Investigating children's acquisition of verb inflection in English, Swedish and Finnish: Challenges for current generativist and constructivist approaches

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Abstract

A debate that lies in the heart of the cognitive sciences is the question of how children acquire their first language. On the one side, generativist accounts have based their explanations on innate knowledge of abstract rules, whilst, on the other, constructivist accounts explain language acquisition as a result of input-based learning. The goal of this thesis is to focus on one of the most vigorously researched areas in language acquisition, the development of inflectional verb morphology, and by doing so not only provide more insight into the acquisition of inflection in general, but also help distinguish between the two competing approaches. More specifically, the thesis will focus on three different languages – English, Swedish and Finnish – and use these languages as a testing ground for explaining how a particular aspect of language is acquired.

Chapter 1 provides a general introduction to the generativist and constructivist approaches to language acquisition, as well as outlining some important linguistic terms. Chapter 2, presents with the two different linguistic phenomena under investigation in this thesis: Optional Infinitive (OI) and person/number marking errors.

Chapter 3 presents Experiment 1, which reports the results of a cross-sectional elicited-production study investigating the possibility that at least some apparent OI errors reflect a process of defaulting to the form with the highest frequency in the input. Across 48 verbs, a significant negative correlation was observed between the proportion of 'bare' vs 3sg *–s* forms in a representative input corpus and the rate of 3sg *–s* production in simple finite contexts. This finding suggests that, in addition to other learning mechanisms that yield such errors cross-linguistically, at least some of the OI errors produced by English-speaking children reflect a process of defaulting to a high-frequency/phonologically-simple form.

Chapter 4 describes Experiment 2, which further investigates the pattern of OI errors, in English and Swedish. In this study, OI errors were elicited in both simple finite and modal contexts. The results support the idea put forward in Experiment 1 that children's (apparent) OI errors have two distinct sources: truncating compound finite structures and defaulting to the most frequent/phonologically simple form.

Experiment 3 in Chapter 5 focused on examining the defaulting errors and further input effects by eliciting present tense verb forms from native Finnish-speaking children. The results provide evidence for the defaulting hypothesis, and suggest that a successful account of the development of verb inflection will need to incorporate both rote-storage and retrieval of individual inflected forms as well as phonological analogy across them.

Finally, Chapter 6 concludes the thesis by summarizing the findings of Experiments 1-3, and discussing the main implications of the results for the generativist and constructivist accounts of acquisition of verb morphology, as well as suggesting some possible future research directions.

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'Nothing is as important as passion. No matter what you want to do with your life, be passionate. And always remember these 3 P's: PASSION+PERSISTENCE=POSSIBILITY.'

~ Jon Bon Jovi on May 16, 2001 at Monmouth University, New Jersey

Rationale for submitting the thesis in an alternative format

This thesis has been submitted in the Alternative Paper Format, which consists of experimental chapters that are in a format suitable for submission for publication in a peer-reviewed scientific journal. However, the formatting of these papers has been matched to the overall formatting of the thesis for consistency. Thus, for instance, no reference section is provided after each paper; all the references are listed together at the end of the thesis. This is also true of the appendices. In all other respects the chapters have been formatted as if they had been published or submitted for publication. This alternative format does not differ from the standards that are expected for a traditional thesis.

Since the experiments are written in publishable form, the experimental chapters do not include extensive background review. Each paper is therefore preceded by a short section tying the paper to the wider theoretical and empirical context and debate in the literature, thus improving the coherence and the flow of the thesis as a whole.

As in the traditional thesis format, a separate general introduction reviews the background of the research conducted (Chapters 1 and 2) and the general discussion summarizes and discusses the overall outcomes of the research and how they fit into the wider context (Chapter 6). The experiments that have been conducted are presented as a series of three papers. As of the thesis submission date, one paper has been published (Chapter 3) in the *Journal of Child Language*, one paper has been resubmitted with revisions (Chapter 5) to *Cognitive Science*, and one paper is in preparation for submission (Chapter 4).

Whilst throughout this process my supervisors and co-authors, Dr. Ben Ambridge and Prof. Julian Pine, have had a central advisory role and provided helpful comments on paper drafts, my own contribution to the papers is as follows. In addition to researching the literature and the research questions for each experimental paper, I have been responsible for the design of the studies including procedure and materials (videos, pictures, etc.), recruiting, piloting and testing participants, coding and analysing the data, writing the papers, submitting them to the journals, and corresponding with the journals regarding revisions.

The reasons for adopting the alternative thesis format include the wish to share my research findings with others in the field, and by doing so, to enrich the existing literature on the given topics. Whilst the results will strengthen some arguments, at the same time, they will add to the evidence against others. The peer-review and publication process is an integral part of the research culture, and provide the opportunity to obtain constructive feedback, criticism and suggestions from other researchers in the field. Of course, there is no doubt that publications in peer-reviewed journals are also helpful in enhancing future career prospects and possibilities, as well as providing a sense of achievement, confidence and satisfaction in the author.

Chapter 1: Introduction to language acquisition research

1. Thesis introduction and outline

One of the most important characteristics of human language is its productivity. Indeed, words and structural elements of human language can be combined to produce completely novel utterances that the speaker or the addressee(s) may have never produced or heard before. Yet they are perfectly able to produce and understand these utterances. This observation has raised two important questions. The first relates to the nature of the knowledge that allows humans to produce an almost infinite number of utterances using a finite set of elements. The second question relates to the origin of this knowledge – where does it come from? Since language is unique to humans, is this knowledge coded in our genes? There are currently approximately 7000 different languages spoken around the world, and a child exposed to any of these languages will acquire that particular language. Therefore, some aspects must obviously be learned from the environment. However, it is very tempting to take the process of language acquisition for granted, as most children acquiring their first language seem to master this complex skill remarkably quickly and effortlessly, as if it were innate to them. Indeed, children seem to progress from their first words to the basic syntactic constructions within just one or two years, and by the age of three, their language is generally well formed. It is therefore not surprising that this topic has attracted a significant amount of research interest over the years. Indeed, one of the most fundamental and fascinating issues within cognitive science is how language is acquired. In fact, it is no exaggeration to say that language acquisition can be considered the most important cognitive achievement of the pre-school years, as language is a tool that is used to express mental representations (i.e., thoughts) and to communicate with other people.

The question of how children acquire their first language has traditionally been approached from two different theoretical perspectives, both offering rather divergent explanations. These explanations are strongly linked to different views of what language is. Within the generativist (also known as nativist and formalist) approach, a language can be divided into two parts: the lexicon ('mental dictionary')

and an abstract grammar. Grammar refers to a collection of abstract rules for how words and other elements combine in a particular language (e.g., word order rules; add *–ed* to form regular past tense). Language acquisition is seen as being universal and internally driven, as all children are assumed to be born with abstract knowledge of grammar that will guide language acquisition. Therefore, they are equipped with both lexical categories such as Noun and Verb, and functional categories such as Inflection and Determiner, even before they produce their first utterances (for a brief review, see Clahsen, 1996). This view has dominated the field of language acquisition since the 1950s.

An alternative approach, challenging the generativist view, is offered by the so-called constructivist approaches. These non-nativist approaches propose that no innate linguistic knowledge is required in order to acquire a language, and that linguistic input has a very important role in the construction of grammar. Importantly, whilst these two basis assumptions are generally shared by all constructivist theories, specific proposals suggest different ideas in regards to how the language is actually acquired. For example, usage-based theories see social communication and interaction as crucial for language acquisition (e.g., Tomasello, 2000a, 2000b). Thus, under this proposal, language is thought to emerge as a result of being used in social communication via generalized, non-specific learning mechanisms. The advocates of construction grammar theories, on the other hand, emphasize that there is no division between lexicon and grammar, and see language as a collection of stored pairings of form and function (e.g., Goldberg, 1995). Thus, one should not perceive constructivism as one single theory – the same, of course, applies to the generativist approach, which also consists of different theories linked by certain core assumptions.

Indeed, over the years, specific theoretical proposals within these two different language acquisition approaches have come and gone, and the general conceptions underlying the two frameworks have changed and developed, but, if anything, the field of language acquisition has become even more polarized (Maratsos, 1999). Thus, there is still no consensus on the topic of language acquisition, and the question of how language is acquired remains unanswered.

In order to distinguish between the generativist and constructivist accounts of language acquisition - and to shed light on the much debated issue of whether or not language is innate - researchers have investigated a number of different linguistic phenomena, from subject drop and basic word order to complex sentences, passives and question-formation, in an attempt to develop models and theories that can account for data from several different languages. However, a serious problem facing this approach is that there are few cross-linguistic phenomena that have been documented in sufficient detail to allow meaningful cross-linguistic comparisons to be made. This is important because theories of language acquisition must be able to explain not only the acquisition data from one particular language, for example, English, but the data from any of the world's languages.

One topic in the field of language acquisition that attracted considerable cross linguistic research from both theoretical positions is the acquisition of verb morphology; the question of, for instance, how English-speaking children learn that they have to "add" *–s* to the end of the verb stem when they are referring to a single third person (i.e., not the speaker or the interlocutor) in the present tense. Over the years, generativist and constructivist accounts have offered radically different explanations of how children come to acquire such knowledge. Generativist accounts have based their explanations on innate abstract knowledge, constructivist accounts on input-driven learning.

The aim of the present thesis is to provide more insight into the acquisition of inflectional verb morphology, and, in doing so, to attempt to distinguish more generally between the two competing approaches. Specifically, the thesis will focus on the acquisition of inflectional verb morphology in three different languages: English, Swedish and Finnish. Whilst English and Swedish both belong to the Germanic branch of the Indo-European language family, Finnish belongs to the Finno-Ugric branch of the Uralic language family. Thus, it is very different from English and Swedish. English and Swedish provide a useful comparison because, whilst they are similar in many respects, this makes it possible to isolate parts of the system where they differ. These three different languages will be used as a testing ground for different explanations of how a particular aspect of inflectional verb morphology is acquired. The structure of the thesis is follows.

The present chapter will continue by explaining certain linguistic terms that are used throughout the thesis. The rest of Chapter 1 will introduce the reader, in a little more detail, to generativist and constructivist approaches to language acquisition. These different positions will be outlined with examples in order to provide an understanding of the field of child language acquisition in general, and to set the thesis in a wider context.

Chapter 2 will move onto the area of language acquisition under investigation in this thesis: the acquisition of inflectional verb morphology. The chapter will outline the two different linguistic phenomena that are the focus of the studies in this thesis: so-called Optional Infinitive (OI) phenomenon and person/number marking errors. Both generativist and constructivist explanations and predictions regarding these errors will be reviewed, and gaps in the literature identified, in order to provide a rationale for the studies presented in the rest of the thesis.

Chapter 3 presents Experiment 1, which investigates an alternative explanation of OI errors in English using an elicited production paradigm. This experiment was motivated by the inability of both current generativist and constructivist accounts to provide an explanation for the particularly high rate of OI errors in English. This experiment tests two leading cross-linguistic accounts of the OI phenomenon, one generativist and one constructivist, and concludes by suggesting that an additional mechanism ("defaulting" to high-frequency input forms) is needed in order to account for the high rate of OI errors in English. As will be seen in Chapter 5, this additional mechanism can also explain different types of errors in a completely different language (Finnish).

In Chapter 4, Experiment 2 is presented. This experiment was developed to further investigate the OI phenomenon in both English and Swedish by comparing the patterning of the data in these two languages. More specifically, the aim of this study was to test the dual-mechanism account proposed in Experiment 1 as a way of explaining differences in the pattern of OI errors across English and Swedish. A similar method of data collection was used as in Experiment 1.

Experiment 3, presented in Chapter 5, moves on to investigate person/number marking errors in Finnish; a highly inflected but understudied language. This study looks at children's early use of verbal inflections in an extensive elicited production

study. The study concludes that, in contrast to the predictions of generativist accounts, children do, in fact, make inflectional errors at high rates in lower frequency parts of the verb paradigm and with lower frequency items, which is consistent with constructivist views of morphological development. The results of this study are also consistent with the dual-mechanism account proposed in the previous experimental chapters.

In Chapter 6 the overall implications of the experimental findings for generativist and constructivist approaches to language acquisition will be discussed. The chapter concludes by suggesting further studies that are necessary to gain a more complete understanding of morphological development.

Before moving on to introduce the generativist and constructivist approaches to language acquisition, the next section will briefly outline some basic linguistic terms necessary to understand the phenomena under investigation in this thesis.

2. Some linguistic terminology regarding inflectional verb morphology

Inflectional morphology refers to the "changes" that are made to words to express certain grammatical features (linguists traditionally describe inflectional morphology in terms of "changes" to a stem, but simply as a convenient way to describe the surface forms, not necessarily as a claim regarding process). Most commonly these changes involve adding a morpheme (= an inflection) to the end of the word (suffix). For instance, past tense in English is marked (for regular verbs) by adding the *–ed* morpheme to the stem form (e.g., *play* → *play-ed*). Similarly, an *–s* morpheme at the end of a noun denotes plurality (e.g., *cat* → *cat-s*). Other features that can be encoded by inflections depend on the language, and can include features such as gender, shape and humanness (Slobin, 1982). The focus of this thesis will be on verb inflection, which in the majority of the world's languages that use verb inflection (many do not) encodes tense and person/number.

2.2. Tense

Tense marking allows speakers to distinguish between present and past tense, i.e., between something that is happening at the moment (or an ongoing state of affairs) and something that happened in the past. For example, as we saw above, in English, the past tense for regular verbs is marked with the inflection *–ed* (e.g., *walk-*

ed). In this case, the tense marking inflection (*-ed*) is added to the bare stem of the verb (*walk*). Languages differ in how tense is marked. In Finnish, the past tense is marked with an inflection *–i* (e.g., *Kävel-i-n* where *–i* marks the past tense and *–n* marks the first person singular). Tense can also be marked using an auxiliary verb (together with a present or past participle). In English, the present progressive is marked using auxiliary BE and a progressive inflection *–ing* on the main verb (e.g., *He is walk-ing*; *They are walk-ing*), whereas the simple present tense uses either 3sg –s or null/zero marking (e.g., *He like-s*; *They like-ø*). Similarly, in Finnish, past perfect is marked using auxiliary BE and the main verb in past participle form (e.g., *Poika*-BOY *on*-BE *kävellyt*-PAST PARTICIPLE '*The boy has walked*').

2.3. Person/number

Person marking allows speakers to distinguish between different persons. For example, English distinguishes three different persons: the first person (the person or people speaking, the second person (the person or people being addressed) and the third person (a person or group of people who are neither the speaker nor the addressee). Due to its impoverished morphology, these different persons are not overtly marked in English except for the third person in the present tense (*-s*) (e.g., *He play-s* vs *I*/*We*/*You*/*They play*). In the past and future tense, main verbs do not mark person at all (though past-tense auxiliaries have some limited person marking). In addition to person marking, more highly inflected languages also mark number on the verb. For example, in Finnish, the first person singular is marked with *–n* whereas the first person plural is marked with *–mme*. The second person singular is marked with *–t* and the second person plural is marked with *–tte*. English, on the other hand, marks number only in the third person (*He play-s* vs *They play*) and only in the present tense. Simple English past tense forms do not distinguish between any number or person (*I*/*We*/*You*/*He*/*They played*). In contrast, Finnish past tense forms mark both person and number: a past tense form is formed by adding the past tense inflection *–i* and the relevant person/number inflection (e.g., *Kävel-i-n* in which *–i* denotes past tense and *–n* first person singular).

The fact that finite verbs are marked for person/number is termed agreement. Thus, the verb form must agree with its subject in terms of person and number. For instance, an English sentence with a third plural subject would be ungrammatical if the verb was infected with a third singular *–s* (**They play*s). Instead, a third person

plural subject requires that a null/zero marked form *play* is used (*They play*). In this case, the verb covertly agrees with its subject (*They*), because third person plural is marked with a null inflection in English.

As shown above, the marking of person and number is usually related. Indeed, in many languages, there is no separate marker for person and number, with a single inflection coding both features (e.g., *-mme* in Finnish codes both person and number, first plural). Languages of this kind, in which means that a single inflection is used to code two or more features, are known as fusional languages. On the other hand, languages that encode each feature with a different inflection are known as agglutinative languages (e.g., the Mayan languages of Central America). It is worth noting that Finnish also has many agglutinative characteristics: for example, the phrase '*In our houses?*' is a single word *taloissammeko* which is formed by adding separate suffixes to the noun stem *talo* '*house*':

(1) *talo - i - ssa - mme - ko?*
house - PL - LOC - 1PL..POSS -Q
'In our houses?'

Thus, as can be seen from the above example, the difference between fusional and agglutinative languages is that, in agglutinative languages, each inflection is clearly identifiable, whereas in fusional languages the inflectional boundaries are more difficult to detect, and a single inflection can encode several grammatical features. For example, the above example *taloissammeko* can be easily broken down into the bare stem word *talo* and the inflections that encode different features (plurality, location, etc.). However, the phrase *Kävele-n* '*I walk*' can only be broken down into the stem of the verb (*kävele-*) and one inflection (*-n*) encoding both person and number. Thus, the boundaries between agglutinative and fusional languages are not sharp but rather they form a continuum, with highly-agglutinative languages at one end and highly-fusional languages at the other. Whilst English and Swedish are mostly fusional, Finnish leans more towards the agglutinative languages.

It is important to note that whilst overt subjects can be dropped in Finnish when the subject can be inferred from the discourse context, the verb must still agree with the "understood" subject. For example, it is not necessary to say *Te syö-tte kalaa* '*You-pl eat-2pl fish*' but the 2pl subject *te* can be dropped: *Syö-tte kalaa* '*Eat-*

2pl fish' as the discourse subject can be identified from the inflected verb. Because of this, the present thesis uses a more neutral term, person/number marking, when talking about subject-verb agreement, since in Finnish subjects are often dropped, and as such, not all sentences show subject-verb agreement *per se*.

2.4. Finite verb forms

A verb form that is inflected for tense and person/number (according to the inflectional system in that particular language) is known as a finite verb form. Consider the following examples in English:

(2) *Jon walked across the stage.*

(3) *Jon sings every day.*

(4) *They work together.*

The form *walk-ed* in (2) is marked for past tense by adding the inflection *–ed* to the stem of the verb *walk*. Similarly, the form *sing-s* in (3) is marked for present tense and third person singular by adding the inflection *–s*. Due to the impoverished nature of English verb morphology, in the present tense, the person feature is overtly marked only on the 3sg form. However, even though there is no overt inflection in the example (4), the verb is considered to be finite, as there is a clear person/number (3pl) and tense (present) context. This can be compared to Finnish, in which each present-tense person/number combination has a separate inflection:

(5) *Hän juokse-e*
He run-3SG
'He runs'

(6) *Minä juokse-n*
I run-1SG
'I run'

(7) *Sinä juokse-t*
You run-2SG
'You run'

(8) *Me juokse-mme*
We run-1PL
'We run'

(9) *Te juokse-tte*
You run-2PL

'You run'

(10) *He juokse-vat*
They run-3PL
'They run'

2.5. Non-finite (infinitive) verb forms

A non-finite verb form is a form of the verb that does not mark tense or person/number. Non-finite verb forms are usually used when there is another (inflected) verb in the sentence acting as the main or auxiliary verb. For example, in sentence (11) the main verb *sing* is non-finite whereas tense and agreement are marked on the auxiliary *doesn't*:

(11) *He doesn't sing.*

As noted above, English is a morphologically impoverished language, and therefore, non-finite verb forms are not usually distinguishable from finite verb forms except in third person singular contexts. *Doesn't* is inflected for third person singular whereas *sing* has no inflection since it is acting as a non-finite verb. It is important to highlight that other morphologically richer languages have separate non-finite inflections that clearly differentiate them from finite forms. For example, in Finnish the non-finite (infinitive) form[1] is marked for certain verbs with the inflection *–a* (e.g., *sano-n 'I say'* vs. *sano-a '(to) say'*). It should be noted that this infinitival form is not the only non-finite form. For example, in English, past and progressive participles (e.g., *walk-ed* and *walk-ing*) are also considered to be non-finite because they are not marked for tense. Instead, tense is marked using auxiliary BE or HAVE (e.g., *I have walked; I am walking*). Note that whilst the past participle *walked* (e.g., *I have walked*) is non-finite (because it is used in conjunction with an auxiliary verb which is marked for tense) the homophonous simple past tense form *walked* (e.g., *I walked*) is finite. Other languages have similar kinds of constructions, where non-finite participles are used with finite main verbs or auxiliaries. For example, the Finnish sentence *Olen kävellyt 'I have walked'* is formed with a finite auxiliary BE (marked for 1sg with *–n*) *ole-n* and non-finite past particle *kävellyt*. Similarly, the same sentence in Swedish *Jag har vandrat* consists of personal pronoun *jag* '*I*', a finite auxiliary *har* '*have*' and a past participle *vandrat* '*walked*'.

[1] Finnish has actually several different infinitives some of which can be inflected in different cases. Here infinitive means the form that one would find in a dictionary.

3. The acquisition of inflectional verb morphology

The above section has outlined and explained the most important linguistic concepts and terminology required for the purposes of this thesis. How children learn to inflect the verbs in their language to designate grammatical features such as tense and person/number is referred to as the acquisition of inflectional verb morphology. As seen above, languages differ in the way they mark inflection, sometimes using an inflection (e.g., *juokse-n*) and sometimes using an inflected auxiliary (e.g., *has walked*). As inflections differ from language to language, they obviously have to be learned from the input to which the child is exposed. However, a question that has remained unanswered – and controversial - is whether the child is equipped with abstract knowledge of verb inflection before she produces her first multi-word utterances and tense/agreement marked verb forms (i.e., with knowledge that is innate, or at least, matures during the first year or so).

Generativist approaches to the acquisition of inflectional verb morphology have argued that acquisition of inflection simply reflects filling in existing innate paradigms on the basis of the language to which the child is exposed. Constructivist accounts, on the other hand, assume that initially children have no knowledge of inflectional marking *per se*, but acquire utterances as wholes from the input (e.g., *I'm playing; It fits*), and only later abstract across these forms, thereby becoming productive with inflection. In order to better understand these different positions on the acquisition of inflectional verb morphology, we will begin by outlining the general assumptions on which they are based. This will enable the reader to appreciate how these different positions have yielded different theoretical proposals that make different predictions regarding children's early use of inflection. In Chapter 2 the reader will then be introduced to the two issues regarding the development of verb inflection that are under investigation in the present thesis.

3.2. Generativist approach to language acquisition

The first thing to note about the generativist approach to language acquisition is that there is no one generativist account of how children acquire their native language, with which all generativist researchers would agree. On the contrary, over the years, there have been several different accounts designed to explain the process of language acquisition and to account for the errors that young children make in their early speech. These different accounts, however, share the same

important central assumption: that the process of acquiring language is strongly constrained and aided by innate knowledge of linguistic categories and principles.

This idea, that language must be at least partly innate, was made popular by Chomsky (1965) who introduced the idea of the Language Acquisition Device (LAD): a set of innate principles and grammatical structures that children are born with, and whose purpose is to aid children in language learning. Thus, with this innate device, children were thought to be able to access all the abstract rules and structures that apply to any of the world's language, including the learner's own. Thus linguistic universals – features common to all the languages of the world – were assumed to be biologically endowed in the brain. These linguistic features later became known as Universal Grammar (Chomsky, 1975), which subsequently became a central construct in generativist approaches. Universal Grammar includes a set of linguistic constraints that helps the speaker to process the language. For example, because of Universal Grammar the sentence '*Ate some boy the cake*', although understandable, sounds incorrect to native English speakers. On the other hand, the sentence '*Colorless green ideas sleep furiously*" is still recognized as a grammatically correct sentence even though it is semantically anomalous. One of the key properties of Universal Grammar is that it is generative and therefore, able to generate novel utterances as per the grammatical rules applicable to that particular language.

Universal Grammar was put forward as a solution to the so-called learnability problem. It was argued that the linguistic input that children receive is so inconsistent and inadequate that children could not learn the language solely on the basis of such impoverished input. Thus, children would never reach the adult end state if the input was the only source of information about the grammar. This argument became known as the argument from the poverty of stimulus (Chomsky, 1980). A related argument posited by generativist researchers is that language is extremely complex, and it is difficult to see how children can acquire it so quickly if they are not aided by innate knowledge. A third issue relating to learnability is the so-called 'no negative evidence' problem according to which children are exposed mostly to grammatical utterances in the input, and yet produce overgeneralization errors such as **I eated the cake,* which are not usually explicitly corrected by adults (e.g., Bowerman, 1988). Thus, children rarely receive negative evidence when

learning the language, yet they learn to stop making these overgeneralization errors.. It has been therefore argued that, without constraints on possible generalizations in the form of Universal grammar, it is impossible for the children to ever reach the adult end state of correct grammar as they would never learn to restrict their linguistic generalizations (e.g., Baker, 1979; Randall, 1990). The concept of Universal Grammar has been argued to be the key to solving the learnability problem.

Universal Grammar posits that there are general principles that are the same across languages and available only to humans. Thus, the core assumption is of a set of innately specified universal principles that are shared by all languages. Languages, as we have seen, do, however, differ from each other, and this is explained (in addition to lexical learning) in terms of linguistic parameters. These parameters are set of the basis of input in the particular language being learned, and define how the universal principles apply to that language. There are argued to be different parameters for different grammatical properties such as whether subjects are obligatory (the null-subject parameter) and whether tense marking is required (the tense parameter) (e.g., Legate & Yang, 2007). Each language can be characterized by how the different parameters are set. For example, for Swedish the verb-second[2] parameter takes a different value (+) than for Finnish (-), which allows relatively free word order, or English (-).

As mentioned at the beginning of this section, there have been numerous generativist accounts of language acquisition since the introduction of Universal Grammar. In order to give the reader a better understanding of how this concept of Universal Grammar has affected language acquisition theories, the following section below briefly outlines two generativist accounts of language acquisition, the *parameter setting* and *performance limitations* accounts.

3.2.1. Parameter setting accounts

The implication of positing universal principles and parameters for language acquisition is that – whilst both are considered to be innate – principles are

[2] Verb-second (V2) word order refers to the placement of the finite verb as the second constituent in a sentence. Thus, in V2 languages, such as Swedish, the finite verb must always be in the second position. For example, *Idag vill jag äta jordgubbar* directly translates '*Today want I eat strawberries*', with the finite verb *vill* '*want*' appearing as the 2nd constituent.

assumed to be the same for every language but parameters are set to certain value by children as they learn the particular language to which they are exposed. This generativist approach to language acquisition is known as the parameter setting approach (e.g., Roeper & Williams, 1987). Parameter setting accounts of language acquisition focus on discovering the parameters and settings that could account for the observed cross-linguistic variation in a particular domain (e.g., whether subjects are obligatory). These accounts have also tried to explain the child language error data. For example, languages differ in whether they allow subjects to be dropped or not (i.e., whether they are pro-drop or non-pro-drop languages). For instance, English is a non-pro-drop language as finite utterances require an overt subject (e.g., *I walk to school vs *Walk to school*). Languages such as Italian and Spanish however allow subjects to be dropped (e.g., i*o credo* vs *credo*, both meaning '*I believe*'). It was therefore hypothesized that there must be a pro-drop parameter, the setting of which depends on the particular language (Chomsky, 1981).

With regard to the acquisition data, English-speaking children have been documented to go through a period during which they produce utterances with missing subjects (e.g., Brown, 1973). Hyams (1986) interpreted this to mean that all children, learning whichever language, set the subject parameter by default to pro-drop which is the correct setting in languages like Italian. Thus, all children will produce subjectless sentences until they discover, for non-pro-drop languages, that they need to change the setting of the parameter, after which subjectless sentences are considered ungrammatical. Once the child has set the parameter to the correct setting, the errors are expected to cease. An alternative possibility is that the parameter is correctly set even at the point at which English-speaking children produce null-subject sentences, which are the result solely of performance limitations; as discussed in the following section.

A problem with simple parameter setting is that it is unclear how it would account for partial pro-drop languages such as Finnish (Holmberg, 2005). In Finnish, 1st and 2nd person subjects can be omitted but 3rd person subjects are obligatory. Simply switching a parameter to an "on" or "off" setting for subject drop will not be able to explain the acquisition of such languages. In Chapter 2 a more recent probabilistic parameter setting model that has been used, rather successfully, to

explain a different phenomenon - children's non-finite utterances - cross-linguistically (Legate & Yang, 2007) will be outlined in more detail.

3.2.2. Performance limitation accounts

Hyams' (1986) parameter-setting account of subject omission errors was criticized by Valian (1991). Valian points out that, in her corpus analysis, English-speaking children produced more utterances with overt subjects than Italian-speaking children (69% vs 30%), and that this finding is inconsistent with the claim that English and Italian-speaking children initially have the same parameter setting (+ pro-drop). If they did, both should produce subjectless sentences at approximately the same rate.

Valian (1991) suggests that, even at the point at which they are producing errors, children have set the parameters correctly, and that errors arise because their language production is subject to three performance limitations in production. This has become known as the performance limitations account of language acquisition. These performance limitations, outlined below, are thought to prevent children from producing long and complex utterances, and therefore, children's language looks different from adult speakers'.

Valian (1991) suggested that one performance limitation affecting children's language production is a limited processing capacity that precludes the child from producing utterances for which the processing load is high. For example, when one constructs an utterance, several different tasks must be completed, including – but not limited to – finding the correct words in the lexicon and deciding on what syntactic structures to use. There is no doubt that children's working memory capacity is smaller than that of adults, and that children are not so used to integrating all these different tasks. This then leads the child to omit certain parts of the utterance when the processing load is too high. Bloom's (1990) analysis of the Brown (1973) corpus is presented as evidence for a processing limitation account of subject omission (Valian, 1991). In this study, the verb phrases of sentences with missing subjects were found to be longer than the verb phrases of sentences in which the subject was present. This finding is consistent with the idea that children omit subjects in response to the higher processing load imposed by the need to construct longer verb phrases.

The second performance limitation suggested by Valian (1991) is children's ignorance of acceptability conditions on "ungrammatical" adult sentences. For instance, even though English grammar does not allow true null subjects, sometimes omitted subject sentences are acceptable due to pragmatics of the discourse situation. Valian (1991:33) gives the example sentence **Sings like a dream* which is ungrammatical as a stand-alone sentence. However, when it is preceded by a sentence such as **She'll be a big hit*, it is acceptable. According to Valian (1991) children have not yet picked up on these fine-graded discourse pragmatic distinctions and hence are not yet aware of the pragmatic conditions under which null subjects are and are not allowed. Thus, children are assumed to know that subjects are obligatory in English, but to over-extend the use of null subjects to pragmatic contexts which do not license them in the adult grammar.

The third performance limitation proposed by Valian (1991) relates to prosody and the tendency of the children to omit unstressed utterance-initial syllables. Whilst no explanation is provided for the underlying cause this tendency, or if it is a consequence of some other performance limitation, it could be used to explain several errors that children make, including the omission of determiners and pronouns in subject position. A repetition study by Gerken (1991) showed that children were more likely to omit pronouns and determiners in subjects than objects, and Valian (1991) cites this finding as support for her performance limitations account.

These aforementioned performance limitations are presumably applicable to any grammatical phenomena. As children grow up and their processing performance and working memory capacity increase, children will make fewer errors and their speech will start to resemble adult speech. However, Valian's (1991) performance limitations account has been criticized by, for example, Pine and Lieven (1997). These authors suggest that rather than operating with adult grammar, young children's grammars might actually consist of categories that are more limited than adults'. Their analysis of data from 11 children at ages between 1;0 – 3;0 revealed that five children showed no overlap in their use of the determiners: *a* and *the*. Thus, the indefinite article: *a* was used with certain nouns and these nouns never appeared with the definite article: *the*. Similarly, some nouns only ever occurred with *the* but never with *a*. This finding suggests that young children do not have

access to an abstract determiner category, but rather have categories of *a* and *the*. A recent, methodologically very rigorous study by Pine, Freudenthal, Krajewski and Gobet (2013) controlled more carefully for both vocabulary and sample size, and showed that the use of the determiners *a* and *the* by young English-speaking children was significantly less flexible than adults', but it become more flexible over the course of development. Thus study clearly suggested that children were not leaving out determiners due to performance limitations but they were yet to learn the applicable determinter+noun combinations.

In a similar naturalistic study of children's use of verb inflections, Pine et al. (1998) showed that there was hardly any overlap between children's use of the 3sg present tense *–s*, present progressive *–ing* and regular past tense *–ed* inflections. For instance, there was no child who had produced both a past tense inflection and a 3sg present inflection with the same verb. Whilst the aforementioned study suffered from the failure to control for children's knowledge of relevant inflections, Pine et al. (2008) conducted a more controlled analysis which indicated differences between children's provision of different morphemes. These studies (see also Theakston, Lieven, Pine & Rowland, 2001, for an analogous study of verb-argument structure) suggest that children are not operating with abstract grammatical categories but with categories that are more limited in scope. Thus, whilst there is no doubt that children have smaller working memory capacity than adults, and that this will have an effect on their language production, the assumption that they have adult-like categories from the beginning does not fit the empirical data available.

3.2.3. Summary: Generativist approaches to language acquisition

To summarise, the two examples of generativist accounts outlined above are both characterized by the shared assumption that innate specifically linguistic knowledge plays an important role in children's acquisition of language. This is indeed what defines any generativist-nativist theory. Thus, generativist accounts have tended to assume a top-down processing view of language acquisition, and focus on explaining why children's speech differs so much from adults when both children and adults are argued to have the same innate knowledge available to them. The implication of such innate knowledge is that once children have, for instance, set the relevant parameters correctly and/or overcome the performance limitations

under which they are operating, their speech will be adult-like and essentially error-free. Importantly, since children are assumed to operate with abstract functional categories (e.g., INFLECTION or AGREEMENT and TENSE), children are expected to apply these categories to all items in their language. For example, once particular person/number inflections (e.g., 3sg *–s*; copula *is*) are present in children's speech, children should systematically mark person/number in this context on all of the verbs in their vocabulary. However, the pattern found in naturalistic data suggests the opposite. For example, Wilson (2003) showed that one of the five children (Nina) that he studied used copula BE correctly in 79% of obligatory contexts whilst the 3sg present tense inflection *–s* was correctly used in only 13% of obligatory contexts. This discrepancy is difficult for generativist accounts to explain since it would be expected that, once children have realized that person/number marking is obligatory, they should correctly mark all the items in the language. Interestingly, another child (Eve) studied by Wilson (2003) displayed an opposite pattern to Nina: her correct use of copula BE was only 18% in obligatory contexts whilst she marked person/tense correctly 38% of the time on 3sg main verbs. An account that would explain why children have more difficulties in marking person/number on lexical verbs than on copula BE (Nina) would not be able to explain the opposite pattern (Eve), and vice versa. Whilst Pine et al.'s (2008) replication of Wilson's (2003) study when controlling for the knowledge of individual inflections revealed similar results, very few differences were found between the children in the order of acquisition of morphemes, suggesting that this was due to the similarities in the input. Furthermore, in an elicited production study, Theakston, Lieven and Tomasello (2003) found that two- and three-year-old children produced 3sg present tense forms significantly more often for real verbs than for novel verbs, suggesting that children were not applying a formal rule ("add *–s* to mark 3sg present tense"). It seems difficult to see how a generativist account could explain this pattern of findings.

The next section describes an alternative theoretical approach to language acquisition. Unlike the generativist approach, this approach assumes no innate language-specific knowledge, but postulates that language acquisition is accomplish using general cognitive abilities. Thus, if the generativist approach can be described as involving top-down learning (from innate categories to individual lexical items),

this alternative approach can be described as using bottom-up learning (from individual lexical items to abstract categories or generalizations).

3.3. Constructivist approaches to language acquisition

An alternative approach to explaining language acquisition is the constructivist approach. Within this framework, no specific knowledge of language (or any other domain) is assumed, but children acquire language using general cognitive abilities and learning mechanisms. The acquisition of language is thought to progress from specific to general gradually, and there is no assumption of full productivity during the early stages of development. This approach is therefore fundamentally different from the generativist approach. It should be noted, however, that even constructivist accounts assume that the *potential* to learn language is innate.

It is also important to emphasize that, although, under this approach, children's very earliest utterances may be rote learned e.g., *whazzat*?, they quickly abstract across these utterances to form productive generalizations. Thus the approach differs radically from Skinner (1957) who proposed that language learning revolves entirely around the acquisition of rote-learned strings which are reinforced by caregivers. The next section will introduce perhaps the most complete theory of language acquisition from the constructivist perspective.

3.3.1. Tomasello's usage-based account of language acquisition

One of the most influential accounts of language acquisition from a constructivist perspective is that of Tomasello (2003). This account, of course, draws on work by other constructivist researchers in the field (e.g., Brown, 1973; Braine, 1976; Bowerman, 1973, 1983, 1988, 1990; Lieven, Pine & Baldwin, 1997; Pine & Lieven, 1993, 1997; Pine et al. 1998; MacWhinney, 1987; MacWhinney & Bates, 1989; Braine & Brooks, 1995; Dabrowska, 2000; Rowland & Pine, 2000; Theakston et al., 2001). Tomasello is thus by no means the first author to suggest a constructivist approach to language acquisition. However, his account is perhaps the most complete and well-specified outline of language acquisition that the constructivist approach has seen.

Before children can acquire grammar or morphology, it is generally acknowledged that they will need to have developed several different cognitive

abilities. For instance, children must be able to segment speech into words (e.g., *apple*) and utterances (e.g., *I'm eating an apple*)[3]. They must also be capable of joint attention in order to know what the speaker is referring to (e.g., the speaker is looking at the apple rather than the orange which is also on the table). Children must also understand the speaker's communicative intention. For example, if the speaker says *Do you want an apple*?, the speaker's intention is to offer an apple to the person he or she is speaking to. If the speaker advises someone to *Turn off the lights* whilst lying in the bed in the evening, the addressee can infer that this means that the speaker is going to sleep. Such cultural and family routines and rituals will also aid language acquisition, as these routines are filled with rich, yet often repetitive and predicable, language. For example, in the cultural routine of bedtime, the child recognizes that she and the caregiver are in a situation in which the aim is to go to sleep, and when the caregiver utters *Close your eyes*, the child's understanding of that utterance will be aided by her knowledge of the elements of the bedtime routine (e.g., closing one's eyes).

Once children have learnt to segment the speech stream into words and utterances, they will first - with the help of intention reading and joint attention - rote-learn an inventory of *frozen phrases* (also known as *holophrases* or *fixed phrases*). These are words and short utterances that have been paired with a particular communicative function. For example, during the cultural routine of bedtime, the child will have heard her caregiver say *Close your eyes* on multiple occasions. The child is aware of the routine of going to bed and can use the skill of intention reading to figure out what the caregiver means. During the mealtime routine, the caregiver might say, for instance, *I'm eating it* whilst putting something into her mouth and the child will understand that the utterance means that the speaker is labeling her own action of eating rather than offering food to the child. The child will learn these phrases as whole utterances, and subsequently use them to describe or request actions. For instance, the child can tell her caregiver to *Close your eyes* in a pretend bedtime play situation, and she can say *I'm eating it* whilst commenting on her own action of eating something. It is important to note that

[3] It should be noted that segmenting speech into words/utterances and grammar development are not really separate processes nor achieved in linear order. Instead, these learning processes occur simultaneously and are not independent from each other.

these early frozen phrases and words are acquired as wholes and are associated with their communicative function.

After the child has stored a large number of these rote-learned utterances (e.g., *Close your eyes*; *I'm eating it; pois 'away'*), she will then be able to begin to decompose them into different parts and construct lexically-specific schemas that share the same lexical items and meaning. These schemas will be partially productive. For example, the child may have encountered utterances such *Close your eyes, Close the door*, *Close that window*, and will then abstract across these to form a lexically-specific schema *Close X* which describes a request to close something. The child can then insert any to-be-closed object into that schema to form a novel request (e.g., *Close the cupboard*). Similarly, utterances such as *I'm eating it*, *I'm drinking it*, *I'm kicking it* and *I'm hitting it* can be abstracted across to form a lexically-specific schema *I'm X-ing it* which the child can use to describe actions that she is performing herself on some object. It must be borne in mind that these lexically-specific schemas are only functional at this stage of development. Thus, in a schema such as *I'm X-ing it* the *X* is a slot for a word that denotes actions that the child can perform herself rather than a slot for any instance of an abstract VERB category.

There is indeed evidence to suggest that children's earliest grammatical constructions are lexically-specific, rather than abstract. For example, Tomasello (1992) proposed a *verb-island* hypothesis based on a diary study of his daughter between the ages of 1;3 and 2;0. His analyses revealed that there was little overlap in the constructions used with individual verbs, with most observed only in one construction type. His suggestion was that every verb is an "island "in the child's grammar, and every "verb island" has its own semantics and syntax. For example, the verb *cut* only appeared in constructions *cut X* but never in constructions such as *X cut*. Similarly, very little overlap (2% of all the verbs) was found for morphological inflections such as the past tense marker *–ed* and the present tense progressive *–ing* (Tomasello, 1992). Relatedly, Pine, Lieven and Rowland (1998) found in their analysis of overlap between the English verbal inflections in a corpus of 12 children that overlap was very low, with children not producing, for instance, the past tense inflection *–ed* and the 3sg present tense inflection *–s* with the same verb.

Their study, however, also suggested other types of islands, such as pronoun islands (e.g., *I'm Xing it*), around which children's early grammatical constructions were based. Some islands were also based on high-frequency nouns such as *Mummy*. Furthermore, verbs were sometimes used as slot fillers in structures such as *Don't X* (e.g., *Don't eat it*). Pine et al. (1998) therefore concluded that the verb-island hypothesis was too strong in its current form, and rather than verbs having some special status, children seem to be sensitive to the distributional patterns of all words and morphological items. Thus, these early lexically-specific schemas and constructions can be built not only around verbs, but around any lexical or morphological item.

Similar findings have also been made in languages other than English. For example, Pizzuto and Caselli (1994) investigated Italian-speaking children's use of verbal inflections between the ages of approximately 1;5 and 3;0. Their results showed that although there are six possible person/number inflections that the child could, in principle, use (1sg, 2sg, 3sg, 1pl, 2pl and 3pl), 47% of the verbs were used in only one form (e.g., only 1sg form), and another 40% of the verbs were used with a maximum of three different inflections. Around half of the 13% of verbs that were used with four or more different inflections were highly frequent irregular forms, which, due to their irregular status, could have been learned only as rote items. Rubino and Pine's (1998) analysis of the speech produced by a child learning Brazilian-Portuguese yielded similar results. In addition, their results revealed that the child tended to use the person/number forms that were the most common in the input to which he was exposed. For example, 1sg forms were used rather often, whilst 3pl forms were very infrequent both in the input and the child's output. Aguado-Orea (2004) replicated these results in a study of two Spanish-speaking children. His detailed analysis of naturalistic data showed that children used fewer inflections per verb as opposed to the parents, and often incorrectly used high-frequency 3sg forms in 3pl contexts. Furthermore, when Aguado-Orea excluded certain very high-frequency verb forms in 1sg contexts (e.g., *quiero 'I want'*), the error rate increased from 5% to 10%. Berman (1993) conducted a novel verb study with Hebrew-speaking children, and found that they had trouble producing transitive sentences with novel verbs that they had only heard in intransitive sentences. Thus, the English-speaking children's difficulties with using novel verbs in

constructions in which they have not heard them before seems not to be a problem that is specific to English (e.g., Tomasello, 2002), but reflects something that is common to language acquisition in general. In other words, the empirical data available seem to suggest that children learning all languages begin by rote-learning frozen phrases, and then construct lexically-specific schemas around verbs and other lexical items, including morphological inflections.

In order to arrive at adult-like abstract constructions (e.g., the SUBJECT VERB OBJECT construction), the child is argued to generalize and analogize across these lexically-specific constructions (e.g., *Close X; Open Y*) that she has stored in memory. How exactly children do this, however, is not very well specified. Tomasello (2003) suggests that children generalise by using *structure mapping* (Gentner, 1983) to create analogies across lexically-specific constructions on the basis of the similar functional roles that particular components play in these constructions. For example, the child could generalize across *I'm ACTION-ing it* and *HIT hit HITTEE* because these schemas share similar AGENT-ACTION and ACTION-PATIENT relations. Similarly, the child could generalize across the schemas *Mummy ACTION-s* and *He ACTION-s* to acquire 3sg-SUBJECT VERB-*s* construction. This process of generalization and analogy will help the child to form adult-like syntactic categories such as NOUN and VERB. This is thought to happen via functionally based distributional analysis. This means that the child will group together words with similar functions that appear in similar positions in sentences. For example, the child may group together *close* and *eat* into a VERB class because they denote actions and appear in similar constructions (*X it*, *I'm X-ing it*).

The generativist side, whilst accepting that lexical knowledge has to be of course acquired from the environment, has heavily criticized the above constructivist account for assuming children's grammatical categories to be more limited in scope than adults', and for the studies presented as evidence in favor of constructivism to be focused on speech production. Indeed, when looking at language comprehension experiments, it appears that children may not be so restricted in their early grammatical knowledge as constructivists predict. For example, Gertner, Fisher and Eisengart (2006) tested the prediction of lexically-specific schemas by showing 25- and 21-month old children videos of a duck and a bunny performing novel actions. Whilst watching the videos, the children heard transitive sentences '*The bunny is*

gorping the duck' or '*The duck is gorping the bunny*'. The hypothesis was that if children's knowledge was in fact tied to specific items and they did not have any abstract knowledge of English word order, they would not be able to interpret the sentences correctly due to the use of a novel verb. However, even the 21-month olds looked at the screen matching the audio sentence. It was concluded that children have abstract knowledge of syntactic structures even before they turn two (for similar evidence by other researchers see for instance Naigles, 1990; Noble, Rowland & Pine, 2011). Furthermore, evidence for early abstract knowledge in the domain of production has been provided by for example a syntactic priming study by Bencini and Valian (2008). The authors showed that children aged between 2;11 and 3;6 were able to produce passive sentences with no shared lexical items when they had been exposed to a passive construction earlier.

Whilst the implications of such early abstract knowledge for constructivism is still under debate, it should be emphasized that constructivist accounts do not by any means assume that early grammatical knowledge consists *exclusively* of rote-learned items and phrases. In fact, there is evidence that abstraction and generalization can take place in the absence of meaning and begin at a very early age at the level of inflections. For example, Marquis and Shi's (2009) preferential-looking study of 11-month old infants acquiring French revealed that the infants were able to recognize the novel verb stem from inflected verb forms. This segmentation of inflected forms into stems and morphemes is helpful in mapping the meaning, and is likely to be particularly useful in highly inflected languages such as Finnish, which has a large variety of different verb and noun inflections. Therefore, studies showing early abstract grammatical knowledge do not count against constructivist accounts since, in principle, these children could have already made an abstraction. Indeed, the constructivist accounts do not aim to predict the age of abstract knowledge; rather, they focus on the unevenness of the input and how it relates to the output that children produce.

3.3.2. Summary: Constructivist approach to language acquisition

To summarise, the core assumption of the constructivist approach to language acquisition is that no pre-existing knowledge of grammar is required for the child to reach the adult end state. Thus, rather than assuming an innate Universal Grammar

that is available to all children, the constructivist approach posits that children build up their knowledge of language and grammar by learning strings from the input, generalizing and abstracting across these strings to finally arrive at the adult-like grammar. It is important to bear in mind that the constructivist accounts do not argue that young children have no abstract knowledge at all. On the contrary, even very young children are expected to have made some generalizations. Therefore, early abstract knowledge *per se* does not necessarily constitute evidence against the constructivist approach. However, the crucial prediction of constructivist accounts is that patterns in children's acquisition will be related to the distributional properties of the input. Thus, children are predicted to perform better with items and constructions that are frequent in the input.

3.4. Summary: Approaches to language acquisition

This chapter has outlined the two main theoretical approaches to child language acquisition: the generativist and constructivist positions. As we have seen, these approaches differ from each other rather dramatically, with the latter assuming no innate abstract knowledge of grammar whilst the former sees innate knowledge as a necessary pre-condition for language acquisition. Any sub-field of language acquisition, such as the acquisition of inflectional verb morphology, can be approached from either of these theoretical perspectives. As noted at the beginning of this Chapter, the overall aim of this thesis is to distinguish between these two theoretical approaches by focusing on the acquisition of inflectional verb morphology.

The next chapter outlines and reviews the two phenomena in the field of the acquisition of inflectional verb morphology that are under investigation in this thesis: the Optional Infinitive (OI) phenomenon and person/number marking errors. The chapter will describe both the phenomena and how they have been approached by generativist and constructivist researchers. The chapter will end by highlighting the need for the present research and outlining the methods used in the studies reported in Chapters 3, 4 and 5.

Chapter 2: Issues in the acquisition of inflectional verb morphology

1. Introduction

One of the most powerful ways of distinguishing between generativist and constructivist accounts is to look at the relationship between cross-linguistic variation in children's early speech and differences in the properties of the language being learned. This is because investigating whether the same model can explain data from several different languages is a much stronger test of that model than investigating whether it can explain the data from one particular language. However, there are still very few cross-linguistic phenomena that are sufficiently well documented to support this kind of approach. As we have seen in the previous chapter, much of the research in the field of child language acquisition has been conducted in English only. However, as will be discussed in the following section, there are two related phenomena in children's acquisition of inflectional verb morphology that have been used as a testing ground to differentiate between generativist and constructivist approaches that have been studied in a relatively large number of different languages.

2. Issues in children's acquisition of inflectional verb morphology

One of the most important debates in children's acquisition of inflectional verb morphology surrounds the so-called Optional Infinitive (OI) phenomenon (Wexler, 1994). This phenomenon refers to the observation that in many languages, children go through a period during which they produce utterances which lack tense and agreement marking (e.g., **He play football*). In other words, children produce utterances with non-finite forms when the adult grammar would require a finite form. As explained in Chapter 1, non-finite verb forms are forms that have no marking for tense or agreement. Importantly, alongside these incorrect non-finite forms, children also produce correctly inflected (tensed) forms. For instance, the same child might produce the utterances **The doll drink tea* and *It goes in there* during the same recording.

Several generativist and constructivist explanations of these erroneous utterances have been developed over the years, but no consensus has yet been

reached, and the status of these errors is still unclear. The aim of this Chapter is to detail these different explanations of the OI phenomenon, and highlight the problems faced by these accounts when explaining OI errors cross-linguistically. The chapter will also introduce another, related issue in the field of inflectional verb morphology, which will be investigated later in this thesis. This is the occurrence of person/number marking errors such as **We plays football*. As we will see later, interestingly, languages that show very few OI errors do tend, however, to show more person/number marking errors.

3. The Optional Infinitive Phenomenon

A common feature of young children's speech is the production of utterances containing verb forms that lack tense and agreement marking that, for adults, would be obligatory given the context in which they occur. For example, English-speaking children often produce utterances such as **Daddy eat cake* instead of *Daddy eats cake* or *Daddy ate cake*. This use of non-finite verb forms in finite contexts in English has been observed in, for instance, the longitudinal spontaneous speech studies of Brown (1973), Brown and Bellugi (1964) and Cazden (1968). At first glance, these errors seem to be simple omission errors, with the child dropping a 3sg *–s* inflection. Indeed, it has been argued in the literature that these errors simply reflect either the omission of a particular inflection, due either to lack of knowledge (Brown, 1973) or to performance limitations in production (Bloom, 1990; Valian, 1991).

However, in morphologically richer languages, children make analogous errors that cannot be described simply in terms of the dropping of inflections. In these languages, non-finite forms carry a distinct infinitival morpheme, and can thus be clearly distinguished from finite forms. In some languages, the verb also undergoes a "stem-change". For instance, a Dutch child might produce an utterance such as **Hij spelen* (**He play-INF*) for the adult target sentence *Hij speelt* (*He plays*), whilst a French child might produce **La poupée dormir* (*The doll sleep-INF)* for *La poupée dort (The doll sleeps*). These errors are characterized by the use of forms with overt infinitival markers (*-en* and *–ir*, respectively), as well as a stem change (*spel/speel; dorm/dor*). Thus, the relevant forms are clearly marked for non-finiteness and are usually longer than the corresponding bare stem, thus making it unlikely that they would be produced as a result of performance limitations in production. It should

also be noted that these non-finite forms include not only infinitives, but also non-finite progressives and past participles; e.g., **Daddy eating cake*; **Daddy eaten cake*.

Children's use of non-finite forms in finite contexts has attracted a considerable amount of research interest. Since the mid-1990s, these errors have been known as *Optional Infinitive* errors (Wexler, 1994; also *Root Infinitives*; Rizzi, 1993/4). The name 'Optional Infinitive' reflects the key property of this phenomenon that these ungrammatical forms typically appear during a period in which the child is also producing correctly inflected forms (Bromberg & Wexler, 1995; Harris & Wexler, 1996; Wexler, 1994, 1998). These errors disappear gradually with age, up until (for English) around age 4;6 (Rice, Wexler & Hershberger 1998; Rice, Wexler & Redmond, 1999).

As noted above, due to its impoverished inflectional morphology, OI errors observed in English do not involve a distinct infinitival marker. Instead, these errors resemble simple omission errors, with children omitting the finite inflection -s. However, the advantage of treating these forms as OI errors is that the concept of an OI stage can be used to provide a unified explanation of the data across a range of different languages.

The observation that children are able to use finite forms correctly but, at the same time, produce erroneous non-finite forms has led a number of researchers (e.g., Rizzi, 1994; Wexler, 1998) to suggest that children are aware of the distinction between finite and non-finite forms, and therefore, must possess innate grammatical knowledge of inflection. A notable property of these errors is that children almost always place the non-finite form in the structurally correct position in the sentence; i.e., the position in which a non-finite verb would appear had the sentence also contained a finite verb For instance, when French-speaking children produce correctly inflected finite forms, they are placed systematically before the negative particle *pas* (Pierce, 1992). However, non-finite forms are correctly placed after the negation marker pas. For example, a child may produce a finite sentence *Louis aime pas Lucie* and an OI error **Louis pas aimer Lucie.*

Similarly, children speaking languages such as German correctly place finite verb forms in the second position whereas non-finite forms occur at the end of the sentence (Boser et al., 1992; Poeppel & Wexler, 1993). Verb-second (V2) word order means that, in the adult grammar, the finite verb must appear in second position in a declarative sentence whereas non-finite verb forms tend to occur at

the end of the sentence. Thus, with regards to the OI phenomenon, a German-speaking child might produce an utterance **Sara Klavier spielen* (instead of *Sara spielt Klavier*), in which the non-finite verb form has been correctly placed at the end of the utterance (e.g., *Sara kann Klavier spielen*) whereas finite verb forms must be placed in the second position (e.g., *Sara spielt Klavier*).

Another interesting property of OI errors is that they tend to be more common with null (covert) subjects. For example, Haegeman (1995; 1996) showed that finite sentences in early Dutch included an overt subject much more frequently than utterances containing an OI error. Whilst null subjects are rather frequent in child speech in general – Hyams and Wexler (1993) suggest that close to 50% of young English-speaking children's spontaneous speech lacks overt subjects – the fact that these subjectless sentences often co-occur with non-finite forms suggests that this is yet another important characteristic of these errors. Thus, during the OI stage children whose language does not allow null subjects tend to drop the subject of the sentence more often in non-finite constructions.

Thus, the properties of the OI phenomenon suggest that children are in fact aware that the infinitival form is different from the inflected finite forms; however, they seem to think it is acceptable to optionally use infinitives in finite contexts. A grammaticality judgement study by Rice, Wexler and Redmond (1999) provides evidence for this claim. The authors showed that children with Specific Language Impairment and typically developing controls were more likely to accept as grammatical utterances that they produced themselves (i.e., OI errors) than incorrect utterances that they did not produce (e.g., errors of tense/agreement marking marking such as '*he are mad*') (see also Montgomery & Leonard, 1998, for similar results). Thus, the fact that children are able to differentia between finite and non-finite forms strongly suggests that OI errors cannot be interpreted simply as lack of knowledge of inflection or inflection "drop".

3.2. Cross-linguistic error rates

The OI phenomenon is one of only a few areas of child language acquisition that have received cross-linguistic research attention. OI errors have been documented in many languages, including Danish (Hamann & Plunkett, 1998), Dutch (Haegeman, 1995; Wijnen et al., 2001), English (Wexler, 1994), Faroese (Jonas, 1995), French (Pierce, 1992), German (Clahsen & Penke, 1992; Poeppel & Wexler, 1993), Hebrew

(Rhee & Wexler, 1995), Russian (Bar-Shalom, Snyder & Boro, 1996) and Swedish (Platzack, 1990; Josefsson, 2002). Importantly, the rate of OI errors is not equal across these different languages but is subject to wide variation (e.g., Phillips, 1995).

Furthermore, in some languages, children do not seem to produce these errors at all. For instance, children acquiring Italian (Guasti, 1994), Spanish and Catalan (Grinstead, 1994; 2000; Torrens, 1995) use non-finite forms in finite contexts very rarely – if at all. Typically these non-OI languages are also null-subject languages with rich verbal morphology. In contrast, obligatory subject languages and languages with more limited verbal morphology (e.g., English, Dutch and German) tend to display higher rates of OI errors. Thus, there seems to be a negative correlation between the morphological richness of a language and the rate at which it displays OI errors (e.g., Phillips, 1995). In these non-OI languages, all verb forms are overtly marked for person/number, and children acquiring these languages therefore 'know' from the earliest stages that marking is always required and is not optional. Indeed, Xanthos et al. (2011) investigated nine different languages, and found that the richness of an inflectional system significantly and positively correlated with the speed of children's morphological development. Thus, the more evidence there was in a particular language for inflecting verbs and nouns, the more quickly the children acquired the inflectional paradigms.

Turning to Finnish, one of the languages under investigation in this thesis, no OI stage has been reported. This is not surprising, as Finnish can be classified as a null-subject language with rich verbal morphology. However, naturalistic studies of child Finnish have documented occasional uses of non-finite forms. For example Laakso (2007) gives the following example of the use of infinitives by a child aged 1;11;

(1) **Adult:** *on-ko* *sisko* *laitta-nut* *kiinni?*
Be.3SG-Q sister put-PRF closed?
'has the sister closed it?'

(2) **Child:** *joo.*
'*yeah.*'

(3) **Child:** *ol-la* *siinä.*
Be-INF there

'it be there.'

(4) **Adult:** *saa se ol-la siinä, kiva.*

may it be-INF there, nice.

'it may be there, nice.'

(5) **Child:** *saa ol-la siinä.*

may be-INF there

'It may be there'

And:

(6) **Child:** *Tommi aina-ta [lainata]*

Tommi borrow-INF

'Tommi borrow'

Other possible uses of infinitives, however, are ambiguous, since it is unclear whether the child is using a non-finite form or the 3sg present tense form (at age 1;7):

(7) **Adult:** *mitä Tommi aiko-o teh-dä kynä-llä?*

what Tommi plan-3SG to do-INF the pencil-WITH?

'what does Tommi plan to do with the pencil?'

(8) **Child:** *piittä-ä* [*piirtää*].

draw-INF;3SG

'*to draw/draws*'

(9) **Adult:** *piirtä-ä-kö?*

draw-INF;3SG-Q

'to draw/draws?'

(10) **Adult:** *no mitäs Tommi sitten tarvitse-e jos tahto-o piirt-ää?*

well what Tommi then need-3SG if want-3SG to draw-INF?

well what does Tommi then need if he wants to draw?

(11) **Child:** *piitä-ä* [*piirtää*]

draw-INF;3SG

'to draw/draws'

(12) **Adult:** *mitä Tommi tahto-o?*

what Tommi want-3SG?

'what does Tommi want?'

(13) **Child:** *piittä-ä* [*þiirtää*].

draw-INF;3SG

'to draw/draws'

Laakso (2007) interprets the latter example as the child using the 3sg form (*draws*), although the question type used by the child's father requires a reply using the infinitive form. Since the 3sg present tense is the dominant verb form used by young children, the author has opted to assign this interpretation to any ambiguous form. However, the use of infinitives – even when used correctly and unambiguously– is very sparse in Laakso's data. She reports two instances of infinitives when the child was aged 1;11, four at 2;1 and 16 at 2;2.

Perhaps the most important challenge for generativist and constructivist accounts of the acquisition of inflectional morphology is therefore to provide an explanation of why OI errors do not occur at equal rates across languages, and why some languages show no, or very low rates of, OI errors. An additional challenge is to explain why error rates often vary across verbs *within* a given language, as detailed in the following section.

3.3. Semantics of Optional Infinitives

Optional Infinitive errors have two important semantic properties that have been frequently noted (Hoekstra & Hyams, 1998); the *Modal Reference effect* and the *Eventivity Constraint*. The Modal Reference effect refers to the observation that, in languages such as German and Dutch, OI errors tend to occur almost exclusively in contexts in which the child is referring to wishes, desires, intentions and unrealized events. Consider for example the following exchange between a child and her mother (Ingram & Thompson, 1996):

(14) **Child:** *Stift haben?*

crayon have-INF?

'Can I have a crayon?'

(15) **Adult:** *Ach, du mochtest einen Stift haben.*

yes, you want-2SG a crayon have-INF

'Yes, you want to have a crayon'

The Eventivity Constraint refers to the related observation that OI errors in the aforementioned languages tend to occur with eventive rather than stative verbs (Ingram & Thompson, 1996; Wijnen, 1998). Stative verbs, on the other hand, are almost always used in finite forms. Eventive verbs (e.g., *eat*) are verbs that denote actions, whereas stative (e.g., *want*) verbs denote static situations (i.e., states). For example, Dutch-speaking children are much more likely to produce utterances such as the eventive **Sara koffie drinken* (**Sara coffee drink*-INF) than the stative **Sara koffie willen* (**Sara coffee want*-INF).

The Eventivity Constraint has also been observed for other languages, including French (Ferdinand, 1996), Russian (Van Gelderen & Van der Meulen, 1998) and Swedish (Plunkett & Strömqvist, 1990). Below is an example from Swedish (taken from Josefsson, 2002) in which the child (at age 2;0) uses a non-finite form in order to express her wish to sit on her mother's lap rather than her father's:

(16) **Adult:** *vill- du sitt-a lite i pappas knä?*

Want-PRS you sit-INF little on daddy's lap
'Do you want to sit on daddy's lap for a while?

(17) **Child:** *sitt-a mamma-s.*

sit-INF mother-POSS
'Sit on mother's'

In another example the child expresses her wish to have something using a non-finite form of the verb:

(18) **Child:** *jag ha denna.*

I have-INF this.
'I want to have this'

Importantly, neither the Modal Reference effect nor the Eventivity Constraint seem to apply to English to the extent they apply to other OI languages (Deen, 1997). Possible explanations for this finding, and for the Modal Reference effect more generally, are explored in Experiment 2 (Chapter 4); thus they will not be further discussed here. However, the ability to explain these semantic restrictions

on OI errors in certain languages should be born in mind when evaluating different theoretical accounts of the OI phenomenon; a task to which we now turn.

3.4. Generativist accounts of the OI phenomenon

Several generativist theories have been developed to explain the OI phenomenon. These include Rizzi's (1994) *truncation* account, Radford's (1996) *small-clause* account and Wexler's (Schutze & Wexler, 1996; Wexler, 1998) *Agreement/Tense Omission Model* (ATOM); see Ambridge & Lieven (2011) for a review.

3.4.1. The Truncation account

Under Rizzi's (1993/4) truncation account, young children have all the necessary functional categories (e.g., Tense and Agreement) available to them, but they do not yet know that it is obligatory to use them. Thus, children may sometimes optionally truncate their sentences at the Verb Phrase level, which results in non-finite forms.

This truncation is argued to be absent from adult language. The advantage of this account is that it can explain why children sometimes produce erroneous non-finite forms and correctly inflected forms during the same developmental period: Non-finite forms are produced when children truncate the utterance at the Verb Phrase, finite forms when they project Tense and Agreement. However, this account is limited in its explanatory power, as it cannot account for the dramatic differences in OI error rates across languages (Phillips, 1995). Furthermore, this account offers no explanation for the finding that, within a particular language, children produce more subjectless sentences with non-finite forms than with finite forms (Wexler, 1998). In addition, it cannot explain the either Modal Reference effect or the Eventivity Constraint, as no mechanism is proposed that would cause children to truncate sentences at different rates across different semantic contexts.

3.4.2. The small-clause account

Radford's (1996) small-clause account assumes that children who make OI errors are still lacking the functional categories of Tense and Agreement. Thus, just as in Rizzi's account, OI errors are VPs. Unlike the truncation account, however, this account cannot explain why children produce both correctly inflected forms and OI errors during the same developmental period. Radford (1996) argued that all correct uses of inflected forms are instances of rote-learned verbs or phrases

(e.g., *It fits*). However, using this logic, any utterance that is not consistent with the predictions of the account can be deemed to be rote-learned, rendering the account untestable. Furthermore, like Rizzi's (1993/94) truncation account, Radford's account is unable to explain the semantic patterning of OI errors.

3.4.3. The Agreement/Tense Omission Model (ATOM)

Perhaps the most popular account of OI errors is the Agreement/Tense Omission Model (ATOM) (Schutze & Wexler, 1996; Wexler 1994; 1998)). The aim of this account is to explain not only the OI phenomenon but also the related observations that (a) OI errors are more frequent in subjectless sentences and (b) fewer OI errors are observed in languages that allow subject omission (e.g. Italian and Spanish) than in obligatory-subject languages (e.g., Dutch, German and English).

According to the ATOM, children have the adult grammar '*from the earliest observation we can make*' (Wexler, 1998:30), but, during the OI stage, 'think' that it is acceptable to omit Tense or Agreement in finite contexts. For example, the child knows that *–s* marks present tense and Agreement for 3sg, and is also aware of other syntactic information related to Agreement. Thus, the child knows that Agreement assigns nominative case to the sentence subject, and is also aware of the 'default case' which is assigned to the subject when Agreement is missing (which, in English, is the accusative; e.g., *me*; *him*). Therefore, the ATOM predicts the following errors if Tense or Agreement is omitted, respectively:

(19) **He shower / *He showering* (Tense omitted)

(20) **Him shower / *Him showering / *Him showered* (Agreement omitted)

In the first erroneous sentence (19), Agreement is specified, which leads to nominative case on the pronoun (*he* instead of accusative case *him*). The reason why a non-finite verb form (*shower*) appears instead of 3sg form (*showers*) is that the system cannot, in the absence of Tense, choose between the present tense (*-s*) and the past tense (*-ed*) morphemes.

In the second erroneous sentence (20), Tense is specified whilst Agreement is not. This lack of Agreement means that the pronoun automatically receives a 'default' case, which in English is the accusative (*him*). In most languages, such as German, the default case is the nominative (*he*). In English, accusative is considered to be the default case since this is the form that is used in response to questions

such as *Who did that*? Since the subject has not been checked for Agreement, the system is unable to choose which verb form to use (3sg vs 3pl). If the system randomly chose a 3sg inflection, the features of this inflection could not be checked at Agreement, and the derivation would crash. However, as the English past tense inflection *–ed* codes tense but not agreement, children can produce utterances such as **him showered*.

It should also be noted that the ATOM specifically predicts that children will not produce errors with correct inflection but non-nominative subject such as (21):

(21) **Him showers*

This is because the child knows that the presence of Agreement requires the subject to be in nominative case, and hence, the use of the non-nominative subject '*him*' implies that no Agreement is present. On the other hand, the presence of a 3sg *–s* verb form that marks Agreement (as well as Tense) implies that Agreement is present. But if Agreement were present, the grammar would have assigned nominative case to the subject (e.g., *he*), leading to the correctly inflected sentences *He showers*. Indeed, Schutze (2001: 508) himself explicitly states that the number of utterances with non-nominative subjects and agreeing verb forms is '*essentially zero, modulo noise in the data*', and takes this finding as support for the ATOM.

However, Pine, Rowland, Lieven & Theakston (2005) (see also, Pine, Joseph & Conti-Ramsden, 2004) showed in an analysis of naturalistic data that children do, in fact, produce non-nominative subjects with agreeing verb forms at higher rates than would be expected by chance, given the independent frequencies of non-nominative subjects and agreeing verb forms in their speech. Further evidence against the ATOM comes from an elicited imitation study (Ambridge & Pine, 2006). The authors used target sentences with a finite verb (e.g., *She plays football*). A number of children produced non-nominative subjects with an agreeing verb (e.g., **Her plays football*) when imitating the experimenter's utterance, and, again, the rate of such errors was higher than would be expected by chance (when measured at the arbitrary 10% "noise" level).

An advantage of the ATOM is that it attempts to explain not only how children produce these non-finite verb forms, but also *why* they do so. According to Wexler

(1998), whilst children in the OI stage have already set all the inflectional and functional parameters of their language, they are subject to a 'Unique Checking Constraint' (UCC), which does not allow the child to check both Tense and Agreement. Thus, items can be checked against only one functional category; either Tense or Agreement. Of course, without some further assumption, this account would incorrectly predict that children in the OI stage will never produce correctly inflected forms, which require checking at both Tense and Agreement. Wexler's (1998) explanation is that children are subject to a number of competing constraints, and that they attempt to minimize the number of constraints that they violate when producing an utterance. A child who produces a finite verb in a finite context violates the UCC, but avoids violating the pragmatic constraint that requires both Tense and Agreement marking in such a context. A child who produces a non-finite verb form in a finite context violates this pragmatic constraint, but avoids violating the UCC. Thus the co-existence of these two constraints is argued to explain the co-occurrence of non-finite and finite forms during the OI stage. The 'competition' between these constraints continues until the Unique Checking Constraint withers away due to maturation (Wexler, 1998), at which point the child ceases to produce OI errors.

The ATOM has several advantages over earlier generativist accounts of the OI phenomenon. First, it provides an explanation for the apparent distinction between OI and non-OI languages. It also predicts – seemingly correctly - that children acquiring non-OI languages such as Finnish, Spanish and Italian will not make errors when inflecting finite verbs. This is due to the null-subject property of non-OI languages, which, according to Wexler (1998), means that the Agreement takes on the role of the subject. For example, the finite verb form '*syön* '*I eat*' in Finnish means that there is no need for an overt subject since Agreement is unambiguously coded, and therefore, there is no need to check Agreement. Since, only one functional category (Tense) needs to be checked, the production of finite verbs does not violate the Unique Checking Constraint, and therefore, the finite inflections are produced correctly.

A problem, however, is that the ATOM simply classifies languages as either OI (i.e., non-null subject) or non-OI (i.e., null-subject) languages, thus treating the phenomenon as qualitative, rather than quantitative. As we have seen above, OI

error rates vary along a continuum from very high to very low (Phillips, 1995). At the higher end of the continuum, Phillips lists English and Swedish. In the middle, with moderate error rates, he lists Dutch, French and German. The lowest error rates are reported for Catalan, Hebrew, Italian and Spanish. Furthermore, the ATOM cannot explain the well-established finding that OI errors occur mostly with eventive verbs and, in languages other than English, in modal contexts (Hyams, 2001). Indeed, the ATOM contains no mechanism that can any explain by-verb differences in rates of OI error.

3.4.4. The Variational Learning Model

All of the generativist accounts outlined above struggle to account for the observed quantitative cross-linguistic variation in OI error rates. One recent generativist proposal, however, was explicitly designed to explain quantitative variation in OI error rates across languages, and therefore gives a relatively good account of the available cross-linguistic data. This account is Legate and Yang's (2007) *Variational Learning Model* (VLM; see also Yang, 2002; 2004). Under this model of language acquisition, children's language is assumed to consist of a finite number of grammars. Each grammar contains parameters specifying, for instance, whether subjects can be "dropped" (i.e., phonologically null) or if tense/agreement marked verb must be in the second position. Thus, a grammar is defined as a set of parameter values. These parameters are set on the basis of the linguistic input that the child hears. At any given time, children have a number of different grammars, each with different parameter settings (e.g., for the null-subject, head-complement and V2 parameters etc.), and these grammars compete with each other probabilistically. Unlike traditional parameter setting accounts, in which each parameter is set to either 'on' or 'off', Legate and Yang's model posits that during the acquisition process, several different grammars, each with different settings, compete with each other. Those grammars that are consistent with the input will be rewarded, which increases the likelihood that they will be used in future to parse input sentences. Grammars that do not successfully parse the linguistic input will be punished, and will be less likely to be used again. The child eventually reaches the adult end state by finding the grammar – i.e., array of parameter settings - that allows her to process or produce any given utterance.

Legate and Yang (2007) offer an explanation for how this model of language acquisition can account for the cross-linguistic pattern of OI errors. In order to do so, they focus on the TENSE parameter: whether or not VERB receives Tense marking in a given language. In some languages (e.g., Mandarin Chinese) the TENSE parameter must be set to –TENSE setting (i.e., switched to "off"). This is because these languages do not mark TENSE morphologically on verbs, with the concept expressed, for instance, by the addition of phrases such as '*tomorrow*'. Children learning languages that do mark TENSE (all the other languages mentioned so far) must set the TENSE parameter to +TENSE. As children entertain several different grammars at the same time, some of these grammars will have the TENSE parameter set to the –TENSE setting (-TENSE grammars) and others to the +TENSE setting (+TENSE grammars). Input utterances with overt tense marking (e.g., *He plays*) reward the +TENSE grammar, whereas utterances with no overt tense marking (e.g., *We play)* reward the –TENSE grammar. These different grammars compete to parse the linguistic input.

It is important to note that, although generativist accounts assume that adult utterances such as *They play* have a null present tense marker, the VLM assumes that children cannot distinguish between such forms and forms in which tense marking is absent. Thus, utterances such as *They play*, *I play* and *We play* would all reward the –TENSE grammar as, whilst the clauses are marked for tense, this marking is null, not overt. It is only, utterances such *He plays* which contain overt tense marking that will reward +TENSE grammar.

Under this account, OI errors occur because children acquiring languages that use tense-marking are yet to definitively set the TENSE parameter to +TENSE, but are still entertaining grammars with the –TENSE setting. The cross-linguistic prediction that follows from this account, then, is that the more evidence there is in the input to suggest that the target language has a +TENSE grammar, (a) the lower the rate of OI errors, and (b) the shorter the length of OI stage. Legate and Yang (2007) provided evidence for the latter part of this prediction in a naturalistic corpus analysis of children learning English, French and Spanish: The proportion of verb forms rewarding the +TENSE grammar was lowest for English (5.80%), intermediate for French (39.60%) and highest for Spanish (60.20%). Consequently, the observed OI stage was longest for English (≈3 years; 5 months), intermediate for French (≈2;8) and shortest for Spanish (≈2;0). Thus, the VLM seems to offer a

better fit to the current cross-linguistic OI data, than earlier explanations of the phenomenon that classify languages simply as either OI or non-OI languages.

However, the current version of the VLM suffers from five problems. First, as OIs are not learned directly from the input, but are a reflection of an incorrect –TENSE grammar, this account does not predict any lexical effects in rates of OI error. In fact, there is evidence to suggest that, within a given language, different verbs generally display different rates of OI error. For example, for English, Freudenthal, Pine and Gobet (2010, p.c.) found that error rates were high for *sit* and *sleep* (100% for both), low for *hurt* (25%) and *want* (33%) and intermediate for *get* (50%) and *go* (67%). Importantly, within each language studied by these authors (English, Dutch, German, French and Spanish), the rate of OI errors across different verbs was positively correlated with the proportion of verb uses that occurred in compound finite utterances (i.e., utterances consisting of a modal or auxiliary plus a non-finite main verb; e.g., *He will go*) in the child's input. As we will see in more detail later, this suggests a direct effect of the input on OI errors at the lexical level, rather than at the level of an abstract TENSE parameter.

Second – and relatedly - the VLM cannot explain the Modal Reference effect and Eventivity Constraint: two cross-linguistic phenomena observed for OI errors. As outlined above, the Modal Reference Effect refers to the observation that most OIs in languages such as Dutch, German and Swedish have a modal reading (i.e., they tend to refer to future events, intentions and wishes). The Eventivity Constraint refers to the related observation that most OI errors occur with eventive (e.g., *go*, *eat*) rather than stative verbs (e.g., *need*, *want*) (Hoekstra & Hyams, 1998; Josefsson, 2002). Since the VLM operates at the level of the grammar (i.e., each clause rewards either the +TENSE or –TENSE setting of the TENSE parameter), it cannot account for any differences in rates of OI error between particular types of verb.

A third problem for the VLM is that it fails to account for the very high rates of OI error observed in English. Whilst the VLM is presented by Legate and Yang as a model that makes predictions regarding to the length of the OI stage and not the rate of OI errors, it is unable to offer an explanation for Freudenthal et al.'s (2010) finding that English typically displays clearly a higher OI error rate than Dutch or German, even though the proportion of "bare" forms (i.e., forms rewarding the –TENSE grammar) is similar across these three languages. If anything, the proportion of bare forms in Dutch is slightly higher than in English.

Fourth, the VLM is rather circular in its explanation. This is because in order to reward the +TENSE grammar, the child needs to recognise the verb forms that are marked for tense in the input. This could be accomplished by noticing that very similar lexical items (e.g., *walk, walks, walked*) are used to describe the same action but in different tense contexts. However, once the child has made this observation, she has discovered that tense marking is obligatory in her language. Thus, she can set the TENSE parameter to the + setting without any further need to entertain – TENSE grammars. Languages with no TENSE marking, by definition, do not contain any tense marked forms. Therefore, once a child has encountered a single tense-marked form, she can abandon the possibility that she might be learning a language without tense marking.

Finally, a related problem is that for some +TENSE languages and some children, non-tense marked forms outnumber tense-marked forms in the input (Freudenthal et al., 2010). Thus, due to the probabilistic nature of the VLM, it is questionable whether the child will ever be able to set the TENSE parameter to the + position, and hence arrive at the correct grammar. This problem could be solved by having the child set the TENSE parameter permanently to +TENSE as soon as she encounters a single tense marked utterance. However, the VLM would then fare no better than, for example, the ATOM in explaining the cross-linguistic pattern of OI error rates.

3.5. Constructivist accounts of the OI phenomenon

As discussed in Chapter 1, according to the constructivist view of language acquisition, children learn language directly from the input to which they are exposed. This raises the question of whether non-finite utterances such as **He play* might reflect learning from the input, coupled with a tendency to omit parts of these utterances (at either the storage or production stage). One possible source of OI errors is compound finite structures. These are utterances that consist of a finite auxiliary (e.g., *does, has*), modal (e.g., *must, can*) or a lexical main verb (e.g., *let, make*) and a non-finite verb (e.g., *He has played*; *He can play*; *He let Sarah play; He makes the car go*).[4]

4 A similar generativist account known as the *null-modal hypothesis* (van Ginneken, 1917; Boser et al., 1992; Kramer, 1993) shares with this account the assumption that OI errors reflect the omission of modal verbs in children's utterances. However, under this account the modal verb is present in the

3.5.1. The Model of Syntax Acquisition in Children (MOSAIC)

A constructivist explanation of the OI phenomenon is offered by a recent computational model, the *Model of Syntax Acquisition in Children* (MOSAIC) (Freudenthal, Pine, & Gobet, 2006; Freudenthal, Pine, Aguado-Orea, & Gobet, 2007). According to MOSAIC, OI errors are truncated sentences learned from compound-finite structures in the input (e.g., *He can play* → **He play*). In other words, the model treats OI errors as compound-finite structures that are missing the modal/auxiliary verb due to young children's limited working memory capacity.

To briefly outline how MOSAIC simulates OI errors (the exact details are not important for the purposes of this thesis), the most recent version of the model learns from both the right and left edges of the utterance, and combines these chunks learned from both edges to produce an utterance. This results in the production of utterances with omitted sentence-internal material (i.e., auxiliary and modal verbs). For example, an OI error such as **He play* might be produced as a truncated version of the input utterance *He can play*. Importantly, this learning mechanism results in OI errors in other languages too. For example, a Swedish OI error **Han sitta här* '**He sit here*' might be learned from a compound finite structure such as *Han vill sitta här* 'He *wants to sit here*'. It should be noted that MOSAIC does not store or have any access any semantic representations and therefore, does not constitute a complete, realistic account of language acquisition. Rather, MOSAIC is a computational model of language learning with no built-in knowledge of grammar, designed to simulate learning from the input data (corpora of real child-directed speech) that is fed to it.

Hence MOSAIC predicts that the rate of OI errors should be positively correlated with the proportion of non-finite verb forms in utterance-final compound finite utterances in the input both (a) across languages and (b) across different lexical verbs within a given language. The study of Freudenthal et al (2010) provides support for both of these predictions across English, Dutch, German, French and Spanish. Firstly, across languages, a correlation was found between the rate of OI errors produced by the model and the proportion of non-finite verb

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underlying representation of the sentence and thus, is only phonologically absent. Moreover, the null-modal hypothesis, as per its name, assumes that OI errors reflect the omission of modals only. Thus, whilst the account provides a good fit for the data from other Germanic languages, it does offer any explanation for English in which OI errors seem to also reflect omission of DO.

forms in utterance-final position in child-directed speech (0.65 and 0.87 for Dutch; 0.63 and 0.78 for English; 0.32 and 0.40 for French; 0.49 and 0.69 for German and 0.15 and 0.21 for Spanish). Secondly, within each language, the study found a significant correlation across verbs between the rate of OI errors and the proportion of utterance-final compound finite structures in the input, ranging from r=.35 in English to r =.71 in Dutch). This finding is not predicted by any of the current generativist accounts discussed above. Indeed, it is difficult to see how any account could explain this pattern without assuming rote-learning of input strings, at least to some degree.

MOSAIC can also explain the Modal Reference Effect and the Eventivity Constraint: Verbs learned from compound structures are likely to refer to unrealized rather than ongoing events (e.g., *He wants to sleep*; *Tomorrow he will study*) and to denote events and actions rather than static situations (e.g., *He can go* vs. ?*He can need*). Thus, it is possible to explain both the Modal Reference Effect and the Eventivity Constraint in terms of the properties of the input, rather than assuming that OI errors contain a null modal in the underlying structure. Interestingly, both effects are significantly less pronounced in English than in other languages (e.g., Blom, 2007; Hoekstra & Hyams, 1998). Freudenthal, Pine and Gobet (2009) successfully simulated this pattern in MOSAIC by showing that the (relative) absence of these effects in English OI errors can be explained by one particular property of the input that English children are exposed to: The dummy modal DO patterns like other modals (e.g., *He doesn't go* vs. *He won't go*) but does not assign a modal meaning to the utterance and can occur with both eventive and stative verbs (e.g. *He doesn't go* but also *He doesn't want)*. Freudenthal et al. (2009) showed that constructions containing 3sg subject + an infinitive in child-directed speech were much more likely to occur in modal contexts in Dutch (68%) and German (88%) than to English (16%). The non-modal constructions in English were mainly used auxiliary DO.

Furthermore, evidence from independent experimental studies supports the central claim of MOSAIC that OI errors are truncated compound finite structures learned from the input. In an elicited-production study (Theakston, Lieven & Tomasello, 2003) English-speaking children aged 2;6 – 3;0 were taught novel verbs in either 3sg form (*It VERBs*) or in an utterance-final compound-finite (*Will it VERB*?).

These novel verbs were then elicited from the children in a context that strongly pulled for 3sg –s forms. The results revealed that, whilst children produced OI errors at a rate of 64% for verbs that they had encountered in compound finite strings, they never produced OI errors for verbs that they had encountered in 3sg *–s* form. For verbs that were presented in both conditions the OI error rate was 52%. Of course, it must be born in mind that such an experimental situation may have encouraged children to repeat the verb form used by an interlocutor to a greater extent than would be the case in a more naturalistic situation. Nevertheless, a similar study which looked at naturalistic data (Kirjavainen, Theakston & Lieven, 2009) showed that children's non-finite non-nominative subject errors (e.g., **Me do X*) were more frequent with verbs that often appeared as utterance-final non-finite verbs (e.g., *Let me go*) as opposed to verbs that appeared in medial position with nominative subjects (e.g., *I want a drink).* These results represent therefore another example of children learning strings from the input and truncating utterances (e.g., from *Let me do* it to **Me do it*), and hence provide evidence for MOSAIC's central assumption. Finally, whilst not a language that shows high rates of OI error, the Finnish corpus study by Laakso (2007) showed a clear pattern in the child's use of infinitives. At first, infinitival forms were not used at all. This phase was followed by a phase characterized by the use of infinitives without the accompanying auxiliary verbs, before, finally, the child started to produce auxiliary + infinitive combinations.

Despite MOSAIC's apparent success in explaining the cross-linguistic pattern of current OI data, it shares with the VLM the problem of seriously underestimating OI error rates for English (see Freudenthal et al., 2010). The model predicts error rates of 65%, 49%, 32% and 15% for Dutch, German, French and Spanish, respectively. These rates are generally consistent with error rates found in children's naturalistic speech data: 77% for Dutch, 58% for German, 32% for French and 20% for Spanish. Whilst the model slightly underestimates the error rates for Dutch and German, this problem is even more serious for English: the actual rate of errors in the child speech is 87% whilst MOSAIC predicts the error rate to be only 63%. This suggests that an account under which OIs result from the truncation of compound-finite structures learned from the input cannot, on its own, account for the very high number of OI errors in early child English (Freudenthal et al., 2010).

Experiment 1(Chapter 3) focuses on this issue by investigating an additional mechanism that could account for OI errors in English.

3.5.2. Summary

To summarise, the previous section has outlined both the main generativist and constructivist explanations of the OI phenomenon. The earlier generativist accounts of Rizzi (1993/94) and Radford (1996) were quickly replaced by other accounts, as they were unable to explain, cross linguistic differences in rates of OI error (or within-language differences caused by semantic effects). Another generativist account, the ATOM (Wexler, 1998), has been more successful in explaining OI errors, including the distinction between OI and non-OI languages. However, it also struggles to explain the clear quantitative variation in rates of OI error across languages. More successful in this regard has been the most recent generativist account of Legate and Yang (2007), the VLM, which assumes a more probabilistic approach and aims to explain the fine-graded crosslinguistic differences observed in rates of OI error. Whilst the VLM explains the crosslinguistic pattern relatively well, an alternative constructivist model, MOSAIC, (Freudenthal et al., 2007; 2009; 2010) provides even better fit to the current data by additionally explaining the lexical effects observed within a given language. Nevertheless, even MOSAIC struggles to explain the high OI error rates observed in English.

Thus, in order for generativist accounts to provide a fit to the current OI data, it would seem necessary to build in a role for lexical learning. Constructivist accounts could benefit from considering other possible sources of OI errors in addition to the truncation of compound structures in the input. This would help to explain the particularly high error rates observed in English, which are also problematic for the VLM. The next chapter outlines an experiment designed to explore a possible additional mechanism that yields OI errors in English.

Before turning to the experimental chapters, however, it is necessary to briefly outline (a) the second issue in the field of the acquisition of inflectional verb morphology investigated in the present thesis - incorrect person/number marking - and (b) the relevant methodological considerations.

4. Incorrect person/number marking

The previous section discussed the phenomenon whereby children use a non-finite verb form in contexts in which a finite form is obligatory. This section will briefly introduce the phenomenon of incorrect person/number marking. This refers to instances where children do use a finite form, but one with incorrect person/number marking features. For example, whereas **He walk* would usually be analysed as an OI error (though see the following chapter), *I walks* is clearly an instance of incorrect marking (a 3sg form used instead of a 1sg form).

As we saw in Chapter 1, generativist accounts assume that once children have acquired the relevant inflection, they will not make person/number marking errors (Hoekstra & Hyams, 1998; Poeppel & Wexler, 1993; Wexler, 1998). Thus, generativist accounts predict that Finnish-speaking children will not, for instance, use a 3sg morpheme in a 1pl context (e.g., **Me kävele-e 'We walks' vs Me kävele-mme 'We walk'*). Constructivist accounts, on the other hand, predict that such errors will occur. This is because these accounts, unlike generativist accounts, assume that children will only gradually master the use of a particular inflection. Thus, if children have not yet rote-learned a particular inflected form or acquired the relevant morphological slot-and-frame construction, they may replace the target form with another form of the relevant verb; most likely a form that is of high frequency in the input. As mentioned in the previous chapter, the important prediction of constructivist accounts is related to the unevenness of acquisition rather than the age of the child. That is, higher frequency items and constructions are predicted to be acquired quicker than lower frequency ones. In terms of children's production of language, this would mean more errors with infrequent verb forms and inflections (i.e,. morphological constructions).

At first glance, there seems to be considerable evidence for the generativist claim of no person/number marking errors. For example, Hoekstra and Hyams (1998) review data on the rate of person/number agreement error rates in several different languages including Spanish (Serra & Sole, 1992) and Italian (Cipriani, Chilosi, Bottari & Pfanner, 1991; Pizzuto & Caselli, 1992) and conclude the rate at which such errors occurred was very low (less than 5%). The authors' interpretation of these results was that children must be equipped with at least some innate knowledge of inflection, since their use of verbal inflections was

basically error-free. The very low error rates in these highly inflected languages do seem to support the generativist view of the development of verb inflection. Indeed, Hoekstra and Hyams (1998) argue that since these languages require children to choose between several different possible inflections each time they produce a finite verb form, it is difficult to see how children could avoid making errors unless they were aided by abstract knowledge.

However, studies of Spanish (Aguado-Orea, 2004) and Brazilian Portuguese (Rubino & Pine, 1998) have recently challenged this view. These naturalistic studies found that low overall error rates, which have been taken as evidence for generativist accounts, actually hide important differences across the verb paradigm, with low error rates on high frequency forms disguising high error rates in lower frequency parts of the verb system. In Rubino and Pine's (1998) study of naturalistic data from a child acquiring Brazilian Portuguese it was found that the overall person/number agreement rate was very low (3%). However, when the authors broke this overall error rate down by different inflectional contexts, it was revealed that, for example, the low error rate for 3rd person contexts was, in fact, composed of an error rate of 0.3% in high frequency 3sg contexts and of 43.5% error rate in low frequency 3pl contexts. Aguado-Orea (2004) reports similar findings in a naturalistic corpus study of two Spanish-speaking children. Although, overall, the person/number agreement error rates for both of these children were very low (<5%), a closer look at the different parts of the verb paradigm revealed that many of these errors occurred in 3pl contexts, which are infrequent in the input. On the other hand, errors in 3sg contexts, which are the forms that occur most frequently in the input, were extremely rare (<1%), Thus, looking only at the overall error rate, as generativist researchers have tended to do, can be very misleading, as this rate is likely to largely reflect the use of forms that are very frequent in the input and thus are possibly rote-learned, or can be formed using frequent slot-and-frame patterns. In addition, when Aguado-Orea excluded the most frequent lexical forms (e.g., *quiero* '*I want*'), the error rates in 1sg contexts doubled. This is strong evidence for storage of high-frequency lexical forms rather than just using slot-and-frame patterns.

Chapter 5 in this thesis reports the results of an experiment in child Finnish designed to investigate person/number marking errors and hence to distinguish

between generativist and constructivist approaches. As discussed in the previous section, Finnish is a morphologically rich language, and has no - or very few - OI errors. However, similar to Spanish and Italian, there seems to be a degree of overuse of certain person/number forms in children's early speech. The overall finding from naturalistic studies of the acquisition of Finnish verb morphology has been that children begin by using 2sg imperative and 3sg present tense verb forms, which have been considered as default, or base, forms by many authors (e.g. Laalo, 2000; Toivainen, 1980). These two forms are not only phonologically simple, but also highly frequent in the input. This is particularly true of 3sg forms. Furthermore, 3sg forms are also the most semantically neutral forms as they are used in impersonal constructions. For example, *It rains* in Finnish translates as *Sataa* which is a 3sg verb form without a subject. The same is also true for Spanish

These forms are usually used accurately from the beginning: 2sg imperative forms are used as requests and 3sg forms in declarative sentences when referring to an ongoing action. Infinitives emerge only later, which could be at least partly due to the fact that they are morphologically complex forms, and that Finnish has several different infinitives, some of which can be conjugated in several cases.

4.2. Summary: Person/number marking errors

The brief outline above has shown that there is currently evidence from several studies that children do sometimes produce incorrectly inflected verb forms, particularly when using low frequency verbs in low frequency inflectional contexts. Generativist accounts do not predict such errors, as children are assumed to be fully equipped with abstract functional categories of Tense and Agreement. Instead, they therefore predict that, once a child has learned the relevant inflection (e.g., English 3sg *-s*), she should be able to use it correctly with all verbs. Thus, whilst generativist accounts predict that children will produce non-inflected verbs (i.e., OI errors) even after they have started to use inflected forms, they predict that children should not use inflections incorrectly.

Constructivist accounts, on the other hand, predict that children will make person/number-marking errors if the target is a low frequency form. Thus, person/number errors are expected within this theoretical framework. This is because children build their knowledge of inflection by first learning inflected lexical

items as wholes (e.g., *halua-n 'I want'*), and only later learn that they can use the inflection (e.g., *-n*) with all verbs when they are referring to an action that they are performing themselves. Non-finite verb forms are also expected to appear as a result of the truncation of utterance-final non-finite forms.

The experiments presented in this thesis are designed to fill the theoretical gaps identified in the above review. The unifying feature of these studies is that all three test the claim that 'defaulting' to the individual lexical form of the target verb with the highest input frequency can explain a particular phenomenon, whether that phenomenon is (Experiment 1) the particularly high rate of OI errors in English, (Experiment 2) different rates and patterning of OI errors in English versus Swedish or (Experiment 3) person/number marking errors in Finnish. In addition, Experiments 1 and 2 suggest that a two-process account incorporating truncating compound finite structures and defaulting will provide the best fit to the current crosslinguistic data.

Experiment 1 focuses on testing the idea that some apparent OI errors in English reflect the use of bare stems rather than non-finite forms. Experiment 2 tests the two-process model of OI errors, motivated by Experiment 1, across English and Swedish, in order to attempt to explain the different rates and patterning of OI errors in these languages. Finally, Experiment 3 focuses on a non-OI language, Finnish, and examines the rate of person/number marking errors across verbs with different input frequencies and phonological neighbourhoods.

Before moving on to the experimental chapters, the next section will outline the methodology used in the present studies.

5. Methodology

5.2. Introduction

An important challenge facing research on the acquisition of inflectional verb morphology is the need to develop a reliable method for collecting comparable data on rates of OI errors and person/number marking errors across children learning different languages. As we have seen above, previous studies have typically relied on the analysis of naturalistic speech samples. This is, indeed, probably the simplest way to study children's language development: data collection can be done by

recording spontaneous speech or simply noting down what the child says. A great advantage of naturalistic data collection is that the same dataset can be used by multiple researchers, and for multiple purposes, if made available publicly (see for example, http://childes.psy.cmu.edu). However, although, in the long-term, naturalistic data collection can be considered as a rather cost-effective way of collecting data, collecting naturalistic data is understandably extremely labour-intensive, and the resulting speech samples are therefore often too thin to permit meaningful analysis at specific points in development.

Another problem with naturalistic data is that it is impossible to record everything that the child is able to produce. Thus, naturalistic data will be limited to what the child chooses to say, whereas in a structured experiment, particular items or structures can be elicited from the children. Recording of spontaneous speech is not therefore a very appropriate data collection method for investigating, for instance, the acquisition of less frequent structures and items (e.g., 3pl) , as the child might never produce any instances of these during the data collection sessions. Indeed, when investigating children's language acquisition, it is important to bear in mind that there is no way to study children's linguistic knowledge directly; this knowledge has to be indirectly inferred from their behaviour. However, if the child does not use a particular structure or inflection, this cannot be taken as evidence of a lack of knowledge. Therefore, experimental data collection methods are more suitable for investigating graded frequency effects and less frequent items. This is because, for example, in an elicited production experiment children are led to use a particular inflection (e.g., low-frequency 2pl morpheme *–tte* in Finnish). If they fail to use this inflection correctly in such a context, this will provide insight into the acquisition of verb inflection. In naturalistic situations, there may not appear any opportunities for the child to use such a low-frequency inflection, which of course does not mean that the child does not know this morpheme. If these rare inflections are elicited systematically from a large number of children, this will allow conclusions to be drawn regarding the use of a particular inflection.

In view of the above problems with naturalistic data, the data collection method employed in the present studies consisted of elicited production (sometimes combined with elicited imitation in a training phase). Both elicited imitation and production are types of experimental production method.

Elicited imitation involves asking children to repeat back a series of target sentences. Sentence repetition is used extensively in language acquisition research (e.g. Gerken, 1991; 1996; Valian, Hoeffner & Aubry, 1996), because children tend to make the same errors in sentence repetition experiments as they make in their naturalistic speech. This technique has the advantage that it allows the experimenter to manipulate the characteristics of the target sentence very precisely, and has already been used successfully to elicit OI errors in English (Ambridge & Pine, 2006). However, elicited imitation is likely to be less sensitive than elicited production and result in lower error rates. For this reason, it was decided to use elicited imitation only in the training phases of the present studies, in order to increase the likelihood that children would then use the target verbs in the main elicited production task on the following day.

Elicited production works by encouraging the child to produce a particular structure under investigation. Thus, unlike in elicited imitation, the child is not asked to repeat a particular target utterance but instead is placed in a discourse context in which this target utterance is natural. For example, the goal is to elicit 3pl verb inflections, the child is placed in a situation in which only 3pl verb forms are appropriate (e.g., describing the actions of multiple characters). This is usually achieved by using videos, pictures or live enactments (e.g., Brooks & Tomasello, 1999). The target structure is then elicited by using, for instance, an open question such as *What's happening*?'. However, it is often more appropriate to use more constraining questions to increase the likelihood that the child will attempt the target structure or inflection. Experiment 3 in Chapter 5 will make use of specific questions to elicit the target inflections. Experiments 1-2 on the other hand use a sentence completion technique made famous by Berko (1958). This works by the experimenter producing a sentence but prompting the child to produce the final word (e.g. Ambridge, 2010). For example, an experimenter may read out loud the following script "*The bear likes to eat. Look, there he is eating. Every day he eats. So yesterday he*…" and the child is expected to complete the sentence.

5.3. Advantages of elicited production paradigms

The greatest advantage of elicited production (and imitation) is that the experimenter has a high degree of control over the child's productions. For example, in Experiment 1, elicited production as a form of sentence completion

allowed the experimenter to elicit 3sg present tense forms. Similarly, in Experiments 1 and 2 elicited production allowed the experimenter to manipulate discourse context to set up either a modal or non-modal context. In Experiment 3 different present tense verb inflections were successfully elicited for a range of verbs of different frequencies.

5.4. Considerations when using elicited production paradigms

Of course, production paradigms do have certain limitations that must be acknowledged. First, elicited production can be a rather demanding task, and the drop out rates can be quite high. A relatively high drop-out rate was observed in all of the experiments reported in this thesis. However, it should be borne in mind that children who fail to complete an elicited production task may do so because they do not understand the task rather than because they do not have the required linguistic knowledge. Thus, a child's failure to respond when 3sg verb forms are elicited may not be due to her lack of knowledge of 3sg verb forms, but her lack of understanding of the nature of the task. Elicited production has been successfully used with children as young as 25 months (Olguin & Tomasello, 1993), but the conclusion from the present studies was that it is quite difficult to elicit responses from two-year olds and young three-year olds.

Second, it must be borne in mind that some errors that the child produces may be due to the particular prompt used to elicit a response. For example, as we will see in Chapter 5, children can, for instance, repeat the verb form that was produced previously by the interlocutor. It is therefore important to take this tendency into account when interpreting the results, and perhaps compare the results with naturalistic data to see if children make the same kind of errors in their spontaneous speech.

A related consideration is that the task should make communicative sense. Thus, it is unlikely that children will respond to questions that seem strange or unnecessary (e.g., because both child and experimenter already know the answer). One solution to this problem is to use a game set-up in which the child is responding to a third party (e.g., puppet, parent) who is unable to, for instance, see the videos or the pictures. This kind of set-up was used in Experiment 3 by having a soft toy dog with speakers inside asking the child questions related to the videos on

a screen that the toy dog could not himself see. Thus, the child was responding to a third party, who could not see what was happening in the videos, and therefore the task of responding to the questions made communicative sense.

A third consideration is that one should always think carefully about how to categorize children's responses. Sometimes it is not appropriate to categorize the responses as simply either correct or incorrect. For example, in Experiment 3, children's incorrect responses were coded into several categories and a separate error analysis was conducted on these responses, revealing important issues regarding children's use of inflection and the type of errors that they made. In contrast, in Experiment 1 a simple coding system of '3sg –s present or not' was appropriate, as the aim of the study was to look at children's use of finite and non-finite verb forms. Furthermore, sometimes it might be important to look at the irrelevant responses that the children produce (often coded as 'other'). This is could reveal important processes that the children are applying. For example, in Experiment 3, children quite often used a higher frequency synonym when low-frequency verbs were the target. These instances were coded as irrelevant as the children did not produce the target verb; nevertheless, children's use of a non-elicited higher frequency item appears to indicate reluctance to produce low-frequency items even when these are explicitly elicited (i.e., a type of avoidance strategy).

Finally, when running production studies it is important to consider whether to use real, familiar items (usually verbs or nouns) or novel items. The obvious advantage of using novel items is that they can be used to investigate if children are able to generalize particular inflections (e.g. English 3sg *-s)* rather than just produce particular lexical items that may have been rote-learned (e.g., *plays*). Indeed, if familiar verbs are used, it is not possible to tell if children have just rote-learned that particular inflected form (e.g., *plays*) or have productive knowledge. If novel items are used, it is important to ensure that they are phonologically similar to real items in the language and hence phonologically plausible.

Of course, the use of novel items is not always appropriate., In fact, all the studies presented in this thesis employed real verbs in order to investigate graded frequency effects on children's production. Novel items have, by definition, an input

frequency of zero, as children have not encountered them before. It is, of course, possible to present novel items with different frequencies during the training phase of the experiment, but it is usually more effective to choose real verbs with different frequencies from a representative corpus. Furthermore, novel items make the study harder for children as they have to remember the novel verb and its meaning. However, it is also worth bearing in mind that some low frequency items will effectively be novel items to children, since they will have yet to encounter them in the input.

5.5. Summary

To summarise, the experimental production methods used in this thesis have several advantages over naturalistic data collection methods. In particular, they allow the experimenter to exert more control over the target items and structures. Of course, many studies combine elements from both experimental and naturalistic studies (e.g., Matthews & Bannard, 2010). Indeed, in this thesis, naturalistic data has been used to select the stimuli verbs for all of the Experiments. We will now turn to the experimental chapters, each of which will have their own methods sections, describing in detail the methods used.

Chapter 3: Experiment 1. Infinitives or bare stems? Are English-speaking children defaulting to the highest frequency form?

1. Rationale for Experiment 1

As discussed in Chapter 2, one of the most intriguing and hotly debated topics in child language acquisition field has been the so-called Optional Infinitive phenomenon: children's utterances that lack finiteness marking when such marking is required by the adult grammar. For instance, it has been observed that English-speaking children often produce utterances with 'missing' 3sg *–s* (e.g., **He play*). This phenomenon has been well documented across different languages and has been approached from both generativist and constructivist perspectives. Since the mid-1990s, such errors have tended to be treated as Optional Infinitive (OI) errors, in which the verb is treated as a non-finite form (e.g., Wexler, 1998; Legate & Yang, 2007). This means that the same concept can be used to account for data in several different languages.

As discussed in Chapter 2, there is considerable cross-linguistic variation in the rate at which these OI errors occur. For example, Phillips (1995) reviews data from nine different languages and concludes that the rate of OI errors varies along a continuum from high in English to low in Spanish, with French, Dutch and German somewhere in between. Many theories of the OI stage (e.g., the ATOM) have difficulty accounting for this pattern of variation. However, as outlined in Chapter 2, there are currently two theories, one generativist and one constructivist, that provide a good fit to the cross-linguistic data. These are Legate & Yang's (2007) Variational Learning Model (VLM) and Freudenthal, Pine & Gobet's (2006) Model of Syntax Acquisition in Children (MOSAIC) (see also Freudenthal, Pine, Aguado-Orea & Gobet, 2007; Yang, 2002; 2004).

According to the VLM, children make OI errors because they have yet to definitively establish that they are learning a tense-marking language. The rate of OI errors should therefore be inversely related to the amount of evidence for tense marking in the input language (i.e. low error rates in morphologically rich languages like Spanish and high error rates in morphologically impoverished languages like

English). According to MOSAIC, children make OI errors because they are truncating compound finite structures in the input (e.g. *He can play → He play*). However, despite both accounts' apparent success in explaining the OI phenomenon, they both struggle to explain the very high OI error rates in English. They also do not provide any explanation for the extended nature of this phenomenon in English. Thus, neither generativist nor the constructivist accounts in their current form can provide a full explanation of the pattern of data found across languages.

Freudenthal et al. (2010) suggest that one reason for MOSAIC's failure to fully account for the high OI error rates in English could be the fact that in English the infinitive is indistinguishable from the bare stem form, which is used for all other present tense person/number combinations except 3sg forms. Thus, rather than producing 'real' OI errors, at least some of the errors could actually be 'defaulting' errors in which children 'default' to the most frequent and phonologically simple verb form in the input, the bare stem form. As discussed in Chapter 2, children learning morphologically rich languages exhibit 'defaulting' behavior by over-using the most frequent and simplest forms in the input. The Experiment presented in this Chapter was designed to explicitly test the assumption that at least some English OI errors reflect 'defaulting' to the highest-frequency form in the input and are therefore not, in fact, non-finite forms. This was tested by using a cross-sectional elicited production study with 22 children (aged 3;1-4;1). Across 48 verbs, a significant negative correlation was observed between the proportion of 'bare' vs 3sg *-s* forms in a representative input corpus and the rate of children's 3sg *–s* production. This finding suggests that, in addition to other learning mechanisms that yield such errors cross-linguistically, at least some of the OI errors produced by English-speaking children reflect a process of defaulting to a high frequency/phonologically-simple form.

This Experiment has been published in the *Journal of Child Language* (Räsänen, Ambridge, & Pine, 2014).

2. Introduction

Young children acquiring English often produce bare verb forms in contexts in which an inflected form is required (e.g., Brown, 1973; Brown & Bellugi, 1964; Cazden, 1968). For example, young English-speaking children often produce

utterances such as the following (taken from Becky in the Manchester corpus, Theakston, Lieven, Pine & Rowland, 2001) in 3sg present tense contexts:

(1) **Andy want it.*

(2) **Daddy like lettuce.*

(3) **Pingu go here.*

Since the mid 1990s, such utterances have tended to be treated as Optional Infinitive (OI) errors (or Root Infinitive errors; Rizzi, 1993/4), because they typically appear during a period in which the child is also producing correctly inflected forms (Bromberg & Wexler, 1995; Harris & Wexler, 1996; Wexler, 1994, 1998). The suggestion is that, during this stage of grammatical development (approximately between the ages of 2 and 4 years), children may 'optionally' use an untensed (non-finite) verb form in a context in which, for adults, a tensed (finite) form is required. It is important to emphasise that under OI accounts, errors such as **Andy want it* explicitly do not reflect either (a) simple omission or dropping of the *-s* morpheme (e.g., due to its low phonological/communicative salience) or (b) defaulting to the form of the relevant verb with the highest lexical frequency or phonological simplicity. Rather, OI accounts assume that when a child produces an utterance such as **Andy want it*, she is producing a non-finite form that is fully licensed by her grammar (and - as such - is an 'error' only when viewed from the perspective of the adult grammar). A detailed account of exactly *why* children's grammars license non-finite forms in such contexts is given by Wexler (1998).

One obvious advantage of treating unmarked verb forms in English as OI errors is that it allows the data from English-speaking children to be assimilated into a unified account of the cross-linguistic pattern of verb-marking error (e.g. Wexler, 1994; 1998; Schutze & Wexler, 1996; Legate & Yang, 2007; Freudenthal, Pine, Aguado-Orea & Gobet, 2007). The claim is that utterances such as **Andy want it* reflect the use of a non-finite form, which - due to a quirk of English - *just so happens* to be identical in its surface form to the bare-stem (and to all present tense forms other than 3sg). In OI languages other than English, the equivalent non-finite forms carry a distinct infinitival morpheme, and so do not share this superficial similarity with the bare stem (though they are sometimes indistinguishable from some of the forms in the present tense paradigm). For instance, a French child

might produce *_La fille jouer_ (*The girl play-INF)* for *La fille joue (The girl plays*) and a Dutch child might produce an OI error such as **Papa koffie drinken* (**Daddy coffee drink-INF*) for the adult target sentence *Papa drinkt koffie* (*Daddy drinks coffee*). These errors are characterised by the use of forms with overt infinitival markers (-*er* and –*en*, respectively). In the case of Dutch, the same marker is used for both the infinitive and present tense plural forms of the verb, but the fact that the verb is generally preceded by its complement (i.e. occurs in non-finite position) suggests that the majority of these errors are non-finite forms, as opposed to present tense plurals.

The OI approach has resulted in models – both generativist and constructivist - that make quite fine-grained predictions about the rate at which OI errors will occur in different languages, and the speed with which children emerge from the OI stage (Legate & Yang, 2007; Freudenthal et al., 2007). However, as these models have been tested against a wider range of languages, it has become clear that they struggle to explain the very high rate of OI errors and the particularly extended nature of the OI stage in English.

Legate and Yang's (2007) Variational Learning Model (VLM; see also Yang, 2002; 2004) proposes that young children entertain several different grammars (where a grammar is defined as a set of parameter values) at the same time, with these grammars competing probabilistically. Parameter settings that are consistent with the linguistic input are reinforced, and the probability that they will be used again in the future increases. Parameter settings that are inconsistent with the input are punished, and the probability that they will be used in the future decreases. The relevant parameter here is the TENSE parameter: The +TENSE setting is rewarded by input utterances with overt tense marking (e.g., *He goes*), and the –TENSE setting is rewarded by verb forms with no overt tense marking (e.g., *We go)*. It is important to note that the VLM operates at the level of the clause, not the individual verb form. For example, *He doesn't play* and *He wants to play* would both reward the +TENSE grammar, as both forms have overt tense marking, the first on the auxiliary and the second on the main verb. On the other hand, *They don't play*, *They play* and *He can play* would all reward the –TENSE grammar as, whilst the clauses are marked for tense, this marking is null, not overt. According to the VLM, OI errors occur when children learning languages that use tense-marking have yet to definitively set the TENSE parameter to +TENSE, but are still entertaining the –

TENSE setting (which is the target setting for languages such as Mandarin Chinese). Legate and Yang (2007) provide evidence that, as predicted, across three languages (English, French and Spanish) the length of the OI stage is positively correlated with the proportion of clauses in the input with no overt tense marking.

An alternative explanation of the observed pattern of cross-linguistic variation with respect to the rate of OI errors is offered by a recent computational model: the Model of Syntax Acquisition in Children (MOSAIC; Freudenthal, Pine, & Gobet, 2006; Freudenthal, Pine, Aguado-Orea, & Gobet, 2007; Freudenthal, Pine & Gobet, 2009; 2010). According to MOSAIC, OI errors are truncated verb forms learned from compound-finite structures in the input (e.g., *He can go* → **He go*) in a way that reflects information-processing constraints on the language-learning mechanism. When processing a new utterance, elements at the beginning and end of the utterance are preserved, due to a small primacy and larger recency effect in learning. These effects are instantiated in the model by having it learn utterances gradually from the right and left edge with a bias towards right- as opposed to left-edge learning. Note that earlier versions of the model (e.g., Freudenthal et al., 2006) only learned from the right edge of the utterance. However, this meant that OIs with subjects were produced as a result of the model learning strings from questions (e.g., *Can he go* → **He go*). This is somewhat implausible, as children are presumably able to differentiate between declarative and interrogative utterances. The version of the model described in the present article, differentiates between declarative and interrogative input and learns declaratives from the former and questions from the latter. The inclusion of both an utterance-final and utterance-initial bias not only allows the model to learn OIs with subjects from declarative input (e.g., *He can go* → **He go*), but also to simulate the cross-linguistic pattern of OI errors in Wh- questions by learning OIs in Wh- questions from interrogative input.

Freudenthal et al. (2010) show that MOSAIC provides a good fit to the cross-linguistic patterning of OI errors in Dutch, German, French and Spanish. They also provide evidence for MOSAIC's prediction that the rate at which OI errors occur with different lexical verbs will be correlated with the proportion of non-finite verb forms in compound finite structures in the input. However, in an explicit comparison of MOSAIC and the VLM, they conclude that both models fail to account for the very high rates of OI error observed in English. In the case of the

VLM, the model has no ready explanation for the finding of Freudenthal et al. (2010) that this error rate is higher for English than for Dutch or German, despite the fact that input corpora from the three languages contain similar levels of evidence in favour of the +TENSE parameter (if anything, Dutch contains slightly less evidence than English). In the case of MOSAIC, the model is unable to simulate the very high rate of OI errors in English (87%), which is more than 20 percentage points higher than the rate at which such errors occurred in MOSAIC's output (63%).

One possible reason for these difficulties is that apparent OI errors in English are actually the result of two separate processes: (1) producing non-finite verb forms, either as the result of an incorrect parameter setting (VLM) or through the truncation of compound finite verb forms (MOSAIC), and (2) defaulting to the most frequent form of the verb when unable to access or retrieve the less frequent marked form. This possibility reflects the fact that, in English, at least for the vast majority of main verbs, the most frequent form is likely to be the bare form, which is indistinguishable from the infinitive. Defaulting errors in English are therefore likely to be indistinguishable from OI errors and hence to increase the rate of (apparent) OI errors in English. Note that, in this context, the term 'bare form' refers to any lexical verb form that does not carry overt tense marking. Thus 'bare forms' include simple finite forms with null marking (e.g., *I/we/you/they* ***go***), imperatives (***Go****!*), 'no-change' past-tense forms (e.g., *She* ***hit*** *him*) and also the lexical verbs in compound finite forms (e.g., *He will/can/should/does/doesn't* ***go***).

It is important to emphasise that the 'defaulting hypothesis' outlined here is intended not as an alternative account of the OI phenomenon per se, but rather as a complementary mechanism that can explain why OI errors are more common in English than would be predicted by current models of the OI stage. The claim is not, therefore, that *all* OI errors reflect a process of defaulting to the most frequent form of the verb. Rather, we suggest that, *in addition to* errors produced by the mechanisms instantiated in MOSAIC or the VLM, children also *sometimes* default to the form of each particular verb that is most frequent in the input. This may occur because children are unsure which form is required in a given context, or because they are unable to retrieve the correct form from memory (for example, under conditions of high cognitive load). Since all English present-tense main verb forms except for 3sg (e.g., *goes*) are bare forms, the bare form is likely to be the most

frequent form of any given verb, and hence the form to which children are predicted to default. Because, in English, bare forms are indistinguishable from genuine non-finite forms (whether licensed by an OI grammar or produced as a result of modal omission), defaulting to the bare form increases the rate of (apparent) OI errors (for a similar proposal from a generativist perspective, see Blom, 2007). Note that, even for languages such as Dutch and German, it is possible that some apparent OI errors are, in fact, a consequence of defaulting to a high frequency present tense form that shares the same inflection as the infinitive (e.g., present tense plural *-en* in Dutch and German). However, in OI errors in Dutch and German, verbs tend to occur in non-finite position (i.e. after their complements), suggesting that the majority are, indeed, OI rather than defaulting errors (Jordens, 1990; Poeppel & Wexler, 1993).

Note that, in English, the bare form is not only the most frequent form but also, by virtue of its lack of additional morphemes, the most phonologically simple. The fact that the bare form is the easiest to produce constitutes another reason why children may default to it, perhaps particularly in cases where they are having difficulty planning an utterance. Indeed, there is evidence from naturalistic studies that children learning languages other than English often make errors in which they default to verb forms in the input that are frequent and phonologically simple. For example, Aguado-Orea (2004) reported that the two Spanish children studied produced errors involving defaulting to the 3sg present tense verb form (particularly in 3pl contexts, e.g., **Javier y Fernando juega*), which is both the most frequent and the phonologically-simplest form. Similarly, although Finnish children probably do not produce OI errors, they do sometimes 'default' to the second person singular (2sg) imperative form, which bears no overt morphological marking, and is hence indistinguishable from the stem form (Laalo, 1994; 2003; Toivainen, 1980). It should be clear from this definition that we are arguing that the bare form is a 'default' only in the sense that – by virtue of its frequency and phonological simplicity – it is the form that is easiest for the child to recall and produce. We are not arguing that the bare form is some kind of morphosyntactic default form that can be used even when its features are not licensed by the subject (as, for example, Radford & Ploennig-Pacheco, 1995, argue for 3sg).

To our knowledge, the idea that English children will sometimes default to a bare form when a 3sg *-s* form is required (i.e. in simple finite contexts) has been tested in only a single study (though see Theakston, Lieven & Tomasello, 2003; Finneran & Leonard, 2010, for studies investigating children's acquisition of 3sg *-s* more generally using novel verbs, and Oetting & Horohov, 1997, and Van der Lely & Ullman, 2001, for studies investigating verb frequency and tense inflection with children with Specific Language Impairment). Song, Sundara and Demuth (2009) found that the raw frequency of the verb in 3sg *–s* form in the CHILDES database (MacWhinney, 2000) did not account for any variability in children's production of 3sg *–s* forms versus OI errors. Although this finding would seem to count against the defaulting hypothesis, it seems likely that the important factor is not the *raw* frequency of 3sg *–s* forms in the input but the *relative* frequency of 3sg *–s* vs bare forms. Any account under which two stored forms (e.g., *plays* and *play*) are competing for activation in memory predicts an effect of relative - as opposed to absolute - frequency. Bare forms of a particular verb in the input pull the child towards producing a bare form for that verb, whilst 3sg forms pull her towards producing a 3sg form (note that the VLM also operates in this manner, though at a higher level of abstraction). Following this logic, Matthews and Theakston (2006) demonstrated that the likelihood of correct irregular plural production (e.g., *feet*) was predicted not by the overall frequency of this form but by the relative frequency of the plural vs singular form (*feet* vs *foot*).

In the present study, we thus test the idea that at least some apparent OI errors in English reflect a process of defaulting to the bare stem, using an elicited production paradigm in which items vary in the extent to which the verb occurs in 3sg *-s* as opposed to bare form in the input language. It is predicted that the extent to which children produce bare verb form errors will correlate with the extent to which particular verbs occur in bare as opposed to 3sg *–s* form in the input language.

3. Method

3.2. Participants

The initial sample comprised 36 participants, recruited from three nurseries in Liverpool. All were typically developing, monolingual speakers of British English. No standardised language tests were used, but all the children were described by their

teachers as displaying normal language development. Thus, there is no reason to believe that the children had any language disorders or particular problems with production of consonant clusters that could have affected the production of 3sg *–s* (none were reported by their teachers). In order to make sure that 3sg *–s* deletion was not a characteristic feature of the local dialect, a corpus search of the six Liverpool mothers' speech in the Post-Manchester corpus (Rowland & Theakston, 2009) was conducted. The rate of 3sg *–s* deletion was 0.6% (22 instances out of a possible 3765). There is therefore no evidence that 3sg- s deletion is a characteristic feature of the local dialect.

Eleven children were excluded because they did not attempt to repeat any sentences during the training phase (all children who completed the training phase also successfully completed the test phase). This relatively high attrition rate is consistent with previous elicited-production studies of morphology (e.g., Gerken, 1996; Song et al., 2009; Valian & Aubry, 2005). As the aim of the study was to explain between-verb variability in children's OI errors, data from another three children who made no OI errors were excluded from the statistical analysis. The final sample consisted of 22 participants with a mean age of 3;7 years (range 3;1-4;1).

3.3. Design and materials

The study used a between-verbs, within-subjects design, with the number of correct uses of 3sg *–s* in the elicited-production task as the dependent variable. The stimuli consisted of 48 sentences and accompanying pictures, presented on a laptop computer. To develop the stimuli, verb frequency counts were obtained from the child-directed speech of the 12 mothers in the Manchester corpus (Theakston et al., 2001), chosen to be representative of British-English child-directed speech heard by pre-school children.

The main continuous predictor variable - designed to test the defaulting hypothesis - was the proportion of uses of each verb in this corpus that were bare forms as opposed to 3sg *–s* forms, regardless of discourse context, collapsing across all 12 mothers (henceforth referred to simply as the 'defaulting' measure). Recall that, for the purposes of this study, a *bare form* is defined simply as a form that lacks overt tense marking on the verb itself, whether or not it is a true non-finite form. For example the proportion of bare forms for *eat* (0.94) was calculated as follows:

$$\frac{\text{Occurrences of } eat \text{ (1429)}}{\text{Occurrences of } eat + \text{Occurrences of } eats \text{ (1429 + 94)}} = 0.94$$

Since the aim of the study was to investigate the effect of the relative frequency of 3sg *–s* forms vs bare forms, any other inflected forms (i.e., present progressive and past tense) were ignored. This is because these forms do not pull towards either the 3sg *–s* or bare form.

From the 100 verbs with the highest overall frequency in the Manchester corpus input data, we selected a set of 48 verbs designed to vary continuously in terms of their values with respect to the predictor variable (excluding verbs that appear only as auxiliaries). Using these verbs, 48 trials were created (see Appendix A for the full set). Each trial consisted of a 'set-up' sentence beginning "*Every day...*", where the relevant verb was presented in a 'bare' (3pl) form (e.g., *the children give*), followed by a sentence containing two clauses conjoined with *and*. Each of these two clauses included a 3sg subject and 3sg *–s* verb form (e.g., *Kate gives....* and *Sam gives...*). For example, the complete trial for *give* was as follows (see Figure 3.1. for the pictorial stimuli used):

Every day the children give Mum something. Kate gives a card and Sam gives a present.

Figure 3.1. Illustration for the trial '*Every day the children give Mum something. Kate gives a card and Sam gives a present*.'

The second clause (underlined in the example above) was designated the target clause (i.e., the clause that children attempted to repeat in the training session, and to produce in the elicited-production test session). This clause always began with a one-syllable word, which was either the name of the character (*Sam* or *Kate*) or, occasionally, the name of a toy (e.g., *Po*). In every target clause, the verb was followed by a phrase consisting of three syllables. Thus, except for five two-syllable verbs (*colours*, *cuddles*, *pushes*, *tickles*, *opens*), the target clause always contained the same number of syllables (five). The three-syllable phrase following the verb always started with a vowel in order to ensure that it would be easy to detect whether or not the child produced the 3sg *–s* morpheme. Importantly, because all target clauses used a 3sg subject (e.g., *Sam*), the use of a bare form (e.g., **Sam give a present*)

always constituted an OI error. In other words, the target clause to be produced by the child always constituted an obligatory context for 3sg *-s*.

Note that the use of the "*Every day...*" context sentence ensured that the use of the 3sg *–s* form (e.g., *Sam gives*) as opposed to the present progressive (*Sam is giving*) or past-tense form (*Sam gave*) was natural. Although the "*Every day*" prompt sets up a context of habitual aspect rather than ongoing action, this was unavoidable, as - in everyday spoken English - the use of a simple present tense form to describe an ongoing action (e.g., *Sam gives a present*) is extremely unnatural; the present progressive form (e.g., *Sam is giving a present*) would be used instead. In any case, this does not affect the predictions of the present study, which relate solely to the use of 3sg *–s*, regardless of aspect.

For each trial, an illustration (see Figure 3.1. for an example) was presented on a laptop computer (with a 17 inch screen) using *PowerPoint* (children were invited to press the button to proceed to each subsequent picture, which served as an incentive to continue). A microphone (Shure SM58) connected to the computer (running *Audacity 1.3.12-Beta* recording software) was used to record children's responses. Loudspeakers connected to the laptop allowed the children to hear their own amplified voices, which constituted an incentive to copy the experimenter (in the training session) and to produce their own sentences (in the test session).

3.4. Procedure

Each child completed a training session then, on the following day, a test session, with each session lasting approximately 15-30 minutes, depending on the child. In both sessions, each child completed all the trials in one of four pre-determined pseudo-random orders. Each child was tested individually with a member of nursery staff present.

3.4.1. Day 1 – Training Session

The aim of the elicited-imitation training session was to teach children the relevant target response for each trial, and hence to ensure that, in the subsequent elicited-production test session, they attempted this 'target clause' (as opposed to making up their own utterances, perhaps using non-target verbs). The child was seated in front of the laptop, and was told that he or she would be playing a turn-taking game with the experimenter in which they would describe some pictures together. First the child completed a brief warm-up that involved 'testing the

microphone' by producing her own name and those of the story characters. The experimenter then brought up the first picture and produced the set-up sentence (e.g., *Every day the children give Mum something*) and the conjoined-clause sentence ending in the target clause (e.g., *Kate gives a card and Sam gives a present*). The experimenter then asked "*Can you say* [target clause]?" to elicit an attempted repetition (though most children spontaneously imitated the target clause after the first one or two training trials). If the child did not attempt to repeat the sentence after three prompts of this nature, the experimenter moved on to the next picture. Eleven children were excluded from the study for failing to repeat four consecutive trials during this training phase (there were no additional drop-outs during the test phase).

3.4.2. Day 2 – Test Session

For the elicited-production test session, children were told that they would be playing the same game as previously, but this time it would be up to them to try to remember what happens in each picture. The experimenter followed the same procedure as for the training session (e.g., saying "*Every day the children give Mum something. Kate gives a card and…*"), except that, instead of producing the target clause, she simply pointed at the relevant character and awaited the child's response. Very occasionally, the child did not attempt a response, in which case the experimenter modelled the beginning of the target clause (e.g., "*Sam...*") up to three times, before moving on to the next picture.

3.5. Transcription, scoring and reliability

The responses were transcribed from the audio recordings and coded by the first author. Each response was coded solely on the basis of the form of the target verb produced: 3sg *–s* (e.g., *gives*) (*N*=696), non-finite (e.g., *give*) (*N*=197) or other/unscorable (including non-target verbs, no response, past-tense/present progressive responses, incomprehensible/inaudible responses) (*N*=164). The average number of unscorable responses per child was 7.45 (*SD* = 7.41). The number of missing values correlated negatively with increasing age: the older the children were, the fewer unscorable responses they produced (simple Pearson correlation r = -0.12, p <.001). Other deviations from the target clause (e.g., substitution of subjects or objects) were ignored. The responses were also transcribed independently by a trained undergraduate research assistant who was

blind to the hypotheses under investigation. Inter-rater reliability, as measured by Cohen's Kappa, was 0.88 (96% agreement). Any disagreements regarding the presence of a 3sg *–s* were subjected to re-listening until agreement was reached.

4. Results

The mean proportion of children producing the correct 3sg *–s* form for each verb (excluding trials for which no valid attempt at the target verb was made) is shown in Appendix B. Note that because trials with missing data were excluded, correct 3sg *–s* forms and OI errors sum to 100%. Overall, children's performance was good (*M*=77.91% correct production of 3sg *-s*, *SD*=41.51), as would be expected given their relatively advanced age (*M*=3;7) (The mean proportion of correct 3sg –s production in the training session = 0.82 [*SD*=0.32]). Appendix B also shows the proportions of bare forms versus 3sg *–s* forms (defaulting measure) in the input corpus, as well as the raw frequencies of bare and 3sg forms. Note that even the verb with the lowest proportion of bare forms (*fit*=0.77) still occurs considerably more frequently in bare than 3sg *–s* form. The data appear to pattern broadly as predicted by the defaulting hypothesis, with lower correct performance (i.e., more OI errors) for verbs that have a high proportion of bare forms relative to 3sg *–s* forms in the input (Figure 3.2. below).

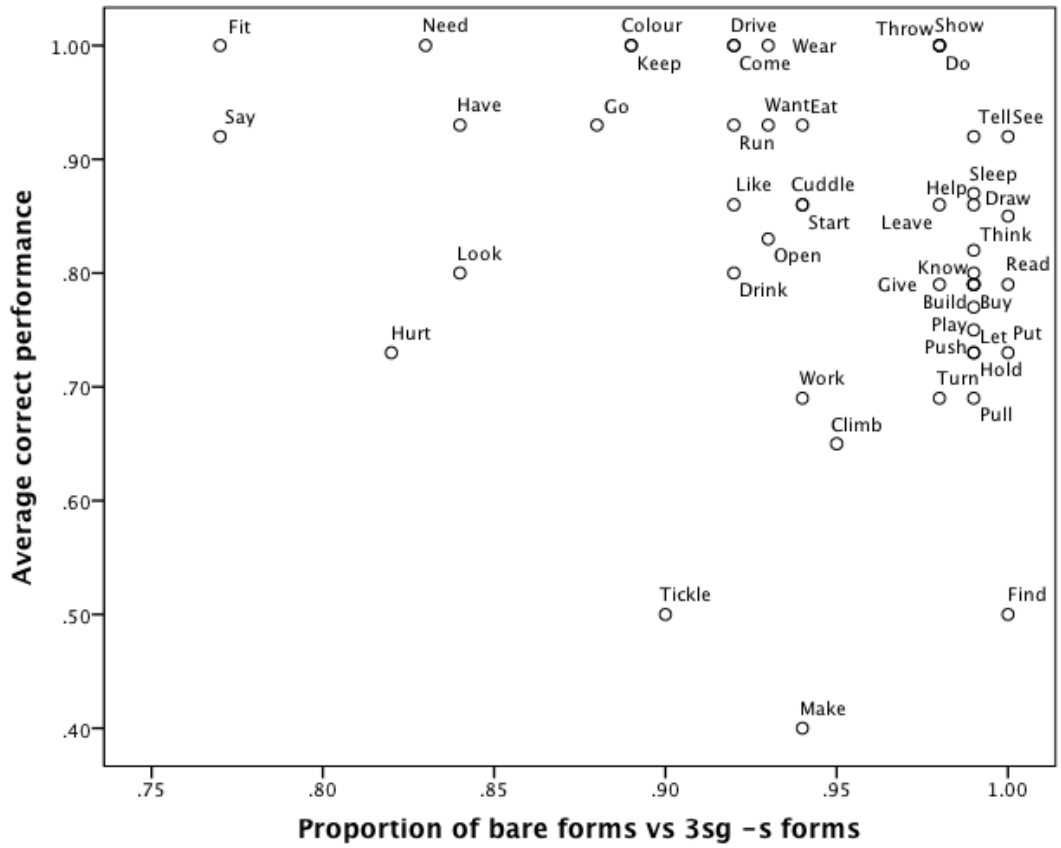

Figure 3.2. Correlation between children's correct production of 3sg –*s* forms and the proportion of bare forms vs 3sg –*s* forms in the input.

The prediction under investigation is as follows. If children show an effect of defaulting to the bare form, then the overall proportion of bare versus 3sg –*s* forms in the input (defaulting measure) will be a significant negative predictor of the rate of 3sg –*s* production across verbs. To test this prediction, mixed-effects regression models with participants and items as random effects (see Baayen, 2008) were fitted to the data. The advantage of using such an approach as opposed to traditional by-subjects/items regression analysis is that the former takes into account both by-subject and by-item variation, and thus has more power. The fixed effects varied by analysis, but included the defaulting measure as described above, age (in months), a compound-finites measure (described with the relevant analysis below), raw bare form and 3sg –*s* form frequencies, and two control predictors: the total length of, and serial position of the verb in, the child's response. As the outcome measure was dichotomous (each child produced either a 3sg –*s* form or an OI error for each verb, with other responses treated as missing data), logistic regression models were used. The outcome measure was coded as 1 = correct production of 3sg, 0 = bare

form (OI error) produced. All model comparisons were made using likelihood ratio tests performed in R with the anova function.

The first (baseline) model (Model A) included age, the length of the child's response, and the serial position of the verb in the child's response as fixed effects. A significant effect of age was observed (β = 0.15, *SE* = 0.06, *z* = 2.34, *p* = .019), reflecting the fact that, as expected, the proportion of correct 3sg *–s* production increased with age. Neither the length of the response (β = 0.23, *SE* = 0.14, *z* = 1.68, *p* = .092), nor the serial position of the verb in the response (β = 0.28, *SE* = 0.29, *z* = 1.00, *p* = .319), had any significant effect on the production of the 3sg *–s*. These two non-significant predictors were thus omitted from the subsequent models, and Model A with only age as a fixed effect was used as a reduced model against which subsequent models were tested (see Table 3.1. for model details).

Table 3.1.

The Mixed-Effects Regression Models Fitted to the Data

Model A: Reduced model

Variable	β	*SE*	*z*	*p*
(Intercept)	-5.13	2.87	-1.79	0.073
Age	**0.16**	**0.07**	**2.4**	**0.017**

Note. Model log likelihood = -399.38. Random effects: Participant (*Var*=1.31, *SD*=1.14), Verb (*Var*=0.65, *SD*=0.81)

Bold values indicate that effect is statistically significant at *p*< .05 or greater.

Model B: Defaulting hypothesis

Variable	β	*SE*	*z*	*p*

(Intercept)	1.5	3.64	0.41	0.68
Proportion of bare forms (vs. 3sg *-s*) in all contexts	**-7.04**	**2.42**	**-2.91**	**0.004**
Age	**0.16**	**0.07**	**2.40**	**0.016**

Note. Model log likelihood = -395.35. Random effects: Participant (*Var*=1.29, *SD*=1.14), Verb (*Var*=0.49, *SD*=0.70)

Bold values indicate that effect is statistically significant at $p < .05$ or greater.

Model C: Raw bare form frequency

Variable	β	*SE*	*z*	*p*
(Intercept)	-5.16	2.87	-1.8	0.791
Raw frequency of bare forms	0.02	0.06	0.27	0.791
Age	**0.16**	**0.07**	**2.40**	**0.017**

Note. Model log likelihood = -399.35. Random effects: Participant (*Var*=1.30, *SD*=1.14), Verb (*Var*=0.65, *SD*=0.81)

Bold values indicate that effect is statistically significant at $p < .05$ or greater.

Model D: Raw 3sg form frequency

Variable	β	*SE*	*z*	*p*
(Intercept)	-5.26	2.85	-1.84	0.065
Raw frequency of 3sg forms	0.84	0.48	1.76	0.078
Age	**0.16**	**0.07**	**2.40**	**0.016**

Note. Model log likelihood = -397.83. Random effects: Participant (*Var*=1.29, *SD*=1.14), Verb (*Var*=0.57, *SD*=0.75)

Bold values indicate that effect is statistically significant at $p < .05$ or greater.

Model E: MOSAIC hypothesis

Variable	β	*SE*	*z*	*p*
(Intercept)	-4.91	2.90	-1.69	0.090
Proportion of compound finites (vs. 3sg *-s*) in 3sg contexts	-0.29	0.61	-0.48	0.631
Age	**0.16**	**0.07**	**2.39**	**0.017**

Note. Model log likelihood = -399.27. Random effects: Participant (*Var*=1.30, *SD*=1.14), Verb (*Var*=0.65, *SD*=0.81)

Bold values indicate that effect is statistically significant at $p < .05$ or greater.

The fixed effects in the second model (Model B) were age and the defaulting measure, in order to investigate the effect of bare forms on the production of 3sg –s. Whilst the fixed effect of age remained significant (β = 0.16, *SE* = 0.07, *z* = 2.40, *p* = .016), a significant negative effect of the proportion of bare forms in the input (defaulting measure) on children's 3sg *-s* production across verbs was also observed (β = -7.04, *SE* = 2.42, *z* = -2.91, *p* = .004). Thus, the more often a verb appeared in bare form in the input, the more often children produced an OI error – and the less often they produced a correct 3sg *–s* form – for that verb. This relationship is displayed below in Figure 3.2. The AIC values revealed that this model (AIC = 800.70; logLik =-395.35) was indeed a significantly better fit to the data than the reduced model (Model A) (AIC = 806.76, logLik =-399.38) (*p* = 0.005). As an estimation of the effect size we compared the log-likelihood of the model B against the log-likelihood of a null-model with only the intercept by calculating a McFadden's Pseudo R^2 value. This was 0.17. By-verb regression on the mean correct performance revealed the R^2 value to be 0.08 (simple Pearson correlation *r* = -0.28).

In order to validate the use of proportional as opposed to absolute frequency as a predictor in the above analysis, models were also derived which included, in addition to age, the raw frequency of the verb in bare stem form (Model C) and the raw frequency of the verb with 3sg *–s* (Model D) as fixed effects. Although there was a marginal effect of raw frequency of the verb with 3sg *–s,* neither model provided a significantly better fit to the data than the reduced (age-only) model A (AIC =808.69, logLik =-399.35, *p* = .971 for model C; AIC =805.66, logLik = -397.83, *p* = .078 for model D). Furthermore, Model B with the proportion of bare forms constituted a significantly better fit to the data than either Model C or D (*p* < .001 and *p* = .024, respectively). These findings are consistent with the view that proportional frequency is the more appropriate measure, and provide a potential explanation of the null effect observed in a similar study that used only the raw 3sg –s frequency measure (Song et al, 2009).

One possible objection to the present results is that children could be producing apparent 'defaulting' errors (e.g., *Sam gives --> Sam give*) by truncating compound finite structures in modal contexts, as assumed by MOSAIC (e.g., *Sam can give --> Sam give*) (although this does not seem particularly likely given the discourse context of the game, which sets up a habitual 3sg context, rather than a

modal context). If this is the case, then the defaulting measure may be a significant predictor of the error rate only because the rate at which verbs occur in bare form (defaulting measure) is an effective proxy for the rate at which they occur in compound finite structures. Indeed, the defaulting measure (proportion of bare vs 3sg forms) includes compound finite uses (e.g., *Sam can* ***give***) - which are, by definition, bare forms - in its counts. In order to eliminate this possibility, we therefore calculated the rate at which each verb occurs in the input *in compound finite structures only*, and ran a final analysis including only this predictor and age as fixed effects (Model E).

This compound finite measure (or MOSAIC measure) reflected the proportion of uses of each verb that were non-finites in 3sg compound-finite constructions as opposed to 3sg *–s* forms. These proportions were calculated by hand-coding the input data of one child (Becky) selected at random from the Manchester corpus. (The input estimates for the compound-finite measure were restricted to one child's input data simply because of the need to hand-code the data for this particular analysis. Hand-coding the data from all 12 children in the Manchester corpus would have been extremely time-consuming. For example, just for the verb *eat*, the number of utterances to hand-code would have been 1,517). The measure included all semi-modal/modal/auxiliary utterances (e.g., *He's going to eat; He can eat; He does[n't] eat*) in 3sg declarative contexts. For example the proportion of compound finites for *eat* (0.68) was calculated as follows:

$$\frac{\text{Occurrences of } eat \text{ as non-finite in declarative 3sg compound finites (15)}}{\text{Occurrences of } eat \text{ as non-finite in declarative 3sg compound finites (15) + Occurrences of } eats \text{ [all in declarative 3sg contexts] (7)}} = 0.68$$

Note that the analysis was restricted to declarative contexts because all the sentences elicited in the present study were declaratives, and because it is somewhat implausible to assume that children take strings learned from questions and use them in declarative contexts. Thus, the MOSAIC measure maps more closely onto the current version of MOSAIC than it would have done had we also included questions.

In order to investigate whether the MOSAIC measure was a significant predictor of the children's performance, this measure was included – in addition to age – in a final model (Model E). No effect of compound finites was observed (β = -0.29, *SE* = 0.61, *z* = -0.48, *p* = .631) with Model E (AIC = 808.54, logLik =-399.27) failing to offer a significantly better fit to the data than the reduced Model A (AIC = 806.76, logLik =-399.38, *p* = .64). Furthermore, Model B provided a significantly better fit to the data (AIC = 800.70, logLik=-395.35, *p* < .001) than Model E. Thus, consistent with the defaulting hypothesis, the compound-finite measure was not a significant predictor of the error rate. Note also that an additional analysis using a version of the MOSAIC measure that included both declaratives and questions yielded a very similar pattern of results. These results appear to be at odds with the results of Freudenthal et al. (2010), who did find a significant by-verb correlation between the proportion of compound finites in the input and OI errors. However, it is worth noting that Freudenthal et al.'s measure of OI errors is based on a much wider range of contexts than those elicited in the present study. This is an issue to which we return in the discussion.

To summarise, the elicited production paradigm was successful in eliciting OI errors in young English-speaking children. The results indicated that the higher the proportion of bare forms in the input, the higher the rate of OI errors in children's productions, thus providing evidence for the defaulting hypothesis. The findings also demonstrate that defaulting to the frequent, phonologically-simple bare form accounts for variance that cannot be explained in terms of differences in the rate at which verbs occur in compound finites in the input.

5. Discussion

The present study was designed to examine the Optional Infinitive phenomenon by investigating whether defaulting to the most frequent and phonologically-simplest form of each verb - the bare form - can explain why English-speaking children produce OI errors at higher rates than would be predicted by current accounts (both the VLM and MOSAIC). The study took the form of a picture-description task designed to elicit attempts at 3sg *-s* verb forms in simple finite contexts. In support of the defaulting hypothesis under investigation, it was found that - across verbs - the proportion of bare vs 3sg *-s* forms in the input was a significant negative predictor of the rate at which children produced correct 3sg *-s* forms vs. OI errors.

The truncated compound-finite structures learned from the input did not, on the other hand, predict any significant variance in children's performance. Our results, therefore, suggest that the process of defaulting is a factor in explaining OI errors in English.

One possible interpretation of these findings is that all apparent OI errors in English can be explained in terms of a process of defaulting to the most frequent (and/or phonologically simple) verb form. This interpretation cannot be ruled out on the basis of the present results. However, it appears somewhat implausible given the cross-linguistic data. This is partly because it is clear that some additional mechanism is required to explain OI errors in languages in which the non-finite form is clearly an infinitival form (Wexler, 1998), and not the most frequent and/or phonologically simplest form in the input. Such a mechanism is likely to generate OI errors in English as well as in these languages.

A more plausible interpretation is therefore that apparent OI errors in English reflect the operation of two distinct processes: one that results in the production of non-finite forms, and one that results in the production of bare stems (although these forms are, of course, indistinguishable in English). For example, one possibility is that OI errors in modal contexts reflect the learning of non-finite forms from compound finite structures (as implemented in MOSAIC), whereas apparent OI errors in simple finite contexts reflect a process of defaulting to the most frequent (and/or phonologically simple) verb form. Although clearly less parsimonious than a single-factor model, a two-factor model of this kind has a number of empirical advantages over its competitors.

First, a two-factor model is consistent with the data from languages such as Spanish in which children have been reported to produce both OI errors (at low rates) and defaulting errors. In the introduction to the present study, we reviewed evidence suggesting that learners of languages such as Spanish and Finnish show defaulting behaviour, but that this leads to forms with incorrect person/number marking (e.g., the use of a 3sg verb form with a 3pl subject), as opposed to OI errors (e.g., Aguado-Orea, 2004, for Spanish; Laalo, 1994; 2003; Toivainen, 1980, for Finnish; see also Dabrowska & Szczerbiński, 2006, for Polish noun morphology). Thus, an account combining learning from compound finites and defaulting has the potential not only to account for both OI errors and incorrect person/number-marking errors, but also to predict how the relative frequency of each error type

will vary across languages, as a function of which particular surface form is of the highest frequency (and/or phonological simplicity). Indeed, it is important to emphasize that our claim is not that defaulting errors are unique to English. All that is unique about English is the fact that defaulting errors result in forms that happen to resemble non-finite forms, as opposed to incorrect person/number-marked forms.

Second, a two-factor model provides a potential explanation of a key difference between English, in which OI errors occur in both modal and non-modal contexts, and other Germanic languages, in which OI errors virtually always have a modal reading (the well-known *modal reference effect;* e.g., Hoekstra and Hyams, 1998; Josefsson, 2002; see also Ingram & Thompson, 1996; Wijnen, 1998): English-speaking children produce both modal OI errors by truncating compound finites and non-modal OI errors by defaulting. Learners of other Germanic languages produce modal OI errors by truncating compound finites, but do not produce non-modal OI errors by defaulting. Defaulting in these languages would lead to person/number-marking errors (as observed in Spanish) and sometimes serendipitously to correct forms, as both Dutch and German have a number of homophonous person/number-marked forms.

Third, a two-factor model provides a way of resolving the apparent discrepancy between the results of the present study, which found no relationship between error rates and the proportion of non-finite forms in compound finites in the input (for English) and the results of Freudenthal et al. (2010), who found a significant correlation, both in English and in a number of other languages. The apparent discrepancy arises because OI error rates based on naturalistic speech (Freudenthal et al, 2010) collapse together OI errors in modal (i.e. compound finite) and non-modal (i.e. simple finite) contexts. One would therefore expect these error rates to be related to the rate at which verbs occur in compound finites in the input. In contrast, the error rates reported in the present study are based only on non-modal contexts. One would therefore expect these rates to be related to the rate at which verbs occurred in bare as opposed to 3sg *–s* form in the input, rather than the rate at which they occurred in compound finites.

An important goal of future research is to establish the relative contributions of defaulting and other mechanisms such as the truncation of compound finites (MOSAIC) or probabilistic setting of the TENSE parameter (VLM). It will also be

necessary to explain how the relative contributions of each mechanism vary across languages, and change with development. Focusing on the MOSAIC account, one way to tease apart the factors of (a) truncating compound finites and (b) defaulting would be to compare children's OI error rates in modal and non-modal contexts (e.g., for the target sentences *Adam will eat an apple* vs *Adam eats an apple*). If, for a given verb, children produce OI errors for the former but not the latter sentence type, this constitutes clear evidence for a pure effect of truncating compound finites. We are currently investigating this two-factor account by conducting a study of this type, comparing across different ages and different languages (English vs Swedish).

Future research should also explicitly test the prediction of the defaulting hypothesis that, across all languages, defaulting errors will be produced for items where a particular target form (e.g., 3pl) is of much lower frequency than a competing form (e.g., 3sg). In principle, the relative frequency of the target and competing forms should predict the error rate, regardless of the particular error type (e.g., OI vs 3sg for 3pl substitution) and the particular language under consideration. In practice, the factors of phonology (ease of production) and type frequency (the number of different verbs and grammatical functions to which a given morpheme applies) will presumably complicate the picture somewhat. Indeed, given the impoverished inflectional morphology of English, the present study does not allow for investigation of the extent (if any) to which the apparent "default" status of the bare form is a consequence of its type frequency and phonological simplicity, as opposed to simple token frequency. This, too, is a question for future research.

A final issue that should be addressed by future research concerns the nature of children's representations. For example, when children produce a correctly inflected 3sg *–s* form, we do not know whether they are (a) directly retrieving a stored form, (b) retrieving the stem and applying a productive 'add *–s*' rule or (c) something in between (e.g., conducting an online generalization over stored forms weighted by frequency and phonological similarity to the target). Conversely, when children produce an (apparent) OI error, we do not know whether they have (a) erroneously stored the bare form as the 3sg form of that verb, (b) know the appropriate 3sg *–s* form, with the problem purely one of lexical retrieval or – again – (c) something in between (e.g., perhaps both the bare and 3sg *–s* forms of each

verb are stored in memory, each linked probabilistically – and, for children, imperfectly – to its role(s) in the inflectional paradigm). The findings of the present study suggest that any successful account will have to incorporate a role for the relative input frequencies of bare and 3sg *–s* at some stage (storage, retrieval or both). Answering the more detailed questions outlined here will require future research using paradigms better suited to revealing participants' underlying representations (e.g., reaction-time measures).

To conclude, the findings of the present study provide evidence that the process of defaulting to a high-frequency/phonologically simple form is a real phenomenon. This phenomenon offers a possible explanation of why English-speaking children produce more OI errors than would be expected by current models of the OI stage. Defaulting and producing OIs by truncating compound-finite input structures should, however, be seen as complementary rather than as competing explanations of the OI phenomenon, as only the latter is able to explain the cross-linguistic error pattern, suggesting the need for a model that combines both factors.

Chapter 4. Experiment 2. Investigating the Optional Infinitive phenomenon: a comparison of English and Swedish

1. Rationale for Experiment 2

The previous Chapter presented Experiment 1, which tested an alternative account of OI errors by using an elicited production task in which simple finite 3sg –s forms (e.g., *Sam gives a present)* were elicited from English-speaking children. The results showed that across the 48 verbs used in the study, the proportion of bare verb forms vs 3sg forms (e.g., *give* vs *gives*) significantly predicted children's correct performance: children were more likely to correctly supply the –s inflection for verbs with a higher proportion of 3sg forms in child-directed speech. This finding suggests that at least some of the (apparent) OI errors observed in English reflect a process of defaulting to the bare form, whilst others are truncation errors learned from compound finite structures in the input, as argued by Freudenthal et al. (2010). Such a dual mechanism account would have the potential to explain not only OI error data but also person/number marking errors in more highly inflected languages.

Experiment 2 was motivated by the results of the Experiment 1, and aims to test this dual mechanism account by comparing the pattern of children's productions of OI errors in simple finite (non-modal) and compound finite contexts (modal) in both English and Swedish. The dual mechanism account predicts that since apparent English OI errors are homophonous to the most frequent form (i.e., the bare form), there would be no difference in error rates in English across modal and non-modal contexts as both processes of defaulting and truncating compound finite structures leads to the bare form. However, since Swedish ha a separate infinitival form, there would be a visible effect of truncating modal + infinitive structures in the modal contexts. Consistent with these hypotheses, the results revealed that Swedish-speaking children made more errors in modal contexts whilst no such difference was detected for English-speakers. Furthermore, the results replicated the finding of Experiment 1 that the rate of bare forms vs 3sg forms (in English) and rate of infinitives vs present tense forms (in Swedish) was a significant predictor of the errors in non-modal contexts. Thus, this Experiment supports the

proposal that a dual mechanism account is needed to account for OI error data crosslinguistically.

This experimental chapter is currently in preparation for submission for publication.

2. Introduction

One of the most intriguing cross-linguistic phenomenon in early language acquisition is the observation that young children between the ages of approximately two and four produce infinitives (and other untensed verb forms) in contexts in which a finite (tensed) verb form is required (e.g., Rizzi, 1994; Wexler, 1994; Phillips, 1995; Hyams, 1996). For example, English-speaking children produce utterances such as the following:

(1) **Sarah build a castle*

(2) **Adam read a book*

(3) **Eve want a cookie*

In each of these cases, the infinitive form of the verb (*build*, *read*, *want*) is produced in a context in which a finite verb form (*builds*, *reads*, *wants*) is required. Since errors of this kind occur at a point in development at which the child is also producing finite verb forms correctly, they are typically referred to as Optional Infinitive (OI) errors, and the period in which they occur as the OI stage.

In English-speaking children, it may be tempting to interpret OI errors as reflecting lack of knowledge of a particular inflection (e.g., 3sg –*s*) (Brown, 1973), or the dropping of an inflection due to performance limitations in production (Bloom, 1990; Valian, 1991). However, in languages other than English, the equivalent errors often include verb forms marked with a distinct infinitival morpheme. Consider the following examples from Swedish:

(4) **Sara bygg-er ett slott.*
Sara build-3SG a castle.
'Sara builds a castle'

(5) **Ulf läs-er en bok.*
Ulf read-3SG a book.
'Ulf reads a book.'

(6) **Sara bygg-a ett slott.*

Sara build-INF a castle.

'Sara build a castle.'

(7) **Ulf läs-a en bok.*

Ulf read-INF a book.

'Ulf read-INF a book.'

Here the grammatically correct utterances (4) and (5) include finite verb forms marked with the finite morpheme –er (*bygg**er*** and *läs**er***). However, the verb forms in utterances (6) and (7) not only lack this finite morpheme, but are also marked with an infinitival morpheme –a (bygg**a** and läs**a**). This morpheme clearly identifies the verbs as non-finite forms rather than forms from which an inflection has been dropped.

A number of theories have been proposed to account for the occurrence of OI errors in children's speech (e.g., Rizzi, 1994; Hyams, 1996; Schütze & Wexler, 1996; Wexler, 1998). These accounts can typically explain why children make OI errors in some languages and not in others. For example, Wexler's (1998) account can explain why children make OI errors in obligatory subject languages such as English, Dutch, French and German, but not in optional subject languages such as Spanish and Italian. However, they are unable to explain the wide range of variation that exists in the rate at which OI errors occur across languages. For example, Phillips (1995) reviews data from children learning 9 different languages (including 5 OI languages and 4 non-OI languages) and concludes that rates of OI errors vary along a continuum from high in English and Swedish through moderate in Dutch, French and German to low (but by no means zero) in Catalan, Hebrew, Italian and Spanish. The implication is that the difference between OI and non-OI languages is not an all-or-nothing qualitative distinction, but a graded quantitative dimension.

2.2. The Variational Learning Model

One recent generativist model of the OI stage that is able to deal with quantitative variation in rates of OI errors is Legate and Yang's (2007) Variational Learning Model (VLM; see also Yang, 2002; 2004). According to the VLM, young children initially entertain several different grammars (where a grammar is defined as a set of parameter values), which compete with each other probabilistically. Parameter settings that are consistent with the linguistic input are reinforced, and

the probability that they will be used again in the future increases. Parameter settings that are inconsistent with the input are punished, and the probability that they will be used in the future decreases. The relevant parameter here is the TENSE parameter: The +TENSE setting is rewarded by input utterances with overt tense marking (e.g., *She goes*), and the –TENSE setting is rewarded by verb forms with no overt tense marking (e.g., *We go*). According to the VLM, OI errors occur when children learning languages that use tense-marking have yet to definitively set the TENSE parameter to +TENSE, but are still entertaining the –TENSE setting (which is the target setting for languages such as Mandarin Chinese); such errors disappear as the child encounters more and more evidence of overt tense-marking in the input.

Legate and Yang (2007) show that the VLM can explain quantitative differences in the length of the OI stage in three languages (English, French and Spanish). Thus, in line with the VLM, the OI stage tends to be longest in English, which has the least overt tense marking of the three languages, and shortest in Spanish, which has the most overt tense marking. However, a critical weakness of the VLM is that, because it explains OI errors at the level of the underlying grammar, it predicts that correct finite forms and OI errors will occur in free variation in the child's speech. In fact, however, there is substantial evidence that, in most OI languages, the contexts in which OI errors occur are semantically constrained. For example, Hoekstra and Hyams (1998) point out that OI errors are typically subject to what they call the 'Modal Reference Effect' and the 'Eventivity Constraint' (Hoekstra & Hyams, 1998: 89).

The Modal Reference Effect refers to the fact that, in most OI languages, OI errors tend to express desires or wishes or refer to unrealized events. For example, when children produce errors such as **Sara bygga ett slott* ('*Sara build a castle*') they tend to mean something like '*Sara wants to build a castle*' or '*Sara will build a castle*' rather than '*Sara builds a castle*' or '*Sara is building a castle*'. This observation was first made for Dutch-speaking children by Van Ginneken as early as 1917, and has since been confirmed by Krämer (1993) and Wijnen (1998). It has also been made for French-speaking children (Ferdinand, 1996), German-speaking children (Ingram & Thompson, 1996), and Swedish-speaking children (Josefsson, 2002).

The Eventivity Constraint refers to the fact that, in most OI languages, OI errors are restricted to eventive as opposed to stative verbs. Eventive verbs are verbs that refer to dynamic events such as *build* and *read*. Stative verbs are verbs that refer to continuous states such as *want* and *fit*. In his analysis of 4 Dutch-speaking children, Wijnen (1998) found that 89% of the utterances containing an OI error had modal meanings, and 95% of these errors involved an eventive verb (see also Blom, 2003). Similar observations have been made in French (Ferdinand, 1996), German (Becker & Hyams, 2000; Lasser 1997) and Swedish (Josefsson, 2002). Interestingly, however, neither the Modal Reference Effect nor the Eventivity Constraint seems to apply to English. For example, Deen (1997) found that only 13% of the OIs in a naturalistic corpus of early child English had a modal meaning, and only 75% included an eventive verb; and Blom, Krikhaar and Wijnen (2001) found that only 44% of the OI errors that English-speaking children produced in an elicited production task had a modal meaning, compared with 64% of the OI errors that Dutch-speaking children produced.

2.3. MOSAIC

An alternative attempt to explain the graded nature of the OI phenomenon is offered by a recent constructivist account, the Model of Syntax Acquisition in Children (MOSAIC) (Freudenthal, Pine, & Gobet, 2006; Freudenthal, Pine, Aguado-Orea, & Gobet, 2007; Freudenthal, Pine & Gobet, 2009; 2010). This account differs from generativist explanations in that its core assumption is that children learn chunks of language directly from the input and only gradually build up the grammar of the language to which they are exposed. According to MOSAIC, children have no innate knowledge of grammar but their learning is constrained by a strong utterance-final bias, which means that children learn strings of language from the right edge of an utterance (e.g., ~~*Will*~~ *Sarah build a castle*? ~~*Mummy helped*~~ *Sarah build a castle* →**Sarah build a castle*). The current version of MOSAIC also instantiates a smaller utterance-initial bias, which means that the model also learns from the left edge of an utterance. This allows it to produce strings with missing sentence-internal elements (e.g., *Sarah* ~~*will*~~ *build a castle*, *Sarah* ~~*wants to*~~ *build a castle* →**Sarah build a castle*).

According to MOSAIC, OI errors are truncated utterances learnt from compound finite structures in the input, the majority of which are modal (e.g., *Sarah*

~~will~~ build a castle, *Adam ~~can~~ read a book*,)[5]. In a series of studies, Freudenthal et al. have shown that this kind of account can explain several features of the cross-linguistic patterning of OI errors. Thus, Freudenthal et al. (2007) show that MOSAIC can explain both the apparently qualitative difference in the rate of OI errors between Dutch/German and Spanish and the more subtle quantitative difference in the rate of OI errors between Dutch and German. In both cases, these differences result from the interaction between MOSAIC's utterance-final bias and the rate of non-finite versus finite verb forms in utterance-final position in the input. In a later study, Freudenthal et al. (2009) show that MOSAIC can simulate both the Modal Reference Effect and the Eventivity Constraint in Dutch and German, and the absence of these effects in English. The Modal Reference Effect and the Eventivity Constraint are simulated because the vast majority of compound finites in German and Dutch have modal and eventive semantics. The absence of these effects in English is simulated because the use of do-support in English results in a large number of compound finite utterances that do not have modal semantics (e.g., *Does Eve want a cookie*? *It does fit there*) and are consequently not restricted to eventive verbs. Finally, in a more recent study, Freudenthal et al. (2010) show that, as predicted by MOSAIC, the by-verb rate of OI errors in English, Dutch, French, German and Spanish is related to the rate at which the verb occurs as an infinitive in compound structures in the input (e.g., high for eventive verbs like *build* and *read* and low for stative verbs like *want* and *fit*). The implication is that the OI errors produced by children in these five languages had indeed been learned from compound finites in the input (see Laaha & Bassano (2013) for a similar analysis of OI errors in French and German).

2.4. The Dual Mechanism Account

It is clear that the account of OI errors implemented in MOSAIC can explain a number of features of the cross-linguistic data. However, Freudenthal et al. (2010) also identify an important weakness of this account: that it seriously underestimates

5 It should be noted that the account implemented in MOSAIC is similar in some respects to a class of generativist models (e.g. Boser, Lust, Santelmann & Whitman, 1992; Ferdinand, 1996) that treats OI errors as finite clauses that contain a null modal. However, the null modal hypothesis provides no explanation of why OI errors occur so much more frequently in early Dutch and German than modal constructions in the input, nor of why OI errors are so rare in languages like Spanish and Italian, which also have modal + infinitive constructions. The learning mechanism implemented in MOSAIC provides a simple and elegant explanation of both of these phenomena, which provides a good fit to quantitative data on the rate at which children produce OI errors at different MLU levels in Dutch, German and Spanish.

the rate of OI errors in early child English[6]. More specifically, they show that MOSAIC provides a good fit to the rate of OI errors at MLU = 2.0 in Dutch, French, German and Spanish, but underestimates the rate of OI errors in English children's speech by approximately 25%. This finding leads them to argue for a dual mechanism account of OI errors in English, in which some OI errors are truncation errors learned from compound finite structures in the input, and some OI errors reflect a process of defaulting to the highest frequency form in the input (in this case the bare stem). According to this view, the former type of error involves the incorrect use of an infinitive and is analogous to the kind of OI errors observed in languages in which the infinitive is not a bare stem (*Sarah ~~will~~ build a castle*). However, the latter kind of error involves the incorrect use of a bare finite form (*Sarah builds → build a castle*), and is analogous to the kind of defaulting error that has been observed in more highly inflected languages such as Finnish (Laalo, 1994; 2003; Toivainen, 1980) and Spanish (Radford & Ploenning-Pacheco, 1995; Aguado-Orea, 2004). For example, Aguado-Orea (2004) reports data from a Spanish-speaking child Juan who produced errors in which he used the most frequent (tensed) form of the verb (the 3sg present tense) in contexts in which a less frequent tensed form (e.g. the 3pl present tense) was required (e.g., **Los niños juega* '*The children plays*'). Interestingly, Juan produced this kind of defaulting error alongside OI errors (e.g., **Los niños jugar* '*The children play-INF*'), though both types of error were relatively rare.

In a recent study, Räsänen, Ambridge and Pine (2014) tested the dual mechanism account using a picture-description task in which 3sg forms were elicited from English-speaking children in simple finite contexts (e.g., Sarah builds a castle). The results revealed that, across the 48 verbs used in the study, the proportion of bare forms versus 3sg forms (e.g. *build* vs *builds*) in a corpus of child-directed speech was a significant positive predictor of the OI error rate (e.g., *Sarah build* vs *Sarah builds*). This finding suggests that at least some OI errors in English reflect a process of defaulting to the bare stem, and is consistent with the dual mechanism account.

6 Note that Freudenthal et al. (2010) also show that Legate & Yang's (2007) VLM suffers from the same problem.

2.5. The present study

Räsänen et al.'s (2014) results provide support for the view that some OI errors in English reflect a process of defaulting to the bare stem. However, the dual mechanism account also assumes that many OI errors in English, and all OI errors in other OI languages, have been learned from compound structures in the input[7]. It therefore predicts that children learning English will produce OI errors in both modal contexts (e.g., *Sarah will build a castle*) and non-modal contexts (e.g., *Sarah builds a castle*), whereas children learning other OI languages will only produce OI errors in modal contexts (e.g., *Sarah will build a castle*). The aim of the present study is to test this prediction by comparing the pattern of OI errors made by children learning English and children learning another OI language (Swedish) in modal and non-modal contexts.

The reason for choosing Swedish as the comparison language is that, although a typical OI language, it shares certain features with English, which distinguish it from other OI languages such as Dutch and German. Thus, on the one hand, like most OI languages, and unlike English, Swedish is subject to both the modal reference effect and the eventivity constraint (Josefsson, 2002). On the other hand, like English, Swedish has a relatively impoverished system of verb morphology, and Swedish infinitives are not restricted to utterance-final position, as they are in Dutch and German. These features of Swedish mean that it is possible to elicit modal and non-modal structures in Swedish that are very similar to the equivalent structures in English. For example, consider the following pairs of stimulus sentences used in the present study:

(8) *Ben will build a castle*

(9) *Per ska bygg-a ett slot*

Per AUX build-INF a castle

'Per will build a castle'

(10) *Ben builds a castle*

(11) *Per bygg-er ett slott.*

7 Note that this prediction does not imply that all OIs in languages other than English will have modal semantics since not all compound finite structures have modal semantics, but it is consistent with the claim that OI languages other than English are subject to the modal reference effect, whereas English is not.

Per build-3SG a castle

'Per builds a castle'

In the modal examples in (8) and (9), the English verb build is a zero-marked infinitive, which combines with the modal auxiliary will to refer to an unrealized event and the Swedish verb *bygga* is a infinitive marked with the infinitival morpheme *–a*, which combines with the modal auxiliary *ska* to refer to an unrealized event. In the non-modal examples in (10) and (11), the English verb builds is a tensed form marked with the 3sg present tense inflection *–s* and the Swedish verb *bygger* is a tensed form marked with the present tense inflection *–er* (note that Swedish verbs are not inflected for either person or number). It is clear that these English-Swedish sentence pairs are structurally very similar. However, because the English infinitive is a bare stem and the Swedish infinitive carries a distinct infinitival marker, the dual mechanism account makes different predictions about the kind of errors that children learning English and children learning Swedish will make when these structures are elicited. More specifically, it predicts that, because, in English, the infinitive is indistinguishable from the highest frequency finite form, children learning English will make OI errors in both modal contexts (Ben will build a castle) and non-modal contexts (*Ben builds → build a castle*). However, because, in Swedish, the infinitive is clearly distinguishable from the highest frequency finite form, children learning Swedish will only make OI errors in modal contexts (*Per ska bygga ett slott*). Since English OI errors are assumed to reflect the distributional patterning of bare stems in the input and Swedish OIs are assumed to reflect the distributional patterning of infinitives, it also predicts that the by-verb rate of OI errors in English will be related to the relative rate of bare versus 3sg forms in English child-directed speech, whereas the by-verb rate of OI errors in Swedish will be related to the rate of infinitives versus finite verb forms in Swedish child-directed speech.

These predictions are complicated slightly by the fact that, as pointed out by Josefsson (2002), for Swedish first and third conjugation verbs, infinitives (e.g., *baka 'bake', öppna 'open'; få 'get', bo 'live'*) and present tense forms (e.g., *bakar, öppnar, får, bor*) are effectively homophonous, making it impossible to distinguish between OI errors and correct finite forms. This is because, in spoken Swedish, the final *–r* is not pronounced very distinctly, and is dropped completely in certain dialects (Hansson, 1998). Some researchers (e.g., Hansson & Leonard, 2003; Josefsson,

2002) have explicitly excluded first conjugation verbs from their analyses for precisely this reason, but others (e.g., Platzack, 1990, Phillips, 1995) have not. This raises the possibility that the high rate of OI errors reported in some studies of early child Swedish may be something of an overestimate. In the present study, we deal with this problem by including both ambiguous and non-ambiguous verbs in our stimulus set in order to see if the verb type has any effect on the OI error rates. If there is a clear difference in the rate of OI errors when ambiguous verbs are excluded, this will tend to support Josefsson's analysis, and suggest that the high rates of OI errors reported in some previous analyses of Swedish may be somewhat exaggerated.

To summarise, the aim of the present study is to test the dual mechanism account of OI errors in English by comparing the pattern of OI errors made by English- and Swedish-speaking children in modal and non-modal contexts in an elicited production task. In line with the dual mechanism account, it is predicted that English-speaking children will make OI errors in both modal (*Ben will build a castle*) and non-modal contexts (*Ben builds a castle*) at similar rates, whereas Swedish-speaking children will only make OI errors in modal contexts (*Per ska bygga ett slott*) – or, at least, that this will be the pattern for non-ambiguous verbs. It is also predicted that the by-verb rate of OI errors in English will be related to the relative rate of bare versus 3sg forms in the input, whereas the by-verb rate of OI errors in Swedish will be related to the rate of infinitives versus finite verb forms in the input.

3. Method

3.2. Participants

The English sample consisted initially of 22 participants, recruited from two nurseries in the Liverpool area, UK. The Swedish sample consisted initially of 20 participants, recruited from four nurseries in Stockholm, Sweden. All children were typically developing, monolingual speakers of British English or Swedish, respectively. No standardized languages tests were applied, but all participants were described by their teachers as exhibiting normal language development. Thus, there is no reason to assume that the children were affected by any language disorders or had any particular problems with production of consonant clusters that could have affected, for instance, the production of 3sg *–s* in the English speaking children or

the production of *–r* in Swedish. Five English-speaking and five Swedish-speaking children were excluded from the study because of their reluctance to participate in the study. The final English sample included 16 participants (10 girls) with a mean age of 3;8 (range 3;2 – 4;6 years). The final Swedish sample included 15 participants (10 girls) with a mean age of 3;8 (2;11 – 4;7 years).

3.3. Design

A between-verbs, within-subjects design was used in this study. The dependent variable was the proportion of correct responses (i.e. the proportion of correct present tense verb forms in the non-modal condition and the proportion of modal + infinitive verb forms in the modal condition).

The stimuli consisted of 34 sentences and accompanying pictures, presented on a laptop computer. The pictures varied slightly for English and Swedish sentences, as the target sentences were matched in syllable length, which led to some differences in the meaning of sentences. The modal target sentences inevitably had one syllable more than the non-modal target sentences, since they contained the modal verb will or ska. The only exceptions were the irregular Swedish verbs *veta* '*know*', *vilja* '*want*' and *köra* '*drive*'. In these cases, the modal target sentences had two syllables more than the non-modal target sentences because of present tense form of the verb was only one syllable in length. The 34 verbs were divided randomly into two sets, and each child was randomly assigned to one of the two sets, for which each verb was elicited in both modal and non-modal contexts. The reason for dividing the stimulus set in this way was simply to reduce the number of trials that any one child had to complete.

The target verbs were selected on the basis of verb frequency counts, which, for the English verbs, were obtained from the child-directed speech of the 12 mothers in the Manchester corpus (Theakston et al., 2001) available in CHILDES (MacWhinney, 2000). This corpus was chosen to be representative of British-English child-directed speech heard by pre-school children. Verb frequency counts for Swedish verbs were obtained from the child Swedish corpora available on CHILDES (Plunkett & Strömqvist, 1992; Strömqvist & Andersson, 1993).

From the 100 verbs with the highest overall frequency in the Manchester corpus input data, we selected a set of 34 verbs and their equivalent Swedish translations from the Swedish corpus. These verbs were chosen to vary

continuously in terms of their values with respect to how often they appeared in present tense or bare/infinitival form (excluding verbs that appear only as auxiliaries). For English, the present tense forms were restricted to 3sg contexts, as the 3sg is the only form that carries overt present tense marking. For Swedish, there was no need to restrict the counts to a particular present tense context since the present tense inflection is the same for each person/number combination. The characteristics of the verbs are presented in Table 4.1. Note that, for English verbs, the proportion of bare forms, which cannot be distinguished from infinitives, is always very high (never falling below .77 and over .95 for 9 of the 17 verbs). However, for Swedish, the proportion of infinitives versus present tense forms ranges from as low .01 to as high as .96.

These verbs were used to create 34 non-modal and 34 modal trials (see Appendix C and Appendix D for the full set). Each non-modal trial had a 'set-up' sentence beginning with '*Every day*…' ('*Varje dag*...'). Each modal trial had a 'set-up' sentence starting with '*Tomorrow*…' ('*Imorgon*…'). These set-up sentences were followed by a sentence containing two clauses conjoined with '*and*' ('*och*'). For English stimuli, each of these two clauses included a 3sg subject and 3sg *–s* verb form (e.g., *Ben reads*.... and *Adam gives*...). For example, the complete non-modal trial for start was as follows (The pictorial stimuli used is depicted in Figure 4.1.):

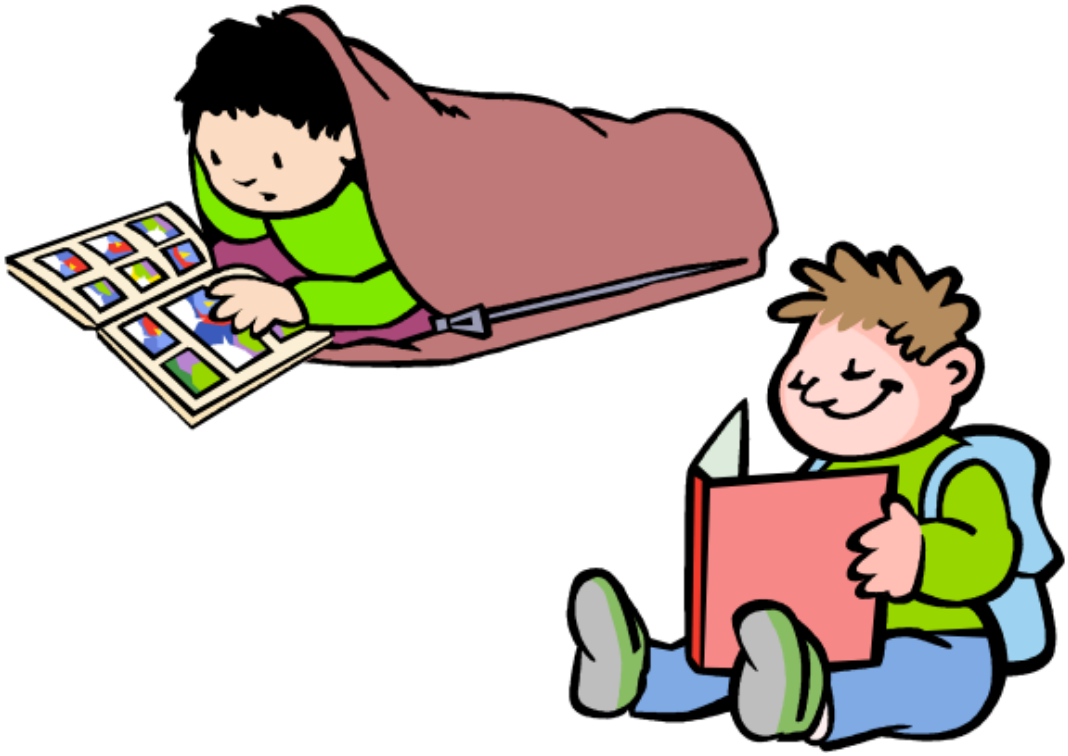

Figure 4.1. Illustration for the trial '*Tomorrow the children will start to read something. Ben will start a comic and… Adam will start a book*.'

The second clause of the stimuli (the underlined clause in the above example) was designed to be the target clause. Thus, this was the clause that children attempted to repeat in the training session, the aim of which was to familiarize children with the target verb, and to encourage them to produce it in the elicited-production test session. The Swedish target clause always began with a one-syllable word, which was the name of the character ('*Per*' or '*Ulf*'). The English target clauses always began with either a one-syllable name '*Ben*' or a two-syllable name '*Adam*'. The reason why the English target clauses sometimes begin with a two-syllable name was to match the overall number of syllables on each trial across the languages. The number of syllables varied from five to seven, and was included as a predictor in the regression analysis.

The phrase following the target verb in each language always started with a vowel in order to ensure that it would be easy to detect whether or not the child produced the 3sg *–s* morpheme, or the *–ar*/*er*/*r* morpheme in Swedish. Importantly, because all target clauses used a 3sg subject (e.g., *Ben*), the use of a bare form (e.g.,

Ben give a present) always constituted an OI error. In other words, the target clause to be produced by the child in non-modal contexts always constituted an obligatory context for 3sg –*s*. As we have seen above, there is no person/number marking in Swedish but only tense is marked.

In non-modal contexts the use of the '*Every day...*' sentence ensured that the use of the 3sg –*s* form (e.g., *Adam starts*) as opposed to the present progressive (*Adam is starting*) or past-tense form (*Adam started*) was natural in the non-modal context. Although the '*Every day*' prompt sets up a context of habitual aspect rather than ongoing action, this was unavoidable, as - in everyday spoken English - the use of a simple present tense form to describe an ongoing action (e.g., *Adam starts a book*) is extremely unnatural; the present progressive form (e.g., *Adam is starting a book*) would be used instead. In any case, this does not affect the predictions of the present study, which relate solely to the use of 3sg –s, regardless of aspect.

For each trial, an illustration (see Figure 4.1. for an example) was presented on a laptop computer (with a 17 inch screen) using PowerPoint. As an incentive to continue, children were invited to press the button to proceed to each subsequent picture. A microphone (Shure SM58) connected to the computer (running Audacity 1.3.12-Beta recording software) was used to record children's responses.

3.4. Procedure

The procedure was the same for both the English- and Swedish- speaking children, and followed the one used by Räsänen et al. (2014). A training session was completed by each child on Day 1, designed to make them familiar with the target verb in each picture, and thus, increase the likelihood that they would use that verb in the test session. This was followed by a test session on the following day. Depending on the child, each session lasted approximately 20-30 minutes. In both sessions, each child completed all the trials in one of two pre-determined pseudo-random orders. Each child was tested individually with a member of nursery staff present. The experimental sessions were audio-recorded by using Audacity 1.3.12-Beta running in the background on the same laptop.

3.4.1. Day 1 – Training Session

The elicited-imitation training session was aimed to teach children the relevant target response for each trial, and by doing so, to ensure that, in the subsequent elicited-production test session, they would attempt this "target clause" instead of

making up their own utterances, perhaps using non-target verbs. The child was seated in front of the laptop, and was told that she would be playing a turn-taking game with the experimenter in which they would describe some pictures together. To make the child feel more relaxed and comfortable, a brief warm-up that involved "testing the microphone" was completed by the child. This involved the child producing her own name and those of the story characters. The first picture was then brought up on the screen by the experimenter, who produced the set-up sentence (e.g., *Today the children start to read something*) and the conjoined-clause sentence ending in the target clause (e.g., *Ben starts a comic and Adam starts a book*). The experimenter then asked '*Can you say* [target clause]?' to elicit an attempted repetition. Most children spontaneously imitated the target clause after a few trials. If the child did not attempt to repeat the sentence after three prompts of this kind, the experimenter moved on to the next picture. Altogether, 10 children were excluded from the study for failing to repeat four consecutive trials during this training phase. There were no additional drop-outs during the test phase.

3.4.2. Day 2 – Test Session

The elicited-production test session began with the experimenter advising the children that they would be playing the same game as the day before, but this time their task would be to try to remember what was going on in each picture and tell the experimenter. The procedure was similar to that of the training session: The experimenter started by saying e.g., '*Everyday the children start to read something. Ben starts a comic and* …'). However, instead of producing the target sentence, the experimenter simply pointed at the relevant character and awaited the child's response. If the child did not attempt a response, the experimenter modelled the beginning of the target clause (e.g., '*Adam*...') up to three times, before moving on to the next picture. However, this kind of prompt was rarely required.

3.5. Transcription, scoring and reliability

The responses were transcribed from the audio recordings and coded by the first author. Each response was coded as correct (*N*=494), incorrect (*N*=214) or other/unscorable (*N*=346). For English non-modal contexts, the correct response was the 3sg *–s* form of the verb (e.g., *buys*). If children produced the bare form (e.g., *buy*), it was coded as incorrect. For Swedish non-modal contexts, the correct

response was the present tense form of the verb (e.g., *köper*). If an infinitival form was produced (e.g., *köpa*), this was coded as incorrect.

For English modal contexts, the responses were coded as correct if they included both the modal auxiliary *will* and the bare form of the target verb (e.g., *will buy*). Similarly, for Swedish modal contexts, the responses were coded as correct if they included both the modal auxiliary *ska* and the infinitival form of the target verb (e.g., *ska köpa*). If children produced only the bare form in English, or the infinitival form in Swedish, the response was coded as incorrect. Any other responses, including present tense forms, were coded as other/unscorable and excluded from the analysis.

Other/unscorable responses in both conditions for both English and Swedish included for instance non-target verbs (e.g., *walk*, if the target was *run*), no response at all, past-tense/present progressive responses, and incomprehensible/inaudible responses. Object substitutions were ignored as the focus of this study was the children's use of verb inflection. The average number of unscorable responses per child was 11.53 (SD = 7.47), and – as would be expected – the rate of these responses significantly decreased with increasing age (simple Pearson r= -.162, p < .001).

In order to calculate reliabilities, 10% of the responses were transcribed independently by a trained undergraduate research assistant blind to the hypotheses under investigation. Agreement was 97.3%. Any disagreements regarding the type or presence of inflection were subjected to re-listening until agreement was reached.

4. Results

Figure 4.2. below presents the means with standard errors for children's correct performance broken down by the context (modal/non-modal) and language (English/Swedish). Separate columns are also shown for Swedish modal and non-modal contexts after excluding ambiguous verbs. By looking at this figure, it can be seen that overall children had better performance in simple finite (non-modal) contexts in both English and Swedish, although the difference in English appears small, as predicted (71.89% for modal contexts vs 77.32% for non-modal contexts). Importantly, after excluding ambiguous Swedish verbs, the performance in the non-

modal context is now close to 100%. This patterning of the data appears to support to the dual-mechanism account outlined in Introduction.

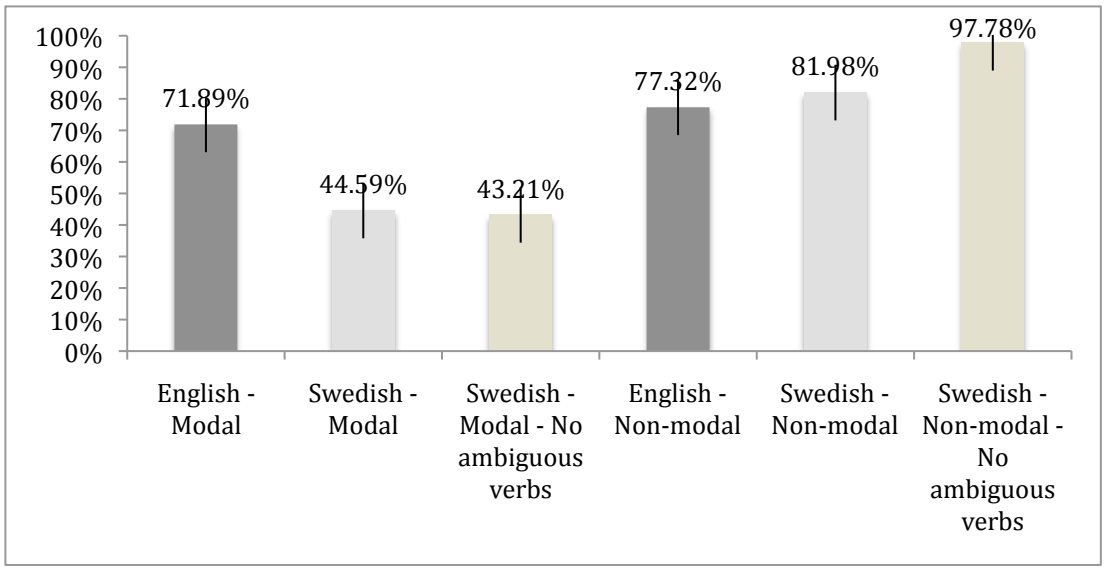

Figure 4.2. Children's correct performance in modal and non-modal context by language.

Appendix E provides the details of the mean proportion of correct responses broken down by the context and language for each verb together with the proportional frequency of bare forms vs 3sg –*s* forms for English and the proportional frequency of infinitives vs present tense forms for Swedish.

In order to investigate the children's performance across language and sentence context, mixed-effects regression models with items and participants as random effects were constructed (see Baayen, 2008). The advantage of using such an approach is that compared with traditional by-subjects/items regression analysis, mixed-effect models take both by-subject and by-item variation into account, and thus provide a more powerful statistical analysis. As the outcome variable was different in modal and non-modal contexts (modal + infinitive form and present tense form, respectively), separate models were run for modal and non-modal contexts.

Since the outcome measure was dichotomous (for each target, each child produced either a correct or an incorrect response [coded as 1/0], with other responses treated as missing data), binomial logistic regression models were used. As fixed effects the continuous effects of age and the proportion of bare forms/infinitives in child-directed speech were used (henceforth the input

predictor). The categorical variable of interest was language (Swedish=0; English=1). Preliminary analysis revealed that the verb set that the children were exposed to did not have any effect on their performance (modal context: *M*=-0.06, *SE*=0.14, *t*[30.51]=-0.44, *p*=.660; Non-modal context; *M*=-0.07, *SE*=0.08, *t*[34.88]=-0.90, *p*=.373). This variable was therefore not included in any subsequent analyses.

For Modal contexts, Model 1 was run (see Table 4.1. for the details of the models). This included the variables of syllable length of the target sentence, age, language and the input predictor described above. Syllable length of the sentence did not have any significant effect on the data (*p*=.200). Age, as would be expected, was a positive predictor of correct performance: older the children were, the more correct responses they provided (*p*=.017). As shown in Figure 4.2., English children were better as opposed to Swedish children in producing the correct modal + infinitive structures (*p*=.050). This result suggest that Swedish-speaking children's OI errors are semantically conditioned, whereas English speaking children's OI errors are not, and are therefore consistent with the view that OI errors in Swedish are truncated modals learned from compound finite structures in the input whereas many OI errors in English reflect a process of defaulting to the bare stem regardless of the sentence context. Interestingly, the input predictor was not significant (*p*=.354); however, this could be due to the fact that this condition was priming modal + infinitive structures, leading children to truncate these structures especially in Swedish. McFadden's Pseudo R^2 value, which compares the log likelihood of the best-fit model to a model with only the intercept, was 0.37 for this model.

To see if excluding ambiguous Swedish verbs would make any difference, the model was rerun without these verbs. This model (Model 1b) now showed no significant difference for languages (*p*=0.149) – this was most likely due to lack of power as a result of small sample size. As shown in Figure 4.2., excluding these verbs in Swedish did not make much difference to the correct performance (difference of 1.38%).

Table 4.1. *Mixed-Effects Regression Models Fitted to the Data.*

Model 1: Modal context

Variable	β	*SE*	*df*	*t*	*p*
(Intercept)	0.13	0.55	64.46	0.23	0.821
Syllables	-0.07	0.05	50.73	-1.30	0.200
Age	**0.02**	**0.01**	**28.01**	**2.53**	**0.017**
Language	**-0.26**	**0.13**	**39.63**	**-1.96**	**0.050**
Input predictor	-0.11	0.12	72.05	-0.93	0.354

Note. Model log likelihood = -152.87. Random effects: Verb (*Var*=0.01, *SD*=0.10), Participant (*Var*=0.10, *SD*=0.31)

Bold values indicate that effect is statistically significant at $p < .05$ or greater.

Model 2: Non-modal context

Variable	β	*SE*	*df*	*t*	*p*
(Intercept)	0.64	0.41	80.1	1.56	0.123
Syllables	0.01	0.05	58.68	0.21	0.838
Age	0.01	0.01	27.28	1.22	0.232
Language	-0.04	0.1	53.99	-0.37	0.701
Input predictor	**-0.29**	**0.12**	**67.28**	**-2.34**	**0.022**

Note. Model log likelihood = -164.74. Random effects: Verb (*Var*=0.02, *SD*=0.13), Participant (*Var*=0.03, *SD*=0.18)

Bold values indicate that effect is statistically significant at $p < .05$ or greater.

Model 0: Null model - Modal context

Variable	β	*SE*	*df*	*t*	*p*
(Intercept)	**0.59**	**0.03**	**2**	**22.32**	**<.001**

Note. Model log likelihood = -242.13.

Model 0: Null model - Modal context

Variable	β	*SE*	*df*	*t*	*p*
(Intercept)	**0.80**	**0.02**	**2**	**37.63**	**<.001**

Note. Model log likelihood = -187.29)

Model 1b: Modal context - No ambiguous Swedish verbs

Variable	β	*SE*	*df*	*t*	*p*
(Intercept)	-0.46	0.61	63.33	-0.75	0.455
Syllables	-0.01	0.06	36.09	-0.54	0.958
Age	**0.02**	**0.01**	**27.97**	**2.5**	**0.017**
Language	-0.21	0.14	45.94	1.47	0.149
Input predictor	0.04	0.15	64.74	0.28	0.784

Note. Model log likelihood = -115.24. Random effects: Verb (*Var*=0.01, *SD*=0.09), Participant (*Var*=0.10, *SD*=0.31)

Bold values indicate that effect is statistically significant at $p < .05$ or greater.

Model 2b: Non-modal context - No ambiguous Swedish verbs

Variable	β	*SE*	*df*	*t*	*p*
(Intercept)	0.42	0.37	88.92	1.13	0.264
Syllables	0.01	0.04	262.06	0.32	0.746
Age	0.01	0.01	31.38	1.21	0.237
Language	**0.20**	**0.09**	**62.78**	**2.09**	**0.041**
Input predictor	-0.09	0.11	263.49	-0.80	0.422

Note. Model log likelihood = -85.92. Random effects: Verb (*Var*=0.00, *SD*=0.00), Participant (*Var*=0.03, *SD*=0.18)

Bold values indicate that effect is statistically significant at $p < .05$ or greater.

For Non-modal context, Model 2 (including all verbs) revealed that there were no significant differences in the correct performance between English and Swedish. Figure 4.2. confirms that Swedish-speaking children's performance was slightly better (81.98% vs. 77.32%). In other words, in simple finite contexts, both languages displayed similar error rates. Unlike in modal contexts, the input predictor was now significant (p=.022): this reflected the fact that better performance in simple finite contexts was predicted by the proportion of bare forms/infinitives vs 3sg –s forms in English and infinitives in Swedish. Thus, the more often a particular verb appeared as either a bare form in English or an infinitive in Swedish, the more likely children were to produce an OI error instead of the correctly inflected present tense form. This relationship is plotted in Figure 4.3. The McFadden's Pseudo R^2 for this model was 0.12.

This finding is in line with the results of a similar elicited production study by Räsänen et al. (2014) with English-speaking children, and a corpus-based study by Freudenthal et al. (2010) with children learning Dutch, English, French, German and Spanish, and suggests that the input effects documented in these studies can be extended to Swedish-speaking children. It thus provides strong support for the idea that OI errors are learned directly from the input.

Perhaps surprisingly, there was no significant effect of age in non-modal context but there was one in modal context. This could be explained by the small sample size, as well as the fact that modal structures are more complex, and age effects are easier to detect.

As with the modal context, the analysis was rerun with ambiguous Swedish verbs removed. Excluding these verbs led to the input predictor to become non-significant, perhaps due to loss of data. However, a significant difference was detected between English and Swedish (p=.041) – as per Figure 4.2., Swedish-speakers' performance in non-modal contexts was significantly better. This is consistent with the hypothesis that most OI errors in Swedish are truncated modal structures, and in non-modal contexts the correct form is provided most of the time – it should be born in mind that there is only one present tense form that

applies to all person/number combinations, and thus, is often much more frequent in the input than the infinitive.

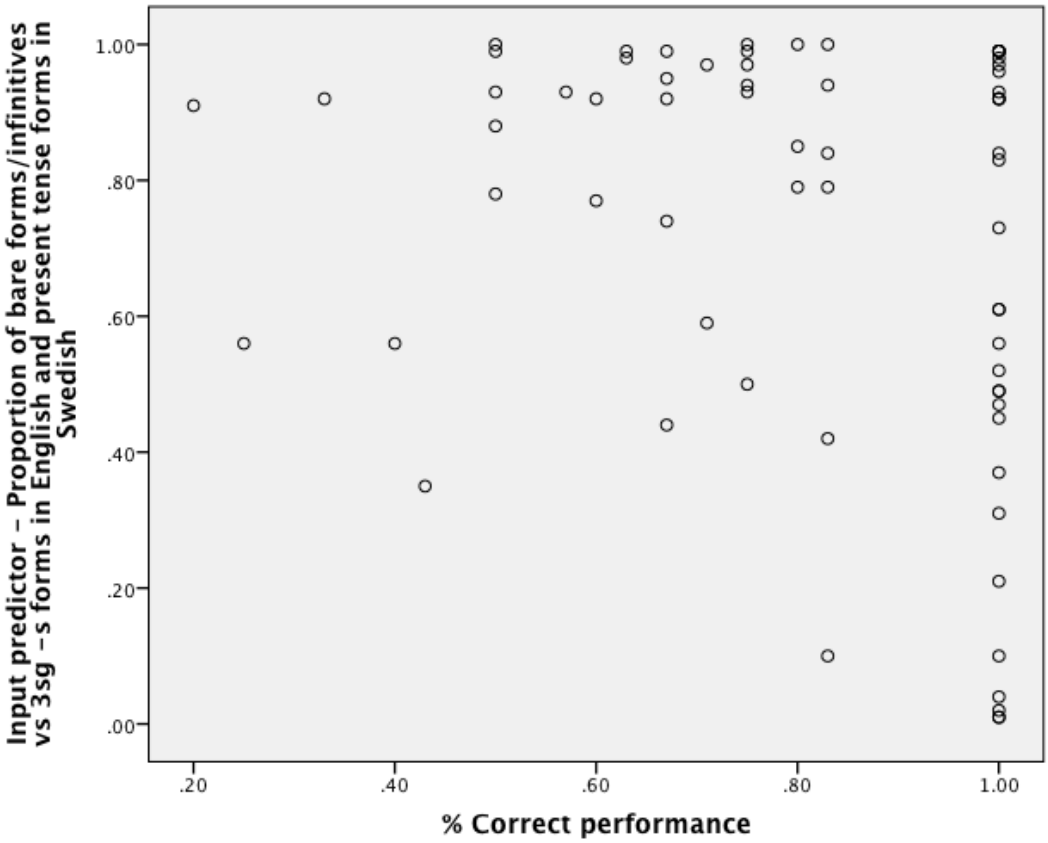

Figure 4.3. The positive relationship between the correct performance and the input predictor (proportion of bare forms/infinitives vs 3sg *–s* forms in English and present tense forms in Swedish).

When taken together the results described above provide strong support for the dual mechanism account. Furthermore, it could be argued that in addition to predicting a different pattern of errors in English and Swedish, the dual mechanism account also predicts that rate at which Swedish-speaking children make OI errors in non-modal contexts will be close to zero. The correct performance rate of 81.98% reported in Figure 4.2. might seem to be at odds with this prediction. However, as noted earlier, the situation is complicated by the fact that for many verbs in Swedish (and 16 of the verbs in the present study), it is impossible to distinguish between OI errors and finite forms from which the final *–r* has been dropped for phonological reasons. The prediction that Swedish-speaking children will not make OI errors in non-modal contexts can therefore only be properly tested by focusing on a subset of non-ambiguous verbs. As we can see in Figure 4.2.,

when ambiguous verbs are excluded, the rate of correct performance in Swedish non-modal contexts increases to 97.78%. Thus, the overall rate of correct performance in modal contexts hides different rates for ambiguous and non-ambiguous verbs. These results are consistent with the view that collapsing across ambiguous and non-ambiguous verbs leads one to overestimate the rate of OI errors in Swedish-speaking children. They also suggest that once one controls for this confound, the rate at which Swedish-speaking children produce OI errors in non-modal contexts is close to zero. They thus provide further support for the dual mechanism account.

5. Discussion

The aim of the present study was to evaluate the dual mechanism account of OI errors in English by comparing the pattern of OI errors made by children learning English and children learning another OI language (Swedish) in modal and non-modal contexts using an elicited production paradigm. In line with the dual mechanism account, the results showed, first, that English-speaking children produced OI errors at similar rates in modal and non-modal contexts, whereas Swedish-speaking children produced clearly more OI errors in modal contexts; second, that it was possible to predict the by-verb rate of OI errors in English and Swedish in terms of the proportion of bare verb forms versus present tense forms in English and the proportion of infinitive versus present tense forms in Swedish; and, finally, that, once one controlled for the fact that, for many Swedish verbs, it is difficult to distinguish between the infinitive and the present tense form, the rate of correct performance in non-modal contexts in Swedish increased to almost 100% (i.e. 97.78%).

These results provide strong support for the dual mechanism account of OI errors in English for two reasons. First, they support the view that, although in most OI languages, OI errors tend to have a modal reading, OI errors in English are not subject to this modal reference effect. Of course, this view, strongly advocated by Hoekstra and Hyams (1998), is not peculiar to the dual mechanism account (see also Ferdinand, 1996; Ingram & Thompson, 1996; Deen, 1997; Wijnen, 1998; Josefsson, 2002). However, it does imply that OI errors in English are different, in some important respects, from OI errors in Swedish, and is hence consistent with the idea that the causes of OI errors in the two languages are also somewhat

different. It is also at odds with a number of generativist models of the OI stage (e.g. Rizzi, 1994/1995; Wexler, 1994; 1998; Legate & Yang, 2007), which predict that correct finite forms and OI errors will occur in free variation in the child's speech. For example, Legate & Yang's (2007) VLM, explains OI errors in terms of the probabilistic use of a grammar with an incorrect parameter setting (in this case [-Tense]). Since the frequency with which this incorrect parameter setting is used is related to the relative frequency of overt tense marking in the input, rather than the semantic contexts in which infinitive forms occur, the VLM cannot explain why OI errors tend to have modal semantics, and would predict similar rates of errors in modal and non-modal contexts in both English and Swedish.

Second, these results provide support for the view that OI errors in both Swedish- and English-speaking children are related to by-verb variation in the relative frequency with which they hear different forms of the verb in the input. More specifically, they show that Swedish-speaking children are more likely to make OI errors with verbs that tend to occur as infinitive forms in the input, whereas English-speaking children are more likely to make OI errors with verbs that tend to occur as bare forms in the input, regardless of whether these forms are functioning as finite forms (e.g. *We go*) or infinitives (e.g. *We will go*). This result is consistent with the view that OI errors in Swedish are truncated modals that have been learned from compound structures in the input, whereas many of the OI errors produced by English-speaking children reflect a different process of defaulting to the highest frequency finite form in the input (in this case the bare stem). It is also a finding that is particularly difficult for generativist theories of the OI stage to explain, since such theories assume that OI errors reflect underlying differences between the child and the adult grammar, rather than differences in children's knowledge with respect to particular verbs. They thus have no means of explaining input effects at the level of particular lexical items.

One possible reason for questioning the validity of these results is that the children who participated in the present study were relatively old (3;8 on average), and hence may have no longer been in the OI stage. There are, however, a number of features of the data that argue against this conclusion. The first is that, although the Swedish-speaking children produced very few OI errors in non-modal contexts, the rate at which the children produced OI errors in all of the other cells of the design was relatively high, decreasing with age (in modal contexts) in precisely the

way one would expect if a reasonable proportion of the sample were still in the OI stage. Thus, it was not the case that the children did not make OI errors; it was rather that they made OI errors at relatively high rates in precisely those cells of the design in which such errors would be predicted by the dual mechanism account, and at very low rates in the one cell of the design in which such errors would not be predicted.

The second is that the pattern of results reported in the present study is consistent with the results of a number of studies of OI errors in English, Swedish, and a wider range of languages, using a range of different methodologies, and conducted by researchers from both sides of the generativist/constructivist divide. For example, there is now a wealth of evidence suggesting that in many OI languages, OI errors tend to have modal reference, but that this is not true of OI errors in English. Thus, on the one hand, Josefsson (2002) argues strongly for a modal reference effect in Swedish-speaking children, similar to that reported for a number of other OI languages, including Dutch (Wijnen, 1998), French (Ferdinand, 1996) and German (Ingram & Thompson, 1996). On the other hand, Deen reports no such effect for English in an analysis of naturalistic speech data; and Blom et al. (2001) report significantly lower rates of OIs in modal contexts in English- than in Dutch-speaking children in an elicited production study.

A similar point can be made about the input effects reported in the present study, which are consistent with the results of two recent studies showing that it is possible to predict by-verb rates of OI errors in terms of the relative frequency of bare/infinitive forms in the input. Thus, Freudenthal et al. (2010) report significant by-verb correlations between the rate of OI errors in children's naturalistic speech and the proportion of infinitives versus simple finite forms in English, Dutch, French, German and Spanish child-directed speech; and Räsänen et al. (2014) report a significant by-verb relation between the rate of OI errors in non-modal contexts in English and the relative frequency of bare versus 3sg *–s* forms in English child-directed speech in an elicited production study similar to the one reported here. When taken together these results and the results of the present study provide strong support for the view that it is possible to explain the patterning of OI errors in children's data in terms of the distributional properties of the input to which they are exposed. They also provide a potential means of explaining why MOSAIC, a computational model that simulates the cross-linguistic patterning of OI errors has

a particular problem simulating the very high rates of OI errors in early child English. This is because, in its current form, MOSAIC can only produce OI errors by learning them from compound finite structures in the input, and hence only implements one of the mechanisms in the dual mechanism account.

Finally, it is worth noting that the dual mechanism account of OI errors in English also provides a potential means of integrating the literature on verb-marking errors across OI and non-OI languages. This is because it assumes that there are at least two sources of such errors in children's early speech: the first being the tendency to truncate compound finite forms and the second being the tendency to default to the phonologically simplest or highest frequency form in the input. It therefore has the potential to explain not only the cross-linguistic patterning of OI errors, but also the cross-linguistic patterning of errors in non-OI languages such as Finnish and Spanish, where defaulting errors tend to be more common (Laalo, 1994; 2003; Radford & Ploenning-Pacheco, 1995; Aguado-Orea, 2004), and the fact that, in some cases at least, children have been observed to use both infinitives and finite forms incorrectly in their speech (Aguado-Orea, 2004). One obvious direction for future research to take is therefore to build more explicit models of the two processes assumed within the dual mechanism account and to test them against cross-linguistic data from both OI and non-OI languages.

To conclude, the present study used an elicited production paradigm to test two critical predictions of the dual mechanism account of OI errors in English. In line with the dual mechanism account, the results showed 1) that English-speaking children produced OI errors at similar rates in modal and non-modal contexts, whereas Swedish-speaking children only tended to produce OI errors in modal contexts; and 2) that it was possible to predict the by-verb rate of OI errors in English and Swedish in terms of the proportion of bare verb forms versus present tense forms in English and the proportion of infinitive versus present tense forms in Swedish. These results provide strong support for the dual mechanism account and, more generally, for the view that it is possible to explain the patterning of OI errors in children's data in terms of the distributional properties of the input to which they are exposed.

Chapter 5. Experiment 3. Comparing generativist and constructivist accounts of the acquisition of inflectional morphology: An elicited production study of Finnish

1. Rationale for Experiment 3

The two previous experimental chapters have looked at the Optional Infinitive phenomenon in both English and Swedish. The results so far have revealed that input has a large effect on children's acquisition of inflectional morphology. Experiment 3 in this chapter examines a non-OI language, Finnish. As seen in Chapter 2, non-OI languages tend to be morphologically richer, and therefore, are highly suitable for investigating person/number-marking errors, and – in particular - the defaulting process suggested by the previous two experiments to be partly responsible for the high OI error rate in English. Specifically, the prediction is that the same defaulting process that yields (apparent) OI errors in English will yield incorrect person/number marking errors in Finnish.

Although a very morphologically rich language, Finnish has been seriously understudied in the field of child language acquisition. Most of the studies that have been conducted on Finnish verb morphology are small-scale naturalistic studies that were designed to investigate the order of acquisition of different inflections. The data sets are usually very thin and often collected using a pen-and-paper approach. For instance, Laalo (2000) based his theory of miniparadigms on just 360 minutes of recordings of one Finnish-speaking child (supplemented by some diary data) between the ages of 1;7-2;1 (1256 utterances) (see also Argoff, 1976; Bowerman, 1973; Laakso, 2007; Niemi & Niemi, 1987; Riionheimo, 2002ab for other naturalistic studies on the acquisition of Finnish). The most extensive naturalistic study of inflectional morphology in child Finnish was conducted by Toivainen (1980), who collected naturalistic speech samples from 25 children aged between one and three years. These recordings were approximately 15 minutes long and made on a weekly basis, although some 25-30 minute recordings were used during the early stages. Table 5.1. below presents the order of emergence of particular verb forms in Finnish-speaking children's speech. It should be noted that these studies are, of course, not comparable with each other due to differences in data collection. Furthermore, Toivainen's (1980) data is based on the median age and only includes

the most common forms. The overall conclusion is, however, the same: amongst the first emergent verb forms are the 3sg present tense and 2sg imperative forms.

Table 5.1.

The Order of the Emergence of Verb Forms in Different Studies (Adapted from Laakso, 2007)

Tuomas-korpus (Laakso, 2007)	Age	Tuulikki-korpus (Laalo, 2003)	Age	Toivainen's (1980) corpus (*N*=25 children)	Age
3sg present	**1;7**	***2sg imperative***	**1;3**	***2sg imperative***	**1;7**
3sg past	1;7	***3sg present***	**1;4**	***3sg present***	**1;8**
2sg imperative	**1;7**	***passive present***	**1;4**	*past tense*	1;11
3sg negation	1;8	*3sg past*	1;5	*negation*	1;11
1sg past	1;9	*3rd infinitive illative*	1;6	***1sg present***	**2;2**
passive past	1;9	***1sg present***	**1;6**	***passive present***	**2;2**
3rd infinitive illative	1;9	*3sg present negation*	1;7	*3sg perfect*	2;4
active 2nd participle	1;9	*1st infinitive*	1;8	*3rd infinitive illative*	2;4
passive present	**1;10**	*passive past*	1;9	*1sg past tense*	2;5
1st infinitive	1;10	*2sg present*	1;10	*1st infinitive*	2;7
3sg past	1;10	*1sg past*	1;11	*past tense*	2;7

negation				*negation*	
1sg present	**1;11**	*3rd infinitive inessive*	1;11	*2sg present*	2;7
passive 2nd participle	1;11	*passive present negation*	1;11	*3rd infinitive inessive*	2;10
passive present negation	1;11	*3sg conditional*	2;1	*conditional*	2;10
2pl imperative	2;0	*2pl present*	2;1		
passive conditional	2;0	*2nd infinitive inessive*	2;1		
3sg present conditional	2;1	*3sg perfect*	2;2		
2sg present	2;1	*3pl present*	2;3		
3rd infinitive inessive	2;2	*2pl imperative*	2;3		
3sg perfect negation	2;2	*2nd infinitive instructive*	2;3		
1sg perfect	2;2	*passive 1st participle*	2;3		
		3sg imperative	2;5		
		1sg conditional	2;5		
		3rd infinitive elative	2;5		
		active 1st participle	2;5		

Indeed, in Finnish, the 3sg present tense verb form is considered the most common and the least complex present tense form in the input (Laalo, 1994; 2003; Toivainen, 1980). The 3sg form generally replaces the 3pl form in spoken language (Mielikäinen, 1984), and is used in certain syntactic constructions (e.g., weather-related expressions). Perhaps unsurprisingly, then, 3sg present tense forms are the first forms to emerge in children's speech and are overgeneralised to non-target contexts (Laalo, 1994; 2003; Toivainen, 1980). In addition to the 3sg form, Finnish children also tend to overuse the 2sg imperative verb form which bears no morphological marking (thus being indistinguishable from the stem form), and which is sometimes even identical to the 3sg present tense verb form, depending on the verb class. A similar kind of 'defaulting' behaviour has been found, for example, in elicitation studies of child Spanish by Perez-Pereira (1989) and Kernan and Blount (1966), who reported that children produced 3sg forms in non-3sg contexts. Similar results indicating overuse of 3sg forms have also been reported for other morphologically rich languages such as Italian (Leonard, Caselli & Devescovi, 2002) and Sami (Ijäs, 2010).

However, the problem with the Finnish studies mentioned above is that they have been descriptive rather than explanatory in nature. They have tended to focus on the emergence of particular forms in children's speech instead of trying to explain the pattern with reference to language acquisition research in general. A serious problem with these naturalistic studies is that they cannot tell whether a particular inflection has been acquired before another. For example, it could be that the child knows both inflections A and B but due to the higher frequency of the inflection A, this inflection appeared earlier than the inflection B in an early data set, leading to conclusions that the inflection A has been acquired before B. Thus, naturalistic studies are not really suitable for testing the fine-grained predictions of generativist and constructivist accounts, but more controlled experimental elicitation studies are needed, such as the present study.

A notable exception to this naturalistic tradition in Finnish child language acquisition has been Lyytinen (1982) who conducted a series of experiments on typically developing Finnish-speaking children aged between two and seven years in order to investigate the main characteristics of morphology in each year group

including age-typical errors. Her total sample consisted of 260 children who she tested using the well-known *wug* (or sentence completion) test introduced by Berko (1958). She concluded that '*…when unable to find a right answer, cognitively brighter children make attempts to solve the task by using a roundabout expression, e.g., overgeneralizing a form they had learned earlier*' (Lyytinen, 1982:8). Thus, her results indicated that if children were required to produce a low-frequency form that they had not heard before, rather than failing to produce anything, they would produce another similar form (e.g., 1sg form for 1pl form). One of the aims of the study presented below was to explore the strategies that children apply when inflecting forms that are not likely to have been stored in the lexicon.

It should be noted that the overall aim of the Experiment reported in this Chapter is not to focus on Finnish *per se*, but to use Finnish as a means of differentiating between the generativist and constructivist positions outlined in Chapter 1 and 2 and, in particularly, to test the 'defaulting' account developed in Experiment 1. Thus, as we have seen, many generativist accounts (e.g., Wexler, 1998) argue for very early knowledge of inflection on the basis of very low rates of person/number-marking errors in young children's speech. However, studies of Spanish (Aguado-Orea, 2004) and Brazilian Portuguese (Rubino & Pine, 1998) have revealed that these low overall error rates actually hide important differences across the verb paradigm. The present study investigated children's production of person/number marking inflections by eliciting present tense verb forms from 82 native Finnish-speaking children aged 2;2-4;8 years. Four main findings were observed: 1) Rates of person/number marking errors were higher in low frequency person/number contexts, even after excluding children who showed no evidence of having learned the relevant morpheme, 2) most errors involved the use of higher frequency forms in lower frequency person/number contexts, 3) error rates were predicted not only by the frequency of person/number contexts (e.g., 3sg > 2pl), but also by the frequency of individual "ready-inflected" lexical target forms, and 4) for low-frequency verbs, lower error rates were observed for verbs with high phonological neighborhood density It is concluded that any successful account of the development of verb inflection will need to incorporate a role for both (a) rote-storage and retrieval of individual inflected forms and (b) phonological analogy across them.

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2. Introduction

An issue that lies at the heart of the cognitive sciences is the question of how children acquire their first language. The central theoretical debate in language acquisition research is between generativist theories, under which grammatical development involves the mapping of the target language onto innate grammatical rules, categories, principles and parameters (see Guasti, 2004; Lust, 2006; Crain & Thornton, 2012 for reviews), and constructivist theories (e.g. Bates & MacWhinney, 1989; Tomasello, 2000b; 2003), which assume the gradual construction of a grammar on the basis of the language to which the child is exposed. Our goal in the present article is not only to pit these two approaches against one another in a domain that constitutes a particularly suitable test case – inflectional morphology – but to begin to move beyond this debate by identifying the processes that underlie developmental changes in children's use of inflections, and hence in language acquisition more generally.

One area that has proved useful as a testing ground for the debate between generativist and constructivist approaches to language acquisition more generally is children's acquisition of inflectional morphology (e.g., Berko; 1958; Cazden, 1968; Bowerman, 1973; Brown, 1973; Hoekstra & Hyams, 1998; Pine, Lieven & Rowland, 1998; Räsänen, Ambridge & Pine, 2014; Rispoli, Hadley & Holt, 2009; Theakston, Lieven & Tomasello, 2003; Wexler, 1998; Wilson, 2003). Since systems of inflectional morphology can be extremely complex (Finnish has approximately 260 verb inflections; Hakulinen et al., 2004), early error-free performance would appear to constitute evidence for innate abstract knowledge of inflection as posited by generativist accounts. Constructivist accounts, in contrast, predict not only that children will make errors, but that the pattern of (in)correct use of inflections will directly reflect the input to which the child is exposed.

Thus the first goal of the present investigation of children's acquisition of Finnish verb morphology is to use this domain as a test case for the wider debate between generativist and constructivist approaches to morphology in particular, and to language acquisition in general. The second goal is to attempt to identify the causes

of any observed developmental changes in children's proficiency with inflectional morphology; a goal that is all too often neglected in the cut and thrust of the debate between opposing theoretical positions. Again, our aim is not only to study morphological development for its own sake, but also to attempt to draw some conclusions about developmental changes in language acquisition more generally.

The structure of the remainder of this introduction is as follows. We begin by examining, in more detail, generativist and constructivist accounts of the acquisition of inflection and their predictions. Next we explore the extent to which these predictions have been supported by previous studies. Having briefly outlined the relevant properties of Finnish, we conclude by summarizing the design and predictions of the present study (including our analysis strategy for investigating developmental change).

First, a brief caveat: Many readers will be familiar with the debate between single- and dual-route accounts of the English past-tense system (e.g., Pinker & Ullman, 2002; McClelland & Patterson, 2002). This debate concerns errors whereby children generate phonological forms that do not exist in the language (e.g., **sitted*, **runned*), but use them in appropriate (past-tense) contexts. The issues explored in the present study are orthogonal to this debate, since they concern errors whereby children produce phonological forms that do exist in the language (e.g., 3rd person singular verb forms), but use them in inappropriate contexts (e.g., 1st person singular contexts; analogous to errors such as **I sits* or **I runs* in English).

2.2. Generativist accounts of inflectional morphology and their predictions

It is important at the outset to clarify our use of the term "generativist account" (Pinker, 1984; Harris & Wexler, 1996; Hoekstra & Hyams, 1998; Wexler, 1998; Deen, 2004; Legate & Yang, 2007). We include under this heading all accounts which assume that children begin the task of morphological acquisition with knowledge of (a) the functional category of INFLECTION (or AGREEMENT and TENSE), (b) the distinctions typically encoded by these categories (i.e., PERSON [1st/2nd/3rd; i.e., the speaker, listener and a third person respectively), NUMBER [singular/plural] and TENSE [past-present]) and (c) the syntactic category of VERB (as well as others that are less relevant for our present purposes; e.g., NOUN).

These accounts assume, either implicitly or explicitly, that every verb form that bears PERSON/NUMBER AGREEMENT (and/or TENSE) marking is generated using a procedure that assigns or checks the relevant inflection. In other words, these accounts incorporate no significant role for rote storage of individual inflected forms. One possible exception is the generativist account of Pinker (1984), which would seem to allow for at least some rote storage; an issue to which we return in the discussion.

The technical details of these accounts are not important here (for a particularly clear exposition, see Blom and Wijnen, 2013: 227). The important point is the following: Because children are argued to begin the processes of morphological acquisition with a rule that assigns or checks the inflection of every agreement-marked (i.e., person/number marked) verb form, these accounts predict that – once the relevant inflections have been learned – children will never produce verb forms that bear incorrect person/number agreement marking (e.g., a 3sg form in a 1sg context8). Indeed, in each of the papers discussed above, this prediction is set out explicitly:

> *Children simply don't say I likes ice cream [A 3sg form in a 1sg context]… The correct agreement features on verbal inflectional morphemes are known* (Wexler, 1998: 42)

> *Young German-speaking children… do not make agreement mistakes* (Wexler, 1998: 19)

> *A well established fact in child language is that errors of omission (e.g., Mommy eat cake) are extremely common, while errors of substitution (e.g., I eats cake) are very rare* (Deen, 2004: 1).

8 Note that the person/number context might be indicated by the presence of a subject (e.g., I….); but it might not. Many languages (including Finnish, Italian, Spanish and Catalan) allow speakers to drop subjects when they can be easily inferred from the discourse. This subject-drop does not absolve the speaker of her responsibility to provide an appropriate person/number marked verb form, even though there is no "agreement" with an overt subject. Thus, all of the generativist accounts and studies discussed in this section include as instances of correct "agreement" utterances in which the intended person/number context is inferred from the surrounding discourse with no overt subject present. Consequently, we follow this standard practice in the present study.

When finite forms are used, agreement is almost always correct (Hoekstra & Hyams, 1998: 84). [The caveat "when finite forms are used" reflects the widespread generativist assumption that, in many languages, TENSE/AGREEMENT marking is optional for young children (e.g., Wexler, 1998). However this consideration is not important for the present study, given that children rarely – if ever – omit TENSE/AGREEMENT marking in highly-inflected languages such as Finnish].

> *Children's morphological errors…[do not reflect] use in inappropriate morphosyntactic contexts.* (Legate & Yang, 2004: 322).

> *The evidence we have adduced [for our hypothesis] includes…(c) Agreement is correct with main verbs* (Harris & Wexler, 1996: 32)

> *Errors of agreement are superbly rare… These data strongly favor the analysis that children have an abstract rule of agreement at these early stages in development* (Deen, 2004: 11)

As this last quotation makes particularly clear, a low rate of agreement-marking errors is presented not simply as a descriptive claim about children's language, but as a prediction of the relevant theories. Indeed, all take the finding that commission errors with person/number agreement marking are "rare (<1%)" (Rice, 2004:226), "vanishingly rare" (Wexler, 1998: 42), and occur at a rate that is "very low even by the most stringent acquisition standards" (Hoekstra & Hyams, 1998: 84) as support for the claim that children have "Very Early Knowledge of Inflection" (Wexler, 1998) or show "Early Morphosyntactic Convergence" (Hoekstra & Hyams, 1998: 81).

On pain of repetition, it is important to emphasize that generativist accounts only predict low error rates provided that all of the relevant inflections have been learned (e.g., Wexler, 1998: 42). Clearly, if a child uses (for example) a 3sg morpheme in a 3pl context, but only because she has yet to learn either (a) the phonological form of the 3pl morpheme or (b) that this phonological form is the 3pl morpheme, this cannot be taken as evidence against knowledge of an abstract system of inflection. Like a struggling second-language learner, the child could have

abstract knowledge of the paradigm (i.e., know that she needs to add the 3pl inflection to the VERB stem), but not know what this inflection is. Consequently, when calculating error rates, it is important to include only data from children who have correctly produced a verb form that bears the relevant inflection in an appropriate context. (Given that generativist accounts take such correct productions as evidence for Very Early Knowledge of Inflection/Early Morphosyntactic Convergence [see quotations above], they cannot – at the same time – dismiss them as rote-learned forms that do not in fact demonstrate knowledge of the relevant morpheme and its person-number agreement properties).

Finally, it is important to note that all the generativist predictions outlined above – and tested in the present study - relate solely to errors of incorrect person/number agreement marking (e.g., the use of a 3sg verb form in a 1sg, 2sg or 3pl context). They do not relate, for example, to errors of tense omission (e.g., **Yesterday I play*) or – for languages that have different phonologically-based conjugation classes (e.g., Spanish, but not Finnish) - the use of one particular 3sg inflectional morpheme in place of another. Hence, in order to be as generous as possible to generativist accounts, in the present study we treat as unscorable any verb form that is neither (a) correct nor (b) an unambiguous error of person/number agreement marking.

2.3. Constructivist accounts of inflectional morphology and their predictions

Constructivist accounts of morphological development (e.g., Bybee, 1995, 2001; Pizzuto & Caselli, 1992; Rubino & Pine, 1998; Pine, Lieven & Rowland, 1998; Gathercole, Sebastian & Soto, 1999; Aguado-Orea, 2004; Pine, Conti-Ramsden, Joseph, Lieven & Serratrice, 2008; Räsänen, Ambridge & Pine, 2014) assume that children do not start out with abstract categories of VERB, INFLECTION or AGREEMENT, and, instead, emphasize gradual, input-based learning. Children first store in memory complete, ready-inflected forms that they have heard used in the input (e.g., *halua-n 'I want'*). Initially, these chunks and frozen phrases function as unproductive rote-learnt forms, with the child being unaware of the internal morphological structure.

Only later in development do children generalize across these stored forms in a way that allows them to generate inflected forms of verbs that they have not heard in that particular form (including novel verbs in experimental studies). The precise characterization of this generalization process varies from theory to theory. Under exemplar-based models (see Skousen, Lonsdale & Parkinson, 2002, for a review), children store individual exemplars – i.e., ready-inflected verb forms – and generate novel unattested forms 'on the fly', on the basis of phonological analogy to these stored forms. Other accounts (e.g., Janssen, Roelofs, & Levelt, 2002; Tomasello, 2003; Croft & Cruse, 2004; Boojj, 2010) posit morphological schemas, constructions or slot-and-frame patterns such as [STEM]-*n* (a putative 1sg schema in Finnish). However, it is unclear to what extent these accounts assume that morphological schemas are represented and stored independently in the brain, or use the term simply as a mnemonic for a particular type of exemplar-based generalization (e.g., Bybee, 2013). Accordingly, whilst the present article will make reference to "morphological schemas" we remain agnostic with regard to the issue of their independent representation.

It should be emphasized that whilst constructivist accounts assume that rote-learning plays a central role in the acquisition of verb morphology, they do not argue that all early knowledge of inflection consists of rote-learnt ready-inflected forms. Whilst this may be the case at the very earliest stages, the generalization processes outlined above are assumed to begin as soon as children have acquired a handful of stored forms. Thus, even children as young as 2 years (the youngest in the present study) are likely to have formed at least some productive schemas; in particular those for which the source forms are frequent in the input (e.g., 3sg [STEM]-*o*). On the other hand, even children as old as 5 years (the oldest in the present study) may have yet to form schemas for which the source forms are infrequent in their input (e.g., 2pl [STEM]-*tte*). Indeed, a study of novel noun marking in Polish (Dabrowska and Szczerbiński, 2006) found that even children aged 2;7 were highly productive (around 75% correct performance) with high-frequency inflections (e.g., masculine genitive), whilst children aged 4;5 showed poor performance for lower-frequency inflections (e.g., 15% for neuter dative).

How exactly does a child arrive at a correct person/number-marked verb form under constructivist accounts? First, the child searches memory for the appropriate

stored ready-inflected form (token) for that verb. If none is found, the child will use one of the following strategies:

(a) Use a stored ready-inflected person/number-marked form that is available for direct recall from memory, either because it is of higher frequency than the target form – and so has a stronger representation in memory - or because another speaker has just produced it (e.g., Rubino & Pine, 1998). There is a trade-off here between availability and semantic/functional appropriateness (e.g., if the target is a 2pl form, it will usually be more appropriate to substitute a 2sg form [maintaining person] than a 3sg form [maintaining neither person nor number]).

(b) Generate the target form by phonological analogy with neighbours; stored forms that are phonologically similar and that bear appropriate person/tense number marking (e.g., Bybee, 1995; Marchman, 1997). For example, in Finnish, the 1sg present-tense form kerää-n 'I pick up' might be generated by analogy with *herää-n* '*I wake up*'. Due to the highly regular nature of Finnish morphology, if an analogy with the target person/number-marked form is available, it will always yield the appropriate form (the same cannot be said for – for example – English irregular past-tense forms; Marchman, 1997). Under some versions of the account, this process could alternatively be conceptualized as retrieving a [STEM]-n morphological schema.

Thus, the predictions that follow from constructivist accounts are as follows:

(1) Although overall error rates may be relatively low, high error rates (and lower rates of correct use) will be observed for person/number contexts that are infrequent in the input and hence for which neither individual ready-inflected forms nor suitable morphological schemas are available in memory.

(2) Error rates will vary not only by person/number context, but also by target lexical form. Specifically, higher error rates (and lower rates of correct use) will be observed for target individual ready-inflected lexical verb forms (tokens) that are of low frequency in the input, and that are therefore represented only weakly – or not at all – in memory.

(3) Similarly, higher error rates (and lower rates of correct uses) will be observed for verbs with fewer phonological neighbors (i.e., with lower phonological neighborhood density), and hence fewer opportunities for successful phonological analogy. Since children are hypothesized to rely on phonological analogy only when a stored ready-inflected form is not available, constructivist accounts also predict an interaction such that phonological neighborhood density will have a greater effect for lower frequency than higher frequency lexical target forms. However, the importance of phonological neighbourhood density may decline into adulthood, as adults build the highly general representations that allow them to generate the semantically-appropriate person/number marked form for a verb, regardless of its phonological properties.

2.4. Previous tests of generativist and constructivist predictions

There is indeed some evidence to suggest that, as predicted by generativist accounts, children rarely produce person/number-marking errors. For example, Hoekstra and Hyams (1998) reviewed naturalistic data on overall rates of such errors in Spanish (Serra & Sole, 1992), Italian (Cipriani, Chilosi, Bottari & Pfanner, 1991; Pizzuto & Caselli, 1992), German (Clahsen & Penke, 1992) and Catalan (Serra & Sole, 1992). In all of the languages in the data reviewed, rates of person/number-marking error were very low (less than 5%). As noted above, these authors, as well as Wexler (1998) and Deen (2004), take these and similar findings as evidence for "very early knowledge of inflection", and for innate knowledge of the abstract functional category of AGREEMENT (and TENSE).

However, there is some evidence from naturalistic studies of Spanish (Aguado-Orea, 2004) and Brazilian Portuguese (Rubino & Pine, 1998) that low overall error rates may hide important differences both across the verb paradigm - with higher error rates in lower frequency parts of the system – and across development. First, overall error rates are misleading because they collapse across data from both high and low frequency person/number contexts (or, from a constructivist viewpoint, morphological schemas). Rubino and Pine (1998) investigated naturalistic data from a child acquiring Brazilian Portuguese, and found that the overall rate of person/number marking errors was very low (3%). However, a closer look at the data revealed that this low error rate was composed of an error rate of 0.3% in

high frequency 3sg contexts and of 43.5% error rate in low frequency 3pl contexts. Similar findings were reported by Aguado-Orea (2004) in a naturalistic corpus study of two Spanish-speaking children.

Second, overall error rates are misleading because they collapse across data from both high and low frequency individual ready-inflected verb forms that could in principle be stored directly in the lexicon (e.g., Maratsos, 2000). For example, when Aguado-Orea (2004) removed just the two most frequent 1sg verb forms ("*I want*" and "*I can*") from the analyses, the error rate for 1sg contexts doubled from 4.9% to 10.4%.

Third, overall error rates are misleading because (presumably due to paucity of data) they tend to collapse data across long periods of time, ignoring the fact that the amount of data is likely to be unequal across different points in development. Given that children's rate of speech production generally increases with development, it is children's earliest speech, which is most likely to contain errors, that is generally under-represented.

Although these naturalistic studies would appear to provide some support for the constructivist prediction of high error-rates in low frequency parts of the system, they do not allow for investigation of the second and third constructivist predictions outlined above; that error rates will vary according to the frequency of the target lexical form and the phonological neighborhood density of the verb. This is simply because, in spontaneous speech, children (and, indeed, adults) tend to use only a small number of verbs, and – in most cases - only one or two inflectional forms of each (Aguado-Orea, 2004). The failure to test these predictions is an important omission, given that studies in other morphological domains have provided some evidence for the role of both lexical frequency and phonological neighborhood density (e.g., Marchman, 1997; Marchman et al., 1999; Dabrowska & Szczerbiński, 2006; Dabrowska, 2008; Kirjavainen, Nikolaev & Kidd, 2012).

Thus, the aim of the present study is to compare generativist and constructivist predictions regarding the development of inflectional morphology, using a method which allows for more control over the target verbs and inflectional contexts; specifically elicited production, focusing on the Finnish present-tense system. Of course, we are by no means the first researchers to conduct an elicited-production

study of verb morphology in a highly inflected language. Previous studies of this type include for instance Kunnari et al. (2011) in Finnish; Leonard, Caselli and Devescovi (2002) in Italian; Lukacs, Leonard, Kas and Pleh (2009) in Hungarian; and Stavrakaki and Clahsen (2009) in Greek. However, as far as we are aware, the present study is the most extensive of its type, with 1sg, 1pl, 2sg, 2pl and 3sg present tense forms elicited for each of 36 verbs, chosen to vary along the dimensions of lexical input frequency and phonological neighborhood density (defined in terms of morphophonological class size). Thus, to our knowledge, the present study constitutes the most comprehensive test to date of generativist and constructivist predictions regarding person/number-marking errors.

2.5. Finnish

An obvious advantage of testing these predictions in Finnish (a member of the Finno-Ugric group of languages, belonging to the Uralic family), is that Finnish is a highly inflected language. Finnish verbs (one popular dictionary, Hakulinen et al., 2004, lists approximately 9,000) mark both person and number, with six possible combinations: 1sg, 1pl, 2sg, 2pl, 3sg and 3pl (although, of course, verbs must agree with their subject, we use the term "person/number marking" as opposed to "subject-verb agreement marking", as overt subjects are rare in informal speech). Although Finnish is an agglutinative language, and sometimes includes a separate tense marker as well as a person/number inflection, this is not the case for the present tense, where only the latter is used[9]. An example present tense verb conjugation is shown below using the verb *sano-a* '*to say*'.

1sg (minä) *sano-n* 1pl (me) *sano-mme*
2sg (sinä) *sano-t* 2pl (te) *sano-tte*
3sg (hän) *sano-o* 3pl (he) *sano-vat*

Unlike – for example – Spanish, Finnish does not have different conjugation classes. Thus, from the point of view of the adult linguist, a particular inflectional morpheme (e.g., 1sg *–n*) applies to all verbs. From the point of view of the child learning the system, however, the situation is far less straightforward. A complex

9 It should be noted that when the subject is not nominative, the 3sg form must be used. This applies for instance to possessive and necessive constructions, which are frequent in the input.

system of morphophonological alternations involving vowel insertion, vowel harmony and consonant gradation[10] means that the "same" inflection can be realized in many different ways, depending on the phonological properties of the verb. Indeed, the scheme adopted for the present study (see Appendix F) divides verbs into 20 morphophonological classes, each of which involves a different realization of any given tense/agreement marker (and more complex schemes propose as many as 46 classes).

Unlike English, Finnish verbs lack a free-standing, morphologically simple form: even the so-called a-infinitive, which corresponds to the English infinitive, has a separate inflection (e.g., *nous + ta* '*get up + INF*; *syö + dä* '*eat + INF*). However, it should be noted that, for some verbs, the infinitive is homophonous with the 3sg present tense form (see Appendix F)[11]. In the present study, these ambiguous forms were scored as correct if they could have been correct (i.e., in 3sg contexts), but were otherwise excluded as unscorable, because we cannot tell whether children are making a person/number marking error or instead producing an infinitive, which is a grammatical alternative for children under generativist "Optional Infinitive" accounts (e.g., Wexler, 1998).

A number of important considerations are in order with regard to colloquial spoken Finnish and its effects on verb morphology. First, in spoken speech, 3pl forms tend to be replaced by 3sg forms (e.g., Mielikäinen, 1984). Thus, it is perfectly acceptable to say, for instance, *Pojat juoksee* '*The boys runs*' instead of *Pojat juoksevat* '*The boys run*', even with an overt plural subject. For this reason, we did not elicit 3pl forms in the present study. Second, the passive form of the verb is generally used instead of the formal 1pl form in colloquial speech. For this reason, passive forms in 1pl contexts were counted as correct. Finally, 2pl forms can replace 2sg

10 With regard to vowel harmony, front vowels (/*ä ö y*/) cannot co-occur with back vowels (/*a o u*/). For example, the verb *syö*/*dä* '*to eat*' has *–dä* as an infinitival ending because the word stem contains front vowels, whereas *juo*/*da* '*to drink*' has *–da* as an infinitival ending because of the back vowels in the stem of the verb. Consonant gradation refers to deletion and lenition of consonants when the verbs are inflected. This phenomenon occurs when long voiceless stops *pp*, *tt* and *kk* are shortened to *p*, *t* and *k*, respectively. This is known as quantitative gradation. In contrast, short voiceless stops p, t and k are weakened in several qualitative ways (e.g., *p →v; p → m; t → d*). The conditions for consonant gradation are rule-governed, but very complex.

11 Although such forms were not elicited in the present study, there is an increasing tendency in spoken Finnish to replace the infinitival form of *Huomat*/*a* verbs (see Appendix A) with the 3sg form in compound finite structures such as *En jaksa pakkaa* (for *pakat*/*a*) '*I can't be bothered to pack*' and *Aloitan pakkaa* (for *pakkaamaan*) 'I start to pack'.

forms in formal contexts (like French *vous* forms). Because the study did not use formal contexts (children addressed a talking dog toy), such substitutions were treated as errors of person/number marking.

2.6. Development

As noted above, an important goal of the present study is not only to mediate between generativist and constructivist approaches, but also to begin to move beyond this debate by investigating the processes underlying any observed developmental changes in children's use of inflection (and – by extension – language in general). To this end, rather than following the more common approach of recruiting a number of different age groups, we instead tested a relatively large number of children (*N*=87) ranging over a wide age span (2;1-4;8). This approach allows us to study development by using statistical techniques that allow for the investigation of interactions between continuous predictors (e.g., age in months and morphophonological class size). Thus if any observed development changes are underpinned by, for example, increasing use of phonological analogy with age, this phenomenon will surface as an interaction between these variables.

2.7. Summary

The present study compares the predictions of generativist and constructivist accounts of the acquisition of inflectional verb morphology by means of an elicited production study of Finnish present-tense inflection. Generativist accounts predict that, provided that the analysis is restricted to children who have learned the relevant person/number morpheme, error rates will be low across all inflectional contexts. Constructivist accounts predict low error rates for frequent contexts (e.g., 3sg), but higher error rates for low frequency (1) inflectional contexts and (2) individual lexical target forms. Constructivist accounts also predict (3) a negative correlation between phonological neighborhood density (i.e., morphophonological class size) and error rate and, perhaps, (4) a developmental decrease in the importance of phonological neighborhood density as learner's knowledge becomes more abstract, and hence less reliant on phonological analogy with close neighbours. Developmental changes in children's ability to supply correctly inflected forms are investigated by testing for interactions between these predictor variables and a continuous measure of children's age.

3. Method

3.2. Participants

There were 93 participants at the beginning of the study, recruited from six nurseries in Kuopio, Eastern Finland. All were typically developing, monolingual speakers of Finnish. No standardised language tests were used, but all the children were reported by their teachers and parents to exhibit typical language development. Eleven children were excluded because they did not attempt to respond on four consecutive trials. The final sample thus consisted of 82 participants (45 males, 37 females) with a mean age of 3;7 years (range 2;1-4;8).

3.3. Design and materials

The study employed a between-verbs, within-subjects design using an elicited production paradigm. The stimuli consisted of 36 verbs and accompanying videos, presented on a laptop computer. These verbs consisted of 18 high-frequency verbs and 18 semantically matched lower-frequency synonyms. The rationale behind selecting verbs in this way was to ensure a good spread of lexical target frequencies whilst minimizing, as far as possible, any confounding effect of semantics. Frequency counts (see below for details of how these were obtained) confirmed that each high frequency verb was indeed of higher frequency than its low frequency synonym and that, as a group, the former (M = 26076, SD = 29249) were significantly more frequent than the latter (M = 2158, SD = 4780), $t(17) = 3.59$, p =.002). An important additional selection criterion for the target verbs was that they were easy to depict on video, and to act out with the child in the experimental setting.

The 36 verbs were divided randomly into two sets, each containing 9 high/low-frequency synonym pairs (with the constraint that very close phonological neighbors *lyödä* '*to hit*' and *syödä* '*to eat*' were not in the same set). Each child was randomly assigned to one of the two sets (the purpose of the sets was simply to reduce the number of trials that any one child had to complete). The same video was used for the high-frequency and low-frequency member of each synonym pair.

For each of the 18 verbs seen by a particular child, each of the following five target present-tense forms was elicited (for a total of 90 trials per child): 1sg, 1pl,

2sg, 2sg, 3sg (3pl forms were not elicited as these are usually replaced by 3sg forms in colloquial speech[12]).

3.4. Predictor Variables

Token frequency counts of each individual lexical verb form were obtained from the CSC Language Bank Newspaper corpora, which includes 131.4 million word tokens (www.csc.fi); the same corpus used in a previous study of Finnish past-tense inflection (Kirjavainen, Nikolaev & Kidd, 2012). Whilst it would, of course, have been preferable to use an electronic corpus of spoken language – ideally child-directed speech – no such corpus was available (though, as discussed in the Results section, a small paper-based corpus was used to verify counts of individual person/number marking contexts).

In order to check that the frequency counts obtained were representative of everyday spoken Finnish, we used an online rating task to obtain subjective frequency estimates from 50 native speakers (see Balota, Pilotti & Cortese, 2001, for evidence that such estimates are an excellent proxy for objective frequency counts). The correlation between these frequency ratings and the counts from the newspaper corpus was high, suggesting that the latter provides a valid measure of lexical frequency.

As a measure of phonological neighbourhood density, the number of morphophonological classmates for each verb (see Appendix F for details) was taken from a Finnish dictionary (Hakulinen et al., 2004). The selection of a classification scheme is not straightforward, as there are various different ways to conceptualize similarity. The broadest scheme groups together all verbs that share a particular infinitival ending (e.g., *kisata*, *kohota* and *hävitä*), ignoring differences between their inflected forms (e.g., *kisaa-n*, *kohoa-n* and *häviä-n*), and results in just 6 classes. The disadvantage of using this scheme is that it assumes that learners are sensitive to phonological similarity at a highly abstract level (i.e., primarily at the level of the "transformation" between the stem and the inflected form [e.g., "*t*-drop"], rather than the inflected form itself: the form that children actually hear in the relevant contexts).

12 The proportion of 3pl forms in 17 transcriptions of child-directed speech is 0.30% (total number of present tense forms = 1748).

Conversely, the most fine-grained scheme posits different classes on the basis of very small phonological differences between inflected forms, and results in 46 classes (many with just a handful of members). The disadvantage of using this scheme is that it assumes that learners recognize no phonological similarity at all between forms that are similar in a great many respects. As a compromise between these two extremes, we used a system that posits 20 classes, 11 of which are represented amongst the 36 verbs used in the present study. Importantly, this scheme still conceptualizes similarity in terms of the inflected forms that children hear in the relevant contexts (e.g., *kisaa-n*, *kohoa-n* and *häviä-n* each belong to a separate class, rather than a single "*t*-drop" class). Appendix G shows the characteristics of the verbs used in the study in detail.

3.5. Procedure

Each child was tested individually in a quiet setting, with each session lasting approximately 15-25 minutes, depending on the child. Trials were presented in random order. Videos were shown on a laptop computer (13 inch screen). Audio recordings of the experimental sessions were made using Audacity 1.3.13 (running in the background on the same laptop).

The child was seated in front of the laptop computer, with the "talking" toy dog positioned so that it was behind the laptop and could not therefore "see" the laptop screen, but faced towards the child and the experimenter. The toy dog's internal speakers were connected to the laptop. First, the child completed a brief warm-up that involved being introduced to the toy dog and the experimenter. The child was told that he or she would be playing a game with the experimenter in which they would watch some videos of the experimenter and the toy dog acting out some actions together, and they would also be performing the actions. The child was told that her task would be to help the toy dog out by answering its questions. The experimenter then brought up the first video, and told the child, for example, that *Tässä on leikkaamista* [*This is cutting*]. Thus, the children were given the target verb in the form of a verbal noun in the partitive. This form was used because it has already undergone the "changes" that must be made to an infinitive form before the "addition" of the appropriate person/number morpheme (i.e., it contains the inflectional stem rather than the infinitival stem). Consequently, the task facing the children is simpler than it would have been had the verb been

presented in infinitival form. Throughout the experiment, if the child had trouble recalling the target verb, the experimenter repeated the target verb in this form. If the child used a non-target verb, that trial was classified as unscorable.

The questions asked by the dog varied according to the target form being elicited. For instance, for 2sg forms, the toy dog asked *Mitä minä teen*? [*What am I doing*?], while the child watched a video of the dog performing the relevant action. For 1pl forms, the experimenter and child performed the relevant action, while the dog asked *Mitä te teette*? [*What are you-pl doing*?]. The question probes for each target inflection are given in Table 5.2. Each video lasted for 5-6 seconds, and was played continuously during each verb trial to emphasize the ongoing nature of the action, and thus to encourage the use of the simple present tense form (Finnish has no present progressive), rather than, for example, the past tense. As an incentive, children were rewarded with stickers throughout the experiment, regardless of the responses produced.

Table 5.2.

Examples of the Probe Items Using the Verb katsoa 'to look'

Verb inflection	**Elicitation task**	**Expected response**
3sg pres	**Watching the video** The experimenter asks: Mitä koira tekee? [*What does the dog do*?]	*Koira katso/o* *The dog looks*
1sg pres	**Imitation of action** The experimenter tells the child that now it is his/her turn to perform the action in the video. Whilst acting out the	*(Minä) katso/n* *(I) look*

	action, the Talking Dog asks: *Mitä sinä teet?* [*What are you doing?*]	
1pl pres	**Imitation of action** The experimenter tells the child that now it is their turn to perform the action in the video together. Whilst acting out the action, the Talking Dog asks: *Mitä te teette?* [*What are you-pl doing?*]	*(Me) katso/mme* *(We) look*
2sg pres	**Watching the video** The Talking Dog asks: *Mitä minä teen?* [*What am I doing?*]	*(Sinä) katso/t* *(You) look*
2pl pres	**Watching the video** The Talking Dog asks: *Mitä me teemme?* [*What are we doing?*]	*(Te) katso/tte* *(You-pl) look*

3.6. Transcription, coding, and reliability

Responses were transcribed from the audio recordings and coded by the first author. The total number of responses was 7380 (5 target forms x 18 verbs x 82 participants). Responses were coded as (1) correct, (2) incorrect or (3) unscorable, as described below.

(1) *Correct inflection* (*N*=4343): The child used the correct person/number marked form of the appropriate verb, given the target context (because subject omission is very common, it was necessary to score relative to the target context, as opposed to the subject).

(2) *Incorrect inflection* (*N*=717): The child produced a person/number marked form of the appropriate verb, but one that was not appropriate given the target context.

(3) *Unscorable* (*N*=2320). The child produced a) no response or an unintelligible response (*N*=1350), b) a repetition of the dog's question (*N*=198), c) a non-present-tense form of the target verb (e.g., stem or infinitive) (*N*=101), or c) any form of a non-target verb (*N*=671). Although the proportion of unscorable responses (31.44%) is relatively high, many of these errors constitute pragmatically appropriate responses to the description task, and are thus very difficult to pre-empt entirely.

In some respects, whether a particular response counts as "incorrect" versus "unscorable" depends on the theoretical stance taken. Given our own theoretical position, our goal in classifying responses as incorrect versus unscorable was to be as generous as possible to generativist accounts, and as strict as possible with regard to constructivist accounts. Thus, we followed Harris and Wexler (1996), Hoekstra and Hyams (1998), Wexler (1998), Deen (2004) and Legate and Yang (2007) in counting as "incorrect" only incorrectly person/number-marked forms of the target verb. Given that other non-target responses are difficult to interpret, including such responses as incorrect (rather than unscorable) would have artificially inflated the error rate, which is predicted by generativist accounts to be very low.

By the same token, since the constructivist account predicts that children may use evasion strategies for low frequency, unfamiliar items, our decision to count any possible instances of evasion as unscorable rather than incorrect biases the analysis against the constructivist position. Indeed, an ANOVA ($F(4,7220)=7.07$, $p < .001$) revealed that unscorable responses were less frequent for 3sg targets (always the most frequent input form) than 1sg, 1pl, 2sg and 2pl targets ($p = .006$; $p < .001$; $p = 0.007$; $p < .001$, respectively). Thus by excluding such responses from the analysis, we are minimizing the likelihood of observing frequency effects, and hence providing for a relatively conservative test of the constructivist claim that error rates are related to the frequency distribution of forms in the input.

The effect of these missing data should not be overstated, however. On average, a scorable response for each verb was contributed by 31 of the 41 children tested (*SD* = 7.8). The average number of unscorable responses per child was 26.70 (*SD* = 24.62). Furthermore, the rate of unscorable responses decreased significantly with

age (simple Pearson r=-.396 $p < .001$); a finding which provides some reassurance that missing data was largely a consequence of memory and processing limitations.

As the focus of the present study was children's correct and incorrect use of person/number marking, phonological errors involving the verb stem only were ignored. Again, the rationale behind this decision was to be as generous as possible to generativist accounts, by counting as correct any response in which the child is clearly attempting to produce the target person/number marked inflection. This decision biases the analysis against constructivist accounts, which would predict higher rates of such errors for target forms that are of low frequency and/or phonological neighbourhood density. An analysis revealed that children did indeed make more stem errors when the token frequency was lower and when the syllable length was longer (β = -0.01, SE = 0.001, z = -2.14, p = .032 and β = 1.40, SE = 0.57, z = 2.46, p = .014, respectively)[13].

Thus the verb was considered to be the target verb if the stem included (a) a gradation error (e.g., *nousetaan* instead of *noustaan*, (b) a local dialect form (e.g., *lukkee* instead of *lukee*; *syyvään* instead of *syödään*), c) misarticulations of consonants (e.g., *kälelette* instead of *kävelette*) or (d) other modifications that still represented clear attempts at the target form (e.g., shortenings, such as *myhäämme* instead of *myhäilemme*). In order to calculate reliabilities, 10% of the responses were transcribed independently by another native Finnish speaker blind to the hypotheses under investigation. Agreement was 97.6%. Any disagreements were subjected to re-listening until agreement was reached.

4. Results

Because the constructivist approach predicts differences in error rates across different target inflectional contexts and across different verbs, in what follows, we generally report error rates by items rather than by subjects (the generativist prediction of very low error rates applies either way). On the more-usual by-subjects calculation, rates of correct use and error were 85.83% (*SD*=34.88%) and

13 Interestingly, the rate of stem errors also increased with age (β = 6.84, SE = 1.98, z = 3.46, p < .001). However, this finding is in line with what is known about the development of the Finnish inflectional system: as children's speech develops, they often overgeneralize the phonological alternations such as consonant gradation incorrectly, especially with passives (e.g., Riionheimo, 2002b). In the present study too, an analysis of the stem errors revealed that such errors were significantly more frequent in 1pl passive contexts than in any other contexts (p < .001), with no other differences between inflectional contexts observed.

14.17% (*SD*=34.90%) respectively (excluding unscorable/ambiguous/infinitival forms from the denominator). The mean proportion of correct inflections for each verb, collapsing across all inflectional contexts, is displayed in Appendix H (again, unscorable/ambiguous/infinitival forms were excluded from the denominator).

Thus, whether the data are analysed by subjects or by items, it is clear that, on trials where they attempted to produce a present-tense form of the relevant verb, children appeared to understand which person/number form was the target in each experimental scenario. This is important, as children very rarely produced subjects (as is usual in Finnish for 1st and 2nd person forms in general, and for 3rd person forms when the referent has already been established [here, by the dog's question]). Stem-only errors (*N*=32, plus *N*=35 errors that are ambiguous between stems and 3sg forms) and infinitive errors (*N*=20, plus *N*=14 errors that are ambiguous between infinitives and 3sg forms) were rare (and were counted as unscorable).

4.2. Analysis by target inflectional context

The overall rate of person/number-marking errors observed was 14.17%. Whilst this error rate is already somewhat higher than rates typically taken as evidence for virtually error-free performance (around 5%; Hoekstra & Hyams, 1998; Wexler, 1998), it hides considerably higher rates in certain parts of the system. Table 5.3. shows error rates broken down by target inflectional context (again excluding unscorable and ambiguous responses as outlined above). The pattern is very similar to that observed by Aguado-Orea (2004) and Rubino and Pine (1998), with a very low error rate for 3sg forms (<1%) hiding rates as high as 32% in other contexts.

Table 5.3.

Error Rates by Inflectional Target Context

	3sg	1sg	1pl	2sg	2pl
(a) Overall error rate	0.46%	10.34%	11.67%	14.38%	35.83%
(b) Error rate excluding children who did not produce at least one instance of the target	0.46%	9.71%	11.68%	13.96%	31.84%

inflection					
No. children contributing to (b)	81	70	71	74	65

However, as we saw in the introduction, generativist accounts predict low error rates only from the point at which children have learned the relevant inflection. We therefore recalculated these error rates, excluding – for each person/number context separately - children who did not produce at least one correct target form (see Table 5.4.). For no inflectional context did this involve excluding more than 20% of children. Perhaps surprisingly, this made very little difference to the error rates, with rates as high as 32% observed. The finding that non-3sg contexts displayed error rates of 10%, 12%, 14% and 32% - even when controlling for knowledge of the relevant inflection – does not sit comfortably with the generativist prediction of "vanishingly rare" errors (Wexler, 1998: 42). Although it is not clear exactly what constitutes a "very low" error rate (Hoekstra & Hyams, 1998: 84), if rates of <5% are to be taken as evidence for this claim, it would seem inconsistent to argue that a rate that is higher by a factor of 7 does not constitute evidence against it.

Of course, as noted by an anonymous reviewer, some of these errors may have a pragmatic element. For example, if the child is asked by the dog "*What are we [the dog and the experimenter] doing*?", and responds with a 2sg form rather than a 2pl form, this could be a pragmatic rather than morphological error, or indeed not an "error" at all; the child may simply prefer to describe the actions of the dog alone, rather than of the dog and the experimenter together (remember that children almost never provided overt subjects). Note, however, that by excluding data from children who did not produce at least one instance of the target inflection, we are restricting the analysis to children who not only clearly understood which form they were supposed to be producing in each person/number context – but were also willing and able to do so. That said, it is probably impossible to design an experimental task that rules out this objection altogether; ultimately only a speaker can decide who she will address, or whose actions she will describe (an issue to which we return in the discussion)

A further justification for including such responses as errors is that doing so biases the analysis against observing the effects predicted by the constructivist account. If these really are pragmatic errors – or not errors at all – there is no reason to expect them to pattern by target context, lexical frequency or phonological neighbourhood density of the target form. Of course, including such forms as errors also drives up the overall error rate, at the expense of the generativist account. But any finding that errors pattern according to these factors would support the constructivist over the generativist account in any case, regardless of the overall error rate.

An important point to note with regard to these person/number marking errors, and their implications for generativist accounts is that the observed error rates are not only high, but also uneven (see Table 5.4.). A one-way ANOVA revealed a significant main effect of target inflectional context, $F(4,5055)=157.46$, $p < .001$. Post hoc tests revealed that 2pl contexts - the least frequent in the corpus (see Appendix E) - attracted significantly more errors than all other contexts ($p < .001$ for all comparisons). Conversely, 3sg contexts – the most frequent in the corpus (see Appendix E) – attracted significantly fewer errors than all other contexts ($p < .001$ for all comparisons). Children also produced significantly more errors in 2sg than 1sg contexts ($p = .045$), with no other significant differences observed.

Recall that the frequency ranking of contexts discussed above is based on a newspaper corpus. In order to check that error rates were higher for person+number contexts that are of low frequency in speech to children, we calculated proportions of different present tense forms in 17 short paper-based transcriptions of child-adult interactions (total length 678 minutes), made available by the University of Oulu in Finland (it was not possible to use this corpus for the main analysis, as the majority of the verbs used in the present study did not appear at all in this relatively small corpus). This analysis was done by hand. All verbs in the corpus were included, regardless of whether or not they appeared in the present study, except for the extremely frequent verb olla, '*to be*'. Figure 5.1. shows the relationship between these counts and the proportion of person/number errors for each inflectional context in the present study. The claims above regarding frequency of individual contexts (3sg most frequent, 2pl least frequent) were clearly supported

(though the correlation - simple Pearson *r* =-.785 - was not significant due to the small sample size: *N*=5).

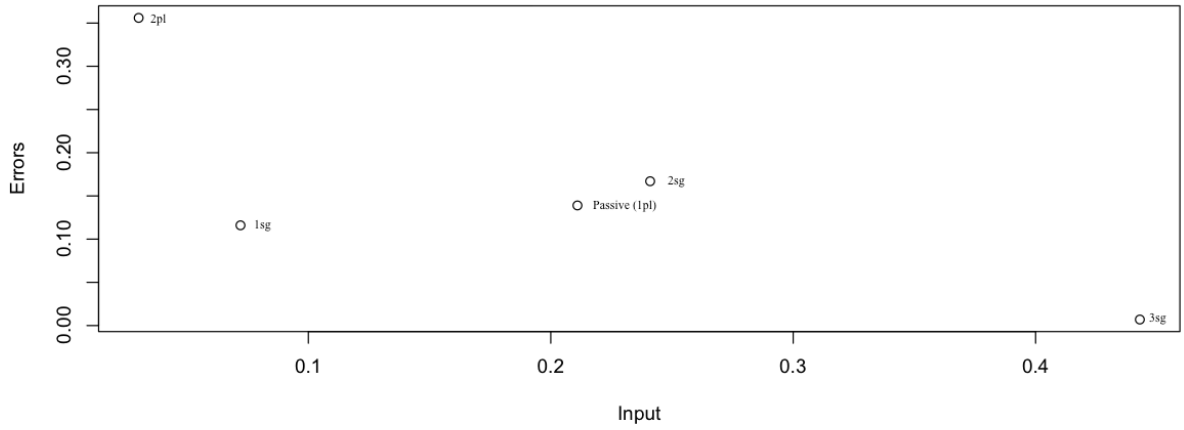

Figure 5.1. Illustration for the correlation between the adult input form frequency in a child-directed speech and children's error rate

The final important point to note from this analysis is that many errors involve the substitution of a higher-frequency form for a low-frequency target form (see Table 5.4.). For example, 42% of errors were substitutions of more frequent forms (mostly 2sg, 1pl passive, or 3sg) for 2pl forms; the least frequent in both the adult and child corpora (see Räsänen et al., 2014, for evidence of "defaulting" to high frequency forms in English). In contrast, fewer than 1% of errors were substitutions of less frequent forms for 3sg forms (the most frequent in both corpora).

Table 5.4.

Errors Broken Down by Inflectional Target Context

	Target inflection				
Actual production	3sg	1sg	1pl	2sg	2pl
3sg	Correct	6	25	57	68
1sg	2	Correct	34	42	10

1pl	0	23	Correct	0	38
1pl passive	1	33	Correct	7	118
2sg	1	38	13	Correct	113
2pl	1	4	42	38	Correct
3pl			1	1	1
Total *N* errors	5	104	115	145	348

The findings that (a) errors are more frequent for low frequency target contexts and (b) almost always involve replacement by higher-frequency forms are obviously consistent with constructivist approaches, which emphasize the importance of frequency-sensitive input-based learning. However, a stronger prediction of such approaches is that errors will pattern according to properties of the input distribution at the level of individual verbs. The following analyses test this prediction, using a developmental approach designed to elucidate the processes underlying changes in children's use of inflectional morphology.

4.3. By-verbs Analysis

The analysis reported above compared the generativist prediction of low overall error rates against the constructivist prediction of high error rates for low frequency target contexts (e.g., 2pl vs 3sg). In order to test the second and third constructivist predictions outlined in the introduction – that error rates will be lower for (a) high frequency lexical target forms and (b) verbs with high phonological neighborhood density – a finer-grained by-verbs analysis is required.

In order to examine patterns of correct use versus error across all of the 180 different target forms elicited in the study (36 verbs x 5 person/number contexts) we constructed mixed-effects regression models with items and participants as random effects (see Baayen, 2008). Compared with traditional by-subjects/items regression analysis, the advantage of using such an approach is that mixed-effects modeling takes into account both by-subject and by-item variation, and thus is more powerful. As the outcome measure was dichotomous (for each target, each child produced either a correct or an incorrect form [coded as 1/0], with all other

responses, including bare stems, infinitives and ambiguous forms, treated as missing data), binomial logistic regression models were used. The fixed effects of interest were the input token frequency of the target lexical verb form (e.g., *sano-n*, *sano-t*, *sano-o, sano-mme, sano-tte*; taken from the newspaper corpus, as most did not occur in the small child-directed corpus discussed above), morphophonological class size and age. Verb length (in syllables) was included as a control predictor: Under any theoretical account, longer verbs might be expected to introduce more processing difficulty and hence increase error rates. Verb set (A or B) was not included, as preliminary analyses revealed that it was not a significant predictor of rates of correct production (β = -0.21, *SE* = 0.22, *z* = -0.96, *p* = .337). All model comparisons used likelihood ratio tests performed in R with the anova function. The details of all statistical models are presented in Table 5.5.

Table 5.5.

Mixed-Effects Regression Models

Model 1: Reduced model - Syllable length

Variable	β	*SE*	*z*	*p*
(Intercept)	2.89	0.33	8.72	< 0.001
Syllable length	-0.35	0.11	-3.22	0.001

Note. Model log likelihood = -1936. Random effects: Participant (*Var*=0.73, *SD*=0.85), Verb (*Var*=0.02, *SD*=0.14)

Bold values indicate that effect is statistically significant at *p* < .05 or greater.

Model 2: Token frequency

Variable	β	SE	z	p
(Intercept)	2.14	0.37	5.76	< 0.001
Syllable length	-0.15	0.12	-1.25	0.211

Token frequency	**0.04**	**0.006**	**6.86**	**< 0.001**

Note. Model log likelihood = -1884. Random effects: Participant (*Var*=0.81, *SD*=0.90), Verb (*Var*=0.04, *SD*=0.19)

Bold values indicate that effect is statistically significant at *p* < .05 or greater.

Model 3: Token frequency + Morphophonological class size

Variable	*β*	*SE*	*z*	*p*
(Intercept)	2.13	0.38	5.61	< 0.001
Syllable length	-0.15	0.13	-1.10	0.271
Token frequency	**0.04**	**0.006**	**6.86**	**< 0.001**
Morphophonological class size	-0.01	0.07	-0.12	0.907

Note. Model log likelihood = -1884. Random effects: Participant (*Var*=0.81, *SD*=0.90), Verb (*Var*=0.04, *SD*=0.19)

Bold values indicate that effect is statistically significant at *p* < .05 or greater.

Model 4: Token frequency + Morphophonological class size + Interactions

Variable	*β*	*SE*	*z*	*p*
(Intercept)	1.84	0.37	5.01	< 0.001
Syllable length	-0.08	0.13	-0.64	0.521
Token frequency	**0.09**	**0.014**	**6.42**	**< 0.001**
Morphophonological class size	0.06	0.07	0.94	0.348
Token frequency * Morphophonological class size	**-0.03**	**0.007**	**-4.38**	**< 0.001**

Note. Model log likelihood = -1873. Random effects: Participant (*Var*=0.83, *SD*=0.91), Verb (*Var*=0.02, *SD*=0.16)

Bold values indicate that effect is statistically significant at *p* .05 or greater.

Model 5: Token frequency + Morphophonological class size +Age + Interactions

Variable	β	*SE*	*z*	*p*
(Intercept)	-1.10	0.77	-1.43	0.154
Age	**6.69**	**1.57**	**4.27**	**< 0.001**
Syllable length	-0.10	0.13	-0.78	0.436
Token frequency	0.10	0.08	1.27	0.205
Morphophonological class size	**0.81**	**0.33**	**2.43**	**0.015**
Token frequency * Morphophonological class size	-0.07	0.04	-1.46	0.146
Token frequency * Age	-0.003	0.18	-0.02	0.986
Morphophonological class size * Age	**-1.63**	**0.72**	**-2.28**	**0.023**
Token frequency *Morphophonological class size * Age	0.6	0.09	0.63	0.528

Note. Model log likelihood = -1863. Random effects: Participant (*Var*=0.67, *SD*=0.82), Verb (*Var*=0.03, *SD*=0.16)

Bold values indicate that effect is statistically significant at *p* < .05 or greater.

Model 1 (a reduced, baseline model) included only verb length (in syllables) as the (control) predictor variable. Verb length was a significant negative predictor of children's ability to supply the correctly inflected target form (β = -0.35, *SE* = 0.11, *z* = -3.22, *p* = .001).

Model 2 added the predictor of lexical verb form token frequency. Whilst verb length was no longer a significant predictor (β = -0.15, *SE* = 0.12, *z* = -1.25, *p* = .211), token frequency was a large and significant positive predictor of children's ability to supply the correctly inflected target form (β = 0.04, *SE* = 0.007, *z* = 6.86, *p*

< .001); i.e., a negative predictor of the error rate. This model (*AIC* = 3778, logLik =-1884) provided a significantly better fit to the data then the reduced model (*AIC* = 3880, *logLik* =-1936; $p < .001$). This finding provides support for the constructivist claim that an important mechanism in early morphological development is the storage and retrieval of ready-inflected forms, and is problematic for those generativist accounts (e.g., Hoekstra & Hyams, 1998; Wexler, 1998) that seek to explain person/number marking errors solely in terms of children's lack of knowledge of particular inflectional morphemes.

Model 3 added the predictor of morphophonological class size. This variable did not predict the rate of correctly inflected target forms (β = -0.01, *SE* = 0.067 *z* = -0.12, $p = .907$), and the model (*AIC* = 3780, *logLik* =-1884) did not provide a significantly better fit to the data than Model 2 ($p = .901$). However, this finding needs to be interpreted in the context of a significant interaction between token frequency and morphophonological class size observed in Model 4 (β = -0.03, *SE* = 0.007, *z* = -4.38, $p < .001$), which provided a significantly better fit to the data than Model 2 (*AIC* = 3760, *logLik* =-1873) ($p < 0.001$). The interaction is plotted in Figure 5.2. from which it can be seen that morphophonological class size had a larger facilitative effect for lower frequency than higher frequency target verb forms. The direction of this interaction suggests that, consistent with the constructivist approach, children rely on phonological analogy only when a stored ready-inflected form is not available.

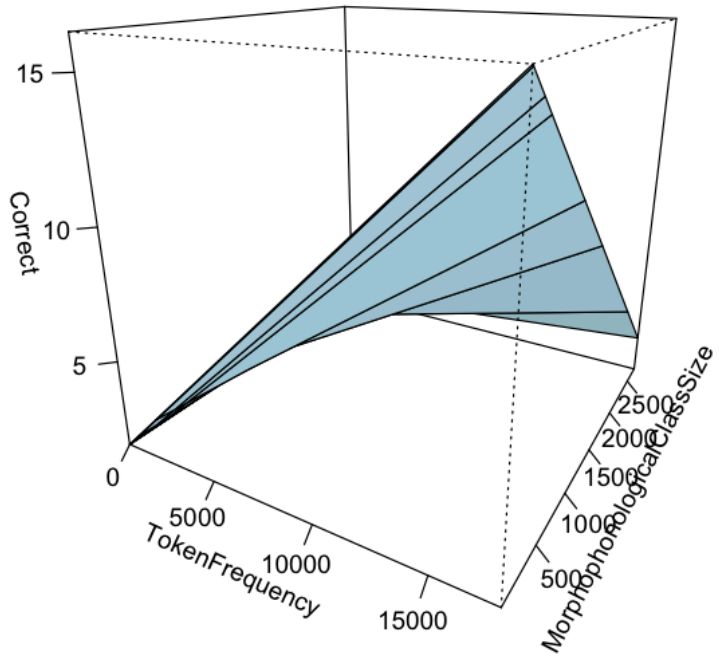

Figure 5.2. Illustration for the interaction between lexical token form frequency and morphophonological class size

4.4. Development

In summary, the findings outlined above – a non-negligible rate of errors, that pattern according to (a) person/number context, (b) target lexical form frequency and (c) morphophonological class size (for lower frequency verbs) – would appear to sit more comfortably with constructivist than generativist approaches. As noted in the introduction, however, an important goal of the present work was to begin to move beyond this debate, and investigate in more detail the factors that appear to influence development in children's use of inflection.

To this end, Model 5 added the children's age (in months) and its two- and three-way interactions with lexical verb form token frequency and morphophonological class size. This model provided a significantly better fit to the data than Model 4 (*AIC* = 3748, *logLik* =-1863) ($p < .001$). The McFadden's Pseudo R^2 value, which compares the best-fit model with a null model, was 0.04. A main effect of age was observed ($\beta = 6.69$, $SE = 1.57$, $z = 4.27$, $p < .001$), reflecting the fact that, as would be expected under any account, older children are better at supplying the correct target form.

More interestingly, this analysis revealed a significant interaction between age and morphophonological class size (β = -1.63, *SE* = 0.72, *z* = -2.28, *p* = .023), but no other main effects or interactions. The negative interaction between age and morphophonological class size, shown in Figure 5.3., could reflect a decrease in the importance of morphophonological class size with age; a finding that might be presumably due to learners' knowledge of the system becoming increasingly abstract with age, leaving them less reliant on analogy with close phonological neighbours. Of course, one should note that this interaction could also be to the process of rote-learning. As children get older, they will have stored more rote-learned items, and be less likely to analogy across similar verbs.

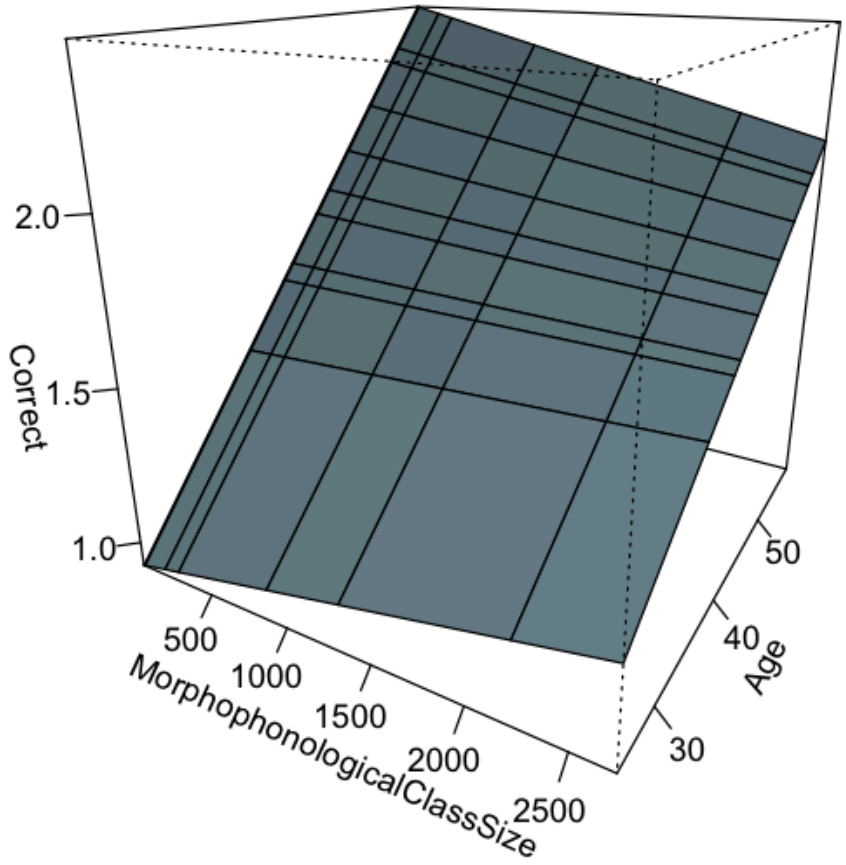

Figure 5.3. Illustration for the interaction between age and morphophonological class size

Under a strict exemplar-based approach, this "more abstract knowledge" would constitute (a) more stored exemplars of each person+number-marked verb form and (b) the ability to analogize across all stored forms with the appropriate person+number features, presumably on the basis of this shared function, even in the absence of close phonological similarity. Under an account that posits the independent representation of linguistic generalizations, this "more abstract knowledge" would constitute stored morphological schemas, constructions or slot-and-frame patterns such as [STEM]-*n* (a putative 1sg schema), with the [STEM] slot having no particular phonological restrictions (due to the phonological heterogeneity of the verb forms in the input that gave rise to this schema).

Either way, the developmental pattern is clear: At all ages, children make use of rote-learned individual ready-inflected verb forms (hence the main effect of lexical target form frequency and no interaction with age). At all ages, children make use of phonological analogy with stored forms, when the target form is of low frequency in the input, and therefore not stored (hence the negative interaction of frequency and morphophonological class size, but no three-way interaction with age). However, as development proceeds, children become less reliant on phonological analogy with stored forms, as they gain the abstract knowledge needed to supply the correct person/number form of any verb, regardless of its phonology (hence the negative interaction of age and morphological class size)[14].

5. Discussion

The present study constituted an elicited production study of Finnish present tense verb forms, designed to test the predictions of generativist and constructivist accounts of the acquisition of inflectional morphology. Four main findings were observed.

The first is that rates of person/number marking errors were as high as 32% for low frequency person/number contexts, even when excluding data from children who showed no evidence of having learned the relevant morpheme. This finding is predicted by constructivist accounts, but is more difficult to reconcile with generativist accounts, which predict very low error rates (at least, once the child has learned the relevant morpheme). Note that because we excluded children who

[14] As noted earlier, this finding could also be due to an increase in the number of rote-learned items, as children get older.

did not produce at least one correct instance of the relevant person/number morpheme, this pattern cannot solely be a reflection of a tendency to avoid using certain person/number contexts for pragmatic reasons.

The second is that most errors involved the use of higher-frequency forms in lower frequency person/number contexts. Again, this finding is more consistent with constructivist accounts, but could, in principle, be reconciled with generativist accounts, provided that one is prepared to additionally posit a significant degree of rote-use of high-frequency lexical target forms, even after the point at which individual person/number marking morphemes appear to have been acquired; though it is important to stress that none of the generativist accounts discussed thus far do so.

The third is that error rates were predicted not only by the frequency of person/number contexts (e.g., 3sg > 2pl), but also by the frequency of individual "ready-inflected" lexical target forms. Again, this finding is predicted by constructivist accounts, which posit an important role for rote-learning of individual lexical forms, and could be explained by a generativist account that adopted this assumption. As we noted in the introduction, the generativist accounts discussed up to this point implicitly rule out this assumption by taking all correctly inflected forms – even high frequency forms that could be rote learned - as evidence of abstract knowledge of inflection.

The fourth finding is that – for low frequency verbs - lower error rates were observed for verbs with high phonological neighborhood density, which allows children to generate otherwise-unavailable target forms by phonological analogy with stored neighbours. However, a negative interaction of age and morphophonological class size could indicate that, as development proceeds, children become less reliant on phonological analogy with stored forms, as they gain the abstract knowledge needed to supply the correct person/number form of any verb, regardless of its phonology. Again, these findings are consistent with constructivist accounts, which posit a role for phonological analogy with stored neighbours, "regular" or "irregular" alike (e.g., Ambridge, 2010). None of the generativist accounts discussed up to this point incorporate a rule for phonological analogy in regular systems.

Do our findings therefore count against only the particular generativist accounts discussed in the introduction (Harris & Wexler, 1996; Hoekstra & Hyams, 1998;

Wexler, 1998; Deen, 2004; Legate and Yang, 2007) or against generativist approaches to morphological acquisition in general? On the one hand, it is certainly true that these data count most straightforwardly against those particular accounts, which specifically and explicitly predict low rates of person/number marking error.

On the other hand, one could, in principle, posit a generativist account that assumed - in addition to early knowledge of an abstract person/number marking system - both (a) considerable use of rote-learned ready-inflected verb forms for a protracted period and (b) phonological analogy across such forms, even for regular forms. However, since such an account would, in effect, constitute a constructivist account with innate knowledge of an abstract system of verb inflection added on, the onus would be on the proponents of such an account to explain exactly what explanatory power the additional innate knowledge is adding. In particular, note that such an account could not take low error rates as evidence for innate abstract knowledge, as low error rates (i.e., high rates of correct use) could reflect the use of rote-learned forms.

One generativist account that exhibits some of these characteristics is Pinker's (1984) paradigm-building account. While this account shares with other generativist accounts the assumption that children start out with abstract knowledge of the cells of person/number marking paradigms, the process by which children fill in these cells – effectively generalizing gradually across stored exemplars – has more in common with constructivist accounts. We suggest, however, that the present findings nevertheless constitute evidence against Pinker's (1984) proposal, for two reasons. The first is the reason that we gave above: Given the present evidence that children are storing and gradually generalizing across individual inflected forms (as assumed by Pinker's, 1984, account), additionally positing innate abstract knowledge of the paradigm would seem to add little or nothing to the explanation.

The second reason is that, in order to account for the phonological neighbourhood effects observed in the present study, Pinker's (1984) account would have to add the assumption of phonological analogy across all stored forms. However, in his work on another domain of inflectional morphology - the English past-tense - Pinker explicitly rules out such a mechanism. For example, although Prasada and Pinker (1993) argue for phonological analogy across stored irregular verb forms, they not only argue specifically against the possibility of phonological analogy across regular morphological forms, but present a study designed

specifically to provide empirical evidence against this possibility (whether or not it successfully does so is a matter of debate; see Albright & Hayes, 2003; Ambridge, 2010). Since all of the verb forms in the present study are regular, Prasada and Pinker's (1993) account would seem to specifically predict that an effect of phonological neighborhood density will not occur.

Thus, although no study could ever provide definitive evidence against all possible future generativist accounts, on our view, the present findings both (a) constitute evidence against all generativist accounts that have been proposed so far (including Pinker, 1984) and (b) suggest that any future account would have to include such a large role for exemplar storage and analogy, that its generativist underpinnings would be seriously undermined: Given that children generate non-rote-stored forms by analogizing across stored exemplars, what do we gain by positing that – sometimes – they may additionally generate them using algebraic rules based on an innate abstract system?

It must be noted that due to the nature of Finnish, an obvious limitation of the present study is the fact that it is impossible to know for certain that, when apparent errors were made, children were indeed attempting to produce the target person+number marked form (subjects are almost always omitted in conversational Finnish). Note, however, that because we excluded children who did not produce at least one correct instance of the relevant person/number morpheme, the high error rates observed for certain inflectional contexts cannot solely be a reflection of a tendency to avoid these contexts for pragmatic reasons (e.g., using a 2sg form rather than a 2pl form because the child prefers to describe the actions of the dog alone, rather than the dog and the experimenter). The fact that these errors (e.g., substitutions of 2sg for 2pl) did not occur at random, but were predicted by both token lexical frequency and phonological neighborhood density provides further evidence that at least the majority were indeed errors, rather than pragmatic substitutions. Furthermore, the pattern of results is very similar to that observed in naturalistic studies of Spanish (Aguado-Orea, 2004) and Brazilian-Portuguese (Rubino & Pine, 1998), suggesting that any occasional misclassifications of errors as well-formed attempts at non-target person+number forms did not substantially affect the overall pattern observed.

Nevertheless, in order to clarify this issue, it may be useful to conduct future studies using paradigms that encourage the production of subjects (e.g., priming

and/or sentence completion). Furthermore, as noted in the introduction, few – if any -studies have examined children's use of inflections in such detail as the present study. Extending this elicited production method to other languages including those that have more complex present tense paradigms (e.g., Spanish with its different conjugation classes) would be informative.

Future research should also address the issue of how children's use of inflection becomes adult-like. The present study provides evidence that children move away from reliance on phonological analogy with neighbors and towards more abstract representations. It does not, however, address the issue of precisely how this change occurs, or what these more abstract representations look like. Do Finnish-speaking adults have, for example, an independently represented [STEM]-*n* construction or a cluster of exemplars tied together by functional as well as phonological similarity? In addition, even though adults seem to use these more abstract representations, there are probably circumstances in which they instead retrieve a ready-inflected form or apply phonological analogy to a close neighbor. Presumably, adults use a mixture of all three strategies, depending – among other factors – on the frequency of the target form, and hence the strength of its representation in memory. Further research is required to fully understand the complex relationship between these factors.

In conclusion, the present findings suggest that any successful account of the acquisition of verb morphology will need to include a role for rote-storage of individual inflected forms as well as phonological analogy across such forms. Explaining how children move from this early stage characterized by rote-learning and errors in low frequency parts of the inflectional system to the fully-productive, error-free adult system remains a challenge for all theoretical approaches. It is to be hoped that future studies of inflectional morphology will cast more light on the relative balance of input-based learning and innate categories and formal rules; an issue that has important theoretical implications not only for accounts of morphological acquisition, but also for accounts of language acquisition in general.

Chapter 6: General discussion

A universal characteristic of human languages is that children seem to acquire their native language very quickly and effortlessly, as if the grammatical rules governing the language were innate to them. However, as English children learn to speak English and Finnish children learn to speak Finnish and so on, imitation of their caregivers must obviously be one of the factors underlying children's language acquisition. However, despite extensive research, the relative contributions of innate abstract knowledge and concrete linguistic experience in language acquisition are still unclear, and one of the most hotly debated issues in the field is indeed the question of whether or not children are born with a set of innate grammatical rules or whether language can be acquired from the input only. As outlined in Chapter 1, this debate has led the language acquisition field to split into two opposing approaches, generativist (e.g. Pinker, 1984; 1989; Wexler, 1998) and constructivist (e.g., Bates & MacWhinney, 1989; Tomasello, 2000ab; 2003). The former position is based on the assumption of innate knowledge of grammatical categories and rules whilst the latter assumes no domain-specific knowledge of language but attempts to explain language acquisition by means of general cognitive learning mechanisms.

The aim of the present thesis was to examine one particular aspect of language acquisition – the acquisition of inflectional verb morphology – and in doing so, to shed more light on the language acquisition processes in general and attempt to distinguish between the two competing approaches. This thesis focused specifically on the acquisition of verb inflection in three different languages, English, Swedish and Finnish, by conducting three separate experiments. Each of these experiments was presented in a journal-paper format, and, in addition to summarizing the findings, this final chapter discusses the three main overall implications of the results for generativist and constructivist approaches to language acquisition. The chapter finishes by suggesting directions for future studies in order to clarify the processes underlying the acquisition of inflectional verb morphology.

1. Summary of the findings

Experiment 1, described in Chapter 3, investigated a dual mechanism explanation of the Optional Infinitive phenomenon in English-speaking children using an elicited production experiment. Whilst Experiment 1 elicited OI errors in simple finite contexts only, Experiment 2, in Chapter 4, explored this dual mechanism account in both modal and non-modal contexts in two different languages, English and Swedish. Finally, Experiment 3 focused on person/number marking errors in a morphologically rich and understudied language, Finnish, and investigated the effect of the input on the pattern of errors.

1.2. Summary of Experiment 1

Experiment 1 investigated the Optional Infinitive phenomenon in English: the observation that children acquiring English often produce bare verb forms, identical to infinitival forms, when an inflected form is required by the context (e.g., Brown, 1973; Brown & Bellugi, 1964; Cazden, 1968). A review of the current models of OI errors revealed that neither the leading generativist (Legate and Yang's Variational Learning model) nor constructivist account (Freudenthal et al.'s MOSAIC) could, in their present form, explain the very high OI error rates in English. Motivated by the 'defaulting' errors found in morphologically richer languages such as Spanish (Aguado-Orea, 2004), it was hypothesized that OI errors in English would be directly related to the extent to which particular verbs occur in bare as opposed to 3sg *–s* form in child-directed speech. In an elicited-production study, a significant correlation was indeed found between children's productions of OI errors and this input measure across 48 verbs. This finding suggests that defaulting to the most frequent and phonologically simplest form can explain at least some of English-speaking children's OI errors.

1.3. Summary of Experiment 2

In Experiment 2, whilst a similar picture-description task was used as in Experiment 1, this time utterances were elicited in both modal and non-modal (simple finite) contexts. In addition to English, Swedish-speaking children were recruited in order to compare the pattern of the error data across these languages and to test the dual mechanism account in more detail. It was hypothesized that both the processes of defaulting and truncating compound finite structures would lead to OI errors in English since the infinitive is homophonous to the most

frequent form (the bare form) whereas in Swedish OI errors would be mostly restricted to modal contexts (i.e., be truncation errors). Consistent with the vast OI literature (e.g., Hoekstra & Hyams, 1998; Josefsson, 2002), the results of Experiment 2 revealed that Swedish-speaking children made OI errors mainly in modal contexts, suggesting that these errors were truncated modal + infinitive structure. On the contrary, English-speaking children showed no significant differences between modal and non-modal contexts, and thus, support the dual mechanism account which predicts that all OI errors are either a) modal deletions (truncation errors) or b) defaulting to the most frequent form. Moreover, the input measure of the proportion of bare forms (in English) and infinitives (in Swedish) significantly predicted the errors on a verb-by-verb basis in non-modal contexts. These two findings support the dual mechanism account, and are very difficult for generativist models to explain. In addition, a closer look at different verb types in Swedish revealed that ambiguous verbs can lead to increased error rates.

1.4. Summary of Experiment 3

Whilst Experiments 1 and 2 investigated the OI phenomenon in English and Swedish, Experiment 3 focused on Finnish, an understudied Finno-Ugric language, and was specifically aimed at looking at defaulting errors identified in the previous experiments. This study also examined input-driven errors more generally in order to draw some conclusions about developmental changes in language acquisition. An elicited production paradigm was used to elicit different person/number present tense forms from 2-4 year old Finnish-speaking children, and four main findings were revealed by the analyses. First, high error rates were detected for low-frequency person/number contexts (e.g., 3pl) even after excluding children with no evidence of having learned the relevant inflection. Second, most person/number errors involved using high-frequency forms (e.g., 3sg) in lower frequency person/number contexts. Third, the error rates were not only related to the frequency of the target context (e.g., fewer errors in 3sg than 2g contexts) but were also predicted by the frequency of the individual lexical target forms. Finally, it was observed that for low frequency verbs, lower error rates were observed for verbs with high phonological neighborhood density, allowing children to generate target forms by phonological analogy with stored neighbors. However, age and phonological neighborhood density negatively interacted, indicating that as their

language skills develop, children become less reliant on phonological analogy with stored forms, as they gain the abstract knowledge to inflect a verb, regardless of its phonology. Alternatively, this last finding could be due to an increased number of rote-learned items as children get older.

2. Overall implications of the findings

The studies reported in the present thesis provide convincing evidence for the constructivist view of language acquisition, and are difficult for generativist theories to account for. This section outlines the three main implications of the results across the three experiments.

2.2. Direct input effects

First, an important implication of the overall findings of the present studies is that all of the three experiments have shown significant input effects by which errors – whether OI or person/number marking errors – are predicted by individual verb frequencies. In Experiments 1 and 2 it was shown that the proportion of bare forms vs 3sg *–s* forms in English predicted children's production of OI errors. Experiment 2 also extended these results to Swedish, in which the proportion of infinitives in the input predicted the production of OI errors. Experiment 3 examined the production of verb inflections in a highly inflected language, Finnish, and the results revealed that the strongest predictor was the lexical token frequency of the particular inflected form in the input. Moreover, person/number marking error rates in Finnish were directly related to the frequency of a particular inflectional context (i.e., higher error rates in low frequency contexts), and were as high as 32% for the lowest frequency context (2pl) even after excluding children who showed no evidence of having acquired the relevant inflection. Constructivist accounts, which assign rote-learning a very vital role in early language acquisition, predict all of the above findings; however, they are very difficult for generativist accounts to explain.

In addition to frequency effects, the present studies have highlighted the importance of phonological factors on the production of verb inflections. The Finnish study provided direct evidence for an effect of phonology on verb inflection in the form of phonological neighbourhood effects. Some evidence for phonological effects was also found in Experiment 1 in which the proportion of the English bare

forms predicted the OI error rates. As the bare form is phonologically simpler than the 3sg –*s* form, this association between the rate of bare forms and OI errors could be due to phonological simplicity as well as the fact that the bare form is the most frequent form. Furthermore, in Experiment 2 it was found that Swedish OI errors were related to the verb type: after excluding verbs in which the present tense form was homophonous to the infinitive form in spoken language, the correct performance in non-modal contexts increased to almost 100%. An important implication of this is that such ambiguous forms may inflate the error rate; a valid observation made for Swedish in particular (e.g., Phillips, 1995; Platzack, 1990). It is therefore vital to be aware of such phonological effects that may influence the error rates.

With regard to Finnish, Experiment 3 provided interesting results about phonological neighborhood effects. The study showed that for low frequency verbs lower error rates were observed for verbs with high phonological neighborhood density, suggesting that phonological analogy with stored neighbors allows children to produce currently unavailable target forms. The effect of phonological neighborhood however decreased with age, which fits the idea that as children gain the abstract knowledge needed to supply the correct person/number form regardless of the verb, the role of phonological neighborhood density becomes less important. Instead, children are now using some kind of abstract STEM + INFLECTION generalization. Whilst generativist accounts do not assume a role for phonological analogy in regular morphological systems, constructivist accounts have no problem explaining this finding (e.g., Ambridge, 2010). Alternatively, this finding could be due to the increased number of rote-learned items as children get older; again, something that fits with constructivist accounts.

Experiment 2 tested empirically the process of truncating utterance-final compound finites as suggested by Freudenthal et al. (2010) as an input-based explanation of OI errors crosslinguistically. Whilst these authors provided evidence for this process with naturalistic data and computational modeling, Experiment 2 showed that it is possible to directly elicit OI errors that appear to be truncated compound finites in an experimental setting. Thus, these results support the view that at least some OI errors are truncated compound finite input structures.

Indeed, a finding that is common to all the studies in this thesis, and across all the three languages, is that it is impossible to account for these data unless one assumes that learning individual inflected forms from the input plays a crucial part in children's early language acquisition. Thus, the findings of this thesis have clearly indicated that young children's use of language is greatly affected by the input that they hear, and differences between languages can be explained by the characteristics of the input. These findings can be explained by most constructivist accounts, but generativist accounts struggle to assume this much rote-learning. This reluctance to allow rote-learning is rather surprising, as by assuming that children rote-learn some individual inflected items and longer strings – as well as using more abstract rules - they would be able to provide a better fit to the current data. Obviously, however, in order to avoid becoming circular, these accounts should build in some sort of criteria for rote-learning. For example, in his account of OI errors, Radford (1996) posited that apparently correct forms are produced as rote-learned chunks. This assumption means that the account is untestable, as any utterance not consistent with the account can be dismissed as rote-learned.

2.3. Defaulting

A second important implication of the present results is that defaulting to the highest frequency and/or phonologically simplest verb form in the input is a real phenomenon and has the potential to explain data from various different languages and as such, provide an explanation for the very high rates of OI errors in English and also explain person/number marking errors in languages such as Finnish and Spanish.

Experiment 3, which was aimed specifically at looking at defaulting errors, showed that Finnish children tended to use 3sg form particularly in low frequency contexts. Throughout the literature, for Finnish, the default – or base – form has been claimed to be the 3sg present tense form (Laakso, 2007; Laalo, 2000; Niemi & Niemi, 1987; Toivainen, 1980). Similarly, it has been suggested that in languages such as Spanish and Catalan (Grinstead, 1998) the 3sg present tense acts a default form. Ferdinard (1996) observed that French-speaking children also overgeneralized 3sg present tense forms despite also producing OI errors. This begs the questions: what determines the default status of a particular form?

Recall that 3sg present tense forms in Finnish have either no marking (i.e., are identical to the inflectional stem) or are marked by just lengthening of the vowel, and are therefore not only the most frequent form in the input but also phonologically simplest present tense form. These characteristics of the 3sg form inarguably affect the default status. It should be noted, nonetheless, that certain generativist accounts have argued that 3sg form functions as a *grammatical* default form that can be used when the child does not know how to mark agreement (e.g., Radford and Ploennig-Pacheco, 1995). Aguado-Orea (2004) argued, however, that the implication of this claim is that 3sg forms would be expected to be used incorrectly to the same extent across all inflectional contexts, and provided evidence that at least in Spanish this was not the case. Similarly in the present study, 3sg forms were not equally distributed across the different inflectional contexts but were most frequent in lower frequency contexts such as 2pl. Thus, it can be concluded that the Finnish 3sg form does not appear to bear any grammatical default status, but it is rather used when the processing load is high, and retrieving or generating the correct form fails. This is exactly what one would expect under constructivist accounts.

Thus, the results of Experiment 3 suggest that while it may seem that the 3sg form is the default form in a grammatical sense, in fact all the other inflected forms are competing with it. Which form actually gets selected and produced will depend on the factors such as the strength of that particular form in memory. For particular verbs, the strongest form might be the 1sg form rather than 3sg. For example, the 1sg form *haluan* '*I want*' might be the strongest form of this verb. This fits well with the constructivist accounts that do not assume any grammatical default forms *per se,* but highlight the importance of the direct effect of the input in producing inflected forms. In Experiment 1 the proportion of English bare forms was found to affect the OI error rates. Of course, English being such an impoverished language in regards to its morphology, it is hard to tease apart the effects of frequency and phonological simplicity, and determine whether the bare form acts a default form due to its high type frequency or because it is the simplest form phonologically.

2.4. A Dual mechanism account of verb-marking errors

A third implication from a theoretical point of view is the proposed dual mechanism account which builds on the two previously discussed implications. In

the Discussion section of Experiment 1 it was argued that a two-factor model incorporating both the process of truncating compound-finite input structures and defaulting to the most frequent/phonologically simplest form could potentially explain not only why the OI error rate is so high in English but also account for person/number marking errors in languages such as Spanish. Recall that traditionally languages have been split into OI and non-OI languages. However, even in languages classified as non-OI, children do make these errors to some extent (e.g., Aguado-Orea, 2004, for Spanish). Similarly, in Experiment 3 of the present thesis, the Finnish children produced some infinitival forms in simple finite contexts. Experiment 2 further tested the two factors identified in Experiment 1, and the results provided positive evidence for this dual-mechanism account. As predicted, in Swedish, more OI errors were found in modal contexts whilst, in English, there were no differences between modal and simple finite contexts. This fits well with the dual-process account according to which both truncating compound finites and defaulting to the most frequent/phonologically simplest form simultaneously affect language acquisition. Due to the morphologically impoverished nature of English, both of these processes lead to OI errors (hence the very high rate of such errors). In Swedish, there is only one present tense form for all person/number combinations; thus, there is no particular person/number inflection that would be more frequent than others (such as 3sg present tense is by far the most frequent in Finnish). This dual process mechanism therefore has the potential to explain a) why OI errors in English occur in both modal and non-modal contexts while in Germanic languages they tend to occur in modal contexts and b) person/number marking errors in languages like Spanish and Finnish.

3. Suggestions for future studies

With regards to future studies, the present experiments have implications for both the development of experimental methods and future theoretical directions.

It was noted throughout the experiments that production methods are rather difficult and demanding, particularly for children aged under three years old and young three year olds, which led to missing data points. Whilst this was at least partly due to lack of concentration and patience, it is also true that young children are often inhibited when interacting with an experimenter and may be cautious with new visitors to the school or nursery. Secondly, it was observed whilst collecting

the data that children occasionally became distracted by the laptop which was used in all of the present studies to present the stimuli. Indeed, in many cases, it appeared that participants were more interested in playing with the laptop, which of course reduces concentration and focus on the experimental task itself. Thus, it is important to consider carefully whether the experimental setting might turn out to be problematic and produce undesirable effects. In the view of the above issues, it would therefore be useful for future studies to try these production experiments in a more naturalist setting which embeds, for example, the modality manipulation in the daily discourse interactions of the children's lives. For example, Experiments 1 and 2 could be presented in a context of a game in which the child and her caregiver take turns in repeating back sentences or describing pictures or videos during the bedtime routine. This would make the setting less artificial and it would be less demanding and artificial than a standard experimental set-up.

With regard specifically to Finnish, due to the properties of the language, the children in Experiment 3 very rarely produced overt subjects. An experiment which incorporates a sentence completion task (e.g., *'Tänään me…'Today we….'*) or a priming study encouraging the production of subjects would help to avoid the possible pragmatic errors that were found in the error data in the Finnish experiment conducted for the present thesis. Similar elicitation experiments in a language that is even more morphologically complex than Finnish (e.g., Spanish, Lithuanian) would help us to understand more about the process of acquisition of inflection.

The studies presented in this thesis have all focused on explaining why children sometimes produce incorrectly marked verb forms, or nonfinite forms. As pointed out in the discussion sections of both Experiments 2 and 3, these error data do not, of course, allow us to tap directly into children's mental representations. For instance, when Finnish-speaking children produce a 3sg inflection for 2pl target, it is not clear if they a) have stored the 3sg form of that verb incorrectly as the 2pl form or b) know the correct form but, due, for example to problems with retrieving the correct form, instead produce the most frequent form.

One way to investigate this issue would be to look at how children respond in a judgment task to verbs that have been incorrectly inflected for the subject (e.g., **Sinä kävelemme* '*You-2sg walk-1pl*' instead of the correct utterance *Sinä kävelet* '*You-2sg walk-2sg*') and manipulate the frequency of the inflected forms that are

presented. If children showed a preference for the correct person/number form, this would provide evidence that they are able to distinguish between the different person/number combinations, and incorrect or lack of use of an inflection was related to for problems retrieving the low frequency form. To recruit even younger children, one could use eye-tracking paradigm, which would be less demanding than for example picture-pointing or grammaticality judgments. Another possible experimental paradigm to investigate children's underlying representations would be to use reaction-time measures to examine how different inflected and non-inflected verb forms are stored and accessed. Furthermore, combining production and comprehension tasks in the same experiment would be desirable to get a fuller picture of children's knowledge.

One interesting finding in Experiment 3 was that quite often children would provide forms with correct person but incorrect number marking (e.g., 2pl for 2sg target). One possible explanation for this finding could be that at least some of these number agreement errors reflect the problem that Finnish-speaking children have in acquiring the specific features (person/number) of each inflection because of the neutralization of number/person distinction in colloquial speech (Kunnari et al., 2010). For instance, the fact that 3sg forms are usually used to replace 3pl forms in spoken language might blur the number distinction and make it harder for children to distinguish between singular and plural inflections. Similarly, 2pl forms can be used in formal 2sg contexts. Furthermore, the passive form of the verb commonly replaces 1pl form in colloquial speech, and this passive form is not marked for either number or person. Thus, one explanation could well be that children acquiring Finnish struggle to learn the specific features of each inflection, and will thus make number agreement errors until they have fully acquired the features of each inflection. It would be thus interesting to replicate the present study in some other highly inflected language that does not have such neutralization of person/number features in spoken language to see if number agreement errors are found to the same extent as in the present study with Finnish-speaking children.

It might also prove worthwhile to investigate the acquisition of inflectional verb morphology in second language acquisition (either sequential or simultaneous). Looking at children as well as adults acquiring a second language could provide important insights into the language acquisition processes and learning strategies,

and how they interact with each other. One possibility would be to test the proposed dual mechanism account with adult learners. This is because for adults one would not expect to see truncation errors, and therefore, one would expect to see no OI errors in modal contexts even in languages such as Swedish. It would be interesting to see if, however, adult learners overused certain inflected forms in the same way as children default to frequent and easiest forms.

It would also be informative to extend the results of the present experiments to other domains, such as acquisition of inflectional noun morphology. Morphologically rich languages such a Finnish with its 15 noun cases would provide a useful testing ground for defaulting effects, and allow to test the claim that defaulting to the most frequent form is a common phenomenon in language acquisition and not just restricted to verb inflection. There is already evidence for such defaulting in, for example, Dabrowska and Szczerbinski's (2006) elicitation study of Polish nouns, which showed strong effects of children defaulting to the most frequent case, and struggling with low frequency targets. It will, however, be challenging to tease apart the effects of frequency and phonological simplicity. Earlier studies of Finnish child language have in common the finding that children tend initially to acquire verb and noun inflections that require only lengthening of the final vowel (e.g., 3sg verb forms and partitive noun forms) (e.,g., Toivainen, 2000).

As has been seen throughout this thesis, the focus of generativist accounts of language acquisition has been on the adult-like end state which is assumed to be in place from the very first utterances that children produce. Such accounts face the disadvantage that it is hard to explain children's erroneous utterances as by assuming full productivity from the beginning, they would seem to predict that no errors will be produced. Constructivist accounts, on the contrary, have tended to focus on explaining the pattern of errors that children do produce. For instance, the computational model MOSAIC can currently provide perhaps the best explanation for the cross-linguistic OI data. However, MOSAIC and other constructivist accounts do not provide any detailed proposals on how children gradually acquire the adult-like knowledge of the grammar. Even Tomasello's (2003) constructivist account does not specify in detail how children move from frozen phrases to abstract constructions.

Indeed, there is still work to be done in order to arrive at a complete account of development of morphology. A full account would have to not only incorporate all factors affecting acquisition of morphology (e.g.., frequency, phonological salience, phonological neighborhood) but also simulate the patterning of errors across different languages and how full competency is achieved. This will no doubt be a difficult task, considering for example the fact that the frequency factor can be divided into absolute (raw) and relative frequency of particular forms to competitor forms. In fact, in the first two studies of this present thesis, relative frequency of bare forms/infinitives to inflected present tense forms was found to affect the correct production of present tense forms in both English and Swedish in simple finite contexts. That is, children were more likely to produce an infinitival/bare form when the inflected target form (always a present tense form) was infrequent relative to the competitor form (infinitival/bare form). Similar findings have been reported by for example Matthews and Theakston (2006) in their study of zero-marking errors of English plural nouns. However, in the third experiment, which looked at Finnish, raw token frequency of present tense forms for each verb predicted the correct performance across the different person/number contexts. The reason for focusing on absolute frequencies in Finnish arises from the complex nature of the Finnish verbal morphology. With there being a separate inflection for each person/number combination (six in total) and several different infinitival forms, it is not an easy task to decide how one would calculate relative frequencies. Which form would one choose as the competitor form against which to compute the relative frequency? In Finnish, one potential candidate could be the 3sg present tense form which has a high frequency count and is usually the first form to be acquired by children. However, even though the children in the Finnish experiment did indeed sometimes supply a 3sg form incorrectly in lower-frequency contexts (e.g., 2pl and 2sg), other substitutions such as 2sg forms for 2pl forms and 1pl for 1sg were not rare. This might suggest that the substitute form that gets selected in morphologically rich languages is not always purely based on the frequency (relative or absolute) but semantics are also important: 1pl form is closer to 1sg form in meaning than 3sg form.

A potential approach to this problem could be to use computational modeling to investigate the contributions of relative and absolute frequency and try to

simulate a learning mechanism that would yield both of these frequency effects. For example, the memory-based computational model MOSAIC is currently sensitive to the statistical distribution of the input, and can therefore successfully simulate OI errors as truncated compound-finite input structures. Making the model sensitive to frequency effects (both absolute and relative) as well as semantics could make it even more powerful in explaining the patterning of the child error data cross-linguistically and determining the exact developmental processes that lead to the adult end-state without assuming any innate linguistic knowledge.

4. Conclusion

This thesis has investigated the acquisition of inflectional verb morphology by focusing specifically on two well-known types of grammatical error, Optional Infinitives and incorrect person/number marking errors. Despite the fact that these two error types have traditionally been treated as constituting separate research areas, they are in fact related to each other more closely than one would at first think. Indeed, the same utterance can sometimes be analysed as being either an OI or as reflecting incorrect marking. For example, an utterance **He eat an apple* could be treated as an OI or an incorrect person/number marking error (e.g., 1pl form used for 3sg). The implication for both generativist and constructivist accounts is that any account must be able to explain all the phenomena that are associated with acquisition of inflectional morphology, and not just some parts of it. The results of the present studies suggest that both OI and person/number marking errors reflect the outcome of a learning procedure which is directly influenced by the frequency and phonological properties of particular verb forms in the input.

To conclude, the three studies reported in this thesis add to the ever-growing body of research suggesting that children's early use of verb inflection is very much dependent on the input to which they are exposed, and that any successful theory of the acquisition of inflectional verb morphology – whether generativist or constructivist – will need to take into account the processes of (a) truncating compound-finite structures, (b) defaulting to the highest frequency/phonologically simplest form, (c) rote-storage of individual lexical forms, and (d) phonological analogy across them. Indeed, the data presented in this thesis supports the idea of two types of verb-marking errors - OI errors learned from compound finite structures and defaulting errors - and the overall pattern of error can be explained

by assuming a dual process account incorporating both mechanisms. Nonetheless, it still remains a challenge for all theoretical approaches to explain how exactly children move from the early stage of erroneous use of inflections to the fully productive, error-free adult grammar, and how these different processes outlined above interact with each other as children get older. Ideally, research in this field should not be restricted to English but also include less-studied languages to gain a more complete picture, as shown by the present experiments. Future studies of inflectional verb morphology will hopefully shed more light on the relative contributions of input-based learning and innate knowledge; an issue that has important general theoretical implications for the field of child language acquisition.

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Appendices

Appendix A. Complete set of test sentences used in Experiment 1 (in alphabetical order). The target clause is in *italics*.

Appendix B. Mean Proportion of Correct Production of 3sg –s on the Elicited Production Task for Each Verb, the Proportions of Bare Forms in All Contexts and Compound Finites as Opposed to 3sg –s Present Tense Verb Forms and the Raw Frequencies of 3sg –s and Bare Forms in the Manchester Corpus Input.

Appendix C. Complete set of test sentences used in the English study in Experiment 2 (in alpabetical order). The target clause is in *italics*.

Appendix D. Complete set of test sentences used in the Swedish study in Experiment 2 (in alphabetical order). The target clause is in *italics*.

Appendix E. The Mean Proportion of Correct Responses for Each Verb Together with the Proportional Frequency of Bare Forms vs 3sg *-s* Forms for English and the Proportional Frequency of Infinitives vs Present Tense Forms for Swedish.

Appendix F. Morphological verb classes of Finnish verbs

Appendix G. Verbs used in Experiment 3 and their characteristics

Appendix H. Mean Proportion of Correct Forms for Each Verb.

Appendix I. Sample parental consent form and information sheet (from Experiment 1)

Appendix A. Complete set of test sentences used in Experiment 1 (in alphabetical order). The target clause is in *italics*.

BUILD Every day the children build something. Sam builds a house and… *Kate builds a castle.*

BUY Every day the children buy some food. Sam buys a banana and… *Kate buys an apple.*

CLIMB Every day the children climb in the woods. Kate climbs a big rock and… *Sam climbs a big tree.*

COLOR Every day the children colour in some pictures. Sam colours in a car and… *Kate colours in a bus.*

COME Every day some visitors come around. The postman comes in the morning and… *Gran comes after school.*

CUDDLE Every day the children want to cuddle a pet. Sam cuddles a puppy and… *Kate cuddles a kitten.*

DO Every day the children do some pictures. Sam does a painting and… *Kate does a drawing.*

DRAW Every day the children draw something. Kate draws a horse and … *Sam draws a rabbit.*

DRINK Every day the children drink something. Kate drinks orange juice and … *Sam drinks apple juice.*

DRIVE Every day the children drive their cars. Kate drives a red car and… *Sam drives a blue car.*

EAT Every day the children eat some fruit. Sam eats an orange and… *Kate eats an apple.*

FIND Every day the children find something. Sam finds a coat and… *Kate finds a jumper.*

FIT Every day the children put their teletubbies away. The toys fit into different containers. Laa-laa fits in the basket and… *Po fits in the box.*

GIVE Every day the children give Mum something. Kate gives a card and… *Sam gives a present.*

GO Every day the children tidy up their toys. The toys go in different places. Rosie goes in the basket and… *Jim goes in the box.*

HAVE Every day the children have a new toy to play with. Today Kate has a doll and… *Sam has a football.*

HELP Every day the children help someone. Sam helps Uncle John and… *Kate helps Auntie Jane.*

HOLD Every day the children hold some animals. Kate holds a puppy and… *Sam holds a kitten.*

HURT Every day the children hurt themselves. Sam hurts a bit and… *Kate hurts all over.*

KEEP Every day when it's time for dinner the children keep on playing. Kate keeps on drawing and… *Sam keeps on painting.*

KNOW Every day Mum asks what animals the children know most about. Sam knows about dogs and… *Kate knows about cats.*

LEAVE Every day the children leave something behind at school. Sam leaves a coat and… *Kate leaves a jumper.*

LET Every day the children let their friends into the house. Kate lets Mary in and… *Sam lets Andrew in.*

LIKE Every day Mum wants to know what the children would like to eat. Sam likes bacon and… *Kate likes egg on toast.*

LOOK Every day the children look for their clothes. Sam looks in the wardrobe and… *Kate looks in the box.*

MAKE Every day the children make something to eat. Sam makes a sandwich and… *Kate makes a big cake.*

NEED Every day the children need to finish off their jigsaw puzzles. Sam needs a square piece and… *Kate needs a round piece.*

OPEN Every day the children open something. Sam opens a can and… *Kate opens a bottle.*

PLAY Every day the children play games. Kate plays a card game and… *Sam plays a board game.*

PULL Every day the children pull things around. Kate pulls a red cart and… *Sam pulls a blue cart.*

PUSH Every day the children push people out of the way. Sam pushes Uncle John and… *Kate pushes Auntie Jane.*

PUT Every day the children put their clothes on. Kate puts a scarf on and… *Sam puts a hat on.*

READ Every day the children read before they go to bed. Kate reads a red book and… *Sam reads a blue book.*

RUN Every day the children run to school. Sam runs down the road and… *Kate runs after him.*

SAY Every day the children say what they want for breakfast. Sam says cereal and… *Kate says apple pie.*

SEE Every day the children see animals at zoo. Sam sees an elephant and… *Kate sees a tiger.*

SHOW Every day the children show their Mum what they have done at school. Sam shows a drawing and… *Kate shows a painting.*

SLEEP Every day the children sleep. Kate sleeps at night and… *Sam sleeps all day long.*

STAND Every day the children stand around waiting for their Mum to come home. Kate stands at the window and … *Sam stands at the door.*

START Every day the children start to read something. Kate starts a book and … *Sam starts a comic.*

TELL Every day the children tell their friends something. Sam tells a joke and… *Kate tells a story.*

THINK Every day the children think about their favorite animals. Kate thinks about horses and… *Sam thinks about dogs.*

THROW Every day the children throw balls. Kate throws a red ball and… *Sam throws a blue ball.*

TICKLE Every day the children want to tickle people. Kate tickles Uncle John and… *Sam tickles Auntie Jane.*

TURN Every day the children turn on Teletubbies. Kate turns on the TV and… *Sam turns up the sound.*

WANT Every day Mum asks what the children want from the shop. Sam wants some sweets and… *Kate wants a Mars bar.*

WEAR Every day the children wear the same colour coats. Kate wears a red coat and… *Sam wears a blue coat.*

WORK Every day the children work. Sam works sometimes and… *Kate works all the time.*

Appendix B. Mean Proportion of Correct Production of 3sg –s on the Elicited Production Task for Each Verb, the Proportions of Bare Forms in All Contexts and Compound Finites as Opposed to 3sg –s Present Tense Verb Forms and the Raw Frequencies of 3sg –s and Bare Forms in the Manchester Corpus Input

Verb	Number of children contributing data	Proportion of correct production of 3sg –*s* (vs OI errors)	Proportion of compound finites	Proportion of bare forms	Raw frequency of 3sg -*s* forms	Raw frequency of bare forms
Build	19/22	0.79	1.00	0.99	4	629
Buy	18/22	0.79	1.00	0.99	3	384
Climb	20/22	0.65	1.00	0.95	6	120
Colour	19/22	1.00	1.00	0.89	19	155
Come	18/22	1.00	0.77	0.92	442	5217
Cuddle	20/22	0.86	1.00	0.94	12	201
Do	15/22	1.00	0.81	0.98	126	6872
Draw	19/22	0.85	1.00	1.00	3	760
Drink	21/22	0.80	1.00	0.92	14	165
Drive	21/22	1.00	1.00	0.92	23	278
Eat	21/22	0.93	0.68	0.94	94	1429
Find	21/22	0.50	0.67	1.00	6	1716
Fit	22/22	1.00	0.87	0.77	70	232
Give	19/22	0.79	1.00	0.98	21	1196

Go	21/22	0.93	0.58	0.88	1201	8831
Have	19/22	0.93	0.65	0.84	1852	9930
Help	15/22	0.86	0.50	0.99	10	663
Hold	22/22	0.73	1.00	0.99	6	446
Hurt	20/22	0.73	0.29	0.82	84	374
Keep	20/22	1.00	0.33	0.89	80	627
Know	21/22	0.79	0.89	0.99	45	4193
Leave	19/22	0.86	1.00	0.98	9	547
Let	20/22	0.73	0.60	0.99	10	1041
Like	15/22	0.86	0.53	0.92	292	3349
Look	20/22	0.80	0.25	0.84	592	3098
Make	17/22	0.40	0.35	0.94	173	2484
Need	19/22	1.00	0.11	0.83	368	1808
Open	16/22	0.83	0.75	0.93	33	453
Play	19/22	0.77	1.00	0.99	12	1705
Pull	21/22	0.69	1.00	0.99	11	703
Push	18/22	0.75	0.88	0.99	5	353
Put	20/22	0.73	1.00	1.00	37	8189
Read	21/22	0.79	1.00	1.00	2	584
Run	19/22	0.93	0.41	0.92	15	177
Say	17/22	0.92	0.09	0.77	583	1959
See	17/22	0.92	0.86	1.00	17	5114

Show	13/22	1.00	0.50	0.98	12	565
Sleep	20/22	0.87	0.89	0.99	7	526
Stand	19/22	0.80	0.94	0.99	6	486
Start	16/22	0.86	0.00	0.94	14	202
Tell	15/22	0.92	0.50	0.99	17	1318
Think	14/22	0.82	0.38	0.99	43	7393
Throw	21/22	1.00	1.00	0.98	10	471
Tickle	16/22	0.50	0.60	0.90	17	160
Turn	17/22	0.69	1.00	0.98	11	560
Want	18/22	0.93	0.27	0.93	605	7572
Wear	19/22	1.00	1.00	0.93	19	248
Work	15/22	0.69	0.85	0.94	20	316

Appendix C. Complete set of test sentences used in English study in Experiment 2 (in alphabetical order). The target clause is in *italics*.

BUILD	*Non-modal*	Everyday the children build something. Adam builds a house and… *Ben builds a castle.*
	Modal	Tomorrow the children will build something. Adam will build a house and… *Ben will build a castle.*
BUY	*Non-modal*	Everyday the children buy some food. Ben buys strawberries and… *Adam buys an apple.*
	Modal	Tomorrow the children will buy some food. Ben will buy strawberries and… *Adam will buy an apple.*
CLIMB	*Non-modal*	Everyday the children climb in the woods. Ben climbs a big rock and… *Adam climbs a big tree.*
	Modal	Tomorrow the children will climb in the woods. Ben will climb a big rock and… *Adam will climb a big tree.*
COME	*Non-modal*	Everyday the children race with their friends. Ben comes before them and… *Adam comes after them.*
	Modal	Tomorrow the children will race with their friends. Ben will come before them and… *Adam will come after them.*
DRAW	*Non-modal*	Everyday the children draw something. Ben draws a horse and… *Adam draws a rabbit.*
	Modal	Tomorrow the children will draw something. Ben will draw a horse and… *Adam will draw a rabbit.*
DRINK	*Non-modal*	Everyday the children drink something. Ben drinks orange juice and… *Adam drinks apple juice.*
	Modal	Tomorrow the children will drink something. Ben will drink orange juice and… *Adam will drink apple juice.*
DRIVE	*Non-modal*	Everyday the children drive their cars. Adam drives a blue

		car and… *Ben drives a red car.*
	Modal	Tomorrow the children will drive their cars. Ben will drive a red car and… *Adam will drive a blue car.*
EAT	*Non-modal*	Everyday the children eat some fruit. Ben eats an orange and… *Adam eats an apple.*
	Modal	Tomorrow the children will eat some fruit. Ben will eat an orange and… *Adam will eat an apple.*
FIND	*Non-modal*	Everyday the children find something. Ben finds a coat and… *Adam finds a jumper.*
	Modal	Tomorrow the children will find something. Ben will find a coat and… *Adam will find a jumper.*
GET	*Non-modal*	Everyday the children get something from the postman. Adam gets a letter and… *Ben gets a postcard.*
	Modal	Tomorrow the children will get something from the postman. Adam will get a letter and… *Ben will get a postcard.*
GIVE	*Non-modal*	Everyday the children give Mum something. Adam gives a card and… *Ben gives a present.*
	Modal	Tomorrow the children will give Mum something. Adam will give a card and… *Ben will give a present.*
GO	*Non-modal*	Everyday the children go to school. Adam goes in the bus and… *Ben goes in the car.*
	Modal	Tomorrow the children will go to school. Adam will go in the bus and… *Ben will go in the car.*
HAVE	*Non-modal*	Everyday the children have something from the fridge. Ben has a Pepsi and… *Adam has a Coke.*
	Modal	Tomorrow the children will have something from the fridge. Ben will have a Pepsi and… *Adam will have a Coke.*

HELP	*Non-modal*	Everyday the children help some animals. Ben helps a dog and… *Adam helps a rabbit.*
	Modal	Tomorrow the children will help some animals. Ben will help a dog and… *Adam will help a rabbit.*
HOLD	*Non-modal*	Everyday the children hold some animals. Ben holds a puppy and… *Adam holds a rabbit.*
	Modal	Tomorrow the children will hold some animals. Ben will hold a puppy and… *Adam will hold a rabbit.*
KNOW	*Non-modal*	Everyday Mum asks what animals the children know most about. Adam knows about cats and… *Ben knows about dogs.*
	Modal	Tomorrow Mum will ask what animals the children know most about. Ben will know about cats and… *Adam will know about dogs.*
LIKE	*Non-modal*	Everyday Mum wants to know what the children would like to eat. Ben likes eggs and bacon and… *Adam likes egg on toast.*
	Modal	Tomorrow Mum will want to know what the children would like to eat. Ben will like eggs and bacon and… *Adam will like egg on toast.*
LOOK	*Non-modal*	Everyday the children look for their clothes. Ben looks in the wardrobe and… *Adam looks in the box.*
	Modal	Tomorrow the children will look for their clothes. Ben will look in the wardrobe and… *Adam will look in the box.*
MAKE	*Non-modal*	Everyday the children make something to eat. Ben makes a sandwich and… *Adam makes a big cake.*
	Modal	Tomorrow the children will make something to eat. Ben will make a sandwich and… *Adam will make a big cake.*
NEED	*Non-modal*	Everyday the children need something when they wake up. Ben needs a cup of tea and… *Adam needs a cold drink.*

	Modal	Tomorrow the children will need something when they wake up. Ben will need a cup of tea and… *Adam will need a cold drink.*
OPEN	*Non-modal*	Everyday the children open something. Adam opens a bottle and… *Ben opens a can.*
	Modal	Tomorrow the children will open something. Adam will open a bottle and… *Ben will open a can.*
PLAY	*Non-modal*	Everyday the children play games. Ben plays a card game and… *Adam plays a board game.*
	Modal	Tomorrow the children will play games. Ben will play a card game and… Adam will play a board game.
READ	*Non-modal*	Everyday the children read before they go to bed. Ben reads a red book and… *Adam reads a blue book.*
	Modal	Tomorrow the children will read before they go to bed. Ben will read a red book and… *Adam will read a blue book.*
RUN	*Non-modal*	Everyday the children run outside. Ben runs in the forest and… *Adam runs in the field.*
	Modal	Tomorrow the children will run outside. Ben will run in the forest and… *Adam will run in the field.*
SAY	*Non-modal*	Everyday the children say what they want for breakfast. Ben says cereals and… *Adam says apple pie.*
	Modal	Tomorrow the children will say what they want for breakfast. Ben will say cereals and… *Adam will say apple pie.*
SEE	*Non-modal*	Everyday the children see animals at the zoo. Adam sees an elephant and… *Ben sees a tiger.*
	Modal	Tomorrow the children will see animals at the zoo. Adam will see an elephant and… *Ben will see a tiger.*
SHOW	*Non-modal*	Everyday the children show their Mum what they have done at school. Ben shows a painting and… *Adam shows a*

		drawing.
	Modal	Tomorrow the children will show their Mum what they have done at school. Ben will show a painting and… *Adam will show a drawing.*
SING	*Non-modal*	Everyday the children sing something. Ben sings the same song and… *Adam sings a new song.*
	Modal	Tomorrow the children will sing something. Ben will sing the same song and... *Adam will sing a new song.*
SIT	*Non-modal*	Everyday the children sit down to do their homework. Ben sits at the table and… *Adam sits at the desk.*
	Modal	Tomorrow the children will sit down to do their homework. Ben will sit at the table and… *Adam will sit at the desk.*
SLEEP	*Non-modal*	Everyday the children sleep. Ben sleeps on the sofa and… *Adam sleeps in his bed.*
	Modal	Tomorrow the children will sleep. Ben will sleep on the sofa and… *Adam will sleep in his bed.*
STAND	*Non-modal*	Everyday the children stand around waiting for their Mum to come home. Ben stands at the window and… *Adam stands at the door.*
	Modal	Tomorrow the children will stand around waiting for their Mum to come home. Ben will stand at the window and… *Adam will stand at the door.*
START	*Non-modal*	Everyday the children start to read something. Ben starts a comic and… *Adam starts a book.*
	Modal	Tomorrow the children will start to read something. Ben will start a comic and… *Adam will start a book.*
TELL	*Non-modal*	Everyday the children tell their friends something. Ben tells a joke and… *Adam tells a story.*

		Tomorrow the children will tell their friends something.
	Modal	Ben will tell a joke and… *Adam will tell a story.*
		Everyday Mum asks what the children want from the shop.
WANT	*Non-modal*	Adam wants some sweets and… *Ben wants a Mars bar.*
		Tomorrow Mum will ask what the children want from the shop. Adam will want some sweets and… *Ben will want a*
	Modal	*Mars bar.*

Appendix D. Complete set of test sentences used in Swedish study in Experiment 2 (in alphabetical order). The target clause is in *italics*.

BAKA	*Non-modal*	Varje dag bakar barnen något att äta. Per bakar bullar och… *Ulf bakar en tårta.*
	Modal	Imorgon ska barnen baka något att äta. Per ska baka bullar och… *Ulf ska baka en tårta.*
BEHÖVA	*Non-modal*	Varje dag behöver barnen något när de vaknar. Per behöver en kopp choklad och… *Ulf behöver en dryck.*
	Modal	Imorgon ska barnen behöva något när de vaknar. Per ska behöva en kopp choklad och… *Ulf ska behöva en dryck.*
BERÄTTA	*Non-modal*	Varje dag berättar barnen något till sina vänner. Per berättar en saga och... *Ulf berättar en vits.*
	Modal	Imorgon ska barnen berätta något till sina vänner. Per ska berätta en saga och… *Ulf ska berätta en vits.*
BÖRJA	*Non-modal*	Varje dag börjar barnen läsa något. Per börjar en serie tidning och… *Ulf börjar en bok.*
	Modal	Imorgon ska barnen börja läsa något. Per ska börja en serie tidning och… *Ulf ska börja en bok.*
BYGGA	*Non-modal*	Varje dag bygger barnen något. Ulf bygger ett hus och… *Per bygger ett slott.*
	Modal	Imorgon ska barnen bygga något. Ulf ska bygga ett hus och… *Per ska bygga ett slott.*
DRICKA	*Non-modal*	Varje dag dricker barnen något. Per dricker apelsin juice och… *Ulf dricker äppeljuice.*
	Modal	Imorgon ska barnen dricka något. Per ska dricka

		apelsin juice och… *Ulf ska dricka äppeljuice.*
FÅ	*Non-modal*	Varje dag får barnen något från brevbäraren. Ulf får ett brev och.. … *Per får ett postkort.*
	Modal	Imorgon ska barnen få något från brevbäraren. Ulf ska få ett brev och.. … *Per ska få ett postkort.*
GÅ	*Non-modal*	Varje dag går barnen till skolan. Ulf går på bussen och… *Per går i bilen.*
	Modal	Imorgon ska barnen gå till skolan. Ulf ska gå på bussen och… *Per ska gå i bilen.*
GE	*Non-modal*	Varje dag ger barnen något till sin mamma. Ulf ger ett kort och… *Per ger en gåva.*
	Modal	Imorgon ska barnen ge något till sin mamma. Ulf ska ge ett kort och… *Per ska ge en gåva.*
HA	*Non-modal*	Varje dag har barnen något från kylskåpet. Per har en Pepsi och… *Ulf har en Cola.*
	Modal	Imorgon ska barnen ha något från kylskåpet. Per ska ha en Pepsi och… *Ulf ska ha en Cola.*
HÅLLA	*Non-modal*	Varje dag håller barnen några djur. Per håller en hundvalp och... *Ulf håller en kanin.*
	Modal	Imorgon ska barnen hålla några djur. Per ska hålla en hundvalp och… *Ulf ska hålla en kanin.*
HITTA	*Non-modal*	Varje dag hittar barnen något. Per hittar en jacka och… *Ulf hittar en tröja.*
	Modal	Imorgon ska barnen hitta något. Per ska hitta en jacka och… *Ulf ska hitta en tröja.*
HJÄLPA	*Non-modal*	Varje dag hjälper barnen några djur. Per hjälper en hund och… Ulf hjälper en kanin
	Modal	Imorgon ska barnen hjälpa några djur. Per ska hjälpa

		en hund och… *Ulf ska hjälpa en kanin.*
KLÄTTRA	*Non-modal*	Varje dag klättrar barnen i skogen. Per klättrar en sten och… *Ulf klättrar upp i träd.*
	Modal	Imorgon ska barnen klättra i skogen. Per ska klättra en sten och… *Ulf ska klättra upp i träd.*
KOMMA	*Non-modal*	Varje dag tävlar barnen med sina vänner. Per kommer före dom och … *Ulf kommer efter dom.*
	Modal	Imorgon ska barnen tävla med sina vänner. Per ska komma före dom och … *Ulf ska komma efter dom.*
KÖPA	*Non-modal*	Varje dag köper barnen mat. Per köper jordgubber och… *Ulf köper ett äpple.*
	Modal	Imorgon ska barnen köpa mat. Per ska köpa jordgubber och… *Ulf ska köpa ett äpple.*
KÖRA	*Non-modal*	Varje dag kör barnen sina bilar. Ulf kör en blå bil och… *Per kör en röd bil.*
	Modal	Imorgon ska barnen köra sina bilar. Ulf ska köra en blå bil och… *Per ska köra en röd bil.*
LÄSA	*Non-modal*	Varje dag läser barnen innan de gå till sängs. Per läser en röd bok och... *Ulf läser en blå bok.*
	Modal	Imorgon ska barnen läsa innan de går till sängs. Per ska läsa en röd bok och... *Ulf ska läsa en blå bok.*
ÖPPNA	*Non-modal*	Varje dag öppnar barnen något. Ulf öppnar en flaska och… *Per öppnar en burk.*
	Modal	Imorgon ska barnen öppna något. Ulf ska öppna en flaska och… *Per ska öppna en burk.*
RITA	*Non-modal*	Varje dag ritar barnen något. Per ritar en häst och… *Ulf ritar en hare.*
	Modal	Imorgon ska barnen rita något. Per ska rita en häst

		och… *Ulf ska rita en hare.*
SÄGA	*Non-modal*	Varje dag säger barnen vad de vill ha för frukost. Per säger flingor och… *Ulf säger "äppelpaj".*
	Modal	Imorgon ska barnen säga vad de vill ha för frukost. Per ska säga flingor och… *Ulf ska säga "äppelpaj".*
SE	*Non-modal*	Varje dag ser barnen några djur i djurparken. Ulf ser en elefant och… *Per ser en tiger.*
	Modal	Imorgon ska barnen se några djur i djurparken. Ulf ska se en elefant och… Per ska se en tiger
SITTA	*Non-modal*	Varje dag sitter barnen ner för att göra sina läxor. Per sitter i soffan och… *Ulf sitter i stolen.*
	Modal	Imorgon ska barnen sitta ner för att göra sina läxor. Per ska sitta i soffan och… *Ulf ska sitta i stolen.*
SJUNGA	*Non-modal*	Varje dag sjunger barnen något. Per sjunger samma sång och... *Ulf sjunger en ny sång.*
	Modal	Imorgon ska barnen sjunga något. Per ska sjunga samma sång och... *Ulf ska sjunga en ny sång.*
SOVA	*Non-modal*	Varje dag sover barnen. Per sover på soffan och… *Ulf sover i sin säng.*
	Modal	Imorgon ska barnen sova. Per ska sova på soffan och… *Ulf ska sova i sin säng.*
SPELA	*Non-modal*	Varje dag spelar barnen några spel. Per spelar ett kort spel och… *Ulf spelar ett brädspel.*
	Modal	Imorgon ska barnen spela några spel. Per ska spela ett kort spel och… *Ulf ska spela ett brädspel.*
SPRINGA	*Non-modal*	Varje dag springer barnen i det fria. Per springer i skogen och… *Ulf springer i fältet.*
	Modal	Imorgon ska barnen springa i det fria. Per ska springa

		i skogen och… *Ulf ska springa i fältet.*
STÅ	*Non-modal*	Varje dag står barnen väntande på sin mamma att komma hem. Per står vid dörren och... *Ulf står i trädgården.*
	Modal	Imorgon ska barnen stå väntande på sin mamma att komma hem. Per ska stå vid dörren och… *Ulf ska stå i trädgården.*
TITTA	*Non-modal*	Varje dag letar barnen efter sina klädar. Per tittar i klädskåpet och… *Ulf tittar i lådan.*
	Modal	Imorgon ska barnen leta efter sina klädar. Per ska titta i klädskåpet och… *Ulf ska titta i lådan.*
TYCKA	*Non-modal*	Varje dag vill mamma veta vad barnen tycker om att äta. Per tycker om bröd och… *Ulf tycker om flingor.*
	Modal	Imorgon ska mamma vilja veta vad barnen tycker om att äta. Per ska tycka om bröd och… *Ulf ska tycka om flingor.*
VETA	*Non-modal*	Varje dag frågar mamma vilka djur barnen vet mest om. Ulf vet om katter och… *Per vet om hundar.*
	Modal	Imorgon ska mamma fråga vilka djur barnen ska veta mest om. Ulf ska veta om katter och… *Per ska veta om hundar.*
VILJA	*Non-modal*	Varje dag frågar mamma vad barnen vill från butiken. Ulf vill godis och… *Per vill en Daim strut.*
	Modal	Imorgon ska mamma fråga vad barnen vill från butiken. Ulf ska vilja godis och… *Per ska vilja en Daim strut.*
VISA	*Non-modal*	Varje dag visar barnen mamma vad de har gjort i skolan. Per visar en målning och… *Ulf visar en ritning.*
	Modal	Imorgon ska barnen visa mamma vad de har gjort i skolan. Per ska visa en målning och... *Ulf ska visa en*

ritning.

ÄTA	*Non-modal*	Varje dag äter barnen några frukt. Per äter en apelsin och… *Ulf äter ett apple.*
	Modal	Imorgon ska barnen äta några frukt. Per ska äta en apelsin och… *Ulf ska äta ett apple.*

Appendix E. The Mean Proportion of Correct Responses for Each Verb Together with the Proportional Frequency of Bare Forms vs 3sg -s Forms for English and the Proportional Frequency of Infinitives vs Present Tense Forms for Swedish

English verb	Proportion of bare forms	Raw frequency of 3sg -s forms	Raw frequency of bare forms	Number of children contributing data (Modal – Non-modal context)	% Correct production (Modal – Non-modal context)
Build	0.99	4	629	8/9 – 6/9	0.63 – 0.50
Buy	0.99	3	384	6/9 – 5/9	0.50 – 1.00
Climb	0.95	6	120	9/9 – 9/9	0.33 – 0.67
Come	0.92	442	5217	3/7 – 3/7	0.67 – 1.00
Draw	1.00	3	760	5/7 – 5/7	0.80 – 0.80
Drink	0.92	14	165	5/7 – 6/7	0.80 – 0.67
Drive	0.92	23	278	6/7 – 3/7	0.83 – 1.00
Eat	0.94	94	1429	5/7 – 6/7	0.80 – 0.83
Find	1.00	6	1716	4/7 – 4/7	0.50 – 0.75
Get	0.97	161	5485	7/9 – 8/9	0.57 – 0.75

Give	0.98	21	1196	6/9 – 8/8	0.67 – 0.63
Go	0.88	1201	8831	4/7 – 4/7	1.00 – 0.50
Have	0.84	1852	9930	4/9 – 6/9	0.75 – 0.83
Help	0.99	10	663	5/7 – 5/7	1.00 – 1.00
Hold	0.99	6	446	6/7 / 5/7	1.00 – 1.00
Know	0.99	45	4193	5/7 – 5/7	0.80 – 1.00
Like	0.92	292	3349	6/9 – 3/9	0.67 – 0.33
Look	0.84	592	3098	5/7 – 6/7	0.80 – 1.00
Make	0.93	173	2484	6/9 – 7/9	0.67 – 0.57
Need	0.83	368	1808	2/7 – 5/7	1.00 – 1.00
Open	0.93	33	453	8/9 – 8/9	0.63 – 0.75
Play	0.99	12	1705	7/9 – 8/9	0.71 – 0.63
Read	1.00	2	584	8/9 – 6/9	0.75 – 0.50
Run	0.92	15	177	4/7 – 5/7	0.75 – 0.60
Say	0.77	583	1959	4/9 – 5/9	1.00 – 0.60

See	1	17	5114	3/7 – 6/7	0.33 – 0.83
Show	0.98	12	565	6/9 – 6/9	0.67 – 1.00
Sing	0.97	13	413	5/7 – 5/7	0.80 – 1.00
Sit	0.97	44	1505	8/9 – 7/9	0.75 – 0.71
Sleep	0.99	7	526	6/7 – 5/7	0.50 – 1.00
Stand	0.99	6	486	7/9 – 8/9	0.71 – 0.75
Start	0.94	14	202	1/7 – 4/7	1.00 – 0.75
Tell	0.99	17	1318	6/9 – 6/9	1.00 – 0.67
Want	0.93	605	7572	5/9 – 6/9	0.80 – 1.00

Swedish verb	Proportion of infinitives	Raw frequency of present tense forms	Raw frequency of infinitives	Number of children contributing data (Modal – Non-modal context)	% Correct production (Modal – Non-modal context)
Bygga	0.73	33	90	5/7 – 5/7	0.50 – 1.00
Köpa	0.92	10	117	5/8 – 6/8	0.40 – 1.00

Klättra	0.59	18	26	7/7 – 7/7	0.29 – 0.71
Komma	0.10	799	93	2/8 – 5/8	0.50 – 1.00
Rita	0.78	59	208	5/8 – 6/8	0.20 – 0.50
Dricka	0.61	71	112	4/8 – 5/8	0.50 – 1.00
Köra	0.52	242	264	7/8 – 6/8	0.29 – 1.00
Äta	0.61	268	419	8/8 – 4/8	0.83 – 1.00
Hitta	0.35	118	64	5/8 – 7/8	0.20 – 0.43
Få	0.10	2716	294	4/7 – 6/7	1.00 – 0.83
Ge	0.74	25	73	6/7 – 6/7	0.33 – 0.67
Gå	0.47	508	448	3/8 – 4/8	1.00 – 1.00
Ha	0.42	3779	2699	5/7 – 6/7	0.60 – 0.83
Hjälpa	0.85	23	131	3/8 – 5/8	0.33 – 0.80
Hålla	0.49	133	126	4/8 – 4/8	0.25 – 1.00
Veta	0.01	689	10	5/8 – 3/8	0.80 – 1.00
Tycka	0.01	604	6	3/7 – 4/7	0.67 – 1.00

Titta	0.91	121	1279	6/8 – 5/8	0.50 – 0.20
Baka	0.56	23	29	6/8 – 5/8	0.50 – 0.40
Behöva	0.02	130	3	1/7 – 4/7	0.00 – 1.00
Öppna	0.79	26	99	6/7 – 6/7	0.17 – 0.83
Spela	0.44	48	37	4/7 – 3/7	0.00 – 0.67
Läsa	0.79	46	169	6/7 – 5/7	0.33 – 0.80
Springa	0.21	77	20	5/8 – 7/8	0.40 – 1.00
Säga	0.31	564	249	3/7 – 2/7	0.33 – 1.00
Se	0.50	869	871	5/8 – 4/8	0.60 – 0.75
Visa	0.93	8	107	3/7 – 6/7	0.67 – 0.50
Sjunga	0.56	53	67	5/8 – 6/8	0.60 – 1.00
Sitta	0.49	421	405	7/7 – 7/7	0.29 – 1.00
Sova	0.45	117	96	8/8 – 5/8	0.38 – 1.00
Stå	0.37	215	128	5/7 – 5/7	0.60 – 1.00

Börja	0.56	60	76	2/8 – 4/8	0.00 – 0.25
Berätta	0.96	11	255	8/7 – 4/7	0.50 – 1.00
Vilja	0.04	745	31	2/7 – 6/7	0.00 – 1.00

Appendix F. Morphological verb classes of Finnish verbs

I *Sano/a* verbs

Sano/a verbs, in which the infinitive inflection *–a* is placed after a short vowel, only have an infinitival stem (*sano/*). Thus, all the finite inflections are added directly to this infinitival stem. The stem may undergo consonant gradation (e.g., *antaa* '*to give*' → *annan* '*I give*'). This is the largest verb group with altogether 5703 verbs. However, it consists of eight subtypes, some of which have very low type frequencies (e.g., *kaartaa* verbs *N*=3).

II *Saa/da* verbs

Just like *Sano/a* verbs, *Saa/da* verbs have no separate inflectional stem, but finite inflections are added directly to the infinitival stem after removing the infinitival morpheme *–da*. The infinitival stem ends in a long vowel or a diphthong. This verb group can be considered as productive, as new polysyllabic verbs can come to this group. The total number of verbs in this group is 750, which consists of 15 highly frequent two-syllable verbs such as *voida* '*to be able*', *syödä* '*to eat*' and *juoda* '*to drink*'. Two other highly frequent verbs in this group, *näh/dä* '*to see*' and *teh/dä* '*to do*' are however irregular as they have an inflectional stem that ends in *–ke* (e.g., *näkee* '*he sees*') and are subject to consonant gradation. Altogether this verb type has three subtypes.

III *Nous/ta*, *Tul/la* and *Men/nä* verbs

Nous/ta, *Tul/la* and *Men/nä* verbs have an inflectional stem that ends in –e. This –e is added to the infinitival stem (e.g. *tul/la* '*to come*' → *tul/e/n* '*I come*'), and consonant gradation may occur depending on the stem (e.g., *ajatel/la* '*to think*' → *ajat**t**el/e/n* '*I think*'). Total number of verbs in the verb type is 1609, which consists of four subtypes.

IV *Huomat/a* verbs

Huomat/a verbs are a very productive class of verbs, as new verbs usually go to this group. These verbs are also known as contracted verbs because the complex relationship between the infinitival and the inflection stem. The final *–t* of the infinitive stem is changed to *–a/-ä* (e.g., *huomat/a* '*to notice*' → *huomaat* '*you notice*'), and as with the group III verbs, consonant gradation occurs only in the infinitival stem (e.g., *tavata* '*to meet*' → *tapaamme* '*we meet*'). The total number of verbs belonging to this verb type is 1067, consisting of three subtypes.

V *Tarvi/ta* verbs

Tarvit/a verbs resemble *Huomat/a* verbs in their infinitival form, but they differ in how their inflectional stem is formed. *Tarvit/a* verbs form their inflectional stem by adding *–se* to the infinitival stem (e.g., *tarvit/a* '*to need*' → *tarvit/se/mme* '*we need*'). This group of verbs is not very large (*N*=49), but it includes two frequent verbs, *tarvita* ('*to need*) and *häiritä* ('*to bother someone*').

VI *Vanhet/a* verbs

Vanhet/a verbs are a rare group of verbs (*N*=143). These verbs form their inflectional stem by changing the final infinitival *–t* to *ne* (e.g., *vanhet/a* '*to get older*' → *vanhe/ne/vat* '*they get older*'). *Vanhet/a* verbs tend to be derived from adjectives, and have the meaning of becoming the adjective (e.g., *lämmet/ä* '*get warm*'; *vanhet/a* '*get older*'; *suuret/a* '*get bigger*').

Appendix G. Verbs used in Experiment 3 and their characteristics

	3sg pres token frequency	1sg pres token frequency	1pl +passive pres token frequency	2sg pres token frequency	2pl pres token frequency
Aterioida	41	0	8	0	0
Hymyillä	1651	29	20	3	0
Ilakoida	119	0	3	0	0
Iloita	1570	66	116	2	0
Juoda	1060	121	609	23	11
Katsoa	1105	1022	7409	148	37
Kävellä	840	162	205	22	7
Kisata	716	352	153	0	0
Kohota	1611	2	5	0	0
Kököttää	39	0	6	2	0
Kulauttaa	21	0	4	0	0
Lastata	50	0	144	2	0
Leikata	1919	30	1904	16	5
Liikuttaa	358	0	23	0	0
Löpistä	1	0	0	0	0
Lukita	33	0	40	2	0
Lyödä	2343	71	917	23	5
Maalata	843	98	327	10	0
Myhäillä	1079	0	3	0	0
Nousta	17755	95	429	19	2
Nukkua	613	182	137	23	4
Pakata	373	7	345	6	0
Panna	2298	134	3110	22	12
Pelata	7839	414	5216	84	10
Piiskata	125	17	19	0	0
Puhua	7686	429	7977	78	39
Saksia	3	0	6	0	0
Salvata	28	0	0	0	0

Seisoa	2290	88	103	76	8
Sijoittaa	4594	32	2350	12	0
Silmäillä	103	12	10	0	0
Sivellä	39	4	67	0	0
Syödä	2957	219	1406	93	13
Talsia	13	2	2	0	0
Uinua	64	0	0	12	0
Viedä	16303	288	5402	65	18

Verb	Morphophonological class size	Adjusted PND	Syllables in infinitive
Aterioida	681	0	5
Hymyillä	1329	1	3
Ilakoida	681	0	4
Iloita	49	0	3
Juoda	15	2	2
Katsoa	2228	0	3
Kävellä	1329	0	3
Kisata	885	0	3
Kohota	170	0	3
Kököttää	2714	1	3
Kulauttaa	2714	0	3
Lastata	885	1	3
Leikata	885	2	3
Liikuttaa	2714	1	3
Löpistä	272	1	3
Lukita	49	0	3
Lyödä	15	2	2
Maalata	885	0	3
Myhäillä	1329	1	3
Nousta	272	0	2
Nukkua	2228	2	3
Pakata	885	3	3
Panna	5	0	2
Pelata	885	2	3
Piiskata	885	1	3
Puhua	2228	0	3

Saksia	402	0	3
Salvata	885	0	3
Seisoa	2228	0	3
Sijoittaa	2714	0	3
Silmäillä	1329	0	3
Sivellä	1329	1	3
Syödä	15	2	2
Talsia	402	0	3
Uinua	2228	0	3
Viedä	15	0	2

Appendix H. Mean Proportion of Correct Forms for Each Verb

	Glossary (low/high frequency status in brackets)	Number of children contributing data	Proportion of correct inflection
Aterioida	*To eat (low)*	7/41	0.86
Hymyillä	*To smile (high)*	35/41	0.84
Ilakoida	*To be happy (low)*	29/41	0.86
Iloita	*To be happy (high)*	31/41	0.83
Juoda	*To drink (high)*	38/41	0.92
Katsoa	*To watch (high)*	37/41	0.87
Kävellä	*To walk (high)*	39/41	0.85
Kisata	*To play (low)*	26/41	0.92
Kohota	*To get up (low)*	27/41	0.78
Kököttää	*To stand (low)*	28/41	0.85
Kulauttaa	*To drink (low)*	10/41	0.93
Lastata	*To pack (low)*	32/41	0.85
Leikata	*To cut (high)*	41/41	0.86
Liikuttaa	*To take (low)*	33/41	0.90
Löpistä	*To talk (low)*	27/41	0.83
Lukita	*To lock (high)*	34/41	0.85
Lyödä	*To hit (high)*	35/41	0.92
Maalata	*To paint (high)*	36/41	0.87
Myhäillä	*To smile (low)*	30/41	0.85

Nousta	*To get up (high)*	37/41	0.86
Nukkua	*To sleep (high)*	41/41	0.82
Pakata	*To pack (high)*	38/41	0.88
Panna	*To put (high)*	28/41	0.81
Pelata	*To play (high)*	36/41	0.82
Piiskata	*To hit (low)*	31/41	0.81
Puhua	*To talk (high)*	33/41	0.87
Saksia	*To cut (low)*	24/41	0.82
Salvata	*To lock (low)*	32/41	0.89
Seisoa	*To stand (high)*	39/41	0.85
Sijoittaa	*To put (low)*	30/41	0.87
Silmäillä	*To watch (low)*	30/41	0.77
Sivellä	*To paint (low)*	27/41	0.79
Syödä	*To eat (high)*	40/41	0.91
Talsia	*To walk (low)*	30/41	0.80
Uinua	*To sleep (low)*	15/41	0.85
Viedä	*To take (high)*	33/41	0.92

Appendix I. Sample parental consent form and information sheet (from Experiment 1).

CONSENT FORM

Dear Parent,

I am a member of a University of Liverpool research group that investigates the question of how children learn to speak their native language. _____ has been kind enough to allow us to conduct one of our language-learning studies at _____.

In this study, we are investigating why children sometimes leave out certain elements in the utterances they produce. The study will involve children playing a game in which they are shown animations depicting different actions, and they are asked to repeat back sentences spoken by the researcher and produce sentences of their own.

Children usually enjoy this game and are extremely eager to participate. Further details of the study are given on the parent information sheet overleaf.

If you WOULD like your child to participate in this study, please sign, detach and return the slip at the bottom of this page BEFORE _____.

Participation is, however, entirely voluntary, and you may withdraw your child at any time without having to give a reason, and without detriment to you or your child (if you withdraw your child after the study has begun we will destroy any data already collected). Any child who does not want to participate will not be asked to do so, even if you have given your consent for your child to participate.

We do hope that you will be happy for your child to participate in this enjoyable and interesting study.

Thank you, in advance, for your cooperation

Yours, sincerely

Sanna Räsänen, PhD Student

University of Liverpool

University of Liverpool

Study of Child Language Learning

Consent Form

I have read and understood the information outlined above and in the information sheet and would like my child to participate in the language-learning study to be conducted at _____.

Signed…….

Date……

Name of parent/guardian…….....

(BLOCK CAPITALS PLEASE)

Name of child…….....

(BLOCK CAPITALS PLEASE)

University of Liverpool

Study of Child Language Learning

Parent Information Sheet

Information about the study

When children are learning to talk they often produce utterances in which the third person present tense marker *-s* has been left out (e.g., "*He eat ice cream*" as opposed to the grammatically correct sentence "*He eats ice cream*"). However, why children make this error is still not well understood. Some researchers argue that children omit the *-s* because they do not yet know that it is obligatory to use it, while others claim that children make these errors by shortening utterances such as "*He can eat ice cream*" because of limitations in their working memory. The purpose of this study is to investigate different explanations of young children's tendency to the omit the *-s* out of their utterances by asking children to repeat back sentences with different verbs and seeing which sentences they repeat back correctly and

which sentences they tend to leave the *-s* out of. Children will also be asked to produce sentences of their own by describing animations.

Ethics, confidentiality considerations and parental consent

Children will work with the researcher (a student or research assistant) on a one-to-one basis, in a quiet corner of the nursery in the presence of other nursery staff. Recordings of their speech will be securely stored in a locked filing cabinet. These recordings will not be labelled with the children's names, but with a numerical "key" for each participant (this is simply to allow us to destroy your child's sheet if you withdraw consent after the data has been collected). After the study has been completed and written-up all the recordings will be destroyed. In the write-up of the research, the data will be presented completely anonymously, without referring to individual children (e.g., The mean omission rate in the sentence '*Sam drives a blue car*' was 78%) Parents will also be sent a summary of the results of the study (again, this will not refer to individual children).

Please note that this research is not aimed at assessing individual children's performance, and indeed does NOT produce any score that can be taken as a measure of language ability. It is simply aimed at understanding why all children between the age of approximately 2 and 4 leave certain elements out of sentences and how they learn to include these elements as they get older.

If you WOULD like your child to participate in this study, please sign, detach and return the slip at the bottom of this page BEFORE _____.

Participation is, however, entirely voluntary, and you may withdraw your child at any time without having to give a reason, and without detriment to you or your child (if you withdraw your child after the study has begun we will destroy any data already collected). Any child who does not want to participate will not be asked to do so, even if you have given your consent for your child to participate.

Contact Details

If you would like further information on this study or have any questions, please do not hesitate to contact me, Sanna Räsänen, on 0151 794 1109 or by email at S.H.M.Rasanen@liverpool.ac.uk. Further details about our research can be found at **www.liv.ac.uk/psychology/clrc/clrg.html**

Many thanks for your help!

Sanna Räsänen, PhD student

University of Liverpool