli verify former findings as to visual strategies being effective in dealing with high level EFL reading skills.

Visual strategies (along with markings which are absorbed visually) seem to assist high level reading skills by reducing the load on memory.

9.3.2 Phonological memory and phonological working memory along with auditory/phonological processing and EFL vocabulary

Below are the test results showing vocabulary scores in the oral proficiency tests and an estimation of vocabulary knowledge in the reading comprehension passages based on Eli's oral protocols.

Table 9.8: Eli's vocabulary knowledge

Vocabulary knowledge	Oral dialogue	Oral role play	Reading passages
Eli	95%	90%	Very high

Table 9.8 shows that Eli's vocabulary both in the reading passages and in speech is very high. Eli is the only one who has very high vocabulary knowledge in speech as well as in reading.

When asked whether she had problems with the vocabulary in the reading passages she says:

" No. It was very easy for me; it really flowed, really easy. (Reading passages, 29, oral protocols, in Hebrew)

When Eli reads, her representation of EFL sounds seem to be completely stable. She does not hesitate before vowels, or vowel combinations, which could cause confusion and she never confuses similar sounding words. Therefore it seems safe to assume that Eli's auditory/phonological processing in EFL, which is presumed to underlie sound representation, is intact.

Strategy for learning vocabulary

Unsurprisingly, like all EFL students in her country, Eli also has to engage in list learning in order to meet school demands:

T: How do you study for a test in English?

E: Usually there are words that you have to learn their meaning and spelling. I look at the list once then write the Hebrew translation near the word and write it in English next to the Hebrew.

T: You look once and you remember?

E: Most of the words I remember after the first time. There are some words that I get a bit stuck with so I go over them a few times. Look at them a few times and then remember. (Interview-phase 1-, 28-30, in Hebrew)

According to this, Eli seems to rely on visual memory only and it seems remarkable that she can remember so many new words just by looking at them. However the quotation below adds insight:

E: ... I look at it and try to read it. If someone who is familiar with it and can pronounce it I will try to repeat after him. Let's say I had the word "description" and I didn't know it, I would try to read it; ask someone who can say it to say it out loud and try to repeat after him. It's easier that way.

T: Let's say you had this word. (Shows her the word scrupulous), Do you know it?

E: Scropless? No.

T: and you have to learn it and I tell you it is..

E: How do you say it?

T: and if I don't tell you how you say it?

E: So I see the /lous/ which is an ending that you meet sometimes, this is already helpful and I know the two first letters are consonants they are together, and then I have /ru/ and /pu/ It's a sort of visual thing so I will now sc and then on.

T: So will you see it like this and know it is (gives the word in Hebrew)?

E: Yes, I can visualize it.

T: How will you read it?

E: (reads /scrupulous/ correctly.)

T: Would it have been easier if I would have told you?

E: Yes.

T: and then what do you do?

E: I repeat it and I learn it visually. (Interview-phase 2, 20-33, in Hebrew)

There seems to be a difference between the way Eli treats new words in the first quotation and the way she approaches the vocabulary learning task in the second one. This leads me to assume that there is a distinction between words that Eli considers as new words in the first quotation and in the second. Whereas in the second quotation Eli relates to words which are completely new and unfamiliar, in the first quotation she may be relating to words which are familiar but have not been internalized for active use. When the words are completely unfamiliar, it is not enough for Eli to look at them. When this is the case she tries to say them out loud or get someone else to do it. From the point of view of strategy, Eli utilizes the phonological as well as the visual modality. When Eli describes how she decodes this unfamiliar word by dividing it into small parts and assembling them back together again, she claims it is a "*visual thing*". However, it is my opinion that the process of assembling the word from its parts whilst vocalizing (or sub-vocalizing) in the process, as described above, involves phonological strategy. The latter observation may point to phonological working memory as being relevant to Eli's EFL vocabulary knowledge both due to her specified vocabulary learning strategy and due to the fact that list learning, on the whole, requires decoding ability, which has been seen to be related to phonological working memory.

Although Eli acquires much of her vocabulary by lists, as described above, the following quotation shows that there is one aspect in her strategy which serves to

absorb new words in their linguistic environment:

E: I start reading the text. If I see there are words that I don't know, I usually mark them. (Reading passage 1, 2, oral protocols, in Hebrew)

The minute Eli marks the words within the text itself and does not only learn them from lists supplied by the teacher, the word stays embedded in context. This way, even if she writes translations above, or under the word, the word itself remains contextualized and may allow some contextual aspects to be absorbed together with the target word. This may enhance the development of an inner voice for L2.

In summary, although studying new L2 words by lists is part of Eli's strategy for vocabulary learning, she also allows for contextualization of new words by marking them in the text itself. As far as modality is concerned, Eli utilizes both visual and phonological strategies for vocabulary learning.

Context of learning - context of performance

Eli's findings seem in line with former findings as to links between the context of learning and the context of performance. Eli, who utilizes both visual and phonological strategies for vocabulary learning in a contextualized, as well as a de-contextualized, manner, performs equally well in reading as in speech.

Summary

Findings from Eli's data analysis support former findings as to relationships between phonological working memory and vocabulary knowledge.

Eli's data seem to support suggestions as to links between auditory/phonological processing and L2 vocabulary knowledge since both her processing and her vocabulary are good. I have also suggested that auditory/phonological processing in reading may be related more to vocabulary knowledge in reading, whereas auditory/phonological processing in speech may be related more to vocabulary utilization in speech. Eli's data seem to support these suggestions since her processing is good in speech as well as in reading, and so is her vocabulary knowledge. Of the six case-studies, four use visual strategies for vocabulary learning, which seem to be more effective in reading after a certain threshold level of decoding has been reached. Natalie uses phonological strategies for vocabulary learning and utilizes vocabulary better in speech. Eli uses both visual and phonological strategies

for vocabulary learning and utilizes vocabulary well both in reading and in speech. These findings support the suggestion that there may be links between the context of learning and the context of performance.

9.3.3 Phonological memory and phonological working memory along with auditory/phonological processing and EFL speech performance

Table 9.9: Eli's results on the EFL Dialogue

Communicative ability	Name	points	Accuracy	name	points	Final grade
Comprehension of questions	Eli	100%	Incorrect/correct use of simple/complex language structures	Eli	90%	
Non-fluent/fluent Interaction	Eli	95%	Limited/basic/rich vocabulary	Eli	95%	
Gives single word/simple sentence/extended answers	Eli	100%	Poor/mostly comprehensive/comprehensible pronunciation	Eli	95%	
Total communicative ability	Eli	98.3%	Total accuracy	Eli	93.3%	**95.8%**

Table 9.9 shows that Eli's speech performance is very good from the point of view of accuracy as well as from the point of view of communicative ability.

When asked to evaluate her speech performance Eli says:

E:.. As far as expressing myself, I am not sure I am so good. I don't think I have enough of the ah I am sure I will get stuck every now and then and also in the grammar when I speak because when you write it or you are given an exercise and you are told to fill in and you have to decide if it's future or past it's something you think about; you stop to think about it and it's easier, but in speech in a conversation I am sure I make mistakes. I don't, I don't feel that I have the fluency to conduct a completely fluent and accurate conversation. (Interview, 20, in Hebrew)

However, when Eli speaks, it becomes clear that her speech is better than that of all the other case-studies. Eli can express ideas fluently and accurately, often using expressions which are much above basic level. Below are a number of excerpts from Eli's speech:

E: When it gets dark I think that my brain is off duty. I try not to learn in the night but it's hard since I go back, I get back from school sometimes at 4 o'clock, or even 5 o'clock so if I want to rest a little bit and especially now in the winter I can't study when it's night, but I think during the years I got used to the idea that I have to study at night. It's more, it's more I don't know it's depressing. (Dialogue, 35, in English)

Or:

E: You're not an animal you're a person but it doesn't matter. He has the right to

live and he has the right to be healthy and if I can help him why wouldn't I? (Role play, 38, in English)

She is also very quick and witty in her responses to my provocations and it doesn't seem that she needs to think much (language-wise, or otherwise) before answering back:

e.g

T: O.K, you have always been a stubborn little child...

E: I took it from you. (Role play, 121-122, in English)

Eli's speech in EFL seems to support suggestions as to a relationship between this skill and phonological working memory since her scores are high on both (PWM – high; speech vocabulary – high).

I have formerly suggested that collocation and colligation theory could serve to make a link between phonological working memory and speech processes as connecting to an inner voice hearing the words which have just been uttered and triggering words to come. The inner voice may facilitate retrieval of words and phrases in L2 accurately in their natural morphological and syntactic environment. The fact that Omer's speech performance is not as good as expected (in light of his phonological working memory) was attributed to his de-contextualized strategy for learning EFL vocabulary and to his constantly translating from L1 in the course of speech (see section 8.3.3). Eli's impressive speech performance, on the other hand, could be attributed to her more contextualized strategy for EFL vocabulary learning which allows words to be absorbed in their linguistic environment. In addition, whereas Omer regards grammar as the most difficult aspect in EFL, which constantly undergoes translation processes in speech (see section 8.1), Eli treats grammar completely differently:

T: So you are helped with the rules of grammar in the process of processing language?

E: I try not to because I don't remember the grammar; I do it according to my hearing; according to what sounds better. (Interview, 21-22, in Hebrew)

In a way, Eli's better performance according to what *sounds* better supports the notion of inner voice operating in a predictable morphological and syntactic sound context.

This is not to say that Eli does not learn grammatical rules in her EFL studies. Such a

claim would not have been plausible in the Israeli EFL classroom. It is, however, the way in which she is able to translate rules into contextualized syntactic knowledge that seems to make the difference. Interestingly, Eli's impressive speech may also serve to consider Krashen's acquisition/learning hypothesis (Krashen, 1982) in spite of the criticism it has drawn. Eli seems to fit Krashen's definition of a person who has not only learnt a foreign language, but has, to a large extent, acquired it. She also seems to be an example of an optimal monitor user.

Strategy in speech performance

When asked about the way in which she studies grammar Eli says:

E: ...as to the grammatical part I take a look at the book of grammar rules; make sure I understand and practise. (Interview, 32, in Hebrew)

Apparently, as mentioned above, Eli does learn grammatical rules and does feel a need to *understand* and even *practise.* However, by the way she expresses her interaction with grammatical rules, it does not seem that all of her grammatical knowledge derives from taking a look at the book.

Stable/unstable speech sounds and speech performance

Similar to her L2 sound representations in reading, Eli's L2 sound representations in speech seem to be accurate and stable. This is presumably due to intact auditory/phonological processing. I have formerly suggested that erratic representations of L2 sounds may be partially involved in vocabulary retrieval difficulties in speech and in problematic pronunciation (see section 8.3.3). Eli's stable L2 sounds as well as her good L2 vocabulary in speech serve to support this proposal.

Summary

Eli's speech performance supports suggestions made in this thesis as to its relationship with phonological working memory. Furthermore, looking at Eli's speech performance in the light of collocation and colligation theory seems to support the qualitative explanation for this relationship pointing to inner voice as the device which enables speakers to incorporate L2 vocabulary and syntax into their speech.

Eli's stable L2 sounds as well as her good L2 vocabulary in speech and good pronunciation serve to support the notion that there are links between these and auditory/phonological processing.

Overall language aptitude

In relating to Eli's data, one cannot ignore the fact that Eli seems to have a way with languages:

E: ...It's a sort of a thing that flows easily. It was also very easy for me to study Arabic and I know some French. (Interview, 16, in Hebrew)

In addition, the fact that Eli writes prose and poetry in L1 *("I publish, I write songs and short stories as well"* Dialogue, 71, in English) shows that her interest in and manipulation of language is much above standard everyday use. Although this is not the topic of this research it may be that the underlying factors involved in Eli's EFL performance have to do with her overall good language aptitude.

9.3.4 Phonological working memory along with auditory/phonological processing.

Reading – Eli's data analysis supports former findings as to relationships between low level reading skills in EFL and phonological working memory. High reading skills in EFL seem to require good strategy in addition to phonological working memory.

Eli's data analysis is in line with former findings as to visual strategies being effective in dealing with high level EFL reading skills specifically by reducing memory load.

Vocabulary – Findings from Eli's data support former findings as to relationships between phonological and phonological working memories and vocabulary with regard to list learning, phonological vocabulary learning strategies and collocation theory.

Eli's data support suggestions as to links between auditory/phonological processing and L2 vocabulary. It also strengthens the notion that auditory/phonological processing in reading is related more to vocabulary knowledge in reading and that auditory/phonological processing in speech is related more to vocabulary knowledge in speech. Eli's using both visual and phonological strategies for vocabulary learning,

which result in good utilization of vocabulary in speech, as well as in reading, supports the point mentioned above as to possible links between the context of learning and the context of performance.

Speech performance - Eli's speech performance supports former findings as to its relationships with phonological working memory mediated by inner voice which triggers on-coming speech.

Eli's good auditory/phonological processing in speech, and her good vocabulary in speech strengthens proposals as to possible links between the two.

9.3.5 Eli - visual memory and EFL performance

Table 9.10: Eli - RCFT

Copy trial	Time to copy (seconds)	RCFT immediate recall	RCFT delayed recall	RCFT recognition
Eli Percentile= >16 normative	180 Percentile>16 normative	42(% score=21) Rating=below average	42(%score=21) Rating=below average	35(%score=7) Rating=mildly impaired

(For qualitative features of performance see table 9.5.)

Table 9.10 portrays Eli as having a grim visual spatial memory profile. However, according to my observation, the results presented above have limited value due to the fact that Eli completely 'switched off' after she reacted to not having been told she would have to draw the figure from memory. Results on this memory test are not in line with what Eli says about her overall learning style and visual memory as discussed below. However it should be considered that Eli's being so annoyed by the task may point to a certain insecurity in performing tasks involving this kind of memory.

Table 9.11: Eli's results on the DTLA-A - Design Sequences

DTLA-A Design Sequences	
Eli	9(% score=37) rating= average

Table 9.11 shows that Eli's visual sequential memory is average and resembles Shandy's and Ori's (See tables 7.6, 6.6). The DTLA-A test was administered before the RCFT, therefore, Eli's performance was not disturbed by the negative feelings she had towards the other visual memory task.

Table 9.12: Eli - EFL Reading

Name	Reading passage 1 (search reading)	Reading passage 2 (careful reading)		Reading passage 3 (mixed search and careful reading)
Eli	100%	100%		100%

Table 9.12 shows that Eli's performance on all three reading tests is excellent. She is able to deal successfully with all text types. Her performance on the EFL reading tasks resembles Aya's (See table 5.3).

Reading

When Eli is asked about her reading skills in EFL she says:

"I think that there is no problem with reading. Sometimes when I read books, I bump into words that I don't understand, but I usually can understand them by the context" (Interview, 18, in Hebrew).

When I ask her whether she actually reads books in English Eli says:

I try, but I don't do it enough. During the summer vacation I always read a book, a big book, in English and during the school year one or two books: what is demanded at school. (Interview, 43-44, in Hebrew)

From the way Eli talks about reading in EFL, it seems that, although she does not feel she reads as much as she should, the reading itself is not a problem. When Eli is asked to read out loud a paragraph from reading passage number 1, she does so with no difficulty. Her reading is both fluent and accurate and her comprehension is complete (see table 9.12 and oral protocols, reading passage 1, 11, in Hebrew). It seems that Eli's visual word recognition, which was seen to involve visual spatial memory, visual sequential memory and good decoding ability, is very good. However, looking at Eli's reading performance vis-à-vis her visual spatial memory test results, and comparing this performance to the other case studies' performance seems to portray a pattern which is not in line with former patterns seen in this research and is discussed below.

Reading processes vis-à-vis visual spatial and visual sequential memory

Table 9.13 below presents results of Eli, Aya and Ori on both visual memory tests as a basis for comparison.

Table 9.13: Eli, Ori and Aya - RCFT and DTLA - A Design seqquences

RCFT immediate recall	RCFT delayed recall	RCFT recognition	DTLA-A Design Sequences
Eli	Eli	Eli	Eli

42(% score=21) Rating=below average	42(%score=21) Rating=below average	35(%score=7) Rating=mildly impaired	9(% score=37) rating= average
Ori 37(% score=10) Rating=mildly impaired	**Ori** 37(%score=10) Rating=mildly impaired	**Ori** 22%score=<1) Rating=moderately to severely impaired	**Ori** 11(% score=63) rating= average
Aya 61 (% score=88) Rating=aboveaverage	**Aya** 60 (%score=84) Rating=above average	**Aya** 47(%score=38) Rating=average	**Aya** 17(% score=98) rating=very superior

Although Eli's EFL reading is as good as Aya's (table 5.3) who has good results on the visual memory tests, her performance on the visual spatial memory test resembles that of Ori, whose EFL reading is very weak. This questions former findings of this research which pointed to possible links between visual memory and EFL reading. At this point I would like to remind the reader that Eli's performance on the visual spatial memory test should probably not be taken at face value. As I have already mentioned, Eli was annoyed by not being told she would have to draw the figure from memory and may not have treated the task seriously enough. In addition, as opposed to the visual memory profile presented in Eli's visual spatial memory test, other parts of the data present a different picture and imply that Eli's visual memory is good:

T: You look once and you remember?
E: Most of the words I remember after the first time. (Interview, 29-30, in Hebrew)
When I tried to probe more Eli assures me by saying:

Yes, I can visualize it. (Interview part 2, 28, in Hebrew)

Eli seems to utilize her visual memory in everyday life situations as well:

T: Let's say you get a new word, or even before that, a date to remember.
E: It helps, it helps the visual when you have a number in front of your eyes like 1/12/ that's how I remember my Mother's birthday. (Interview, 15-16, in Hebrew)
In addition to what Eli says about her learning style, from watching Eli doing the reading comprehension tasks, she did not seem to have difficulties in remembering surface visual features. Eli generally knew where to look for her answers and did not need to go back and forth from question to answer several times. It is therefore possible to argue that although Eli's visual memory may not be as good as Aya's, the qualitative features of her performance, as well as additional data, seem to limit the

validity of her very weak performance on the visual spatial memory test. Former findings (see section 5.5) suggest that in the process of reading, the two visual memories operate together and are facilitated by good knowledge of L2 spoken vocabulary, intact decoding ability and good receptive syntax. If we assume, even for the sake of a theoretical exercise, that Eli's visual spatial memory is as presented in table 9.13, this would mean that Eli and Ori, who have similar visual memory, have very different EFL reading ability (Eli's is excellent, but Ori's is weak). In this case Eli's excellent spoken EFL vocabulary, her very good receptive syntax and her good decoding ability could be the factors which distinguish between her reading in EFL and that of Ori's.

In summary, Eli's data do not contradict former findings which propose that visual spatial and visual sequential memory operate together in the process of reading and are facilitated, and may even be compensated for, by good EFL spoken vocabulary, receptive syntax and decoding ability which are all utilized in word recognition processes and text generation processes while reading.

Strategy

Eli's strategy for high level reading was discussed in detail in section 9.3.1 this chapter, where I checked whether her reading strategies involved phonological working memory. There, it was suggested that Eli does not much utilize phonological strategies for high level reading skills (reading comprehension passages), but does utilize visual strategies effectively. In relating to her learning styles in EFL she says:

For English I think that my eyes are important because I find myself many times looking at words especially and it's easier to learn them by looking at them then memorizing. (Dialogue, 29, in English)

As if to prove this observation, a few minutes later Eli commits a mistake which can be attributed to her storing and retrieving words visually:

T: Really, that's interesting. Maybe that has to do with some kind of psychological pressure.

E: For sure it has to do with psychological (pronounces the p) pressure, yes. (Dialogue, 48- 49, in English)

Eli pronounces the /p/ in *psychological* even though I had just used the word in the question correctly. Pronouncing the /p/ when she says *psychological* may be due to

her retrieving the word form from visual memory. It may also have to do with the fact that in Hebrew the word is pronounced similarly and includes the /p/ sound. However, apart from this mistake in pronouncing *psychology,* Eli's vocabulary knowledge is very high:

T: Were there words that you didn't understand here?

E: No. It was very easy for me; it really flowed, really easy. (Oral protocols, 28-28, in Hebrew)

This is not in line with former observations in this research which show that visual strategies, in general, and visual vocabulary list learning, in particular, are not effective for new word learning in EFL. However, as discussed in 9.3.2, Eli does (subconsciously) utilize phonological and linguistic strategies in addition to visual ones for new word learning in L2.

When Eli learns grammar she also combines the visual with additional supportive factors. In her words:

I look, and then I write. And as to the grammatical part I take a look at the book of grammar rules; make sure I understand and practice. (Interview, 32, in Hebrew)

It may be that a combination of visual memory with kinaesthetic practice anchors the syntactic rules visually, and that a deeper understanding along with hands-on practice accounts for Eli's successful utilization of these grammatical rules in reading and in speech.

Summary

Eli's data analysis supports former findings as to visual spatial and visual sequential memory operating together in the process of reading.

Findings in this section support former findings which suggest that visual memory is facilitated by L2 spoken vocabulary, receptive syntax and intact decoding in the process of reading.

Analysis of Eli's data supports former findings as to visual strategies being effective for high level reading skills and adds an observation that high level reading skills can be facilitated by suitable markings which assist visual memory by reducing the burden on it. These markings may also serve to lay the foundations for effective high level integration.

Eli's data suggest that visual strategies for vocabulary learning are more effective

when supported by phonological and linguistic strategies which render new words familiar (sound-wise) and meaningful.

It is proposed that visual strategies are good as far as remembering the grammatical rules, but that effective syntactic knowledge requires understanding and hands-on practice.

9.3.6 Auditory verbal memory and EFL performance

After analyzing five case studies' EFL performance vis-à-vis auditory verbal memory, a pattern of possible relationships between the two seems to evolve. In the following section I attempt to see whether Eli's data support these former suggestions.

Eli's results on the Rey Auditory Verbal Learning Test (RAVLT) are presented below in table 9.14.

Table 9.14: Eli - RAVLT

RAVLT trial 1	RAVLT trial 2	RAVLT trial 3	RAVLT trial 4	RAVLT trial 5	RAVLT Trial 6 proactive interference	RAVLT Trial 7 retroactive interference	RAVLT Trial 8 LTM	RAVLT Trial 9 recognition
(SD=1.59)	(SD=2.13)	(SD=1.63)	(SD=1.54)	(SD=1.44)	(SD=1.80)	(SD=2.04)	(SD=2.11)	(SD=2.46)
0.83	+1.53	+0.97	+0.29	-0.71	+0.81	+0.06	-0.52	+0.32

Table 9.14 shows that Eli's performance on this memory test is within average range of normative performance. Like Omer, her best performance is in the immediate short term memory trial (trial 1). Like Omer and Shandy (See tables 8.4 and 7.4), her performance drops slightly between the 3rd and 4th trial, but unlike Omer and Shandy, she does not perform better in the 5th. Eli does not seem to be specifically prone to interference.

Unlike Omer and Shandy, Eli always repeats new words provided by the interlocutor in the course of on-line speech and utilizes them in her own. Eli's ability to do this may be reflected in her normative auditory verbal memory. Below are some excerpts which show the process:

E: That's something that it's a big change in my life that made me eh HOW DO YOU SAY TO GET RID OF?

T: Get rid of

E: To get rid of lots of pressure that I had in school. It changed my life completely (Dialogue, 51-52, in English)

And:

E: Your flowers can, MAKE DO WITH

T: Make do with

E: Make do with small amount of water... (Role play, 22-24, in English)

In the next excerpt, Eli does not repeat the word *supervisor* immediately, but she internalizes the word and utilizes it a few sentences later:

E: Everyone says good, good, but the real, the real thing is to hear it from people that are objective and have the authority to tell you if it's good or not, and I get this from my SUPERVISOR?

T: Supervisor

E: In. I am in a group WRITING WORKSHOP

T: Writing workshop

E: Writing 'worshop'

T: Workshop. Workshop.

E: There I have a supervisor, his name is ... if you heard about him. (Dialogue, 79-85, in English)

Unlike Omer and Shandy, Eli's auditory phonological processing seems to be intact (Her mispronouncing *workshop* is a single instance). Moreover, Eli feels the importance of correct and stable phonological representations of words. When she is not completely sure, she asks me to repeat the word and then she repeats after me, in order to verify:

E: You can eat bread and egg and vegetables and CARBOHYDRATES

T: carbohydrates

E: Say that again

T: carbohydrates.

E: carbohydrates... (Role play, 56-60, in English)

Eli seems to make sure she has the right phonological representation of the word by asking me to repeat and the repetition helps anchor the word in auditory verbal memory. Eli's stable phonological processing which enables her to utilize words provided by the interlocutor on-line may also make these words available for

retrieval in the longer term. These findings support former findings as to possible links between auditory verbal memory and the ability to utilize words in EFL provided in the course of speech, as well as the suggestion that intact auditory phonological processing is necessary for auditory verbal memory to come into play where L2 is concerned.

Unlike the other case studies, Eli consciously utilizes both modalities for learning. Moreover, she actually learns different subjects via different modalities:

In the humanistic subjects like History or Bible studies it is difficult to listen. (Interview, 14, in Hebrew)

And:

... but in Literature, for example, I find that I learn and internalize the material much better when I listen in class and concentrate when the teacher speaks because then when I read the material, am already familiar with it and I don't need to learn the details when I already understand. (Interview, 12, in Hebrew)

Interestingly, when Eli is actively involved in the lesson, she learns better auditorily. However, when she is not actively involved she does not gain much from learning via the auditory modality and turns to visual learning. This supports former suggestions as to the auditory modality being more prone to drops in attention. According to Eli, the best results are achieved when both modalities are utilized for learning as is generally the case when she learns new English vocabulary:

It helps me, I look at it and try to read it. If someone who is familiar with it and can pronounce it I will try to repeat after him. (Interview, 20, in Hebrew)

Or:

I repeat it and I learn it visually. (Interview, 34, in Hebrew)

And:

...when I see a word that is eh that is not familiar to me when I know how to say it, I think about and, and then I feel like I know this word if I know how to pronounce it I can write it as well. (Dialogue, 31, in English)

Eli's good performance in both EFL reading and EFL speech may be related to her utilizing both modalities for learning EFL. This supports former suggestions as to relationships between the modality of learning and the modality of performance.

Auditory recognition in speech

Eli understands speech in EFL with no difficulty. Her score on comprehension is

100% since she has no difficulty in understanding the vocabulary or the syntax used by the interlocutor. Eli's score on the recognition trial of the RAVLT is normative, which may partially account for her high comprehension score. Eli's data support former proposals as to possible links between EFL speech comprehension and auditory verbal memory via recognition after a certain threshold level in EFL has been achieved.

Retrieval in speech - speech performance

Eli is the only case study whose speech is both fluent (95%) and accurate (syntax 90%, vocabulary 95%). Her score on the auditory verbal long-term memory test is normative. From the point of view of accuracy Eli's good productive vocabulary and normative score on the auditory verbal long-term memory test may be related. This would support former findings as to links between the two. However, the second parameter of accuracy, which is productive syntax, was not seen to be related to auditory verbal memory.

From the point of view of fluency, Eli's retrieval strategy seems to rely on the auditory modality:

T: So you are helped with the rules of grammar in the process of processing language?

E: I try not to because I don't remember the grammar; I do it according to my hearing; according to what sounds better. (Interview, 21-22, in Hebrew)

As opposed to Omer, Eli, consciously, tries to avoid thinking about how to say things correctly. She feels on safer grounds when she can rely on the auditory modality for speech. Interestingly, when, occasionally, she does stop in order to think, she commits a mistake:

...And I have to have people around me that aren't so worried about me that aren't eh that doesn't have the job of parents. (Role play, 94, in English)

It seems safe to assume that Eli's normative auditory verbal long-term memory enables her to rely on this modality in the first place. However, other case-studies, who have similar scores on auditory verbal long-term memory, do not have the same fluency in speech. It may be, therefore, that Eli's ability to rely on the auditory modality in speech may have to do with her consciously utilizing the auditory modality for EFL learning. It is possible that Eli's learning through the auditory modality and her seeking exposure to authentic language facilitates her sensitivity to

the collocatedness of words and enhances processes of lexical priming.

These findings support former findings as to possible relationships between the modality of learning and the modality of performance.

When looking at speech performance in terms of auditory verbal memory, we see that although four of the case studies have normative scores on all trials on the RAVLT memory test (Shandy's score on trial 1 being even higher than Eli's), Eli's speech performance is by far superior to theirs. In order to try and find patterns in the phonological/auditory aspects of memory which could be linked to speech performance, the relevant scores are presented in table form.

Table 9.15: Eli and the other case studies - phonological factors and speech production

(+ stands for normative performance or more, - stands for weak performance)

	PWM	Phono. processing	Auditory Verbal LTM	Productive vocabulary	Productive syntax	learning modality	fluency	accuracy
Eli	+	good	+	95%	90%	visual+ auditory	95%	92%
Omer	+	uneven	+	80%	50%	mainly visual	65%	65.5%
Shandy	_	uneven	+	65%	50%	visual	65%	61%
Ori	_	low	__	40%	40%	visual	50%	47%
Aya	+	good	+	75%	75%	visual	65%	78%
Natalie	_	low	+	65%	50%	mainly auditory	95%	67%

Table 9.15 presents scores on speech performance along with the phonological aspects of memory.

Accuracy in EFL speech seems to be related to phonological working memory and phonological processing either via vocabulary or syntax or both. It appears that reduced phonological working memory or reduced phonological processing hinders auditory verbal memory functions in the process of EFL speech.

Fluency seems to be related to the modality of learning: retrieval seems easier via the modality of acquisition. This could explain why Natalie is fluent in speech notwithstanding her unimpressive vocabulary range and low syntactic knowledge, whereas Aya is less fluent even though her vocabulary and syntactic knowledge are

better.

It appears that intact auditory verbal long-term memory is a necessary, but not sufficient, condition for good speech performance in EFL. It seems to be necessary because even the case-studies who have weak phonological working memory and unimpressive phonological processing ability can conduct an intelligible conversation in EFL, presumably due to intact auditory verbal memory. It is insufficient because reduced phonological skills seem to impair accuracy and diminish auditory verbal memory in the course of EFL speech.

Summary

Findings from Eli's data support former findings as to possible links between the ability to utilize words in EFL provided in the course of speech and auditory verbal short-term memory, as well as the suggestion that intact auditory phonological processing facilitates auditory verbal memory in EFL speech.

Eli's data support former proposals as to possible links between EFL speech comprehension and auditory verbal memory via recognition after a certain threshold level in EFL has been achieved.

Eli's good productive vocabulary and normative score on the auditory verbal long-term memory test may be related. This supports former findings as to links between the two.

Eli's data support former suggestions as to the auditory modality being more prone to drops in attention.

Analysis of Eli's data supports former suggestions as to relationships between the modality of learning and the modality of performance and emphasizes that retrieval seems to be easier via the modality of acquisition. Eli's data indicate that fluency in speech is better when material has been studied auditorily.

EFL accuracy in speech seems to be related more to phonological working memory and phonological processing than to auditory verbal memory per se. However, it appears that reduced phonological working memory or phonological processing themselves might hinder auditory verbal memory functions in the process of EFL speech.

It appears that intact auditory verbal long-term memory is necessary for good speech

performance, but that additional factors are involved.

9.3.7 Central executive function and EFL performance

Data analysis of four of the six case studies pointed to possible relationships between the central executive function and high level language skills (both reading and speaking). Analysis of the fifth case study (Omer) somewhat modified these suggestions: Omer's speech performance was found to be erratic and his high level reading comprehension was problematic despite his having an effective central executive function. It was suggested that Omer's translation strategy and inappropriate utilization of a particular reading strategy prevented effective utilization of his central executive and, therefore, Omer's performance was felt not to rule out the possibility of the suggested connections. In this section Eli's data are analyzed in order to see how it relates to these suggestions.

Eli's score on the Active Memory-Complementing Words test which was administered to the subjects in order to test central executive skill was +0.50 (average rating) and resembles that of Natalie (See table 4.6) .

Eli's performance on all of the reading comprehension passages is 100%. Of all case studies, only Eli and Aya (who scored high on the central executive test) have scores of 100% on all reading comprehension passages. As mentioned before (see sections 7.3.1 and 7.3.7), reading passage number 2 involves mainly careful reading, whereas the other reading passages involve mainly search reading. It is my observation that, as opposed to search reading, which involves more visual memory, careful reading requires more of the ability to carry information from sentence to sentence and from paragraph to paragraph. It requires the ability to integrate pieces of information from various parts of the text and from both modalities. This kind of reading ability seems to be in the domain of the central executive. Moreover, it seems that the ability to cope with the complicated structure of the questions following reading passage number 2 and to juggle between the questions and the text also puts a higher burden on the central executive than the questions following the other reading passages. In what follows, I present the way in which Eli tackles reading passage 2:

T: (referring to "Six Good Reasons to Subscribe to the 'Science Scene'")
This is a different kind of unseen. How do you approach it? Here you need to give three reasons when every reason is from a different paragraph.

E: Here I read the whole passage first.

T: You read all of it?

E: Yes, and then I just connected everyone to where it belongs.

T: Could you explain the process.

E: I read all the text and then looked at the question.

T: Let's say you read the question...

E: Here I saw "offers many different options" and here I remembered there was "a variety of viewpoints" so it gave me a hint it could be suitable. I read it again and saw that it's right. (Reading passage 2, oral protocols, 17-23 in Hebrew)

Eli's reading strategies involve heavy use of the central executive function: She marks words/phrases that seem important and then she can switch her attention between the question (or parts of the question) to the things she marked. Eli holds complete concepts/ideas in memory (not only elements which can be attributed to visual memory) and looks for similar ones in the text. A question may be raised as to differences in performance between Eli and Natalie, who also has a normative central executive skill, but performs very poorly in the reading. It seems that although Natalie has normative central executive skill, reduced vocabulary and weak decoding skills (presumably due to weak phonological working memory) mean that the central executive does not have enough accurate data for the integration process. Natalie's erratic low level reading skills which feed into the integration process restrict high level reading ability, notwithstanding an adequate central executive function. Eli, on the other hand, has no difficulties with vocabulary or with phonological working memory. When asked about possible difficulties with vocabulary in the reading comprehension passages she says:

E: No. It was very easy for me; it really flowed, really easy. (Reading passage 2, oral protocols, 28-29, in Hebrew)

In the light of this analysis, it is suggested that the central executive function is a necessary condition in order to achieve high level reading skills, but not a sufficient one in itself. The end result of the central executive function depends on the quality of the information fed into the integration process. When Eli is asked to point to specific aspects in her EFL studies she differentiates between the skills and says:

As far as expressing myself, I am not sure I am so good. I don't think I have enough of the ah I am sure I will get stuck every now and then and also in the grammar when I speak because when you write it or you are given an exercise and you are told to fill in and you have to decide if it's future or past it's something you think about; you stop to think about it and it's easier, but in speech in a conversation I am sure I make

mistakes. I don't, I don't feel that I have the fluency to conduct a completely fluent and accurate conversation. (Interview, 20, in Hebrew)

Eli differentiates between speech and writing, although both are productive elements in L2 and both seem to require the ability to integrate numerous linguistic, cognitive and ideational factors. The main difference, however, between the two is that in speech the integration process is on-line, whereas writing leaves time to think the integration through. Since both speech and writing require varying degrees of integration, it seems that both require varying degrees of use of the central executive function. However, Eli's speech performance, which is both fluent and quite accurate, and the way she describes this performance (*in spite of* her harsh judgement) leads me to add the notion of automaticity in speech to the analysis and try to differentiate between the effects the central executive function and automaticity have on L2 productive skills. It seems that since, by definition, the central executive function is controlled and involves cognitive activity, it plays a larger role in writing than in fluent speech. Eli's fluent speech does not seem to involve much thinking or cognitive effort. Eli's own accounts of her writing and her speech seem to confirm this distinction:

T: You say that when you write, you have time to think. Do you mean to think about words or what?

E: When I have to fill in a worksheet in grammar, for example, I don't have any problem with it. I know more or less what is suitable and what not, but when I speak, if we converse in English, I am sure I'll have mistakes every now and then like confusing haven't or weren't etc. It's not natural like people who really speak the language as a mother tongue it flows correctly. (Interview, 23-24, in Hebrew)

And:

T: So you are helped with the rules of grammar in the process of processing language?

E: I try not to because I don't remember the grammar; I do it according to my hearing; according to what sounds better. (Interview, 21-22, in Hebrew)

Eli tries not to think while speaking, and this presumably facilitates her fluency in speech probably at the price of a few grammatical errors. Her overall accuracy may have to do with different factors.

A look into Eli's speech itself supports the notion of her automaticity in speech. Below are some excerpts from her speech:

T: What if you have to write something?

E: On my bed. That's one of the disadvantages of studying on a bed. (Dialogue, 2-3,

in English)

Eli's reply is fast and does not seem to involve hard grammatical thought. Her reply includes English language collocations which would have probably been used by a native speaker. *That is one of the...* appears 353 times in the BNC and Guardian corpora and is often followed by an evaluative word. The fact that this seems to come naturally to Eli points to her speech being more automatic and less controlled.

Below are a few more examples which show Eli's automaticity in speech:

T: So you are busy with the radio all the time?
E: Not all the time. Once in a while (Dialogue, 11-12, in English)
Or:

E: The mess is never too big so I can handle it. (Dialogue, 24, in English)

Once in a while and *I can handle it* are quite idiomatic and could not have resulted from translation, grammatical thinking or cognitive effort. In addition, some of Eli's replies actually involve sarcasm in an almost reflexive response:

E: What's so good about it? (Role play, 116, in English)
Or:
T: (laughs) You go into class and 40 kids want to kill you...
E: It sounds exciting. (Role play, 117-118, in English)
And:

T: O.K, you have always been a stubborn little child...
E: I took it from you! (Role play, 121-122, in English)

In all of the excerpts above it seems that Eli's speech is more automatic than controlled and therefore, probably involves less use of the central executive function. This is not to say that executive skill is not part of Eli's speech altogether. On the contrary, the fact that Eli does not need executive capacity for the technicalities of speech in EFL, leaves free capacity for content. When I ask her in the role play if she thinks that I do not have a heart, automaticity is interrupted in order to think of a suitable response or in other words automaticity is interrupted by executive activity:

E: You have but eh you have the potential but eh I have to work on it. (Role play, 50, in English)

It would be interesting to investigate whether automaticity is a product of a very high level of use of the central executive function or it is something functionally different. Theoretically speaking, is 100% central executive skill equal to automaticity or does

a repetitive central executive procedure lead to automaticity which is no longer in the domain of cognition? This issue is further addressed in chapter 11.

How do these suggestions relate to findings from the former case studies and why is it that the issue of automaticity is only addressed at this late stage of the research? In the former case studies we saw that the central executive function was related to higher level speaking skills, but here it is suggested that EFL speech which is both accurate and fluent may be beyond the domain of the central executive. This could not be seen with the former case studies since Eli is the only case study with such good speaking skills: Aya and Omer, who have a high central executive function, do not speak fluently, though Aya's speech is quite accurate whereas Omer's is not. Eli and Natalie, who have a normative central executive function, both have fluency in speech. However, whereas Eli's speech is accurate, Natalie's speech is not. Ori and Shandy, who have a weak central executive function, are neither accurate nor fluent in speech.

In the light of this, along with the qualitative analysis of Eli's data, it is suggested that an adequate central executive function is a necessary condition for higher level speaking skills, but not a sufficient one. Although it is very likely that a normative central executive function is necessary in the pre-automatic stage, near native speech performance which is both accurate and fluent may be beyond the central executive function. In the advent of near-native speech performance, accuracy may be related to pre-integration factors and fluency may be related more to automaticity than to the central executive function.

In summary, the qualitative analysis of Eli's data supports former findings as to links between the central executive function and high level reading skills in EFL. It is suggested, however, that although an adequate central executive function is a necessary condition for successful high level reading comprehension, it is not a sufficient one in itself since the quality of information fed into the integration process affects the end result.

Likewise, it is suggested that an adequate central executive function is a necessary but not sufficient condition for developing high level speaking skills in EFL. It is proposed that although the central executive function is crucial throughout the learning process, when EFL speech reaches near-native performance, automaticity takes the place of controlled processing.

9.4 Eli – general summary of EFL performance vis-à-vis memory profile

Eli manifests the highest EFL performance of all case studies. Her vocabulary range is high, her syntax is generally correct, her reading skills are excellent and her speech is both fluent and generally accurate.

Eli's vocabulary range is high in reading and in speech. Her high vocabulary range in the reading may be related to her adequate phonological working memory via good decoding ability and intact phonological processing. This enables her to learn new words in English by lists, which is still very common in the EFL classroom.
Eli's excellent vocabulary range in the reading may also be linked to the fact that she utilizes visual (as well as phonological) strategies for new word learning, and tries to do so in a contextualized manner. Eli's impressive vocabulary range in speech is also enhanced by her exact phonological processing which facilitates clear storage and, therefore, easier retrieval and by her normative auditory verbal long-term memory. Eli's good vocabulary range in speech may be related to her utilizing phonological strategies (as well as visual ones) for new word learning, in a meaningful and contextualized manner. She thereby allows for the development of an inner voice sensitive to word collocations. Intact phonological and phonological working memories facilitate the inner voice which seems to facilitate vocabulary retrieval in speech. Eli's fine EFL syntax could be related to her adequate phonological working memory via the inner voice which triggers suitable collocates (in short chunks) and colligates. Eli's excellent low level reading skills might also be due to her phonological working memory, this time via correct decoding. Eli's good higher level reading skills cannot be explained in terms of visual spatial memory since her results on the visual spatial memory test are poor. Even if I choose not to take these results at face value due to her questionable attitude toward the test (for details see section 9.2), it is not possible to ignore them. It seems possible to suggest, however, that Eli's good word recognition processes while reading result from a combination of her normative visual sequential memory and her (questionable) visual spatial memory, and that these are facilitated by, or maybe even compensated for, by her good EFL vocabulary, syntax and excellent decoding ability. Eli's good higher level reading skills may be related to an adequate central executive function which allows for high level text generation. In addition, Eli's good performance on search reading

may be attributed to her applying suitable visual strategies. Eli's careful reading is also assisted by visual strategies. However, she is seen to assist her visual memory by suitable markings on the written text, which serve to reduce the burden on visual memory and lay the foundations for later integration. Eli's good careful reading is also boosted by good EFL vocabulary and syntax. Eli's oral skills are quite impressive. Her fine comprehension may be related to her normative auditory verbal memory via recognition and good auditory phonological processing. Eli's excellent speech production may be related to phonological working memory via inner voice which triggers collocates and colligates as well as to auditory verbal long term memory which enables her to remember words along with their meanings. Eli's excellent speech seems to be connected to her utilizing phonological strategies via the auditory modality for new word learning. This seems to facilitate speedy word retrieval and thereby enhance fluency. In addition, Eli's good speech production may also be initially related to an adequate central executive function. However, her impressive fluency in EFL speech seems to reach the level of automaticity which is probably above the domain of controlled executive processes.

Chapter 10: Summary of the findings

10.1 Issues of EFL performance in terms of overall phonological memory, phonological working memory and auditory/phonological processing

The purpose of this research is to try and explain EFL performance in terms of memory. The first memory functions looked at are phonological memory and auditory phonological processing. Aspects of EFL performance which seem to be related to these memory functions are reading and speech performance. Likewise, vocabulary and syntax, which are part of both reading and speech, seem to be related to phonological memory and auditory/phonological processing on their own account. Two additional issues emerge from the data analysis: strategy issues and links between the context of learning and the context of performance.

10.1.1 Reading

All the case-studies who have weak PWM have weak low level reading skills in EFL as well as weak high level reading skills in EFL. All the case-studies who do not have weak PWM have good low level reading skills in EFL, but one of the three (Omer) does not cope as well as expected with high level reading skills, which require high degrees of integration. The case-studies who cope very well with high level reading skills are seen to use much strategy in their work (as is discussed below). Qualitative analysis of the data points to possible relationships between PWM and low-level reading skills via decoding ability. The qualitative explanation for the relationship between decoding and PWM is an *inner voice*. It is my suggestion that in the process of decoding, an inner voice enables the reader to hear the sound-symbol correlations just read and anticipate the on-coming data in light of former knowledge. PWM may also impact higher level reading (on the sentential level) by enabling a person to hold in memory sentence components for immediate processing. In addition, it was seen that impaired low-level reading skills implicate the quality of higher-level reading skills. However, excellent performance in the high-level reading skills requires the ability to use strategy as well.

10.1.2 Speech performance

At first it seemed that there are no visible links between speech production and phonological and phonological working memories along with auditory phonological processing. However, when I reached case number 5 (Omer) two things happened to change my approach. First, the numerical results started to point to possible links and, second, the notions of collocation and colligation seemed to provide a qualitative explanation for such a relationship. Findings from case number 6 further supported these notions.

Of the three case-studies who have a weak phonological working memory, one has very low-level speech production (Ori), one has a low intermediate level of speech production (Shandy) and one has a somewhat higher level of speech production (Natalie). All three manifest poor vocabulary and syntactic knowledge. The case-study with the highest level of speech of the three (Natalie) manifests more fluency in speech and an ability to utilize the small range of vocabulary she has. Of the three case-studies who do not have weak phonological working memory, one has high speech production (Eli), and two have varying degrees of high-intermediate speech production. All three manifest a good knowledge of vocabulary, and two of the three manifest good syntax as well (Eli and Aya). However, one of the three has weak syntax (Omer). The qualitative explanation of possible relationships between phonological working memory and speech production is suggested in light of collocation and colligation theory and proposed that phonological memory facilitates an *inner voice* which hears the uttered word or words and triggers on-coming words or phrases embedded in their morphological and syntactic environments. Numerical results relating specifically to vocabulary and syntax in speech seemed to support this suggestion. The relationship between phonological memory and speech production can be obscured when vocabulary is learnt solely by lists and when translation strategy is utilized systematically in speech, because of the consequence of blocking inner voice processes.

Erratic auditory/phonological processing seems to be related to overall speech production via reduced vocabulary in speech, problematic pronunciation and lack of security in producing speech.

10.1.3 Vocabulary

Three of the case-studies, who have weak phonological working memory, have low to low-intermediate vocabulary scores in speech, and low vocabulary knowledge in reading. The other three case-studies, who do not have weak phonological working memory, have high-intermediate to high vocabulary scores in speech and very high vocabulary knowledge in reading.

It is suggested that phonological working memory is implicated in reading vocabulary mainly due to learning new vocabulary via lists, which requires decoding ability; overall phonological memory is implicated in speech mainly due to the inner voice and the lexical priming processes that the inner voice both instigates and utilizes.

Auditory/phonological processing seems to be related to EFL vocabulary knowledge via the stability of L2 sound representations. Erratic auditory/phonological processing resulting in unstable sound representations in the reading seems to be more related to weakness in EFL reading vocabulary, whereas erratic auditory/phonological processing resulting in unstable sound representations in speech seems to be more related to weakness in speech vocabulary.

10.1.4 Syntax

The three case-studies who have weak phonological working memory have poor syntactic knowledge. Of the three case-studies who do not have weak phonological working memory, two have high-intermediate to high syntactic knowledge, but one (Omer-case 5) has poor syntactic knowledge.

In this research phonological working memory is related to syntactic knowledge in light of colligation theory in a similar way that it is related to vocabulary knowledge in light of collocation theory, namely, mediated by *inner voice*.

Because collocation and colligation point to the fact that most words in a language generally appear in similar morphological and syntactic environments and are tied to each other by invisible linguistic strings, spoken words held in phonological working memory as inner voice serve as retrieval lines for the next items. Because words and phrases are believed to be tied to each other in a fixed manner, inner voice enables

words to be retrieved in an accurate syntactic environment as well as an accurate morphological environment.

10.1.5 Strategy

Two of the case-studies are helped by phonological strategies in dealing with low-level reading skills, whereas one of the case-studies tries to utilize visual strategies to cope with low-level reading skills and is unsuccessful in doing so. Three of the case-studies, who are beyond the threshold of low-level reading skills, successfully utilize visual strategies to cope with high level reading skills. It is, therefore, suggested that phonological strategies are helpful for dealing with low level reading skills, whereas visual strategies are helpful for dealing with high level reading skills.

The one case-study who learns vocabulary in a phonological and contextualized manner (Natalie) utilizes vocabulary better in speech than in reading. However, this could also be due to decoding difficulties. One case-study who combines phonological and visual strategies for vocabulary learning (Eli) utilizes vocabulary well in reading and in speech. The other case-studies study vocabulary mainly visually and utilize vocabulary better in reading than in speech, even when they have decoding difficulties. These findings lead me to suggest that modality-wise there may be a link between the context of learning and the context of performance.

List learning and de-contextualized EFL learning strategies as well as translation strategies are seen to inhibit EFL performance, especially in speech.

10.2 Issues of EFL performance in terms of visual memory

Two aspects of visual memory are checked by two separate visual memory tests. As we have seen, visual spatial memory is tested by the Rey Complex Figure Test (RCFT) and visual sequential memory by the DTLA-A Design Sequences Test. Naturally, the major aspect in EFL related to visual memory is reading. Therefore, a qualitative analysis of the case studies' EFL reading, along with the visual memory tests, serve as a basis for the findings presented below. In addition, I attempted to see to what extent the cases utilized visual strategies for learning vocabulary and to what extent these strategies were effective. Finally, I set out to learn to what extent the cases utilized visual strategies for coping with reading comprehension passages and how successful they were.

10.2.1 Reading

My findings relating to the relationships between EFL reading and visual memory are not as conclusive as my findings relating to the relationships between EFL reading and phonological working memory.

Of the six case studies, one, who scored low on the visual sequential memory test, also has weak visual word recognition while reading (Natalie); one case study, who scored high on this test, has good visual word recognition in the process of reading (Aya). Three of the case studies scored average on this test. Of the three, one has low visual word recognition (Ori), one has high visual word recognition (Eli) and one has uneven visual word recognition across texts (Shandy).

Of the six case studies, one, who scored low on the visual spatial recognition test, also has weak visual word recognition (Ori); the other case study who scored low on this test has good visual word recognition, but the validity of her performance on the visual memory test is questionable (Eli). Four of the case studies scored average on this memory test. Two of the four have good visual word recognition (Omer and Aya), one has low visual word recognition (Natalie) and one has uneven visual word recognition while reading (Shandy).

A qualitative analysis of the reading suggests that in the process of reading, visual spatial memory and visual sequential memory operate together as visual word recognition is facilitated by positive or negative general word-configuration or orthographic awareness.

In the light of the above, it seems that visual memory in itself does not seem to account for strong or weak reading in EFL. However, a qualitative analysis of the data shows that in the process of reading, visual memory while reading may be enhanced or inhibited by additional factors. Two of the cases, who present good visual word recognition while reading, in spite of their performance on the visual memory tests being between weak to average, have a very good knowledge of EFL spoken vocabulary, receptive syntax and decoding ability (Omer and Eli). It is suggested that these factors support visual memory and facilitate visual word recognition in the process of reading. Conversely, two other cases, who present a similar performance on the visual memory tests but have weak visual word recognition while reading, have weak knowledge of EFL spoken vocabulary,

receptive syntax, and weak decoding ability (Natalie and Ori). It is therefore suggested that visual memory which facilitates visual word recognition in the process of EFL reading is affected by EFL oral knowledge of target language vocabulary, receptive knowledge of the target language syntax and target language decoding ability.

10.2.2 Vocabulary knowledge and strategy for vocabulary acquisition

One case study (Ori), who scored between weak to average on the visual memory tests, utilizes visual memory alone for vocabulary learning, resulting in weak vocabulary knowledge both in reading and in speech, whereas another case study (Aya), who scored between average to very superior in the visual memory tests and utilizes visual memory for vocabulary learning, has good vocabulary knowledge, although it is somewhat prone to decay over time. Aya's vocabulary knowledge is better in reading than in speech.

Two of the case studies, who scored between low to average on the visual memory tests and also have low phonological working memory, were seen to use either phonological or visual strategies usually under different circumstances (Natalie and Shandy). Natalie's phonological strategies (from films) and Shandy's phonological strategies (at the very beginning of learning EFL) seem to be more successful than their list learning visual strategies. Both have better vocabulary knowledge in speech than in reading.

Two of the case studies, who scored between low to average on the visual memory tests, successfully learn new L2 vocabulary by utilizing both visual and auditory memory, contextualizing words and using them meaningfully (Omer and Eli).

In the light of the above, it is suggested that utilizing visual strategies alone for learning new L2 words is not very effective, unless one has a very good visual memory. Even when this is the case, it seems that words acquired by the visual modality alone are prone to decay over time.

The data above also suggest that vocabulary acquired via the auditory modality in a meaningful way is less prone to decay (even when the person's phonological working memory is weaker than his or her overall visual memory)

The best vocabulary knowledge is presented by case studies who utilize both visual

and auditory modalities, contextualize new words and use them in a meaningful manner.

The data also support former suggestions as to links between the modality context of learning vocabulary and the context of performance.

10.2.3 Strategy for reading comprehension

Two of the case studies do not seem to reach the level of high-level reading skills in EFL because of their weak low-level reading skills (Natalie and Ori).

Two of the case studies who scored between low to average on the visual memory tests utilize visual strategies for high-level reading skills in EFL, especially for the fast location of surface visual cues in a given text (Shandy and Omer). In both cases these visual strategies are successful for dealing with search reading and less successful when the text comprehension requires careful reading and high degrees of integration between text parts.

Two of the case studies who manifest excellent reading comprehension on all text types scored very differently on the visual memory tests. Aya scored between average (visual spatial) to superior (visual sequential), whereas Eli scored between low (visual spatial) to average (visual sequential). However, the validity of the latter's performance on the memory tests is questionable since a qualitative analysis of her performance shows no such weakness. In addition Eli is helped by markings which lower the burden on visual memory and serve as a good basis for later high-level integration.

In light of the above it is suggested that visual strategies are effective for search reading in EFL even when visual memory is not very strong. However, visual strategies alone do not suffice for more complicated careful reading which requires high degrees of integration. Nevertheless, it may be that visual strategies do suffice even for careful reading when the visual memory is exceptionally strong.

10.3 Issues of EFL performance in terms of auditory verbal memory

10.3.1 Speech comprehension

Five of the six case-studies who have normative auditory verbal memory via recognition also have a good ability to comprehend EFL vocabulary in speech, which points to possible relationships between the two. The qualitative causal link seems to be the ability to recognize words in speech, or auditory word recognition. One case-study (Ori), however, who also has normative auditory verbal memory via recognition, presents weak L2 vocabulary comprehension. However, since Ori's overall EFL knowledge is very weak, it is suggested that the relationship between auditory verbal memory via recognition can come into play only after a certain threshold level of EFL (which has to do with additional cognitive factors as well).

10.3.2 Speech production

Five of the six case-studies, who have normative auditory verbal long-term memory, also have between intermediate to high scores on productive vocabulary. One case-study (Ori), who has weak auditory verbal long-term memory, also scores poorly on productive vocabulary. This indicates that there may be links between auditory verbal long-term memory and productive EFL vocabulary. However, in light of the qualitative analysis of the data, it appears that intact auditory verbal long-term memory is a necessary but not sufficient condition for good speech performance. It appears that phonological processing and phonological working memory are relevant factors in EFL speech performance and that reduced phonological processing and phonological working memory hinder auditory verbal memory functions in the process of speech.

10.3.3 Context of learning/context of performance

Retrieval appears to be easier, for all case-studies, via the modality of acquisition. Therefore, where speech is concerned, case-studies who consciously utilize the auditory modality for acquisition present better speech than those who don't. The aspect of fluency in speech seems to be specifically related to the modality of acquisition.

During the process of the qualitative analysis it appeared that case-studies who have attention and concentration difficulties find it more difficult to concentrate on auditory presented materials. It is suggested that the auditory modality may be more prone to attention drops.

10.4 Issues of EFL performance in terms of the central executive function

10.4.1 Reading

It is suggested that there are links between the central executive function and higher level reading skills in EFL. However, it seems that although an adequate central executive function is a necessary condition for acquiring higher level EFL reading skills, it is not in itself a sufficient condition. Being an integration system, the central executive function depends on the quality of factors fed into the integration process. When the information fed into the integration process is erratic (for reasons including erratic low level reading skills, additional information from the visual spatial sketchpad, the phonological loop and long-term memory), an adequate central executive function cannot ensure adequate high level reading skills.

10.4.2 Speech

It is suggested that there are connections between the central executive function and EFL speech from the sentential level upwards.

The central executive function seems to be related to EFL speech in stages prior to automaticity. It seems to be utilized in the stages of L2 learning when cognitive resources are activated for vocabulary retrieval and syntactic accuracy. However, when EFL speech reaches near-native performance, automaticity takes the place of central executive-controlled processing.

It is suggested that an adequate central executive function is a necessary, but not sufficient, condition for developing good speaking skills in EFL, since the integration process depends on the quality of the on-coming information from working memory slave systems and long-term memory.

10.4.3 Strategy

The qualitative analysis of one specific subject (Omer – case 5) raises the possibility that applying an inappropriate strategy might impair the central executive function even when central executive performance in itself is high. One inappropriate use of strategy observed was that of utilizing *translation in a persistent* manner. It was seen that persistent use of translation resulted in reduced speaking skills even when the central executive function was high. Consequently, it may be that persistent translation to and from L1 causes such a central executive overload that the system cannot cope effectively with the integration. An additional inappropriate use of strategy was that of applying the translation strategy and the search reading strategy to reading passages and reading comprehension assignments which required careful reading. It may be that when this happens, the central executive function cannot come into play effectively.

10.5 Summary

The qualitative analyses of the six case studies have suggested that **phonological processing, phonological memory** in general and **phonological working memory**, in particular, have an underlying influence on EFL performance. The proposed link between the phonological aspects of memory and EFL ability is a theorized **inner voice** factor. The impact of inner voice on vocabulary acquisition is twofold. First, it triggers appropriate collocates in a cumulative manner. Second, it facilitates intact decoding which enhances the learning of new vocabulary embedded in written texts and/or provided in written form. The impact of inner voice on syntactic knowledge is by triggering appropriate sentence-level and phrase-level colligates. Since inner voice underlies decoding processes, it is suggested that it also has a significant function in reading ability. Phonological processing is suggested as prerequisite for **auditory verbal memory** which was seen to have an impact on speech perception and production. The proposed causal link between auditory verbal memory and speech performance is auditory word recognition. **Visual memory** is seen to impact both vocabulary acquisition and reading separately. Two causal links between visual memory and vocabulary acquisition are suggested: visual spatial memory is as facilitating the person's memory for word configurations and visual sequential

memory as underlying orthographic awareness. Importantly, it is suggested that the visual memory itself is facilitated when supported by the phonological memory in the process of reading. The visual memory is also suggested as facilitating reading comprehension processes by applying visual strategies. **The central executive function** is seen to enhance all aspects of EFL performance which require processing, control, attention-switching and retrieval from long-term memory. However, even an intact central executive function cannot come into play effectively when the elements for integration are imperfect. Inappropriate learning strategies such as list learning and translation strategy were seen to inhibit EFL acquisition even when memory was intact. In light of the above, it is suggested that the phonological aspects of processing and memory are the most significant factors underlying EFL performance.

Chapter 11: Discussion and conclusions

11.1 Introduction

In the previous chapters I have provided a qualitative comparative multiple cross case analysis of the EFL performance of six EFL pupils in their last year of high school and have attempted to explain their performance in terms of memory. In this chapter I discuss the findings which emerged from the data analysis vis-à-vis the main conceptual frameworks underpinning this research and its aims. In order to do so, I return to the research questions and attempt to see to what extent they have been answered, whilst providing explanations for my findings in light of the literature, discussing the possible contributions of my research to further research in the field, reflecting on the limitations of my research and providing recommendations for practitioners in the field of EFL teaching.

Unlike traditional research pertaining to memory and to foreign language acquisition, which generally adopts a positivistic research paradigm, this research adopts a multidisciplinary research paradigm which includes conceptual frameworks deriving from a multidisciplinary theoretical background, numerical test results, qualitative analysis of the data and a discussion which combines all of the above in newly specified conceptual frameworks.

The conceptual frameworks driving this research point to there being relationships between performance in EFL and memory. However, since most of these important findings derive from quantitative research, they provide insight into specific and isolated aspects in both fields. Therefore, these findings, although undoubtedly very significant, provide a partial account of the complexity involved. In this research, I try to account for more of the complexity using qualitative research tools which lead to more specification and explanations and set these findings in a comprehensive framework of relationships. The main research question in this research was:

How might (the level of) performance in EFL be explained in terms of memory?

Illustration 11.1 presents the conceptual framework of relationships between EFL performance and memory underlying this research, and illustration 11.2 presents the conceptual framework which reflects the findings of my research.

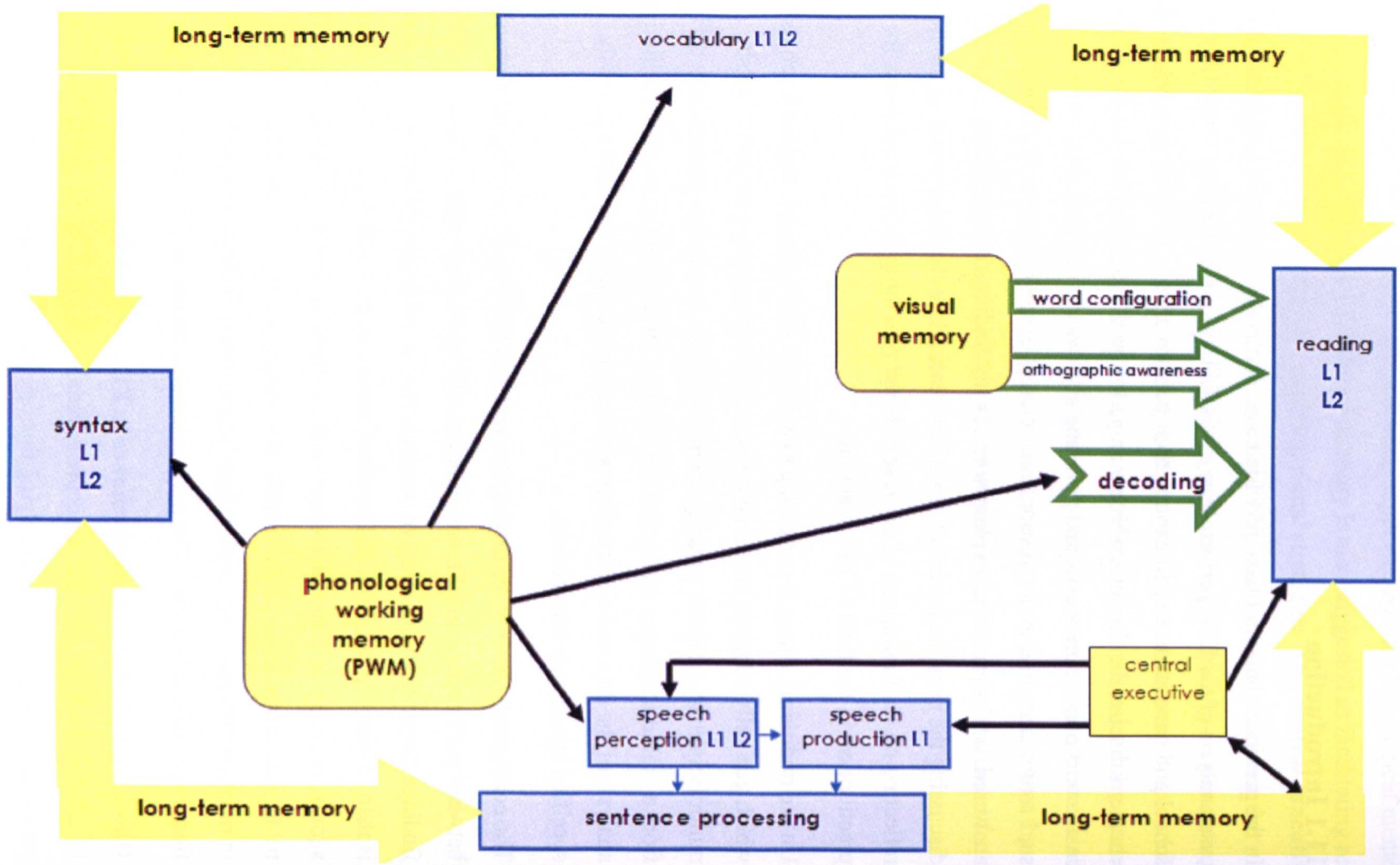

Illustration 11.1: Conceptual framework

Illustration 11.1 shows that research has established relationships between memory and language. Phonological working memory was seen to be related to vocabulary, syntax and reading in L1 and L2. The relationship with reading was thought to be mediated via decoding ability. Visual memory was related to L1 and L2 reading via word configuration and orthographic awareness. The central executive was seen to be related to reading in both L1 and L2 and to speech perception and production in L1. The central executive function included retrieval from long-term memory (see section 2.3).

My research supports all these findings, adds to them, and provides explanations for the relationships, as presented in illustration 11.2.

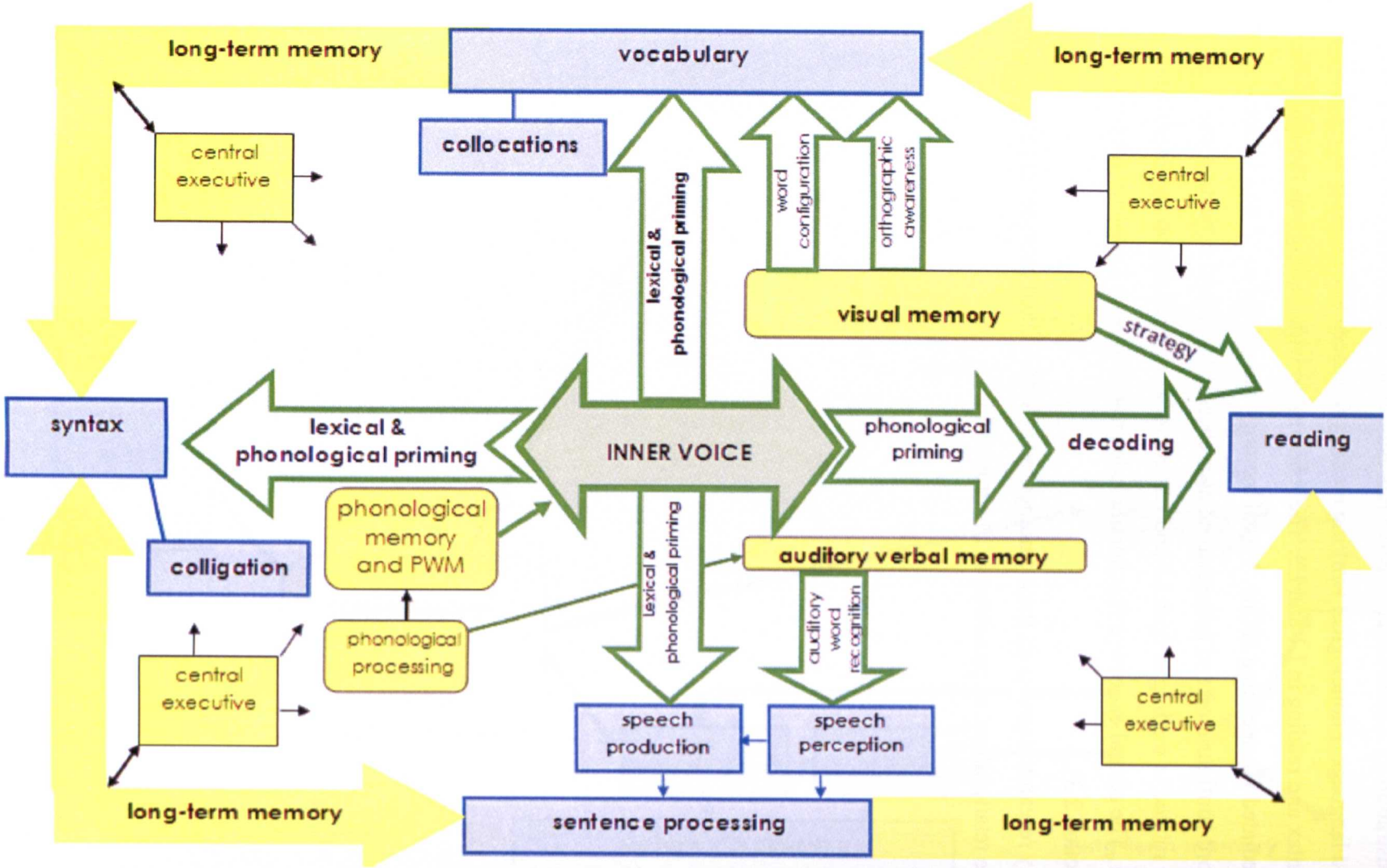

Illustration 11.2: EFL components in terms of memory

Illustration 11.2 is explained in the discussion below.

The main research question is tackled via a number of sub-questions, each relating to a specific parameter of EFL. Originally the first research question related to vocabulary knowledge and the second research question related to knowledge of syntax. However, the research findings have led me to combine the two issues and discuss the first and second sub-questions in conjunction with each other. The first sub-question (rephrased) is:

11.2 RQ1: How might EFL vocabulary and syntactic knowledge be explained in terms of memory?

Research points to relationships amongst vocabulary acquisition in L2, phonological memory in general and phonological working memory, in particular (2.3.1)[4]. The results of my research are in line with this (10, 10.5). Moreover, the qualitative perspective of the research reported in this thesis has allowed me to gain a wider perspective of the relationships.

The findings of my research suggest that the driving force *underlying* L2 vocabulary acquisition via both the auditory and the visual modality is a theorized **inner voice.**

Whereas in different contexts the inner voice is defined in terms of an inner life (Vygotzky, 1962 [1934]), self awareness (Morian and Everett, 1990) or state of consciousness (Husserl, 2001 [1900]), I am integrating it with a view of how language processing works. In the context of this research inner voice is a voice a person hears inside his/her head anticipating integration with on-coming phonological data. In a sense, inner voice could be seen as a phonological stepping stone resulting in a form of phonological priming. Inner voice is enhanced by phonological memory and enhances EFL vocabulary acquisition due to lexical and phonological priming and is evoked phonologically or orthographically (in reading).

Since the term priming is used in a variety of ways in psychology, psycholinguistics and linguistics, I would like to stress that, in the context of this research, I do not use the term in the sense that a given word sets a semantic or syntactic background for the next word/words to come. Instead, priming is used related to the notion of lexical

[4] I henceforth, where appropriate, refer back by section number to where the literature is first discussed.

priming as used by Hoey (2005) who focuses attention on the properties of the priming word rather on the relation between the priming word and the primed word. Hoey sees the priming word as narrowing the likely choice of following words because of collocation and other linguistic relationships. Once the primed word becomes linked to its primer (a phenomenon which Hoey calls nesting) the new word sequence in turn becomes the priming element. Lexical priming is seen by Hoey as a property of the word/words which echoes back and forth from the primed to priming word/words. I have extended this notion of priming to include the ability to anticipate speech more generally in terms of the phonological properties of the word rather than only its lexical or semantic properties.

Likewise, I would like to make a distinction between inner voice, phonological memory, and lexical priming, in order to set a clear basis for the following discussion. The difference between inner voice and phonological memory is that whereas phonological memory pertains to what was, inner voice has the property of anticipation in light of what was. The difference between inner voice and lexical priming is that inner voice is phonologically, rather than only lexically or syntactically, driven. One example of inner voice, or rather lack of inner voice, is when two of the case studies read *high-teach* instead of *high-tech* although *high-tech* functions as a cognate and is used in Hebrew speech as such (4.3; 7.3.1). The subjects did not have the inner voice which anticipates *tech* after *high*. It seems that inner voice seems to anticipate what happens on the basis of phonological information as well as lexical information and triggers all of the priming effects.

As shown in illustration 11.2 the inner voice affects L2 vocabulary acquisition both via the auditory modality and via the visual modality. Inner voice affects vocabulary and syntactic acquisition via the auditory modality because of phonological and lexical priming in respect of such phenomena as collocation and colligation (10.). Collocation is defined as a sequence of words which co-occur more often than could be attributed to chance (Hoey, 2005). Colligation is defined as "the co-occurrence of grammatical choices." (Sinclair, 1996, p 85) Theories that take account of Collocation and colligation claim that most words in a language generally appear in similar morphological and syntactic environments and are tied to each other by invisible linguistic strings (Sinclair, 2004; Hoey, 2005). It seems reasonable to assume that words which co-occur so often become represented in conjunction to

each other in the memories of those who are exposed to the language. It is suggested that phonological memory via inner voice and lexical and phonological priming facilitate the acquisition and retrieval of L2 words in their lexical and syntactic environments.

The notion of L2 vocabulary development being related to phonological memory via inner voice could also explain the phenomenon noted by Wray (2002) who claims that when native speakers acquire L1, they acquire vocabulary in a form of formulaic collocations (fixed and inseparable word sequences) which are broken only when thought necessary, whereas with L2 learners, collocations are essentially separate items which have become paired and hence manifest looseness and frequently erratic pairing (2.2). In my research, it is suggested that the ability to group vocabulary items is related to phonological memory and inner voice. Support for the idea that inner voice and phonological priming are involved in L2 language development is provided by Trofimovich (2005), who claims that L2 learners use auditory word priming which he defines as "unconscious and unintentional facilitation in auditory processing of words." (Trofimovich, 2005, p. 481) According to Trofimovich, auditory priming is pre-semantic, but helps to support auditory lexical representations (Trofimovich, 2005). Support for this could be found when one of the case studies in this research utters the sound /tʃ/ before the word *kitchen and* says: *"I'm learning in the ch kitchen"* (8.5). The difference between the degrees of difficulty in the grouping process in L1 and L2 may also be related to the level of exposure to the language. Hence, when a foreign language is concerned, the burden on phonological memory is much more pronounced and individual differences in phonological memory and inner voice are likely to play a greater role in vocabulary acquisition. This is also in line with Ellis (1996, in Wray, 2002), who suggests that the ability to remember sequences affects the ability to learn a language (2.2). Ellis and Sinclair (1996, in Hulstijn, 2001) also suggest that exposure and production of words in L2 facilitate knowledge of statistical frequencies and sequential probabilities in L2.

In the framework of the research reported in this thesis, exposure to and production of words in L2 are argued to facilitate the development of the inner voice which will in turn facilitate L2 language development. It is suggested that sensitivity to the linguistic phenomenon of collocations and colligations influences vocabulary

development and depends on phonological memory and inner voice on the one hand, and on the level of exposure to the target language on the other hand. The fact that L2 vocabulary development is related to factors other than individual differences in phonological memory has implications for practitioners in the field of EFL teaching and points to vocabulary being best taught in a contextualized manner embedded in its linguistic environment along with its characteristic collocates and colligates. This is further specified in section 11.5.

One issue, among many others which requires further research, is the extent to which inner voice can account for linguistic ties which are distant from the priming word/words or sounds. In other words, to what extent is inner voice restricted by distance. Interestingly, when Unsworth and Engle (2007) brought back the notion of primary memory capacity (2.1.13), they claimed that primary memory capacity is limited and theorized to have a four item capacity (2.2). It may be that inner voice is also restricted by a similar distance.

An interesting aspect of inner voice and the phonological priming underlying language development can be seen in the sad case of Genie, a girl who had been held in appalling conditions and complete social isolation for fourteen years. Genie, who was thought to be physically healthy, could not achieve a normative linguistic development in spite of the massive help she received from some of the best professionals in the field. Interestingly, although Genie acquired an impressive vocabulary, she was not able to grasp the underlying linguistic ties of the language (Curtiss, Fromkin, Krashen, Rigler and Rigler, 2004). This may seem, at first, to be counter to Chomsky's claim that language is innate and grows in children's minds naturally. However, 'naturally' includes exposure to surrounding language, something that, unfortunately, Genie was deprived of. In terms of inner voice, Genie's deprivation of language may have prevented the development of inner voice along with the priming mechanisms which facilitate the development of linguistic ties.

The notion that inner voice facilitates acquisition of vocabulary in its linguistic environment is both in line with current linguistic theories which maintain that lexis is systemic and may account for correct syntactic use (2.2), as well as with very established second language acquisition theories. Viewed along the lines of Krashen's acquisition/learning hypothesis (2.2), inner voice may account for the difference between *knowing that* the dictionary definition of a word is X, and that we

use the present progressive tense in specifically defined situations, and *knowing how* to utilize our knowledge of L2 vocabulary and syntax. Whereas *knowing that* or *knowing about* does not require an inner voice, *knowing how* does. In a sense, the ties specified above are reintroducing Krashen's theory in terms of priming. Likewise, viewed along the lines of Anderson's ACT model (2.2), inner voice may account for the difference between declarative and procedural knowledge. Going back to the example of Genie, although she was able to gain quite a lot of the declarative *know that* aspects of the language, she was less able to acquire its procedural *know how* aspects facilitated by inner voice.

One of the case-studies in this research is actually able to feel the difference between the two forms of knowledge as expressed in the following quotation from our conversation:

T: So you are helped with the rules of grammar in the process of processing language?

E: I try not to because I don't remember the grammar; I do it according to my hearing; according to what sounds better. (Interview, 21-22, in Hebrew) (9.3.3)

In fact, according to this, it may be that after a certain threshold of inner voice development, the inner voice may facilitate procedural memory to the extent that it overrides the declarative aspects.

Notwithstanding the importance of exposure to authentic language, it is a known fact that in many EFL classes L2 vocabulary is presented to the pupils by word lists alone and EFL syntax is taught by dry rules drilled in a rote manner. In terms of Anderson's ACT model, learning vocabulary by word lists may be laying the foundation of declarative knowledge which should be proceduralized in order to be utilized in target language use. I would like to suggest that inner voice as pointed in this thesis cannot come into play under such conditions since vocabulary and syntax are stripped of their contextual environments.

When language elements are learned in written form, a different level of inner voice comes into play: inner voice which underlies meaningful decoding necessary for this form of learning. If this is the case, inner voice underlies the acquisition of vocabulary and syntax via the visual modality as well. The relationship between inner voice and decoding is specified below.

Research has already pointed to relationships between phonological working memory and L2 vocabulary (2.3.1) and between phonological working memory and reading (2.3.4). The qualitative analysis of my research data suggests that the link between phonological working memory, vocabulary, and low level reading skills is decoding ability. It is suggested that it is the inner voice which facilitates meaningful, as opposed to mechanical, decoding. Mechanical decoding occurred when a case-study read *really* instead of *rely* (7.4.1) and applied the mechanics of reading (which were quite reasonable) without an inner voice. She ended up with the wrong word. Once more, I would like to stress that as opposed to the phonological working memory in the phonological loop, which has the function of rehearsal, inner voice leans on phonological working memory in the process of decoding, and adds the element of priming. Obviously, the reading process involves visual memory as well and this aspect is discussed in relation to research question 3.

One of the case studies examined in my research who did not appear to have phonological memory or phonological working memory weakness but whose learning of EFL vocabulary and syntax was mainly through word lists and grammatical rules, had an excellent receptive knowledge of EFL but manifested difficulty in utilizing this knowledge in speech. The girl, who scored 100% on all of the reading tests and almost 100% on oral comprehension, seemed to be tongue tied:

T: What motivates you?

A: Ah eh (long pause) <u>to</u> (long pause) Idknow eh to get eh ah (long pause 18 seconds) when I know that eh (pause) this is a subject that I know very well and eh eh and I can get and I can get and I can get eh good notes so eh I try to study a little bit more so...

It may be that learning by lists and rules enhances storage in long-term memory in declarative form which may suffice to gain receptive knowledge of the language. However, in order to be utilized for productive use, the knowledge gained by lists and rules must become proceduralized. It may be that the difference between vocabulary that has been learnt and vocabulary that has been acquired lies in the extent of its procesuralization. Proceduralization processes may be facilitated by exposure to the language whilst focusing the learner's attention on the specific language use. This exposure may facilitate the development of an inner voice sensitive to the collocations and colligations of the target language. In a sense, vocabulary proceduralization may have to do with the development of inner voice.

Interestingly, whereas the girl mentioned above does not seem to utilize inner voice for productive use of vocabulary, she does utilize inner voice for decoding. This may have to do with the fact that her main exposure to EFL is via reading and decoding, which enhance the development of an inner voice for decoding and the proceduralization of reading. The scope of my research did not allow me to further specify all aspects of inner voice, but this may be an interesting issue for further research.

The fact that the level of vocabulary and syntactic knowledge in EFL depends on both internal factors (memory) and external (knowledgeable teaching) is important for practitioners in the field and points to ways in which teaching can make a difference. Suggestions for practitioners regarding L2 vocabulary teaching are given in section 11.5 below.

To summarize the issues addressed in research question 1, the findings of my research suggest that underlying EFL vocabulary and syntactic knowledge is a theorized element of inner voice which is driven by phonological memory and PWM. Inner voice is related to acquisition of vocabulary and syntax via the auditory route through a process of lexical and phonological priming which is sensitive to linguistic collocations and colligations. Inner voice is related to the acquisition of vocabulary and syntax via the visual route when vocabulary is learned by lists and syntax is learned by rules. In this case learning depends on meaningful decoding ability which also depends on inner voice (at a different level) and phonological priming as explained above.

11.3 RQ2: How might EFL sentence processing (specifically speech perception and speech production) be explained in terms of memory?

The second research question relates to the extent in which memory is involved in the processing of vocabulary and syntax which are considered to be the building blocks of language.

Research in the domain of sentence processing has linked L1 and L2 speech perception and production to long-term memory defined as linguistic and world knowledge and to working memory (2.3.2); 2.3.3); L1 speech has also been related

in the literature to the central executive function (2.3.3).

The discussion below relates to sentence processing. First I discuss memory factors which were seen to affect the case-studies' EFL speech perception and then go on to discuss memory factors which were seen to influence their ability to produce speech in English. Naturally, most of the processing aspects relevant to speech perception are also relevant to reading. However, reading involves an additional layer of literacy in EFL and is discussed in connection with research question 3.

11.3.1 Sentence processing - Speech Perception

At the outset, I must acknowledge the fact that it was difficult to analyze speech perception via qualitative research tools since there was no output which could serve to single out specific elements in receptive ability. My first step in the analysis of sentence processing was to assume that since the building blocks of sentences are vocabulary and syntax, factors which were suggested as having an impact on the acquisition of vocabulary and syntax in EFL also have an impact on sentence processing.

The findings of my research relate speech comprehension to auditory verbal memory which influences the ability to recognize and comprehend vocabulary in speech via auditory word recognition. The notion that auditory verbal memory via auditory word recognition facilitates vocabulary comprehension in speech is in line with speech perception models which view the ability to understand speech as an interaction between WM and LTM. In a model devised by Doughty (2001), memory is seen as an initial and necessary stage in L2 acquisition in general, and L2 speech perception in particular. Doughty claims that that on-coming speech is initially held in WM where it is instrumental for further processing. In the following stages this information is integrated with linguistic and world knowledge stored in LTM (2.3.2). I would like to suggest that linguistic information stored in LTM includes L2 vocabulary knowledge which is stored in auditory verbal form in LTM and accounts for auditory word recognition in the process of speech perception.

Likewise, viewing auditory verbal memory as enhancing auditory word recognition in speech fits into three main linguistic approaches to sentence processing: the principle-based approach which maintains that syntactic processing precedes semantic processing, the constraint based approach which claims that all knowledge

is processed simultaneously and that each additional piece of information constrains the final interpretation, and the referential based approach which sees sentence processing as a combination of both of the above approaches and proposes that syntactic processing is modular and independent but that each addition of contextual information constrains the final interpretation (2.3.2). Although there is a difference in the order of processing between these approaches, they all involve access to information stored in LTM, and according to the findings of my research this information may be stored in the auditory verbal LTM, hence the involvement of auditory verbal memory in speech perception.

At this point I would like to add that although the notion of auditory verbal memory may seem to refer to vocabulary alone, the discussion which followed research question 1 points to the possibility of vocabulary being stored in memory along with its linguistic environment. Therefore, EFL words which are studied in a contextualized manner are likely to be stored along with their collocates and colligates. Hence, vocabulary stored in auditory verbal LTM may be more that mere lists of individual words.

Along the same line of thought, involvement of auditory verbal memory in EFL speech perception seems to be consistent with research by Romani et al, who distinguish between the way words and *non-words* function in the phonological loop. Originally, phonological information in the phonological loop was thought to be sensitive to word length (Baddeley, 1997). However, Romani et al (2005) showed that real words in the phonological loop are less sensitive to length, their explanation being that real words evoke lexical and semantic representations in memory (2.3.2). It is very likely that these lexical and semantic representations are stored in LTM memory in auditory verbal form and are evoked when perceiving speech.

Support for the involvement of auditory verbal memory in speech perception in general and L2 speech perception in particular is found in research by Martin and Freedman (2001) who show that better perception of speech occurs when semantic integration can be achieved in the early stages of sentence processing (2.3.2). Since information held in memory in auditory verbal form is likely to carry semantic value, better auditory verbal memory may be involved in better speech perception.

11.3.2 Sentence processing – Speech Production

Similar to speech perception, speech production also depends on the building blocks which construct sentences. Therefore, factors which influence vocabulary and syntax are also thought to have an effect on speech production. However, the process of producing speech involves more layers of memory and processing.

The findings of my research pointed to relationships between productive vocabulary in speech and the auditory verbal LTM. However, although auditory verbal memory was seen as necessary for speech production it was not in itself sufficient for good speech in EFL. Weak phonological processing and PWM were seen to hinder speech (10.). The central executive function which integrates information from the different modalities and retrieves information from LTM was also seen as related to speech production.

Once more, the link between PWM and speech production which is suggested in the light of the qualitative analysis of the research data is the theorized inner voice facilitated by phonological memory. In the context of speech production, inner voice hears the uttered word or words and triggers oncoming words or phrases in their morphological and syntactic environments (10.). Below is an example of a case-study who seems to lack inner voice, has very weak vocabulary and seems not to have been primed by what she heard or read:

O: Ah, eh I didn't eh table in the room.

The next is an opposite example of a case-study whose inner voice seems to trigger the right collocates and colligates. This inner voice connects *has* with *the right* followed by *to* rather than, for example, by *for*:

He has the right to live ...(Eli, role play, 38, in English)

The examples above show the difference between the presence or absence of the theorized inner voice which facilitates phonological and lexical priming which, in turn, enhances speech production in EFL. This theorized inner voice enhanced by phonological and phonological working memories leads me to suggest links between the two and EFL speech production, although no such links appear to be referred to in the literature.

As stated above, the findings of my research link auditory verbal memory to speech production as well as speech perception. In the context of my, research auditory verbal memory is memory for phonological information that has acquired semantic value and has semantic representations in LTM. It is suggested that the involvement of auditory verbal memory in speech production is not unlike its involvement in speech perception in that after a certain (as yet unspecified) level of knowledge of EFL vocabulary and syntax, the ability to recognize and produce vocabulary in speech depends on the lexical representations stored in auditory verbal form in LTM. In the light of our former analyses, it seems logical to assume that auditory verbal memory and the phonological aspects of memory operate together in the process of EFL speech production. A question may be asked at this point as to whether these operate in a similar way to that of speech production in L1. The scope of this research does not allow me to discuss this issue in any great depth although it seems to be a worthy issue for further research. It seems logical to assume, however, that whereas inner voice has similar functions in L1 and L2 speech production, the function of auditory verbal memory in L1 speech production is questionable since, after a certain age, vocabulary and syntactic knowledge in the native tongue become automatic. The issue of automaticity in speech is discussed later in this section.

The notion that PWM and auditory verbal memory operate in conjunction with one another in the process of speech production may map onto the distinction between primary memory and secondary memory made by Unsworth and Engle (2007) (2.1.10). It may be that where L2 is concerned, PWM influences the ability to utilize things which are in primary memory via inner voice. However, since primary memory is limited in the number of units it can hold, information which is stored in the more durable secondary memory depends on auditory verbal memory for utilization in speech. This issue also seems worthy of further research.

Also relevant to speech production are research findings pointing to relationships between the context of learning and the context of performance from the point of view of modality. Retrieval was often seen to be easier via the dominant modality of acquisition. Case-studies who studied more via the visual route found it easier to cope with written materials in EFL, whereas those who studied more via the auditory route found it easier to cope with information presented orally and found it easier to speak. The one case-study who utilized both modalities for learning was balanced in

her performance ability (10.). This finding is also in line with Unsworth and Engle (2007) who maintain that retrieval from secondary memory requires a search process which depends on search cues cued in at the stage of encoding the information, and that encoding information is associated with contextual elements that constrain search during recall. When contextual cues at encoding are similar to contextual cues at recall, the search is thought to be more effective. I do not see this as contradicting Pickering (2001) who claims that with age, children begin to utilize phonological cues in order to retrieve visual stimuli (2.1.2), but as complementary to this claim. Firstly, whereas Pickering's research points to phonological cues as assisting in visual retrieval, there is no mention of visual cues assisting in phonological retrieval. Therefore, students who learn solely by the visual modality do not develop phonological abilities along with an increase in visual experience. Secondly, the fact that children develop the ability to utilize phonological cues in order to retrieve visual information does not contradict the proposal that when information is presented visually, retrieval is easier via the visual modality and when information is presented auditorily, retrieval is easier via the auditory modality.

Interestingly, my findings also pointed to the fact that a bad strategy could inhibit performance even when the learning and performing modalities are the same. One of the case-studies, who experienced total immersion in an English speaking country, presented impaired speech performance although his reading skills in English were very good (8.5). I attributed this to his constant translating strategy which he himself acknowledged as underlying his EFL speech:

...you think in Hebrew and then you translate it in your head to English...
*(*Interview, 18, in Hebrew*)*

In the terms used by Unsworth and Engle (2007), because of the translation strategy, the retrieval cues (the word/words in L1) were completely different from the cues which were cued at the stage of encoding (authentic language in L2) and therefore the search became less effective.

One important memory factor seen to be involved in EFL speech is the central executive. My research findings suggest that the central executive function is utilized in L2 speech in the stages prior to automaticity when cognitive resources are activated for vocabulary retrieval and syntactic accuracy. At this point I would like to acknowledge the fact that since the central executive is a control system which

correlates information from the various sources, it is difficult to single out exactly performance which was due to central executive weakness and that which was due to weakness in one of the slave systems. This is why it was not possible to show how the central executive affects speech perception, although it seems quite safe to presume such influence.

It is interesting to discuss the central executive function in terms of Krashen's (1982) monitor hypothesis (2.2). Krashen theorized a monitor which combines *know about* with *know how* (see research question 1, above) in the process of producing language. If we place the monitor hypothesis in the domain of memory theory, one of the monitor's tasks is to coordinate information from WM with information retrieved from LTM. Since there is a certain degree of overlap between monitor functions and central executive functions, the monitor could be viewed as partially fulfilling the central executive function in the process of foreign language production. Hence, Krashen's monitor hypothesis could be viewed as supported by this research in regards to links between the central executive function and EFL speech production.

The central executive function could also be considered in respect of Levelt's model of L1 speech production. According to Levelt (1989), four stages underlie L1 speech production: conceptualizing, formulating, articulating and self monitoring (2.2). It seems logical to assume that, being a control system, the central executive is most involved in conceptualizing (stage1) and self monitoring (stage 4). However, when speech is in a second language, there is likely to be central executive involvement in the formulating and articulating component as well. The central executive function may also be considered vis-a-vis the adaptation of Levelt's model to speech production in L2 by Kormos (2006) (2.2). Kormos maintained that the development of L2 proficiency involves both acquisition of declarative knowledge and proceduralization processes and that proceduralization occurs via automatization (2.2). It seems plausible that, in this framework, the level of central executive function in the formulating and articulating stages decreases as the level of L2 proficiency increases.

In discussing L2 vocabulary acquisition, I suggested that vocabulary proceduralization may have to do with the development of inner voice. It seems to me that the notions of vocabulary proceduralization and speech production are very close, hence the possibility that proceduralization and automatization as

conceptualized by Kormos (above) may also be explained in terms of an inner voice which triggers chains of lexical primings in a cumulative manner.

One interesting issue regarding the involvement of the central executive function in EFL speech production relates to the stage in which the central executive function is most pronounced. According to Anderson's ACT model, which has been applied to second language learning, L2 information moves from declarative knowledge to procedural knowledge in three stages. In the first stage theoretical knowledge about L2 grammar is acquired; the second stage is the associative stage where this theoretical knowledge is applied through practice; the third, autonomous, stage is when performance becomes automatic, sometimes to the extent of losing theoretical knowledge (2.2). I would like to suggest that the second, associative, stage of applying the theoretical rules to speech is the stage where central executive, being a control system, is most required for vocabulary retrieval and syntactic accuracy. In the third, autonomous, stage, there seems to be less involvement of the central executive as production becomes less controlled and more automatic. Hence, my proposal that the more fluent one's L2 speech is, the less central executive control is involved.

Not unlike Anderson's notion of an associative stage in speech production, Towell and Hawkins place less fluent speech production in associative form in procedural memory, where it undergoes stages of knowledge reorganization (2.2). Similarly, McLaughlin and Heredia, point to a cognitive restructuring process (2.2). It seems that these are the stages where the central executive function is most involved in order to facilitate these small adjustment processes. It is easy to see why these processes inhibit fluency. However, with practice, L2 knowledge moves to the autonomous stage in procedural memory and speech becomes automatic. It is important to stress that, according to this view, although the central executive function is less involved in fluent EFL speech, it is a necessary factor in reaching that fluency.

Below is one example from the research data which supports this dissociation between the central executive function and fluency in speech. The case-study quoted has excellent central executive function as measured in the memory tests and her speech is quite accurate. However, her fluency is far less than perfect:

T: What motivates you?

A: Ah eh (long pause) to (long pause) Idknow eh to get eh ah (long pause 18 seconds) when I know that eh (pause) this is a subject that I know very well and eh eh and I can get and I can get and I can get eh good notes so eh I try to study a little bit more so... (Aya, dialogue, 103-104, in English)

On the other hand, a case-study who had an average score on the central executive skills test and who was on the whole far less accurate than the former, seemed to be much more fluent in answering the same question:

N: I need to see if I, if I study hard and then I get eh very low so all my motivation will just go. (Natalie, dialogue, 149, in English)

Interestingly, the latter seems to have reached the autonomous stage without successfully going through the associative stage. Why and how this could happen is an interesting issue for further research.

The dissociation between fluency in EFL speech and the central executive function is also in line with Unsworth and Engle (2007) who claim that whereas controlled cognitive processes are constrained by working memory capacity, automatic processes are less so. This could also explain findings by Gathercole, Pickering, Knight and Stegman (2004) which showed that whereas literacy acquisition at young ages was linked to working memory, higher level comprehension and literary analysis at 14 was less so. It seems safe to assume that by the age of 14 the technicalities of reading have become automatic and therefore require less working memory capacity and that, on the other hand, the higher levels of content comprehension and literary analysis involve much more than working memory.

In the light of the analyses above, the challenge for practitioners in the field may be twofold: on the one hand, to lower the burden on working memory by teaching appropriate learning strategies; on the other hand, to attempt to bypass constraints imposed by working memory and gain automaticity by different routes.

To summarize the issues addressed in research question 2, the findings of the research I undertook suggest that auditory verbal LTM, phonological memory in general and phonological working memory in particular, operate together in the process of speech production. Auditory verbal memory facilitates retrieval of lexical representations stored in LTM in auditory verbal form. The phonological memories enhance speech production via the inner voice and the priming processes. Research

findings suggest that the central executive function is utilized in L2 speech as a control system and that its main impact is in the pre-automatic stages.

My third research question related to the extent in which memory is involved in reading.

11.4 RQ3 - How might EFL reading be explained in terms of memory?

Most of the memory factors discussed above are involved in the reading process since reading involves vocabulary and syntactic knowledge as well as the ability to process sentences. However, reading includes an additional layer of literacy which involves visual aspects of memory and the ability to translate visual information into phonological representations.

Previous research has pointed to relationships between EFL reading and memory, specifically PWM, visual memory and the central executive function (2.3.4). The research reported in this thesis has come up with similar findings and extends the research to suggest explanations for the relationships and further specifications.

The findings of my research show that PWM is related to low level reading skills via decoding ability and to higher level reading skills by facilitating sentence processing. Once more, **inner voice** which enhances priming is suggested as the driving force. It is my suggestion that in the process of decoding, the theorized inner voice enables the reader to hear the sound-symbol correlations not as mere individual entities but as a combination of the individual units which have been deciphered into longer units, with on-coming information by way of phonological priming. In a sense, inner voice and phonological priming facilitate the integration of bottom-up with top-down processes, and account for what is generally described as *intelligent guess*. As mentioned earlier, an example of reduced inner voice and lack of priming is seen in two of the case-studies reading *high-teach* for *high-tech,* notwithstanding the fact that *high-tech* could be considered as a cognate since it is used in Hebrew in the same way. In higher level reading skills, inner voice is involved through sentence processing as discussed above. Both processes involve visual elements which are discussed along with the impact of visual memory on EFL reading.

The notion of inner voice in decoding bears a resemblance to the articulatory

rehearsal process in the phonological loop (Baddeley, 1997) (2.3.2). Inner voice is different in that it is a theorized combination of articulatory rehearsal and phonological priming. The element of priming in the decoding process adds an element of anticipation to rehearsal. At this point, I would like to clarify that I use the term phonological priming when I refer to the priming of sounds and the term lexical priming when I refer to priming of a word or words. Therefore, it seems logical to assume that phonological priming is more involved in decoding and that lexical priming is more involved in sentence processing and in higher level reading and that both operate together in the process of meaningful reading.

The qualitative analysis of the data that I have undertaken has shown that the ability to utilize priming processes in EFL reading depends on prior phonological, lexical and syntactic knowledge of the target language (10.). Phonological priming is likely to be related to phonological representations in LTM and lexical priming is likely to be related to lexical and semantic representations. Support for this notion can be found in Pickering and Jarrold (2001) who show that performance on a visual spatial memory task is better when the stimuli have high pattern likeness and in Loggie (1995) who claims that visual spatial working memory always accesses LTM first. Loggie based this claim on the fact that when shown the same picture, some people see a rabbit and some see a duck (2.3.3). An example from my research data of priming processes in reading being utilized by representations in LTM is when a case-study reads *technological adventures* instead *of technological advances*. The pupil did not have enough knowledge of the spoken language to know that *adventure*s does not collocate with *technical*, but for whom her existing phonological and lexical knowledge primed her to follow *adv* with *enture*. In this case the pupil was driven by phonological priming to override the lexical/semantic aspects of the words and to operate her phonological system independently from her morphological system. The notion that reading is facilitated by inner voice which enhances priming processes, and that priming depends on knowledge of the spoken language, is specifically relevant when the spoken language is a second language, and familiarity with its spoken form cannot be taken for granted. Importantly, all of the above processes which involve working memory access to LTM are in line with the idea of the episodic buffer added by Baddeley to the model of working memory in 2000 (Andrade, 2001) (2.1.4).

How are inner voice and phonological priming related to existing reading models? In Frith's (1985) reading model, phonological priming seems to be relevant at the alphabetic stage when knowledge of sound-symbol correlations is utilized in order to read new words. It is thought that reading experience and exposure to written texts facilitate the development of sight vocabulary (Share, Jorm, MacLean & Mattews, 1984 Gathercole and Baddeley, 1993) (2.3.4). In terms of the research reported in this thesis, it may be that exposure enhances the development of inner voice which in turn facilitates phonological priming. This, together with familiarity with the visual aspects of the word, enhances the development of sight vocabulary. In a sense, inner voice and phonological priming move the process of decoding from being a mere technical activity of sound-symbol deciphering to being a meaningful process of semantic decoding.

Although the role of inner voice and phonological priming in facilitating the decoding process seem to be relevant to reading in both L1 and L2, it seems reasonable to assume that their influence in L1 is more pronounced than in L2. Whereas in L1 phonological priming may be restricted by familiarity with sound-symbol correlations (assuming that everyone is familiar with his/her spoken native tongue), in L2 it is restricted by knowledge of the spoken form of the target language as well. Moreover, there is a possibility that L1 priming will interfere with priming in L2. Notwithstanding, the notion of inner voice and priming underlying L2 reading ability is in line with three major approaches to reading in L2. The first approach regards competence in the foreign language as underlying successful reading in L2. The second approach points to L1 reading skills as predictive of L2 reading skills, and the third approach regards both foreign language knowledge and L1 reading as being predictive of L2 reading ability (See 2.3.4).

The issue of difference between inner voice functions in L1 and L2 may be addressed in the light of research by Bernhardt (2003). Bernhardt maintains that, in the process of reading, input information from the text interacts with representations in LTM. She adds that when reading is in L1, input information from the text and representations in LTM derive from the same linguistic resource (L1). However, when reading is in L2, representations in LTM are not necessarily the same as input from the text. According to Bernhardt, degrees of difference/similarity between the L1 and the target language (typology, phonology, syntax) determine the level of

difficulty in L2 reading (2.3.4). In terms of inner voice, when L1 and target language are similar to one another, the inner voice developed through years of exposure to L1 may be more readily transferred to L2 and facilitate reading. However, when the languages are very different from each other, the inner voice developed in years of exposure to the native tongue may become an interfering factor. The inner voice of a native English speaker, for example, will probably not be very helpful in learning Chinese. How is this related to the way in which memory affects L2 reading? Since the qualitative analysis of the research data led me to conceptualize inner voice as a theorized process enhanced by phonological memory and PWM, a strong phonological memory may facilitate better development of inner voice for L2 and help the learner overcome the differences between the languages in the process of reading.

As mentioned above, former research has linked reading in L1 and L2 to visual discrimination, memory and processing (2.3.4). The findings of my research in regard to relationships between EFL reading and visual memory are not as conclusive as the findings tying EFL reading to phonological memory. Nevertheless, although my results do not point to visual memory in itself as leading to weak or strong EFL reading, the qualitative analysis of the data shows that utilization of visual memory while reading is enhanced, or inhibited, by knowledge of spoken English (10.). The qualitative analysis suggests that, in the process of reading, visual spatial memory and visual sequential memory operate together because visual word recognition (positive or negative) is facilitated by general word configuration and/or orthographic awareness. Interestingly, the data analysis shows that visual word recognition is facilitated by phonological memory via inner voice and priming which help to provide phonological cues for visual stimuli. Consequently, it is suggested that effective utilization of visual memory depends on phonological memory in the process of reading.

I would like to address the issue above by reference to research by Baddeley (1997) and Loggie (1995) who point to instances where images are retrieved from LTM and surface on the visuo-spatial sketchpad (VSSP) for further activation (2.1.2). When placed in the context of reading, skilled reading may occur when there is a match between the written word and representations which surface onto the VSSP. In the context of this research, this match occurs when the written word matches the visual

representation of the word in LTM along with matching phonological representations which carry semantic meaning. Visual representations devoid of these phonological-semantic constituents may not be enough for skilled meaningful reading to take place. An example from the research data which shows reduced utilization of visual memory because of presumed lack of inner voice is seen when a case-study reads *hands hoff no hands won* instead of *Hands Off? No, Hands On!* (Ori, reading passage 1, 66-67). Although it is very likely that she could have read the words *off* and *on* if presented individually, lack of inner voice may have obstructed visual memory of these words in the process of reading.

The notion that effective utilization of visual memory in the process of EFL reading is enhanced by phonological memory is in line with research by Pickering (2001) which shows that visuo-spatial working memory develops with age, and suggests that age-related improvements in visuo-spatial working memory are partially attributed to children's ability to use phonological cues to retrieve visually presented material (2.1.2). The second factor pointed out by Pickering as influencing the development of visuo-spatial working memory is expansion in overall visual spatial knowledge, which creates more chances for pattern likeness, which, in turn, facilitates coding and retrieval (Pickering and Jarrold, 2001) (2.1.2). I would like to propose that in the context of L2 reading visuo-spatial knowledge and pattern likeness relate to visual word recognition which develops with exposure to written texts in the foreign language. An interesting issue for further research may be whether the development of visuo-spatial working memory has to do with age *per-se*, or with the level of exposure to relevant stimuli: in this context, exposure to the sights and sounds of the foreign language.

The challenge for practitioners in the light of this analysis is to try and combine bottom up and top down methods for L2 reading instruction and to try and provide meaningful phonological and lexical cues along with the visual cues at the stage of encoding.

The qualitative analysis of my research data has pointed to visual memory involvement in higher level text generation as well. Cain et al (2004) name three factors which account for text generation: inference making, comprehension monitoring and understanding text structure. They define inference making as integration between different parts of the text as well as integration of these with

world knowledge. Comprehension monitoring is defined as the ability to detect inconsistencies in the text, and understanding text structure as the ability to utilize structural information (2.3.4). It is suggested that all three factors require visual memory, especially when the texts are academic and do not involve plot. Visual memory involvement in high-level reading skills is also interesting in regard to the additional finding which emerged from my data pointing to relationships amongst visual memory, reading strategies and reading comprehension. Effective reading strategies served to lower the burden on visual memory, thereby enhancing reading comprehension. Below is an excerpt from the research data which seems to support this claim:

E: ...say there are words that look to me as key words or important things, I write down points that look important. (Eli, reading passage 1, 1-4, oral protocols, in Hebrew) (9.3.1)

and:

E:...Usually in an unseen passage I do look first at the first question and if, for example, they write "paragraph 1" I read the paragraph, stop reading and answer the question. I find that it's easier when it's fresh in my head and not to have to go back at the end of the text. (Eli, reading passage 1, 6, oral protocols, in Hebrew) (9.3.1)

The same case study also marks specific parts of the text which seem important and this enables her to see the main points when looking at the text, instead of having to reread or visualize larger portions of the text.

The notion that reading comprehension can be enhanced by effective strategies may also challenge practitioners to provide ample instruction regarding reading strategies.

Text integration also involves the central executive function which is addressed in the discussion following. Similar to findings in the literature, findings in this research point to relationships between the central executive function and reading in EFL. At this point, it must again be acknowledged that my ability to distinguish between weak performance resulting from a weak central executive function, and weak performance due to weakness in one of the slave-systems, was limited as regards my qualitative analysis of EFL reading, especially where reading was weak. Central executive function involvement in high-level reading skills was seen in the good text- integration ability (2.3.4) of the case-studies who presented strong EFL reading comprehension.

It is interesting to compare L2 reading and L2 speech production vis-à-vis the central executive function. In speech, the central executive function was related in my research to the pre-automatic stages where the processes are more controlled. I suggested in section 11.3 that once speech becomes automatic, there is less involvement of central executive as a control system. However, it seems that all levels of reading require controlled processing. It may be that whereas in the initial stages of L2 reading, central executive skills are needed for low-level reading skills, when the technicalities of reading become automatic, the central executive function is required only for higher level integrative reading. As mentioned above, I could not single out the central executive function in low-level reading.

11.5 Implications for practitioners in the field of L2 instruction

One issue which emerges from the findings of my research is the suggestion that external, as well as internal, factors are seen as being influential in one's ability to acquire English as a foreign language. Whereas EFL teachers may not be able to change their pupils' memory capacity, there seems to be much they can do by way of effective teaching-strategies. Some suggestions have been incorporated along the way in this thesis. In what follows, by way of exemplification, I provide some practical suggestions for practitioners in the field of EFL teaching which I have devised in the light of the qualitative analysis of my research data. They have been tried out by me and seem to work well.

The first suggestion relates to learning new vocabulary items which appear in a text. I provide the steps in chronological order and explain the underlying rationale. I call this the Rec-Rec (recognition/recall) procedure.

1. The teacher marks new words in a text, which are important for text comprehension. Since there are likely to be quite a few unfamiliar words, it is left to the judgment of the teacher as to which words to mark. Generally speaking, it is advisable to single out words that are necessary for text comprehension along with unfamiliar vocabulary items which are generally used in unseen passages. It is important to limit the number of new words. Personally, I give approximately ten words at a time. Marking the words serves to embed words in their linguistic environment and to focus the pupils' attention on aspects which will later be essential for text comprehension.

2. Explain the new words, in their context. Give and elicit examples. Write each word on a card and on another (identical) card, write the word's meaning in L1 and below give a short sentence in L2 using the word (All the sentences could eventually make a short episode so this needs to be worked out ahead of time.)

3. Ask the pupil to match the cards (face up). It may come as a surprise, but the pupils are capable of matching quite a lot of the words, notwithstanding the fact that they did not seem to be familiar with them before. This may be due to the fact that the words have been explained in the context of the text and also to the fact that below the translation, the word appears contextualized in a sentence. This can be done a few times until the pupil is capable of matching all the cards. In terms of memory, the pupil can now deal with the new words via recognition.

4. Turn the cards face down. Now there are approximately twenty cards on the desk and the pupil needs to lift a card, read what is on it, and then try to find the matching card (which is face down). This is essentially a memory game played either by two pupils, or by pupil and teacher. The great advantage of this game is that the pupil sees and reads the words, translations and sentences time and again without feeling that he/she is 'learning' and without engaging in boring rote rehearsal. Playing this game is an enjoyable activity; moreover, the pupils usually win more times than the teacher...In terms of memory, the pupil is now moving from memory via recognition to memory via recall.

5. The teacher divides the words into two piles: one pile consists of the words and the other of the translation and contextualization. The teacher takes the new word- piles and places one card at a time in front of the pupil. The pupil is asked to read the word in English and then say what it means.

6. The teacher says the word in Hebrew, or gives a sentence with a missing word, and asks the pupil to say the English word. In terms of memory, now the pupil can deal with the word via recall as well.

7. When all the short sentences together form a story, the pupil is asked to place the sentences according to their logical order.

8. The pupil is now asked to provide his/her own sentences/story using the words and, as homework, to revise the words again.

This procedure has proved to be very successful and has become a standard practice in my teaching. What is also very important regarding this procedure is to access the same words in later lessons until they have reached 'a point of no return'. From my experience, if done once, and left at that, the words will eventually be forgotten. Therefore, in every lesson, it is advisable to choose a pile of words (at random) and do stages 5 and 6 with the pupil. It is also advisable to use the learnt words in future sentences so that they become part of the pupil's knowledge.

This procedure can be computerized, as well. Then teachers can feed in vocabulary items according to the subject matter studied.

Another suggestion for practitioners relates to reading instruction. One of the challenges for practitioners mentioned in the discussion above was to try and provide meaningful phonological and lexical cues along with visual cues at the stage of encoding. I would like to suggest that the procedure for learning new vocabulary described above, to a large extent, serves that purpose. When pupils sees a new word in its written form, see it contextualized and say it out loud, they are providing themselves with phonological and lexical cues along with visual cues at the stage of encoding. Thus, reading is enhanced as well as vocabulary acquisition *per se*.

The suggestion for practitioners is therefore to try and combine bottom-up and top-down methods for the instruction of EFL reading in other words, the combination of phonetic and global reading instruction is advised. One phonetic method which I have adapted in my teaching of EFL reading is the Hickey Multisensory Language Course. Although this method was devised for the instruction of SpLD children whose native tongue is English, I have adapted the Hickey methodology to suit the needs of children beginning to learn to read and write in English. This method teaches the sound- symbol correlation of each letter (or letter combination) separately until words can be read by way of letter decoding. After a number of specific letters have been learnt in this very phonetic and multisensory method, I introduce a method developed in Israel (by Shlomit Ilan) called G.A.M.E (Global Analytical Method of teaching the reading of English). Here the idea is that words and sentences are taught globally. Meaning is facilitated by accompanying pictures. The same letters which have been taught in a phonetic manner are now used in many possible combinations (not necessarily phonetic) and repeated in various texts. I find that whereas the Hickey method provides stable building blocks for the reading process, G.A.M.E

facilitates automaticity and meaning in reading which is often very delayed when left to phonetic instruction alone.

11.6 Limitations of the study

While I believe that the findings of my research are firmly grounded in my data, I also realize that there are limitations to this research as well. Firstly, it must be acknowledged that a number of cases do not represent all others and that therefore generalizations made in light of my data must be further tested on other data. Secondly, the core of this research was a qualitative analysis of the cognitive processes underlying the case studies' performance on EFL and memory tests. It must be acknowledged that any attempt to analyse cognitive processes via output runs the risk of wrongly attributing certain patterns of performance to certain cognitive processes, since cognitive processes are not transparent and are often on the level of the sub-conscious. The difficulty is even more pronounced in analysing receptive skills (speech perception and reading) when there is no visible or audible output. Thirdly, the main finding of this research relates to a newly theorised factor which I labelled *inner voice* drawing on a concept used by linguists and philosophers in significantly different contexts. Naturally, inner voice, as incorporated into memory models, is a theoretical proposal and will need to generate hypotheses to test whether it can be supported in future research.

Notwithstanding the above, I believe that this research offers some new insights to the field of memory as it relates to EFL.

11.7 Contributions to knowledge

Despite the research limitations acknowledged above, I believe that the findings of the research reported in this thesis contribute to the existing body of knowledge in the many disciplines involved. Moreover, one aspect which differentiates this research from many others is its ability to pull together knowledge from the different disciplines and assemble former knowledge, together with the findings of this research, into a new holistic conceptual framework of relationships.

In addition, traditionally, both linguistic and cognitive memory researchers generally utilize quantitative research tools in order to establish relationships amongst

parameters. I have also used quantitative tools in a former study relating to similar topics. In this research I have however utilized qualitative research tools to analyze the impact of memory on EFL performance. I do not know of any research to date which has engaged in a similar research design. Moreover, this research design was not merely new; it yielded interesting results. Firstly, it showed that, overall, qualitative analysis yielded many similar findings to the quantitative research in the field. This may serve to "upgrade" qualitative analysis to the quantitative eye at the same time as verifying the results of that qualitative research. Secondly, the qualitative analysis pointed to some new links; links which emerged from the data and could not be quantified. For example, this research pointed to relationships between the modality of learning and the modality of performance. Thirdly, the qualitative analysis suggested explanations to the links between the parameters, explanations which were not pointed to in any quantitative research that I know of.

The qualitative character of this research has enabled me to provide a better specification of relationships which had been seen both in this and in former research. For example, it had long been accepted that PWM is related to low-level reading skills, but why and how exactly this relationship operates has not been specified in any great detail. The findings of my research have provided these, and additional, specifications. One such specification was my new notion of a theorized inner voice as the driving force underlying the ability to acquire L2, a notion which draws on linguistic and philosophical research dating back to the 19th century but which is newly incorporated into linguistic memory and which draws on insights from corpus linguistics.

An additional finding unique to this qualitative research is the involvement of auditory verbal memory in speech perception and production and the specification of this involvement.

Finally, I have used the findings of my research to devise some teaching strategies for practitioners in the field. The strategies recommended derive from insights I have gained in the course of this research. Since I am a practising EFL teacher, the recommended strategies have been tried out by myself and have yielded satisfactory results.

11.8 Concluding remarks

The present research set out to examine how a pupil's ability to acquire English as a foreign language might be related to his/her memory. Data from six EFL high school pupils were analyzed via both quantitative and qualitative research tools with the latter dominating. The research findings pointed to the phonological aspects of memory as a prominent factor in the pupils' EFL ability. The qualitative explanation for this relationship is a theorized inner voice which underlies EFL oral and reading ability via processes of lexical and phonological priming. The concept of inner voice conceptualized in terms of how language processing works could be further researched and specified. It would be interesting to place the concept in a framework of neurological research and see whether current brain imaging techniques support the notion of inner voice. It would also be challenging to utilize this inner voice in the learning and teaching of a foreign language, specifically by finding ways to enhance such an inner voice in order to facilitate the acquisition of a new language. I believe that EFL practitioners who read this thesis will gain a better understanding of memory as a factor in EFL learning and hope that some of my research findings will encourage teachers to incorporate memory theory into their teaching.

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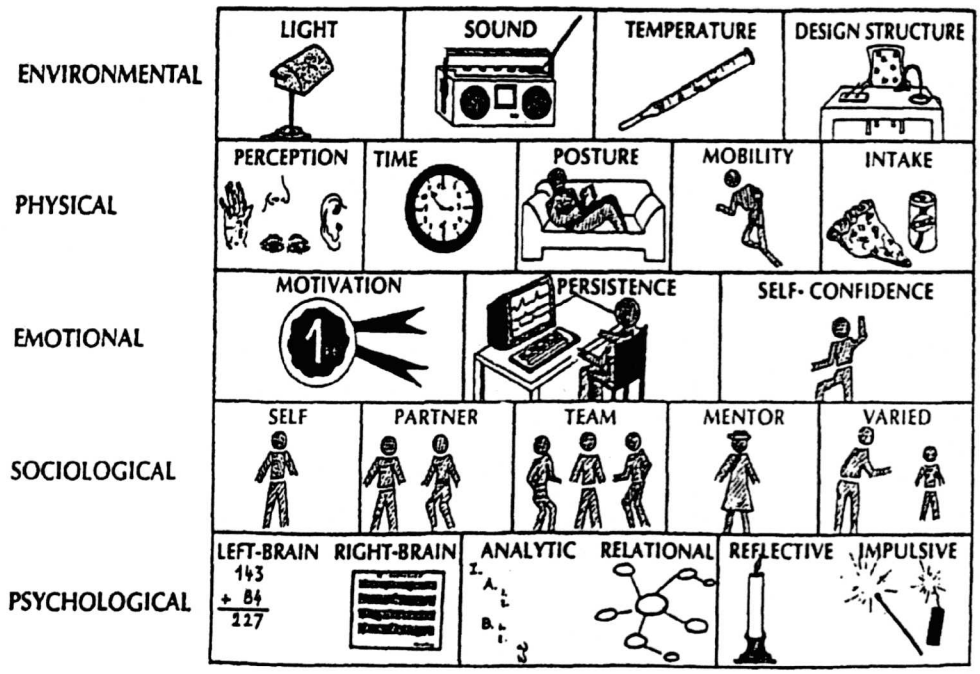
Appendix A: Oral Productive Test – Dialogue

Learning Styles Chart



Source: Kinsella & Esquerre, 1993

Appendix B: Role Play

Instructions for the examiner

This task consists of a role play between a test taker and an interlocutor, recorded on tape recorder for further assessment.

The prompt

The prompt is written in English and in the subject's mother tongue (Hebrew). The task is explained in both languages as well. The interlocutor may change roles with the test taker at any point he/she wishes to.

Time

The interlocutor spends approximately 5 minutes with the test taker, before the actual testing begins in order to make sure that the task is fully understood. The role play itself is approximately 10 minutes.

The task

Your task is to have a typical conversation/argument with your parents/son/daughter according to instructions from the interlocutor.

The role (adapted from Israeli matriculation exams)

You are 17 years old and live comfortably with your parents and an elder brother and sister in the city. Your father is an engineer and your mother is a teacher. You and your parents do not see eye to eye on some matters and occasionally have arguments on the following topics:

1. You are an enthusiastic environmentalist, who cannot bear pollution, water waste and animal suffering. You are forever bringing into the house neglected street dogs and cats and practically drive your parents crazy (although they respect your good meaning and kind heart).
2. You are a vegetarian, eat very little and look very skinny. Your parents are worried.
3. You are talented in all fields, but insist on taking art and music as major subjects in high school. Your parents would like you to study something more practical.
4. You hang out with people much older than yourself. You claim that kids your age are boring. Your parents are worried and don't approve.

Appendix C: Reading 1

Hands Off? No, Hands On!

Israel's matriculation exam summer 2002

A decade ago, visiting a children's museum wasn't very different from visiting any other museum. They all had the same rules: keep your voice down and your hands in your pockets.

In the USA today that is no longer the case. Adopting a new approach, American children's museums now encourage young visitors to handle exhibits and interact with them. In Birmingham, Alabama, for example, kids who dream of becoming doctors can learn about anatomy by taking a plastic skeleton apart – and then trying to put it back together again. In Oak Ridge, Tennessee, aspiring engineers can explore a model coal mine, and in New York City cinema museum, youngsters are invited to produce their own films in a real studio. As museum director Jane Bennet explains, "Such experiences help children develop a passion for learning."

Curators of the new museums often rely on high-tech electronic devices to attract children and hold their interest. With the same aim in mind, many of them offer exhibitions on subjects that appeal to a young audience, such as comics, space flight or ecology. Judging by the numbers, the strategy has succeeded: children's museums have become so popular that there are more than 300 of them in the USA today – twice as many as a decade ago.

(Adapted from "Children's Museums Get a New Look" , Time, 19 February, 1990)

Answer questions 1 – 3 in Hebrew.

1. What TWO things were people NOT allowed to do in museums in the past?

1_____

2_____

2. Give TWO examples of "experiences" offered today by American children's museums.

1_____

2_____

3. Name TWO ways in which children's museums in America attract visitors.

1._____

2_____

Appendix D: Reading 2

Six Good Reasons for Subscribing to the Science Scene

Israel's matriculation exam summer 2002

1. Be the first to learn about important discoveries. Get the latest news about scientific and technological advances. THE SCIENCE SCENE gives you more up-to-date information than any other popular science magazine.

2. Understand how science applies to you. Read about the practical applications of scientific breakthroughs and their significance to you.

3. Read articles written especially for you. Get comprehensive analyses plus briefer reviews of the most recent scientific discoveries, all written in clear and simple terms.

4. Get the whole picture. THE SCIENCE SCENE presents a variety of viewpoints, giving you all sides of the story.

5. Enjoy the most advanced graphics. Our eye-catching graphics and photographs illustrate and clarify the text, helping to bring the information to life.

6. Get a good value for your money. Too busy to read THE SCIENCE SCENE from cover to cover? Don't worry, even reading just a few articles in each issue will keep you well informed in this exciting period of rapid change.

Questions

4. Which of the six reasons specifically mentions the following?

WRITE THE NUMBERS OF THREE REASONS (ONE NUMBER IN EACH SPACE.)

.....a) The magazine offers many different options.

.....b) The information is relevant to the readers' own lives.

.....c) This magazine has an advantage over similar magazines.

(8 points)

5. How does the magazine make its articles easier to understand?

In your answers, relate to TWO of the six reasons.

COMPLETE THE SENTENCES (TWO WORDS IN EACH SPACE).

It uses.....-הוא משתמש ב

It uses.....- הוא משתמש ב

(10 points)

6. COPY TWO phrases which show that the magazine deals with new developments. Take your answers from TWO of the six reasons.

1).....

2).....

(8 points)

7. According to reason number 6, it is worthwhile subscribing even if you don't have

.....

(4 points)

Appendix E: Reading 3

Europe's Common Language Israel's matriculation exam summer 2002

1

Every Monday morning, Luigi Rinaldi, the manager of a clothing company in Milan, Italy, meets the designer Ingrid Presson and tailor Antonio Ramirez. Their meetings are always held in English. "When you're Italian and you work with people from Sweden and Spain," says Rinaldi, "how else can you communicate?"

2

In the past, managers of European companies rarely need to communicate with foreigners at work. Before the 1980s, companies in Europe generally sold products in their own countries, and hired workers locally. However, in the 1980s the situation began to change. Many companies started doing business all over Europe, and hired workers from other countries. These changes greatly increased the need for a common language. English was already a dominant language in the fields of international finance and technology. It was therefore only natural for the same language to become dominant in business as well.

3

Today, Europeans who are fluent in English have a considerable advantage over those who are not. Their salaries may be 20%-30% higher than the salaries of people with similar skills who do not know English well. Moreover, numerous jobs at all levels are open only to English speakers. "While I was looking for work back in 1992, I took a 120-hour English course," says 32-year-old Belgian Marianne Gant. Today she is a well paid secretary at a medical laboratory. "My English got me the job," she says. I use it every day – mainly to talk to my Spanish boss."

4

Ms Gant is only one of many young adults who are part of Europe's language revolution. People in their twenties and thirties are filling up English language courses. Others combine learning English with travel by going to England or Ireland to work as waiters and waitresses. Clearly young Europeans now see fluency in English as a key to a successful future.

(Adapted from "The Great English Divide", BusinessWeek, August 13, 2001)

Questions

8. In the context of the article, what is the main point made about the participants in the meeting? (paragraph 1)

   a. They all speak different languages at work.
   b. They all use a foreign language to communicate.
   c. They all hold high positions in the clothing industry.
   d. They all work for the same clothing company.

   (3 points)

9. According to paragraph 2, before the 1980s, European companies did not use English much because:

1.....

2.....

(10 points)

10. What do we learn about the English language from the last three lines of paragraph 2?

.....

(8 points)

11. According to the context of paragraph 3, what advantages do Europeans who know English well have?

1.....

2.....

(10 points)

12. Why is English so important in Ms Gant's job?

.....

(8 points)

13. Name TWO ways of learning English mentioned in paragraph 4.

1.....

2.....

(10 points)

Appendix F: Rey Auditory Verbal Learning Test

(Hebrew translation Vakil & Blachstein)

List A (translated into English by Tammy Landau)

List A	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Drum					
Curtain					
Bell					
Coffee					
School					
Parent					
Moon					
Kindergarten					
Hat					
Farmer					
Nose					
Chicken					
Colour					
House					
River					

List B	Trial 6-List B	Trial 7-List A	Trial 8-List A
Table			
Guard			
Bird			
Shoe			
Oven			
Hill			
Glasses			
Towel			
Cloud			
Boat			
Sheep			
Rifle			
Pencil			
Church			
Fish			

Appendix G: Active Memory-Complementing Words

(Siegal and Ryan, Hebrew version Shani, Ben-Dror, Zeiger & Ravid)

First try	score	second try	score	total
We write on the blackboard with - (chalk) Milk is given by the - (cow) --------- ----------		Hens lay - (eggs) The moon shines a - (night) --------- ---------		
A plane flies high in the – (sky) In fall trees lose their -(leaves) On a letter we put a – (stamp) -------- --------- ----------		Cars stop when the light is - (red) A picture hangs on the – (wall) He crossed at the - (traffic light) -------- -------- --------		
Washing is hanged on the - (line) The colour of oranges is - (orange) Cars have four - (wheels) In the morning the sun - (shines) ------- ------- ------- -------		In winter the wind - (blows) In Passover we eat - (matza[5]) A ship sails on the - (sea) The colour of lemons is - (yellow) ------- ------- ------- -------		
On Yom Kipur we blow the - (shofar[6]) Our hands have ten - (fingers) The colour of coal is - (black) In Suckot[7] we build a - (sucka) Cars go when the light is - (green) ----- ----- ----- ----- -----		The colour of snow is - (white) Birds lay eggs in a - (nest) A dog wags its - (tail) To eat an orange we peel its - (peel) The taste of sugar is - (sweet) -------- -------- -------- -------- --------		

Instructions for the examiner

You will hear sentences with the last word missing. Provide the missing word and then repeat all the words you have suggested according to the original order.

Example: A person who is short sighted needs to wear-(glasses)

The colour of Israel's flag is blue and-(white)

Now say the final words that you have given- glasses, white

[5] 'Matza – Flat bread eaten in Passover.
[6] Shofar – Ram's horn
[7] Suckot – A Jewish holiday in which people build a 'sucka' – a temporary hut.

Appendix H: Detroit Test of Learning Aptitude-Adult (DTLA-A)

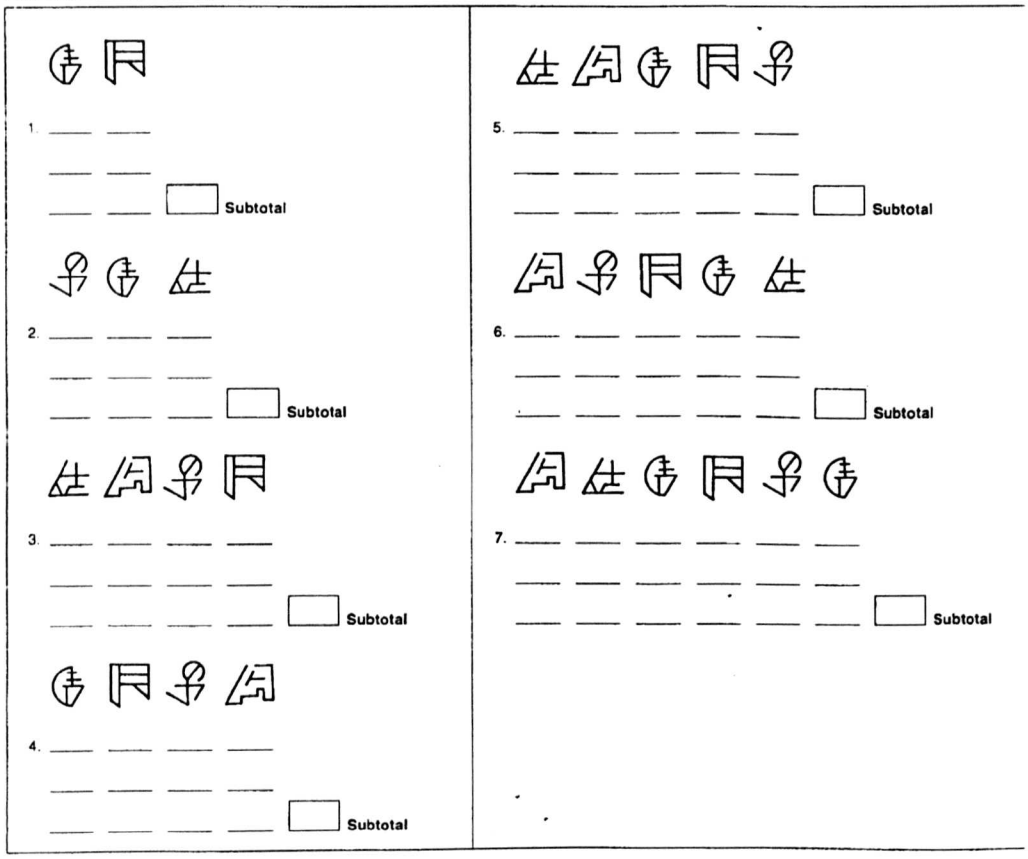
Design Sequences

Subtest VI. Design Sequences

Ceiling: None

Instructions:
Administer the practice items using the instructions in the manual. When the practice items have been given, place the Picture Book over the cubes, show the first item for 5 seconds, and remove the book from view. Say, "PLACE THE CUBES IN THE PROPER ORDER." Repeat a second and third time if necessary.

Items (view from examinee's perspective):

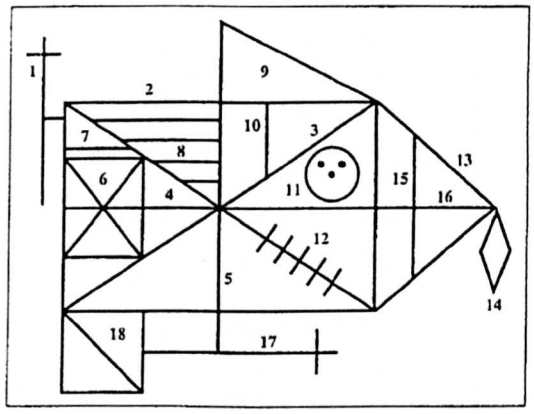


Total raw score

Anecdotal Remarks: _____

Appendix I: Rey Complex Figure Test (RCFT)

Scoring Sheet



Scoring Criteria for RCFT Drawings

Score	Accuracy	Placement
2	Accurately drawn	Correctly placed
1	Accurately drawn	Incorrectly placed
1	Inaccurately drawn	Correctly placed
0.5	Inaccurately drawn, but recognizable	Incorrectly placed
0	Inaccurately drawn and unrecognizable, or omitted	Incorrectly placed

Scoring Element	Copy	Immediate Recall	Delayed Recall
1. Vertical Cross	2 1 0.5 0	2 1 0.5 0	2 1 0.5 0
2. Large Rectangle	2 1 0.5 0	2 1 0.5 0	2 1 0.5 0
3. Diagonal Cross	2 1 0.5 0	2 1 0.5 0	2 1 0.5 0
4. Horizontal Midline of Large Rectangle (2)	2 1 0.5 0	2 1 0.5 0	2 1 0.5 0
5. Vertical Midline of Large Rectangle (2)	2 1 0.5 0	2 1 0.5 0	2 1 0.5 0
6. Small Rectangle	2 1 0.5 0	2 1 0.5 0	2 1 0.5 0
7. Small Horizontal Line above Small Rectangle (6)	2 1 0.5 0	2 1 0.5 0	2 1 0.5 0
8. Four Parallel Lines	2 1 0.5 0	2 1 0.5 0	2 1 0.5 0
9. Small Triangle above Large Rectangle (2)	2 1 0.5 0	2 1 0.5 0	2 1 0.5 0
10. Small Vertical Line within Large Rectangle (2)	2 1 0.5 0	2 1 0.5 0	2 1 0.5 0
11. Circle with Three Dots	2 1 0.5 0	2 1 0.5 0	2 1 0.5 0
12. Five Parallel Lines	2 1 0.5 0	2 1 0.5 0	2 1 0.5 0
13. Sides of Large Triangle attached to Large Rectangle (2)	2 1 0.5 0	2 1 0.5 0	2 1 0.5 0
14. Diamond	2 1 0.5 0	2 1 0.5 0	2 1 0.5 0
15. Vertical Line within Sides of Large Triangle (13)	2 1 0.5 0	2 1 0.5 0	2 1 0.5 0
16. Horizontal Line within Sides of Large Triangle (13)	2 1 0.5 0	2 1 0.5 0	2 1 0.5 0
17. Horizontal Cross	2 1 0.5 0	2 1 0.5 0	2 1 0.5 0
18. Square attached to Large Rectangle (2)	2 1 0.5 0	2 1 0.5 0	2 1 0.5 0
	Raw score	Raw score	Raw score

Appendix J: Shatil Syllable Range Test

Syllables first try	Subject's reaction	Score 0/1	Syllables second try	Subject's reaction	Score 0/1
1. doz			1. boog		
2. poon			2. lut		
3. doz mell			3. pon boog		
4. pon lut			4. lut meck		
5.doz mell pon			5. pon lut bog		
6. mell id nush			6. meck bog pun		
7. doz id lut nush			7. pon lut id mull		
8. mull tud id lut			8. nush tud pon id		
9. lut pon id meck pul			9. meck bog lut mell pon		
10. meck doz mell nush lut			10. doz id mell tud bog		

Total score:

Standard score:

Percentile: