

Children's faithfulness in imitating language use varies crossculturally, contingent on prior
experience

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Abstract

Despite its recognized importance for cultural transmission, little is known about the role imitation plays in language learning. Three experiments examine how rates of imitation vary as a function of qualitative differences in the way language is used in a small indigenous community in Oaxaca, Mexico and three western comparison groups. Data from 138 3- to 10-year-olds suggests that children selectively imitate when they understand the function of a given linguistic element because their culture makes frequent use of that function. When function is opaque, however, children imitate faithfully. This has implications for how children manage the imitation-innovation tradeoff, and offers insight into why children imitate in language learning across development.

(111 words)

Children's faithfulness in imitating language use varies cross culturally, contingent on prior experience

The unique way in which humans imitate each other is generally agreed to be central to explaining the complexity of our culture (e.g. Tennie, Call & Tomasello, 2009). Of all the cultural artifacts that we transmit from one generation to the next, none could be more important than the languages we speak. And yet despite this there is very little contemporary research studying (or proposing models of) how imitation works in language acquisition.

Perhaps the best-known study of imitation in language development is Snow (1981). This paper studied one child from age 1;10 to 3;0. The child's utterances were classified as either non-imitation or as one of three kinds of imitation (exact, reduced and expanded). Snow found that about 50% of the child's utterances fell into one of her categories. Furthermore, she found that exact imitations increased with age. Other papers from the same era (Clark, 1977; Moerk & Moerk, 1979) report similar findings. However, while all theories of language acquisition must allow for children learning words (which vary in arbitrary ways across languages) by copying others (e.g. Hauser, Chomsky & Fitch, 2002), and some theories propose that children learn grammar from others (e.g. Tomasello, 2003), the finding that children imitate whole utterances (and that this continues into the preschool period) does not follow directly from most theories.

One explanation for children's imitation of whole utterances is that this copying allows them to use forms ahead of achieving full understanding. In order to use an utterance successfully (e.g. a request), one must know what the whole form allows one to accomplish (e.g. convey one's desires to another; Shwe & Markman, 1997). And yet it is not always necessary to understand why all aspects of the utterance are the way they are. It is not, for example, necessary to understand why each word has been included or why the sounds are in the order they are.

Thus, imitation of whole utterances allows speakers to a) communicate with language without having to wait for full understanding, and b) practice using a given aspect of language themselves, which is likely to lead to full understanding more quickly than observation. This is related to the process of “blame assignment” as proposed by usage-based researchers (e.g. Tomasello, 2003).

The imitation of components of a communicative act without an understanding of the purpose they are serving is an example of over-imitation, much discussed in the non-linguistic literature. Over-imitation is the copying of apparently unnecessary behaviours. Most work has focused on the copying of actions performed on a novel “puzzle box”. In a number of studies (Horner & Whiten, 2005; McGuigan, Makinson, & Whiten, 2011), children and adults have been found to imitate unnecessary actions (e.g. tapping the box) performed by an experimenter. Evidence that children over-imitate in language learning is provided in Bannard, Klinger and Tomasello (2013). This reported that while 3-year-olds can selectively omit novel adjectives based on context they nonetheless imitated unnecessary adjectives over 50% of the time.

The model of language learning we are proposing here has implications for the course of language development. As the range of things that children are able to do with language expands, they should move in and out of periods of overly-faithful imitation as they first use a resource and then begin to understand it (to assign “blame”). We predict that children will imitate most where prior experience has not provided them with the basis for understanding a behaviour. In this paper we test this prediction by exploiting differences in the linguistic experience of children from different cultures. Despite many formal similarities between different languages when looked at en masse, there are differences not just in the form of languages but also in how speakers use them (Evans & Levinson, 2009). We conducted experiments from Bannard et al.

(2013) among Chatino-speaking indigenous children from Santa Lucia Teotepec in Oaxaca, Mexico. There are reasons to think that Chatino culture differs from German culture (the context of Bannard et al., 2013) in the way that reference is used in interaction with children. Our hypothesis is that Chatino children will be more faithful in their imitation of adjectives than Western children as a result of their different experience with descriptive adjective use.

Chatino is an Otomanguean language spoken in Oaxaca, Mexico. Chatino adjectives can be used attributively (as in the English *red ball*, in which case they follow the noun) or predicatively (as in the English *the ball is red*) and are a large open class referring to a range of semantic features (see Rasch, 2002). According to the classification of Dixon (2010), Chatino adjectives are syntactically and semantically similar to adjectives in European languages.

There are substantial differences between Chatino and Western cultures. Santa Lucía Teotepec is a rural community of about 1300 inhabitants, and although most younger Teotepec community members go to school (from age 6) and have at least basic literacy, many Chatinos do or did not go to school and cannot read or write. The crucial difference for our purposes, however, is in child-rearing practices. There is no published ethnography of child rearing among Chatinos. There are, however, detailed ethnographies for other indigenous Central American cultures (the literature on child-rearing in Mayan culture is as large as for any other non-Western culture; e.g. Correa-Chavez & Rogoff, 2009; de Leon, L., 1998, Gaskins, 2000; Rogoff, Mistry, Güncü & Mosier, 1993; Pye, 1986; Shneidman & Goldin-Meadow, 2012), and descriptions of child-rearing in even more closely historically and geographically related peoples (e.g. Nader, 1969). These report that child-rearing practices vary radically from those seen in the West. One difference that these groups have in common is that children do not spend their time at home

with a single caregiver, but rather in larger groups or outside among the community. It is also common that “[c]hildren are expected to care for younger children” (Nader, 1969; p.345).

This difference in child-rearing - the fact that the children do not spend their days in dyadic interactions - has implications for children's linguistic experience. Gaskins (2000, p.383) reports that in the Mayan village she studied “[a]dults rarely speak to young children unless it is to tell them to do something (or not to do something) or to offer information they think the child needs to do a task”. Indigenous Central American cultures fit Keller (2007)'s “interdependent” parenting model, which contrasts with the Western “independent” model. Keller (2007) notes that “independent” mothers address more speech to their infants than “interdependent” mothers, and do so in a way that is more contingent, and that acknowledges the infant's “autonomy”, by, for example, commenting on what they can see. This complements studies reporting the same for particular cultures (see Lieven, 1994 and Sterponi, 2010 for overviews).

The linguistic phenomenon that this paper concerns is the use of adjectives in referring expressions. The prototypical use of reference is to pick an object out – to discriminate it from other possible referents. Clarifying reference is, however, not the only way in which adjectives are used. They can also, for example, draw attention to features (*look at that huge dog*) or express attitude towards an object (referring to a *comfy sofa* in a room with only one sofa). Karmiloff-Smith (1979) refers to these functions as the *determinor* and the *descriptor* functions respectively. She found the descriptor function to be primary for the Swiss children she tested.

The relevance of this distinction to our concerns comes in Karmiloff-Smith's explanation of the developmental primacy of the descriptor function: "...since daily discourse between child and caretaker is usually about very obvious referents...[i]t is suggested that children will initially expect words to function as descriptors rather than as determiners because

the referent is already implicitly or explicitly clear from context and there is no need to determine it linguistically" (Karmiloff-Smith, 1979; p.47). This tendency to refer to "given" referents has often been observed in speech to Western children. Hoff-Ginsberg (1987) studied three middle-class children's interactions in their second and third years, and found that as little as 4% and no more than 16% of caregiver utterances referred to absent or imaginary topics, with between 70% and 84% of utterances relating to the topic of the child's previous utterance.

Chatino child-rearing is far from this pedagogically-focused dyadic model. Instead of interacting with a primary caregiver, Chatino children spend their days among peers in a dynamic environment. This means that (while purely descriptive use of adjectives is permitted in Teotepec Chatino, as is clear from McIntosh, 2015) the Chatino children will not encounter extensive use of adjectives modifying objects that are given in the discourse. We are not claiming that the speech to Chatino children is unusual but rather that Western speech to children is a particular speech genre that is, in crucial ways, unlike other speech genres (e.g. Heath, 1983; Hoff, 2003). Our proposal is that differences in children's exposure to adjectives will affect their understanding of reference and hence when they will chose to imitate referential terms.

The first (of three) experiments we report on follows the method of experiment 1 from Bannard et al. (2013). In this within-subjects study, two experimenters played a game with each child. A first experimenter (the gamemaster) presented an item or set of items and the other experimenter would request it/one of the set. They always preceded the label of the requested item with a novel adjective (e.g. Could you give me the snibby cup?). They received the target item. The gamemaster then presented another object or set of objects and it was the child's turn. They were told that their goal was to obtain the same object as the experimenter. In the experimental condition two objects of the same category, one plain, one adorned (e.g. with

cotton balls) were presented. In the control condition a single plain object was presented, rendering the adjective unnecessary. German children imitated more in the two-object condition. However they were still found to imitate over 50% of the time in the single object condition. Since the adjective was unnecessary for both determinor (there is only one object) and descriptor purposes (the object was an unmodified cup), this was over-imitation.

Our interest in this first study was whether Chatino children would imitate adjectives used as descriptors of given referents more faithfully than Western children. We thus also conducted experiment 1 in an additional western society - an English-speaking group in Texas. A weakness of English speakers as a comparison group is that like German, and unlike Chatino, adjectives occur before the noun. To preemptively rule out a confounding effect of word order on imitation, we collected additional data in Geneva, Switzerland with French-speaking children (most adjectives in French follow the noun). Finally the verbal imitation task was paired with an action imitation task in order to check whether any effect of culture was specific to language.

Experiment 1

Method

Participants

Teotepec: We tested twenty-nine typically-developing, Chatino-speaking children aged 3 to 10 years (2 3-year olds, 4 4-year olds, 6 six year olds, 4 7-year olds and 3 children at each of the other ages). The data was collected in January and July 2012. The families were all indigenous Chatinos, primarily farmers, with tightly-knit kinship structures and mostly basic education. The age range was chosen to provide an adequate sample size given the size and demographics of this community. The specific ages tested reflect responses to recruitment efforts during our visit. The population of Teotepec is approximately 1300 people. The official 2010 census for the region in

which Teotepec falls (Juquila) estimates that among the population of indigenous language speaking people, 4.4% are in the age range 3-4, suggesting a total population in this age group of 60. The children were native speakers of Chatino. Those who attended elementary school (ages six and older) were also exposed to Spanish. The children were tested in a field lab in Santa Lucía Teotepec. The experimenters conducting the study were local Chatino high school graduates who had previously received training in conducting research.

Austin: Thirty-one typically-developing, English-speaking children were included. Their families were residents of Austin, Texas, primarily middle-class and primarily European-American.

There were 4 children at each age 3-9 and 3 children aged 10. The sample was designed to match that collected in Oaxaca. English accounted for more than 50% of the language heard by all these children. One additional child was tested, but not included due to fussiness. The children were tested at the University of Texas at Austin between May 2012 and August 2013.

Geneva: Thirty-nine typically-developing, French-speaking children were included. Their families were residents of Geneva, Switzerland, primarily middle-class and primarily Caucasian (>80%). Nineteen of the children were 5 years old; the remainder were 9 years old. Testing took place in January and February 2014 in schools and the ages reflect the populations available. The sample size reflects the need to a) approximately match the Oaxaca sample, and b) ensure that all interested children could take part. The children were native speakers of Swiss French and bilingual in a variety of other languages. The experimenters were University of Geneva students.

Design for the verbal component

In a within-subjects design for each culture we observed whether children would imitate in two conditions (single object and choice). Each participant completed 8 condition-alternating trials.

Stimuli for the verbal component

We used 8 items that children of the three cultures are familiar with (e.g. plastic flower, bucket). They existed in plain and modified version (e.g. stickers attached). Our novel words had language-appropriate positions and phonotactics for adjectives. Additional items were used for the warm up. Details of all materials are in the supplementary materials.

Procedure for the verbal component

The procedure began by testing the children's familiarity with the objects. E1 had the children label pictures of the objects. In the rare case that a child failed to produce a label, E1 identified the object for them and then asked them again to name it. E1 then explained the game, and there followed a warmup in which the gamemaster (E2) would hold out single plain items, sets of plain items (e.g. red and blue block) and single adorned items. E1 would make requests, and the child would follow. The child was told to try to obtain the same object. The study then began. E1 and the child took turns requesting objects from E2. E1 always went first and preceded the object's familiar name with a novel adjective (e.g., "the wassy shovel"). It was the child's goal to obtain the same object, and we observed whether they copied the "adjective". In one condition two objects were presented (one plain, one modified), making the adjectives necessary for disambiguation, while in the other only one unmodified object was presented. Regardless of condition or response the child always received the same object as E1. If the child hesitated, E1 encouraged them to ask for an object. Each child completed eight trials alternating between 2-object choice and 1-object control condition. Items always occurred in the same order and were arranged in sets of two. The conditions were fully counterbalanced across items within sets.

Transcription and coding for the verbal component

We coded for four types of response: production of a *bare noun* (e.g. "Could you give me the duck"), *imitation* of the novel adjective and noun (e.g. "Could you give me the wassy duck"),

production of a *familiar adjective and noun* (e.g. "Could you give me the shiny duck"), and production of a *paraphrase* (e.g. "Could you give me the duck with the shiny things on it"). While some of the Texan and Swiss children used familiar adjectives and some of the older (7+) Texan and Swiss children used paraphrases, the only response types that we observed in Chatino children were bare nouns and imitation. When the child failed to produce a request in the first trial, we repeated that condition, but coded that trial as a missing data point. If the child did not produce a request in other trials, this was treated as a missing data point. These criteria left us with 3 missing data points out of 224 trials for the Chatino data (32% randomly chosen for reliability coding, agreement between coders 100%). For the Texas data, this same criteria resulted in 2 missing data points out of 248. Agreement with a reliability coder on a randomly chosen 32% of trials was at 98.4%, $\kappa = .96$. For the Swiss data the criteria gave 8 missing data points out of 312 trials. Agreement with a reliability coder on a randomly chosen 25% of trials was 99%, $\kappa = .983$. The Chatino data was coded by local Chatinos. The Texas and Swiss data was coded by undergraduates of the University of Texas at Austin and the University of Geneva respectively.

Design for the instrumental component

We observed whether children would imitate 12 unnecessary actions performed by the experimenter on a puzzle box, before the experimenter retrieved a reward. Each child saw the experimenter's demonstration 5 times (3 prior to performing themselves) and completed 3 trials.

Materials for the instrumental action component

Following Horner and Whiten (2005) we used two 8 cubic inch boxes, one transparent and one opaque. Each box afforded a number of redundant actions (e.g. insert stick into hole, use stick to remove bolt) and contained a reward inside a compartment protected by bolts and a little door.

Procedure for the instrumental action component

E1 seated the child in front of the box and told them to pay close attention, since it would be their turn soon. E1 then used the stick to perform a series of unnecessary actions, before using it to remove the bolts from the door. He then opened the door with his hands and retrieved the reward. E1 demonstrated this twice and then E1 and the child took three turns each. Half of the children in all groups were tested with the transparent box and the other half with the opaque. Half of each group (transparent/ opaque) of the Chatino children were tested without E1's demonstration to make sure they would not produce the actions regardless. As over imitation had previously been demonstrated in Western children, they all received a demonstration.

Transcription and coding for the instrumental action component

Each action demonstrated by E1 one was coded as either 0 or 1 depending on whether the child imitated it. 25% of each group's data was additionally coded by a second coder. For the Chatino and the Texas data agreement was 100%; for the Swiss data it was 99.5%, $\kappa = .987$.

Analysis for the verbal component

We analyzed the data using logistic choice models. As each child participated in multiple trials, we used multilevel versions in which participant was included as a random effect on the intercept(s). The models were fitted with Bayesian Markov Chain Monte Carlo (MCMC) methods using the JAGS software. Diffuse (noninformative) priors were used for all parameters. Model comparisons used the Deviance Information Criterion, and model selection was performed by comparing all combinations of predictors and interactions including a null model. We report the mean value as well as the standard deviation and the bounds of the 95% credible interval for each parameter.

In multinomial logistic regression, one assigns one response type to be the reference

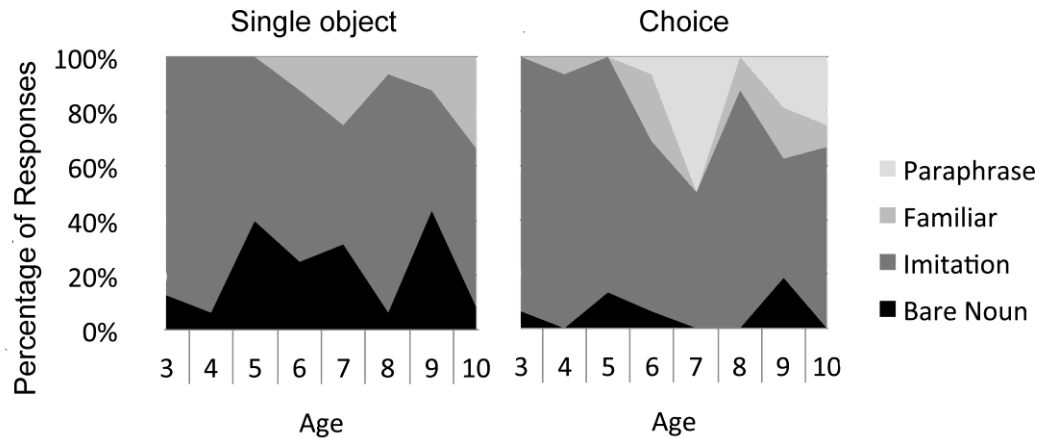
outcome and estimates how the different predictors affect the odds of seeing the other responses types relative to this. It can thus be interpreted in the same way that one would interpret multiple binomial logistic regressions. We chose bare noun to be our reference. The tables of model parameters thus contain intercepts for each of the other responses (imitation, familiar adjective and paraphrase) and estimates of how being in the choice condition rather than the single-object condition affected the (log) odds of that response. Age was mean centered for the Texas and Chatino samples (where we had a wide spread of ages) and factorialized for the Swiss sample.

Experiment 1 Results

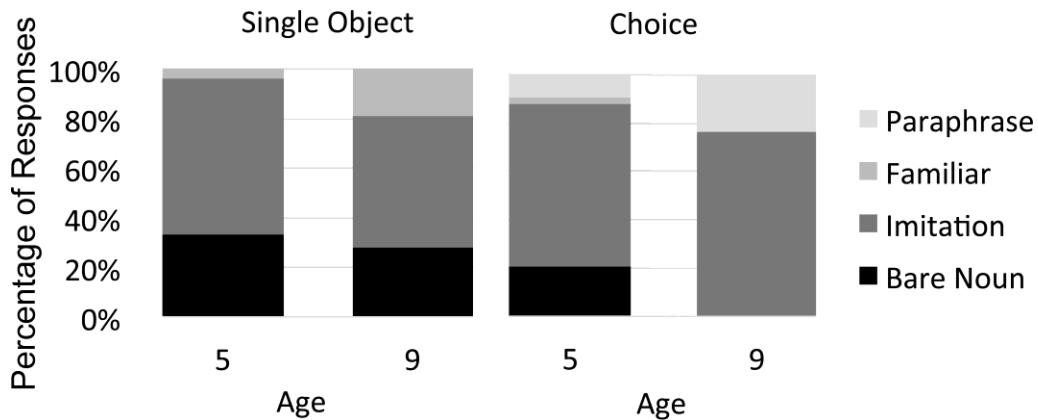
Results for the verbal component

The responses for the verbal component for all participant groups are summarized in figure one. These stacked area/bar charts show the proportion of responses of each type for each age group for each condition. These are proportions of the trials in which the children produced a response. A comparison of the single object and choice conditions for the three cultures show a clear pattern – the English-speaking and the French-speaking children produce a bare noun more in the single object condition (where it serves no determinor or transparent descriptor function) than they do in the choice condition (where is it essential to resolve reference), while the Chatino-speaking children imitate the novel adjective at the same (high) rate regardless of condition.

a) English speaking children in Austin, Texas



b) French speaking children in Geneva, Switzerland



c) Chatino speaking children in Santa Lucía Teotepec, Oaxaca, Mexico

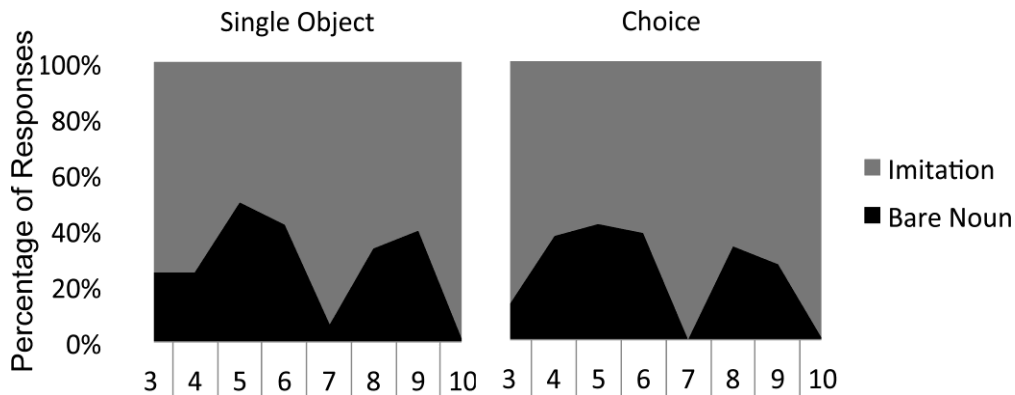


Figure 1: The proportions for each different response for each condition by age for all three cultures in experiment 1

Comparison of cultures

In order to test for a basic effect of culture on selectivity in imitation, we first report on a model including data from all three groups. One difference between groups is that while the Texas and Geneva participants produced four different responses (bare noun, imitation, familiar material and paraphrase) the Oaxacan participants produced only two (bare noun and imitation). To enable comparison we performed an analysis only over the two response types that all groups produced. The coefficients from our model can be seen in Table 1. This tells us that for the Texas children (the reference case) imitation was significantly more likely in the choice than the single-object condition (log odds = 2.005 $p < 0.0001$). The Oaxacan and Genevan children did not significantly differ from the Texan participants in their rates of imitation in the Single Object Condition. However, the interactions reveal that while the Genevan children did not differ from the Texan children in how condition affected imitation rate, the Oaxacan children did (log odds = -1.63, $p = 0.021$), with the difference between conditions for these children being close to zero.

Table 1.

Summary of fixed effects for multi-level binomial logistic regression analysis for verbal component of experiment 1 for all cultures (choice condition coded as 1)

	<i>Mean</i>	<i>95% Intervals</i>		<i>SD</i>	<i>pMCMC</i>
	<i>Estimate</i>	<i>Lower</i>	<i>Upper</i>		
Intercept	2.44	0.832	4.279	0.874	0.0031
Condition	2.005	0.807	3.356	0.648	0.0001
Geneva	-0.7312	-2.982	1.478	1.123	0.2527
Oaxaca	-0.1979	-2.596	2.164	1.203	0.4354
Condition*Geneva	0.3938	-1.291	2.049	0.851	0.3143
Condition*Oaxaca	-1.6298	-3.308	-0.060	0.823	0.0209

English-Speaking Children in Texas

The English-speaking children produced all four possible response types. We therefore analysed their data using a multinomial logistic regression model. A model with Condition and age as predictors (but no interaction) was found to provide the best fit. The fixed effects can be seen in table 2. All three of the non bare noun responses - imitation (log odds = 2.075, $p < 0.0001$), other linguistic material (log odds = 2.3006, $p = 0.0042$) and paraphrase (log odds = 97.378, $p < 0.0001$) - were significantly more likely in the choice condition than the single-object condition. The rate of imitation was not significantly affected by age, but the rate of paraphrases significantly (log odds = 0.965, $p = 0.048$; and the rate of familiar adjective marginally significantly, log odds = 0.659, $p = 0.087$) increased with age.

Table 2.

Summary of fixed effects for multi-level multinomial logistic regression analysis for verbal component of experiment 1 for Texas participants (choice condition coded as 1).

		<i>Mean</i>	<i>95% Intervals</i>		<i>SD</i>	<i>pMCMC</i>
		<i>Estimate</i>	<i>Lower</i>	<i>Upper</i>		
Imitation	Intercept	2.5953	1.968	4.649	0.930	0.0004
	Condition	2.0745	0.892	3.414	0.641	<0.0001
	Age	-0.2404	-1.049	0.527	0.397	0.2693
Other linguistic material	Intercept	-2.7416	-5.398	-0.560	1.259	0.0042
	Condition	2.3006	0.666	4.067	0.864	0.0026
	Age	0.6585	-0.317	1.769	0.528	0.0871
Paraphrase	Intercept	-98.122	-227.149	-10.055	77.54	<0.0001
	Condition	97.3737	9.361	226.714	77.51	<0.0001
	Age	0.9851	-0.161	2.364	0.645	0.0482

French-Speaking Children in Geneva

A multinomial logistic model with Condition and age and an interaction between the two was found to provide the best fit. The fixed effects can be seen in table 3. Imitations (log odds = 1.076, $p = 0.032$) and paraphrases (log odds = 26.642, $p < 0.0001$) were significantly more likely in the choice than the single-object condition. The rate of imitation significantly decreased with age in the single object condition (log odds = -37.739, $p < 0.0001$), but remained almost constant

in the choice condition (as indicated by the significant condition*age interaction). The rate of familiar adjectives and that of paraphrases were not significantly affected by age.

Table 3.

Summary of fixed effects for multi-level multinomial logistic regression analysis for verbal component of experiment 1 for Swiss participants (choice condition coded as 1).

		<i>Mean</i>	<i>95% Intervals</i>		<i>SD</i>	<i>pMCMC</i>
		<i>Estimate</i>	<i>Lower</i>	<i>Upper</i>		
Imitation	Intercept	0.968	-2.087	4.380	1.638	0.2570
	Condition	1.076	-0.0391	2.268	0.588	0.0322
	Age	-37.739	-83.798	-9.815	21.16	<0.0001
	Condition*Age	37.858	10.294	83.408	21.044	<0.0001
Other linguistic material	Intercept	-6.817	-13.958	-1.363	3.196	0.0090
	Condition	0.694	-2.291	3.618	1.496	0.3190
	Age	14.691	-64.030	74.024	39.766	0.2478
	Condition*Age	-9.621	-67.909	68.556	39.586	0.3022
Paraphrase	Intercept	-55.810	-112.306	-15.157	26.100	<0.0001
	Condition	26.642	6.388	54.929	13.047	<0.0001
	Age	-43.876	-167.307	35.706	55.048	0.3274
	Condition*Age	41.597	-2.406	97.770	32.127	0.1080

Chatino-Speaking Children in Santa Lucia Teotepac

This group produced only two different responses – bare noun and imitation. We therefore analysed the data using a binomial logistic regression model. No combination of predictors improved fit over a null model, meaning responses were unaffected by either condition or age.

Results for the Instrumental Component

First we compared imitation in the demonstration and the no demonstration condition. Their mean rate of production of the coded actions on the box in the demonstration were 74.2%, and significantly less at 2.4 % in the no-demonstration condition as confirmed by a t-test ($t(16) = -17.7561, p < 0.0001$). There was no difference in imitation between transparent and opaque boxes. To analyze how culture or age might affect the rate of imitation we built several linear regression models predicting imitation rate from all combinations of culture and age, including the null model. A model predicting imitation rate from age alone offered the best fit for the data. Imitation rate increased with age ($B = 0.041, p < 0.0001$). Culture had no effect on imitation rate.

Discussion of Experiment 1

The combined results of experiment 1 present a striking picture. The children in Texas and Switzerland showed the same pattern as the German children from Bannard et al. (2013) – they were significantly more likely to imitate the experimenter's novel adjective when it had a communicative function and to drop it otherwise. The Chatino children, by contrast, show no such discrimination, imitating the novel adjective at 74% and 72% in the choice and single object conditions respectively. In the Texan and Swiss children the selectivity of imitation increases with age, albeit that we also see something new in the older children – the use of alternative phrasing in making their requests. In the Chatino children neither imitation rate nor selectivity changes with age (or formal education and resulting exposure to Spanish).

So why do we see this difference between cultures? One explanation would be that the Chatino children are just more imitative across the board. To explore this we also tested the children on an instrumental imitation task. We saw no difference between the three groups here. It seems then that the difference is specific to the verbal domain. There are a number of different ways in which this could hold. It could be that the contexts of acquisition in Chatino mean that children are more imitative in language learning as a whole (for example because more of their learning is observational rather than interactional). Secondly, it could be that their ability to interpret speaker intentions differs from that of the western children. Social cognitive abilities develop in interactions and have been argued to be socially transmitted (Carpendale & Lewis, 2004). Cross-cultural differences in the deployment of social cognition have also been reported (Wu & Keysar, 2007). Thus we might expect to see some variability. Finally, it could be that the way in which adjectives are used in speech to Chatino children affected how they performed.

In the introduction we hypothesized that child-rearing practices, and specifically differences in the nature of the speech addressed to the child would lead to different understandings of reference. These facts about language use in the different cultures can explain the observed pattern of results in the following way. In the single object condition in experiment 1, the experimenter used a novel adjective and a noun to request an object when there was only a single object present. In this case, the referent was already given by the context and no disambiguation of the referent was needed. The adjective then is unnecessary with regard to the making of a successful request, and indeed even a pronoun would suffice. For the English- and French-speaking children, who will have often heard adjectives being added descriptively to nouns in speech, this would have been a familiar scenario. They would be aware of the optional nature of the adjectives and since it apparently had no function they may have omitted it. The

Chatino children, by contrast, will mostly have experienced adjectives being used when they were necessary for disambiguation. Since they would not have inferred what purpose the adjective here served, they may have assumed that it served a hidden function and that the safest thing would be to copy it. This would be in line with over imitation in other domains where it has been suggested that children assume tasks to have a hidden causal (Lyons, Young & Keil, 2007) or conventional (Kenward, Karlsson & Persson, 2011) structure when none is apparent to them.

We ran further tests in order to exclude alternative explanations. Experiment 2 checked that Chatino children are not more faithful in linguistic imitation in general, and experiment 3 checked that they were not failing to infer speaker intentions. In experiment 2, one condition (the same category condition) was the same as the choice condition in experiment 1. Two items of the same type were presented, one modified and one plain. Because the objects offered were of the same category, the adjective was essential in order to unambiguously determine reference (it served an obligatory determinor function). In the other condition (the different category condition), however, a modified object of the same kind was paired with a plain object of a different kind. Thus only the noun is needed for nonambiguous reference.

It is important to note that unlike in the single object condition in experiment 1, the referent in the different categories condition in experiment 2 was not entirely given by the context, as there are two candidate objects and some disambiguation was required. And while the adjective was not essential for disambiguation it did support it (as the target item was decorated but the distractor not), so that its use was not efficient but might nonetheless contribute to discrimination. If, as we propose might be the case, the difference between the Chatino and the Western children in experiment 1 is due to differing experience with the use of adjectives to refer to given objects, then Chatino children (being familiar with, and hence not confused by, the

inefficient use of optional adjectives in situations of ambiguous reference) should follow the Western children and imitate less in the different categories condition.

Experiment 2

Method

Participants

We tested 23 typically-developing, Chatino-speaking children. Their ages ranged from 3 to 10 years (6 4-year-olds, 2 7-year-olds, 2 9-year-olds, 4 10-year-olds, and 3 children at each of the other ages excluding age 6). The data was collected in January 2012 and (primarily) June 2014. The children tested had not taken part in experiment 1. The participant profile, sample rationale and recruitment method was the same as in experiment 1.

Materials and Design

We used the same objects and adjectives as in experiment 1. We introduced four new objects that served as distractors in the four control trials. See supplementary materials for details.

Procedure

We used the same procedure as in experiment 1. The only difference was that in the control condition E2 presented a modified object and a plain object of a different category.

Coding

We used the same coding scheme as in experiment 1. We obtained a total of 176 data points. The data were coded by a Chatino research assistant on the field site. A second Chatino research assistant further coded data for a randomly chosen 32% while only having access to the audio tracks of the recordings and thus being blind to condition. Agreement between coders was 100%.

Experiment 2 Results

The children's responses are summarized in figure two, which shows the proportion of responses of each type for each condition (for the trials in which the children produced a response).

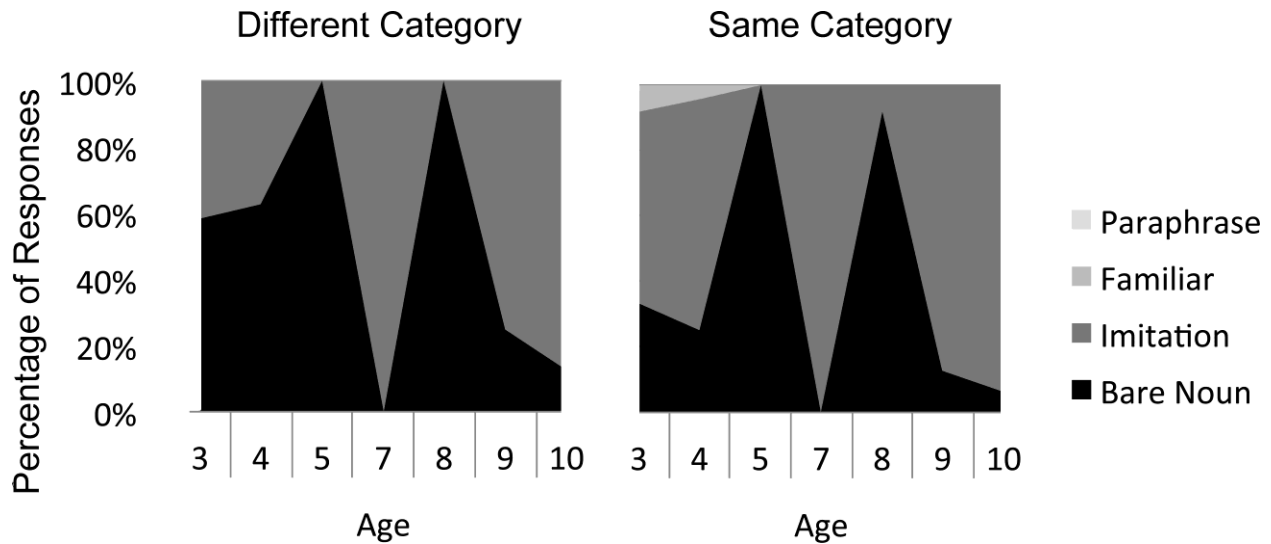


Figure 2: The proportions for each different response for each condition by age in experiment 2

In order to analyse this data we again built a logistic choice model. Because all except for 2 responses in a single condition were bare nouns or imitations, rather than having to impute so many missing values for the paraphrase response, we simply discarded the two data points and performed a binomial logistic regression. A model with condition and age as predictors but no interaction was found to give the best fit. The rate of imitation was found to be significantly greater in the same category condition than in the different category condition (log odds = 1.6, $p = 0.0008$). It also marginally significantly increased with age (log odds = 0.616, $p = 0.070$).

Table 4.

Summary of fixed effects for multi-level binomial logistic regression analysis for verbal component of experiment 2 (same-category condition coded as 1)

	<i>Mean</i>	<i>95% Intervals</i>		<i>SD</i>	<i>pMCMC</i>
	<i>Estimate</i>	<i>Lower</i>	<i>Upper</i>		
Intercept	-2.1751	-5.012	0.422	1.380	0.0479
Condition	1.600	0.585	2.686	0.531	0.0008
Age	0.6158	0.196	1.682	0.464	0.0700

Experiment 2 Discussion

Unlike in experiment 1, and in line with our predictions, we see a difference between conditions in experiment 2. This is the same broad pattern as seen in the German children. This is consistent with our proposal that the difference seen in experiment 1 is due to the greater use of the descriptor function of adjectives in the input to Western children. It is interesting to note that the difference between conditions was greater for Chatino children than for the German children (German children imitated 65% of the time in the different category condition, Chatino children just 46% of the time). The age difference in the samples makes comparison problematic, but it is plausible that Western children with their reduced exposure to determinor uses (as proportion of total adjective uses) find the different categories condition more opaque and choose to imitate.

In experiment 3, we explored the possibility that the differences seen in experiment 1 might be due not to differences in prior experience of reference but rather to differences (possibly derived from differences in the nature of their social interaction) in the ability to

determine speaker intentions. We did this by replicating experiment 3 from Bannard et al. In this study, the control condition was similar to the control condition in experiment 1 - E2 presented a single plain object and E1 used a novel adjective in his request. In an "accident" condition, however, the set up was the same except that immediately after uttering the adjective E1 would indicate via gesture that he had misspoken and the adjective was unintentional. In the original study the children were less likely to imitate the novel adjectives when they were marked as accidental in this way. We here wanted to see whether Chatino children would do the same.

In order to allow us to determine whether any effects found were particular to language, we also ran an analogous instrumental imitation study based on Carpenter, Akhtar and Tomasello (1998) in the same children. E1 demonstrated two actions on an object that activated an outcome (sound being played). E1 verbally and gesturally marked one of them as accidental. Then it was the child's turn and we observed whether they would selectively imitate the intentional actions.

Experiment 3

Method

Participants

We tested 17 typically developing, Chatino-speaking children. Their ages ranged from 4 to 10 years (2 4-year-olds, 3 5-year-olds, 2 6-year-olds, 1 7-year-old, 4 8-year-olds, 3 9-year-olds and 2 10-year olds). The data was collected in June 2014. The participant profile, recruitment method and sample selection was the same as in experiments 1 and 2. Each child participated in both verbal and instrumental tests. The children tested had not taken part in experiments 1 or 2.

Materials and Design for the Verbal Component

We used the unmodified objects and the adjectives from experiment 1.

Procedure for the Verbal Component

The requesting game was the same as in Experiments 1 and 2, but for a few critical differences. In both conditions a single plain item was used. In the accident condition, right after E1 uttered the adjective, he performed a gesture to mark it as unintentional. The gesture consisted of a face-palm and head-shaking, while looking at the child. We also made changes to the warm-up. To introduce the slip-of-the-tongue gesture, we presented three additional items (during the label-check) and E1 made use of the gesture when labeling these, before stating that he had misspoken and producing the correct label. During four warm-up trials in which pairs of objects were presented, E1 requested one item, but then used the accident gesture, corrected himself and then requested the other item (“Give me the red . . . *gesture* blue brick”).

Coding for the Verbal Component

We used the same coding scheme as in experiment 1. We obtained a total of 136 data points. 8 data points had to be dropped due to the respective child losing interest in the game, which left us with 128 data points. The data were coded by a Chatino research assistant on the field site. A second Chatino research assistant further coded a randomly chosen 25% of the data while only having access to the audio tracks of the recordings. Agreement between coders was 100%.

Materials and Design for the Instrumental Action Component

Each of six objects had two modifications that each afforded one action (e.g. pull a stick out of a hole). All object action had an outcome – a chime sound - that was activated by E2. Additionally we created two warm-up objects, one of them with one modification, the other one with two.

Procedure for the Instrumental Action Component

In a warm-up, the child was familiarized with the kind of objects used in the experiment via demonstrations on two items. After the warm-up the experiment started. E2 put a randomly

chosen object between himself and E1/the child. E1 then performed the two actions on the object. Either both actions were gesturally and verbally marked as intentional, or one was marked as intentional and the other as accidental. It was then the child's turn and we observed their imitation of the demonstrated actions. This was repeated twice per object for six objects.

Coding for the Instrumental Action Component

For each trial we coded whether the child imitated the actions. Out of a total of 432 we obtained 428 data points. Four data points from one child were incomplete due to fussiness. The data were coded by a research assistant at the University of Texas at Austin. A research assistant further coded data for a randomly chosen 25% of trials. Agreement between coders was 100%.

Experiment 3 Results

Verbal Component

The children's responses are summarized in figure three, which shows the proportion of responses of each type for each condition (for trials in which the children produced a response).

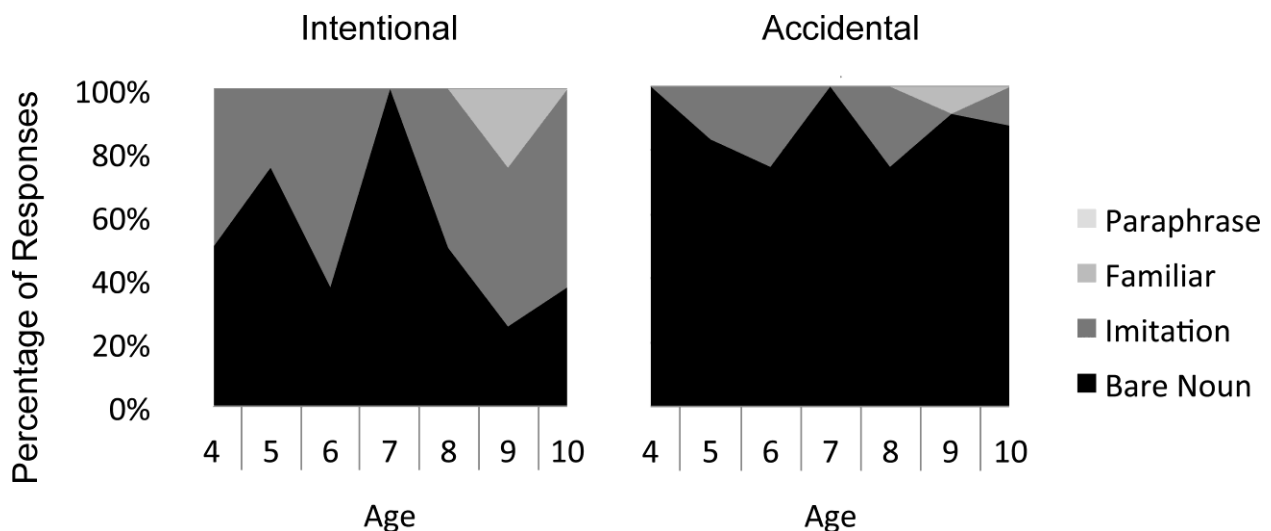


Figure 3: The proportions for each different response for each condition by age in experiment 3

In order to analyse this data we again built logistic choice models. Because all except for 4 responses were either bare noun or imitation, we again simply discarded the four data points and performed a binomial logistic regression. A model with condition and age as predictors but no interaction was found to give the best fit to the data. The rate of imitation was found to be significantly lower in the accidental condition than in the intentional condition (log odds = -2.557, $p < 0.0001$). It was not significantly affected by age.

Table 5.

Summary of fixed effects for multi-level binomial logistic regression analysis for verbal component of experiment 3 (accidental condition coded as 1)

		<i>Mean</i>	<i>95% Intervals</i>		<i>SD</i>	<i>pMCMC</i>
		<i>Estimate</i>	<i>Lower</i>	<i>Upper</i>		
Imitation	Intercept	2.159	0.148	4.225	1.040	0.0159
	Condition	-2.557	-3.823	-1.462	0.601	<0.0001
	Age	0.273	-0.414	1.097	0.374	0.2102

Results for the Instrumental Component

The responses for the instrumental component were analyzed with a multilevel binomial logistic choice model with child and trial block (as there were multiple responses on each trial) as random effects on the intercept. Model selection was performed by comparing all possible combinations of predictors and interactions between predictors including a null model. The best fit to the data was given by a model with condition, age and an interaction between the two included as predictors. Imitation rate was significantly lower in the accidental condition than in

the intentional condition (log odds = -3.6733, $p < 0.0001$). Imitation rate increased significantly with mean-centered age (log odds = 1.0840, $p = 0.003$), but this increase was significantly lower in the accidental condition than in the intentional condition (log odds = -0.5899, $p = 0.016$).

Experiment 3 Discussion

The pattern of results for the verbal imitation component of experiment 3 are the same as seen for German-speaking children. The results for the instrumental task were the same as in Carpenter et al. (1998). It seems that the Chatino children prefer to imitate words and actions that are intentional (not marked as accidental) just like their counterparts in the West. We conclude that a difference in intention reading abilities is not responsible for the finding in experiment 1.

General Discussion

In experiment 1, we found that while English- and French-speaking children (like German-speaking children in prior work) were more likely to imitate a novel adjective when that adjective transparently served a determinor function, Chatino-speaking children imitated the novel adjective regardless of context. No difference was found between the three groups with regard to faithfulness of imitation on an instrumental action task, suggesting that the difference between groups was specific to language. We propose that this is due to the children's differing linguistic experience. In a second study we provided further support for this, by confirming the prediction that Chatino children should selectively imitate (due to familiarity with situations similar to both conditions) when an adjective has an essential determinor function in one condition and is useful but optional in the other. In a third study we ruled out the alternative that the difference we had seen in the first experiment was due to differing intention-reading abilities.

Thus, while over imitation of non-linguistic behaviors has been argued to be culturally invariant (Nielsen and Tomaselli, 2010), in the domain of language there is variability. The

children seemed to employ an if-in-doubt-then-copy strategy, over-imitating when motives for an action were opaque to them. This claim has important implications for how children construct their knowledge within social interactions. A pattern in our Western data from experiment 1 was that the children's linguistic creativity (their use of unseen familiar adjectives or of paraphrases) was limited at first and increased with age. At younger ages the two responses seen were either exact imitation or reduction of the utterance seen. And reduction of the utterance (the isolation and reuse of the noun) was only reliably seen across the three groups when the children had an understanding of what the component words were for. This suggests a true social learning model of language development – imitation enables children to engage in interactions, which in turn lead to a greater understanding, which subsequently enables selectivity in copying and eventually creative speech. The route by which this happens vary cross-culturally depending on the different things that different cultures do with words.

References

- Bannard, C., Klinger, J., & Tomasello, M. (2013). How selective are 3-year-olds in imitating novel linguistic material? *Developmental Psychology*, *49*(12), 2344.
- Baayen, R. H., Davidson, D. J., & Bates, D. M. (2008). Mixed-effects modeling with crossed random effects for subjects and items. *Journal of Memory and Language*, *59*, 390–412. doi: 10.1016/j.jml.2007.12.005
- Carpendale, J., & Lewis, C. (2004). Constructing an understanding of mind: The development of children's social understanding within social interaction. *Behavioral and Brain Sciences*, *27*, 79-96.
- Carpenter, M., Akhtar, N., & Tomasello, M. (1998). Fourteen- through 18-month-old infants differentially imitate intentional and accidental actions. *Infant Behavior and Development*, *21*(2), 315-330.
- Clark, R. (1977). What's the use of imitation? *Journal of Child Language*, *2*, 341-359.
- Correa-Chavez, M., & Rogoff, B. (2009). Children's attention to interactions directed to others: Guatemalan Mayan and European American patterns. *Developmental Psychology*, *45*, 630–641.
- de Leon, L. (1998). The emergent participant: interactive patterns in the socialization of Tzotzil (Mayan) infants. *Journal of Linguistic Anthropology*, *8*, 131–161.
- Dixon, R., (2010). *Basic linguistic theory, Volume 2, Grammatical topics*. Oxford: OUP.
- Evans, N., & Levinson, S. (2009). The myth of language universals: Language diversity and its importance for cognitive science. *Behavioral and Brain Sciences*, *32*(5), 429-492.
- Gaskins, S. (2000). Children's daily activities in a Mayan village: A culturally grounded description. *Cross-Cultural Research*, *34*(4), 375-389.
- Hauser, M., Chomsky, N., & Fitch, W. T. (2002). The language faculty: What is it, who has it, and how did it evolve? *Science*, *298*, 1569–1579.

Heath, S.B. (1983). *Ways with words: Language, life and work in communities and classrooms*. Cambridge: CUP.

Hoff-Ginsberg, E. (1987). Topic relations in mother-child conversation. *First Language*, 7, 145-158.

Hoff, E. (2003). The specificity of environmental influence: Socioeconomic status affects early vocabulary development via maternal speech. *Child Development*, 74, 1368–1378.

Horner, V., & Whiten, A. (2005). Causal knowledge and imitation/emulation switching in chimpanzees (*Pan troglodytes*) and children (*Homo sapiens*). *Animal cognition*, 8(3), 164-181.

Karmiloff-Smith, A. (1979). *A functional approach to child language*. Cambridge: CUP.

Keller, H. (2007). *Cultures of infancy*. Mahwah, NJ: Erlbaum.

Kenward, B., Karlsson, M. & Persson, J. 2011. Over-imitation is better explained by norm learning than by distorted causal learning. *Proceedings of the Royal Society B*, 278, 1239-1246.

Lieven, E.. (1994). Crosslinguistic and crosscultural aspects of language addressed to children. In C. Gallaway & B. Richards (Eds.), *Input and Interaction in Language Acquisition* (pp. 56-73). Cambridge: CUP.

Lyons, D., Young, A., & Keil, F.. (2007). The hidden structure of overimitation. *Proceedings of the National Academy of Sciences*, 104(50), 19751-19756.

McGuigan, N., Makinson, J., & Whiten, A. (2011). From over-imitation to super-copying: Adults imitate causally irrelevant aspects of tool use with higher fidelity than young children. *British Journal of Psychology*, 102, 1-18.

McIntosh, J. (2015). *Aspects of Phonology and Morphology of Teotepac Eastern Chatino* (Unpublished doctoral dissertation). University of Texas at Austin.

- Moerk, E. and Moerk, C. (1979) Quotations, imitations, and generalizations. Factual and methodological analyses. *International Journal of Behavioral Development*, 2, 43-72.
- Nader, L. (1969). The Zapotec of Oaxaca, In R. Wauchope and E. Vogt (Eds.), *Handbook of Middle American Indians*, Vol.7, Ethnology (pp. 725-773). Austin: University of Texas Press.
- Nielsen, M., and Tomaselli, K. (2010). Overimitation in Kalahari Bushman Children and the Origins of Human Cultural Cognition. *Psychological Science*, 21 (5): 729-36.
- Pye, C. (1986). Quiché Mayan speech to children. *Journal of Child Language*, 13(01), 85-100.
- Rasch, J. W. (2002). *The basic morpho-syntax of Yaitepec Chatino* (Unpublished doctoral dissertation, Rice University).
- Rogoff, B. Mistry, J. Güncü, A. and Mosier, C. (1993), Guided participation in cultural activity by toddlers and caregivers. *Monographs of the Society for Research in Child Development*, 58.
- Shwe, H., & Markman, E. (1997). Young children's appreciation of the mental impact of their communicative signals. *Developmental Psychology*, 33(4), 630 – 636.
- Shneidman, L, & Goldin-Meadow, S. (2012). Language input and acquisition in a Mayan village: how important is directed speech? *Developmental Science*, 15, 659–673.
- Snow, C. (1981). The uses of imitation. *Journal of Child Language*, 8, 205-12.
- Sterponi, L. (2010). Learning communicative competence. In D. Lancy, J. Bock, & S. Gaskins (Eds.), *The Anthropology of learning in childhood* (pp. 235-259). New York: Rowan & Littlefield.
- Tennie, C., Call, J., & Tomasello, M. (2009). Ratcheting up the ratchet: on the evolution of cumulative culture. *Philosophical Transactions of the Royal Society B*, 364(1528), 2405-2415.
- Tomasello, M. (2003). *Constructing a Language: A Usage-Based Theory of Language Acquisition*. Cambridge, MA: Harvard University Press.

Wu, S. & Keysar, B. (2007). Cultural effects on perspective taking. *Psychological Science*, 18, 600-606.