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**Imitation of Words and Actions Across Cultures**

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# **Imitation of Words and Actions Across Cultures**

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Humans imitate in a unique way. They imitate selectively, that is, they imitate intentional actions at a higher rate than accidental ones. At the same time humans tend to faithfully imitate actions that do not seem to be relevant to an end goal. Selectively imitating intentional actions allows us to learn efficiently from others, while faithful imitation makes it possible to acquire complex cultural conventions without immediately understanding the contribution of each of its components. Recent studies suggest that this unique way of imitating is universal across cultures and enables humans to develop complex cultural practices that set them apart from other species. The evidence so far, however, is almost exclusively based on studies about the imitation of actions, while little work has been done on the imitation of language. Language is arguably humanity's most important cultural product and unlike instrumental actions that are restricted by the laws of physics, language is a fairly arbitrary system of conventions and thus more prone to cross-cultural variance. Claims about the cultural universality in imitation learning thus need to be supported by data from verbal imitation.

The present work addresses this point in four studies. The first three studies tested children's imitation of adjectives in different contexts across three different cultures: a small indigenous community in Mexico and two western large-scale societies. In various verbal imitation tasks we found cross-cultural differences. We propose that these

differences are due to differences in the amount of time spent in dyadic caregiver-child interaction in indigenous and western culture. Further, the data suggest that this cultural variation arises from the fact that humans across cultures in both verbal and instrumental tasks imitate selectively when the function of an element is transparent to them. When its function is opaque they do the safe thing: faithfully imitate. This account is tested in study four. In an instrumental task adults and children imitated faithfully when the function of the actions performed was opaque, but not when they were transparent. This allows us to propose that the cross-cultural differences we observe are thus due to differences in experience that make different aspects of language use more or less transparent to learners.

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## **SECTION 1: INTRODUCTION**

A great deal of research on imitation in humans over the last few decades has suggested that it involves the use of cognitive abilities that go beyond reflexive behaviors and rote copying. When imitating, humans determine which actions performed by a model are intentional and which are necessary to achieve the outcome, and prefer to imitate those over accidental and redundant actions (Meltzoff, 1995; Carpenter, Akhtar and Tomasello, 1998). Furthermore humans also take into account the means that an actor has at his or her disposal. If the actor chooses a seemingly less efficient strategy over an obvious and more efficient alternative this suggests the presence of a hidden intention behind the action, resulting in a higher imitation rate (Gergely, Bekkering and Király, 2002).

Despite these insights, humans still imitate redundant and accidental actions at a high rate (Horner and Whiten, 2005). This is widely known as over or faithful imitation. As other great apes do not display such over imitation, it might be that this behavior is a factor in enabling the development of complex cultural conventions that set humans apart from other animals (Ramscar and Githcho, 2007). Most research investigating over imitation in non-Western cultures suggests that the presence of over imitation is culturally invariant (Nielsen and Tomaselli, 2010, but see Berl and Hewlett, 2015 for a striking exception). Other research, however, has identified cross-cultural differences in the context in which over imitation occurs, for example, instrumental versus normative (Clegg and Legare, in preparation).

Although there is a large body of research on mimicry in language acquisition, work on more complex imitative behavior, which involves the use of social-cognitive abilities, such as intention reading, is still relatively scarce. The next section will discuss the difference between mimicry and the more complex imitation mechanisms that the present research is concerned with in greater detail. Most research on that second kind of imitation that goes beyond mimicry has focused on the instrumental domain, that is, the imitation of actions, with little work having been done on verbal imitation. This poses a major problem to anyone interested in developing an overarching theory of imitation in humans. Language is arguably our most important cultural product and thus a topic of interest in many disciplines. Unlike instrumental actions, which are constrained by the laws of physics (for instance, the ways in which one can use a marble run are constrained by gravity, as the marble will always run downwards), language is an arbitrary system of conventions agreed on by a community of speakers (Lewis, 1969). Thus drawing general conclusions about human imitative behavior solely on the basis of findings from studies on instrumental imitation might not tell the whole story. Investigating verbal imitation at the same level of depth as that used in exploring instrumental imitation has the potential to yield benefits that will be felt beyond the language research community.

So far research suggests that verbal imitation makes use of the same social-cognitive abilities as instrumental imitation (Over and Gattis, 2010; Bannard, Klinger and Tomasello, 2013) and that humans over imitate words as they do actions (Bannard, Klinger and Tomasello, 2013), but there are no studies exploring verbal imitation across cultures. This is important because while the literature on instrumental imitation is mainly concerned with finding universal patterns (e.g., Nielsen and Tomaselli, 2010; see Berl and Hewlett, 2015 as well as Clegg and Legare, in preparation, for an exception),

there is reason to suspect that there is more cross-cultural variance in the imitation of language. Although all languages allow speakers to communicate efficiently, there are pronounced differences not only in the formal features of languages, but also in the way in which they are used by their speakers (Evans and Levinson, 2010).

The present research aims to explore verbal imitation across different cultures, by conducting the three adjective imitation experiments reported in a previously published paper (Bannard, Klinger and Tomasello, 2013) in the small indigenous community of Santa Lucia Teotepec in Oaxaca Mexico inhabited by Chatino people. In contrast to the German children tested in Bannard, Klinger and Tomasello (2013), who grow up in a loosely knit large-scale industrial society, Chatino children grow up in a tightly knit small-scale agricultural community. The population of Teotepec is about fourteen hundred inhabitants. Teotepec Chatino, the dialect spoken in Teotepec is a variety of Eastern Chatino, an Otomanguan language. It usually follows a VSO word order and has a strikingly complex tone system (McIntosh, 2015). Apart from the structure of society and the grammatical properties of the language, there is another difference between Chatino and western culture: child rearing practices. Unlike western children, who spend the majority of their time in caregiver-child dyads in their homes, Chatino children pass much time with their peers in the larger community. This can be expected to have an effect on the linguistic experience of children.

The primary goal of the present research is to explore the effects of different cultural practices and the differences in language use that they bring with them on imitation behavior in the indigenous Chatino children on the one hand, and western children on the other hand. The first two of four experiments are recreations of Bannard, Klinger and Tomasello's (2013) experiments one and two. In these two experiments we

play an imitation game with the child participants that allows us to test whether in verbal imitation they take into account a novel word's function in the context of the utterance. Experiment 3 is a replication of Bannard, Klinger and Tomasello's experiment three. We investigated whether, like German children, Chatino children are able to use intention-reading skills when imitating verbal material. The insights from the three experiments above allow us to put forward a general theory on when humans imitate regardless of domain (instrumental or verbal) and culture (western or indigenous). Experiment 4, conducted on children and adults provides a first test of that theory.

The second section of this dissertation contains background information on research on instrumental and verbal imitation, a discussion of cultural differences around the world including cross-cultural differences in child rearing, as well as an overview of referring expressions, the crucial verbal elements for the current studies. The third section describes and discusses four experimental studies, followed by a general discussion and conclusion.

## **SECTION 2: BACKGROUND**

This section discusses relevant background information. Although a small number of recent studies investigate verbal imitation, most research on imitation in developmental psychology has focused on the instrumental domain. This means not only that many of the terms used to describe different imitative behavior stem from work on instrumental imitation, but also that most of the general insights into imitative behavior, be it verbal or instrumental, were gained by exploring the imitation of actions. Additionally, much of the research done in the verbal domain aims to establish whether the same fundamental cognitive abilities that are utilized in the imitation of actions also account for the imitation of verbal material. In order to give an overview of the aspects of imitation that are relevant to an understanding of the present research, this section introduces different aspects of imitation through describing studies undertaken on instrumental action. It then proceeds to give a similar overview of the work on verbal imitation. Thereafter it includes sections on referring expressions (the type of verbal material that is most crucial to the present research), Chatino culture and language, and a comparison of child rearing practices across cultures.



## **Chapter 1: *Instrumental Imitation***

This section provides an overview of relevant research on instrumental imitation. The first section introduces a variety of terms used to differentiate between simple and more complex imitative behaviors and describes the social-cognitive that they entail in greater detail, followed by a section that focuses on another uniquely human trait of imitation: the fact that humans, but not other animals, faithfully imitate. Alongside a general explanation of how such faithful imitation could facilitate cultural learning, a series of experiments that investigate the reasons behind faithful imitation is discussed. Last I present a summary of cross-cultural work on instrumental imitation.

### **1.1 THE DIFFERENT KINDS OF IMITATIVE BEHAVIOR**

The literature on animal learning uses more specific terms for what popular parlance has loosely called imitation. The following explains imitative behaviors of varying complexity according to the terminology used by Want and Harris (2002) and contrasts simpler imitative behavior with the more complex imitation that the present research is concerned with.

Local enhancement and stimulus enhancement are two related types of social learning behavior. The former refers to the process of seeing a model perform an action at a particular location, which in return enhances the child's interest in that location. This may then lead to the child producing similar behavior as the model once they get to the location. The latter, stimulus enhancement, is very similar, but in this case the attention is enhanced towards an object rather than a location. The child sees the model using a

particular object, gets interested in the object and may then figure out how to obtain the desired goal on his or her own.

Perhaps the most cognitively simple form of imitation is mimicry. In mimicry the child replicates actions performed by a model, but no attention is paid to understanding the mechanisms involved in the task. The child copies the model's actions precisely, without any insights into why these actions are chosen or what the intended outcome is.

The more complex forms of imitation encompass two behaviors, blind imitation and insightful imitation. In blind imitation the child is aware of the fact that the model's actions serve to achieve a goal. The child reproduces the actions and knows that they are crucial in achieving the goal, but is unaware of how each individual actions contributes to the goal. Insightful imitation takes this one step further: The child replicates the actions and the goal of a model and is also aware of how each single action contributes to the end result.

While local and stimulus enhancement, as well as the ability to mimic, are certainly important to human learning, it is the use of the more complex blind and insightful imitation (and over imitation) that distinguish human imitation from the imitative behaviors of other animals. The next subsections thus cover the nature and role of social-cognitive abilities that are utilized in blind and insightful imitation, but not in enhancement and mimicry: intention reading and rationality judgments.

## **1.2 THE ROLE OF INTENTION READING IN IMITATION**

Early evidence for imitation that goes beyond reflexive behavior, that is, blind imitation or insightful imitation, comes from Meltzoff (1995). He used a behavioral re-enactment task that exploits children's proclivity for replicating actions of adult models.

In the experimental condition the model attempted to perform an action, but failed and thus never reached the end state. While it was easy for adults to figure out the model's intention and thus infer the model's desired end goal, the question was whether young children would reproduce the intended outcome or simply replicate the exact bodily motions, that is, display mimicry. Producing the intended outcome would thus require intention reading and such behavior would be classified as (blind or insightful) imitation.

Meltzoff tested children in four different conditions. In the first demonstration condition the adult performed actions on objects and actually reached the desired outcome. In a second demonstration condition the adult attempted to perform the actions, showed a desire to reach an end goal, but failed to achieve it. In a control condition the children were handed the objects without any prior demonstration. In a second control condition the experimenter handled the objects before giving them to the child, but refrained from performing any of the actions in question. This condition served to explore whether the children observing the adult handle the objects in general would lead to them spontaneously performing the target actions.

The results showed that whether the model actually achieved the end goal or tried to and failed had no impact on the children's rate of production of the end goal. Thus children were able to estimate the model's intended goal via intention reading. The behavior shown in this study is thus imitation. The design, however, does not warrant saying whether the imitation was blind or insightful. Last, the rate of production of the end goal was significantly higher in the demonstration conditions than in control conditions with no demonstration, meaning that children produced those actions, because they saw the model do them, rather than randomly.

Following up on the findings of Meltzoff (1995), Carpenter, Akhtar and Tomasello (1998) found that 16 month olds reproduce intended actions more often than accidental actions – that is, imitate selectively based on the model’s intentions. An adult model performed two neutral-looking actions on an apparatus, one of which was verbally marked as intentional (“There!”), while the other was verbally marked as accidental (“Whoops!”). The child participants did not mimic the adult’s bodily motions, which were the same in both cases, but selectively imitated those actions that the model performed intentionally with a greater frequency.

In addition to showing the central role of intention reading for imitation, studies have also found that children take into account the means that the model has at his disposal in the context of the action. Like intention reading, the use of this skill sets imitation apart from rote copying and makes it a more efficient learning mechanism. The next subsection gives a brief overview of the literature on rational imitation.

### **1.3 RATIONAL IMITATION**

In a study by Gergely, Bekkering and Király (2002) fourteen-month-old infants (see Schwier, Van Maaren, Carpenter and Tomasello, 2006 for a replication of the study with twelve month olds) saw a model turn on a light by pushing the switch with his or her head. In one condition, the adult was apparently cold and held a blanket in his or her hands, such that the more efficient alternative way to turn on the light, that is, using his or her hand, was not available. In the other condition the model’s hands were free, such that he or she could have used them to press the button to turn on the light. When it was their turn to switch on the light, children did so using their head more often in the condition in

which the model's hands were free. The reasoning is that in the first condition children were aware that the model could not use his or her hands, since they were occupied with holding the blanket. In the second condition, however, the model had his or her hands free and thus could have used them to turn on the light. Because he or she did not choose that more efficient alternative, it might be inferred that there must have been a specific reason for him or her using the head. Hence these findings suggest that the use of an unconventional action, even when more efficient alternatives are available, highlights the model's intentional use of that unconventional action.

Children are thus not only able to read a model's intentions, but also take into account the context of the performed action when performing the modeled action themselves. Imitation involving these two social-cognitive abilities is only found in humans. However there is another feature that sets human imitation apart from intention-reading great apes – over imitation. This might be a significant factor in explaining why human culture is so highly evolved. The next section will explain what over imitation is by reviewing a set of studies on the phenomenon. The section after that will provide some thoughts on why humans over imitate and why over imitation could be the crucial factor for human culture's uniqueness.

#### **1.4 OVER IMITATION**

Despite displaying sophisticated social-cognitive abilities in imitation behavior, participants in the above-mentioned studies also imitated redundant and accidental actions at a high rate. In the study by Carpenter, Akhtar and Tomasello (1998), the children imitated 39-45% of the actions marked as unintentional (depending on whether the intentional or the accidental action was performed first). This phenomenon, referred

to as over imitation in the literature, has been the subject of numerous studies. Similar to how Carpenter et al. investigated differences in imitation rate contingent on whether an action was intentional or accidental, a variety of studies explored the effects of necessary and redundant actions on faithfulness of imitation. While these studies unanimously find that necessary actions are imitated at a higher rate than redundant actions, participants still imitate the redundant actions at a high rate.

Horner and Whiten (2005) investigated this. They used a medium-sized plastic box with a hole on the topside that was protected by a bolt, such that removal of the bolt would expose the hole. The front of the box contained another hole that was protected by a door and two small bolts. A reward was placed in a plastic tube connected to the hole on the inside of the box. An adult model then used a stick to perform a series of actions (e.g., tapping the bolts, inserting the stick into the top hole) on the box that were irrelevant to retrieving the reward, before opening the front door and obtaining the reward. Both three and four year olds faithfully imitated the irrelevant actions. Since the box was opaque, the children may not have been aware that some of the actions did not at all contribute to obtaining the reward. However, this explanation cannot be correct, since their behavior did not change when a similar transparent box was used. When it was obvious that most of the experimenter's actions did not contribute to opening the box and retrieving the reward, children still displayed a high fidelity in imitating actions that were causally irrelevant to obtaining the reward.

McGuigan, Whiten, Flynn and Horner (2007) conducted a similar study with five year-olds. A possible prediction is that the older children's heightened causal awareness would lead to lower imitation rates in the transparent box condition, since children would be more likely to understand the irrelevance of the actions performed by the

experimenter. Nonetheless the pattern of results for five year-olds is similar to that of younger children. Actually, in both the opaque and the transparent box condition, participants displayed an even higher degree of imitation. This trajectory continues into adulthood, such that adults display even greater rates of imitation (McGuigan, Makinson and Whiten, 2011). A similar pattern was found Reader, Bruce and Rebers (2008), who used a different paradigm. They had an experimenter lead the participant out of a room. The experimenter chose an obviously longer route. After that they asked the participant to retrieve a person from the room. When they did so, the participants chose the longer route that the experimenter demonstrated to them instead of a shorter alternative.

At first these findings might be surprising, since their heightened causal understanding should have helped older children and adults in particular to omit irrelevant actions and display more goal-oriented behavior (Want and Harris, 2002). However, looking back at the findings reported in Gergely, Bekkering and Király (2002), where children may have attributed the use of a seemingly more complicated and less efficient action in favor of a more efficient alternative, might help us account for these results. Gergely et al. attributed children's behavior to their awareness of the model's intentions; we could apply a similar explanation here: Participants might be aware of the fact that the irrelevant actions performed by the adult model do not causally contribute to retrieving the reward from the box. However, this just highlights that, even though they might seem pointless, these actions are intentionally performed by the model. Hence for five year-olds, who have a higher causal awareness, the model's intentions will be even clearer, resulting in an increasing rate of over imitation in older age groups. This explanation is supported by McGuigan and Whiten (2009). Testing very young children (twenty-four and thirty month olds) whose intention-reading abilities may not be as

sophisticated yet, they found that their participants used an emulative rather than imitative strategy, performing only the causally necessary actions.

### **1.5 WHY DO HUMANS OVER IMITATE?**

Because over imitation is basically described as the imitation of actions that are irrelevant to an overall goal, one might think of the human tendency to over imitate as an obstacle that delays humans in understanding and performing actions. However, if we consider the nature of cultural norms that are essential to being part of human societies, it is plausible that over imitation is not only conducive, but also necessary to developing, maintaining and transmitting complex cultural conventions.

Cultural practices often contain steps whose impact on the result is not clearly visible for the members of the respective culture. Take cooking a meal by following a recipe as an example: The person who cooks the meal is often aware of the desired outcome (How the meal is supposed to look or taste), but unaware of the effect of each step or ingredient on said outcome (e.g., adding certain spices, adding yeast when making bread). When the cook reproduces all the steps in the recipe faithfully, he or she will produce the desired outcome, without having a sophisticated understanding of each component. The same is true for the faithful replication of verbal material, for example, when buying things. When the above-mentioned cook buys certain ingredients for his meal, using the exact terminology stated in the recipe will result in the vendor selling him the correct ingredients. Again, the cook does not need to know the precise meaning of each part (e.g., *scaloppini* veal) of his request, to successfully obtain the required items. Hence, over imitation allows for reproducing an outcome, but does not require the



imitator to invest large amounts of energy and time that would be required to thoroughly understand each step of the action or utterance.

Current research on over imitation supports the above-described idea that over imitation plays a crucial role in developing, maintaining and transmitting complex cultural conventions (Nielsen, 2012). Studies found that (at least in western children) over imitation extends robustly to other objects similar to that on which the demonstration had been performed (Nielsen, Mushin, Tomaselli and Whiten, 2014); and that children over imitate indirectly, that is, they imitate seemingly unnecessary actions demonstrated by an adult model to another adult (Nielsen, Moore, Mohamedally, 2012). Further, children have been found to prefer copying adults (Flynn and Smith, 2015), allowing for knowledge to be passed on from one generation to the next. Thus the current state of the field suggests that over imitation indeed seems to be a strong tool for cultural evolution and transmission.

## **1.6 OVER IMITATION ACROSS CULTURES**

As alluded to in the previous section, over imitation is plausibly a mechanism that any human culture, whether it be a western industrialized society or an indigenous community, can profit from. Combined with its ability to enable and facilitate cultural transmission, it is not surprising that over imitation has been found in different cultures. Nielsen and Tomaselli (2010) conducted a series of experiments similar to those of Horner and Whiten (2005) on Bushman<sup>1</sup> children from the Kalahari desert in south-west Africa: using three different apparatus that were adapted to fit in with the culture of the

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<sup>1</sup> Bushman is the ethnonym that these people use and prefer to be used for themselves (Nielsen and Tomaselli, 2010).

participants, Nielson and Tomaselli observed robust over imitation, which again increased with age. Hence their data support the notion that the findings of Horner and Whiten, as well as McGuigan, Whiten, Flynn and Horner might be universal across cultures (however, see Berl and Hewlett, 2015, for a striking exception). In addition to being possibly culturally universal, over imitation, in its strongest form, where the learner imitates even obviously irrelevant actions, is only found in humans. When comparing their human participants to a group of chimpanzees, Horner and Whiten (2005) found that the chimps display moderate over imitation in the opaque box condition, where it is relatively unclear whether the additional actions contributed to the goal, but none at all in the transparent box condition. Humans, by contrast, displayed strong over imitation in both cases. Over imitation is thus not only observed across different human cultures, but also exclusively found in humans, supporting the theory that it is an important factor to the complex culture that we as humans developed.

### **1.7 OVER IMITATION TO FORM SOCIAL RELATIONS**

While in our examples of following a recipe (p. 24), faithful imitation has a concrete positive outcome (a tasty meal) for the imitator, the benefits of other cultural practices are often dependent on being part of a community and are also less direct. Adhering to traffic rules only bears a positive outcome if there are other drivers. Following rules of behavior during dinner leads to being accepted by the group. This brings us to another function of imitation. When imitating other people, even though it is not required, the imitation behavior may allow expression of affiliation to the model. In everyday-life this can be observed in people wearing certain clothes that are typical for a social group, or people adopting expressions of other people in conversation. On a low

level, Lakin, Chartrand and Arkin (2008) argue that mimicry of motor functions is an affiliative response to social exclusion among adults. A study by Watson-Jones, Legare, Whitehouse and Clegg (2014) demonstrates this social function of imitation on a higher level and in children. Half of their child participants watched an animation that depicted a situation of ostracism: Three shapes interacted on the screen as a group, while a fourth shape attempted to join the group, but got rejected and eventually gave up. The other half of the participants watch an animation that depicted affiliation: Four shapes moved around the screen as a group. In a subsequent imitation task those children that had previously been primed for ostracism showed a greater degree of faithfulness in their imitation than those who had been primed for affiliation. Watson-Jones et al. argue that this difference is due to the children's need to seek affiliation when they encounter a situation of ostracism and the lack of that need when the situation already suggests inclusion – when children sense the need to establish affiliation, they use faithful imitation to do so.

Nielsen, Simcock and Jenkins (2008) compared a child's interaction with a live experimenter to that with a videotaped familiar experimenter and a videotaped unfamiliar experimenter. The model grabbed a box, and used a stick to release a switch and retrieved the contents of the box. Using the stick was less efficient than just using one's hands. After three demonstrations it was the child's turn. Children in the live condition were more likely to copy the model's ineffective way of opening the box with a stick. In the video conditions, where the opportunity for spontaneous contingent interaction was removed, the inefficient actions were copied less often. Copying of efficient actions was unaffected by condition. The familiarity of the televised demonstrator also had no effect

on the results. These findings were corroborated by a similar study by Marsh, Ropar and Hamilton (2014).

One explanation for why the children may have been less likely to copy ineffective actions when seen on video is that they could have inferred that videotaped demonstrations do not provide socially relevant information to their current circumstances (Troseth, Saylor and Archer, 2006). If this had been the case, children should imitate a model seen on TV, as long as there is evidence that the information provided by the model is relevant to the here-and-now. In a second experiment Nielsen et al. had one condition in which the model interacted socially with the child via CCTV and a control in which no interaction took place. In the no interaction condition the children watched a video of the experimenter and the previous participant in the interactive condition. To control for potential effects produced by mentioning the other child's name, a third baseline, non-interactive condition was included. In this condition the children watched a pre-recorded video of a similar interaction without the use of any personal names.

Children copied the model's inefficient action more often in the interactive condition. There was no difference between the two non-interactive conditions. Furthermore the children in the interactive condition performed no differently from those in the live condition of the first experiment. There was no significant difference in the copying of outcome-relevant actions, that is, opening the box. These results thus show that social interaction with the model increases the rate of imitation of infelicitous actions. This supports the theory that imitation serves as a way for the child to show and establish affiliation to the model.

## **1.8 OVER IMITATION AND ACQUIRING CAUSAL INFORMATION**

The proposal that the main use of over imitation, beyond cultural transmission, lies in establishing social affiliation is not undisputed. Lyons, Young and Keil (2007) argue that over imitation occurs not primarily for social reasons, but as a mechanism to acquire causal information about the observed actions and objects. This information is there even when the actions are not relevant to the goal of the task. If this hypothesis is true, children should imitate actions even when they are informed of the irrelevance of those actions for the task at hand. Lyons et al. investigated this possibility in a series of studies.

In their first study, in the warm-up the model retrieved an object from a container and performed a series of irrelevant actions in the process. Participants were asked which of the actions had to be done and which were "silly". They were subsequently praised for identifying irrelevant actions. In the experimental phase a comparable "puzzle-box" was presented and the child was asked if he or she remembered the box from the training phase, because the box they currently had was just like it and also had a toy inside. Then the experimenter retrieved the toy. The box was reset and the experimenter left the room telling the child that he or she could get the toy and could do so "however they wanted". Despite the training phase and observing the model as being unreliable (in the sense that he or she kept performing irrelevant actions) over imitation was found. A control group that retrieved the toy from the box with no prior demonstration did not display much imitation of the irrelevant actions. Over imitation was also not correlated with the children's ability to identify irrelevant actions in the training phase. In some cases children, in addition to imitating the adult's inefficient use of an irrelevant mechanism, also displayed selective imitation, when it came to sub-parts of the overall actions (e.g.,

pulling a bolt out, rather than pushing it) because it was easier. The results suggest that, at least on a broader level, children infer causal significance from observed actions.

If this is the case, then over imitation should persist even outside of the context of the experiment. To test this, Lyons et al. did a follow-up experiment. After the child had finished the first experiment he or she received a small gift and were told that the study was over. Then the experimenter told them that the next participant was going to arrive soon and that the research assistant had a habit of forgetting to put the toys back into the puzzle-boxes. The child was then asked to help check whether the toys were in the boxes and was left alone to do so. Despite taking away any pressure to over imitate that may have arisen from the experimental context, children's over imitation remained robust.

A stronger form of the causal-inference hypothesis of over imitation would predict that children would even imitate unnecessary actions when explicitly told to omit them. This manipulation did not do away with over imitation. Lyons et al. conducted another experiment that set out to rule out the possibility that children could have imitated the irrelevant actions as kind of a social game (in line with the opposing view that over imitation is mainly social in nature). If causal inference causes over imitation, children should be less likely to imitate actions that are devoid of any causal relation to an end goal. This study showed that children who saw irrelevant actions in which the contact principle was violated showed less over imitation than a control that observed the same actions without any violation of the contact principle.

Thus the findings by Lyons et al. provide support for the hypothesis that children over imitate because they attribute superior knowledge and expertise to the adults and can use the observed behavior to infer causal relations of a given apparatus or situation. The

claims by Lyons et al. are, however, not unchallenged. Nielsen and Blank (2011) contest the findings of Lyons et al. and argue in favor of the social-affiliation hypothesis.

To test these two hypotheses Nielsen and Blank devised a study in which a child saw two adults retrieve a toy from a novel box-like apparatus. One model used only causally relevant actions. The other model also included irrelevant actions. After both adults demonstrated, one of them left the room and the other one handed the apparatus over to the child. In one condition the adult who performed only causally relevant actions stayed in the room, in the other condition the adult who performed irrelevant actions stayed in the room. Thus in both conditions the children saw that the toy could be retrieved without the irrelevant actions, making which experimenter stayed and gave them the apparatus the only difference between conditions. If the desire to indicate social affiliation causes the child to copy irrelevant actions, one would expect them to omit irrelevant actions only when the model that performed them left the room. To explore this further Nielsen and Blank added a third condition in which both experimenters performed the irrelevant actions. Thus they gave the child no cues on the bases of which it could omit these actions. If causal understanding were the main factor in faithful imitation children should replicate the irrelevant actions only in this condition. Children omitted the irrelevant actions only when the efficient model stayed in the room. This supports the hypothesis that it is the need for social affiliation that drives faithful imitation. Children in the irrelevant-adult-stays condition reproduced the irrelevant actions just as often as children who saw those actions modeled by both adults. This supports the notion that faithful imitation not only plays a role in the transmission of culture, but also serves as a mean to foster affiliation with individuals and groups.

Kenward, Karlsson and Persson (2011) also challenge the causal-inference hypothesis put forward by Lyons et al., but do so on different grounds. They argue that instead of inferring that an unnecessary action is causally necessary for the goal, the children could have inferred the action to be a precautionary measure that is important to the goal, but does not produce the goal itself. Further they challenge the validity of Lyons et al.'s claim that the apparatuses used were causally transparent. Even if they were, according to Kenward et al., this does not guarantee full causal understanding by the child. The produced behavior could thus be due to goal-directed exploratory manipulation without full causal understanding. Kenward et al. put forward a new hypothesis that over imitation is related to norms and their social acquisition by children. Their experiments had children verbally justify their over imitation. Before their main experiment Kenward et al. tried to establish whether children encode unnecessary actions as related to the end goal or more generally associate them with the apparatus they are demonstrated on. To test this, a model retrieved two different objects from the same apparatus and paired an unnecessary action with the retrieval of only one of the objects. Children imitated the unnecessary actions more frequently when retrieving the object that it was paired with, supporting the hypothesis that they associate the irrelevant action with the end goal (retrieving that particular object) instead of the apparatus in general.

A second experiment was undertaken to determine what form the association takes. Children were again asked to retrieve the object associated with the unnecessary action. In some cases the action had already been performed (a dial had been turned). If children had a declarative belief that the dial needed to be turned before retrieving the object, they would be more likely to omit it, when it had already been done. If they presume a procedural rule that the dial should be turned prior to obtaining the object,



frequency of dial turns should be similar or potentially higher due to local reinforcement. The results support the declarative belief hypothesis. When the dial had already been turned, no child turned it again, but when it had not been turned, the majority of children performed the irrelevant action. The ambiguity remains that children could have learned an implicit rule that the dial needs to be turned before getting the object, but not necessarily by the same person.

This possibility was explored in a third experiment. To do so Kenward et al. asked the children about why an action had to be performed after the demonstration by the model, but before it was the child's turn. The hypothesis by Lyons et al. predicts a causal justification of even the unnecessary actions, while the unspecified purpose hypothesis that Kenward et al. argued for does not. In a second question children were asked if the object could be retrieved without performing the action. According to Lyons et al.'s hypothesis children should answer 'no' for each action. If they answered 'yes' for the relevant action and 'no' for the irrelevant action this would support Kenward et al.'s hypothesis. A further purpose of this experiment was to test if the unnecessary action was more likely to be encoded as relevant when the causal structure of the apparatus is less obvious. Hence a more complex apparatus was added to the procedure. On top of the questions described above children were also asked 'What will you do to get out the marble?' and 'Will you perform the unnecessary/necessary action?' Most children stated that they would perform the necessary action and the majority also stated that they would perform the unnecessary action. When asked about the cause, the necessary action was related to retrieving the marble much more often. Most children also stated that the marble could not be retrieved without the necessary action, but fewer said that it could not be retrieved without the unnecessary action. These results suggest that children learn

a prescriptive norm that unnecessary actions should be performed in the context of the task, rather than that they infer that a unnecessary action is causally relevant as suggested by Lyons et al.

### **1.10 CONCLUSION ON INSTRUMENTAL IMITATION**

This section covered the imitation of instrumental actions. It started with a discussion of the terminology used to describe imitative behavior. The crucial distinction here is between simple social learning behaviors (local enhancement, stimulus enhancement and mimicry) on the one hand and more complex imitation behaviors (blind imitation and insightful imitation) on the other hand. The latter involve the use of complex social-cognitive abilities. The section then proceeded to review studies that show the role that intention reading and rationality judgments play in instrumental imitation, before moving on to over imitation. This tendency to imitate accidental and irrelevant actions at a relatively high rate is unique to humans. Various scientists have been conducting experiments to determine the causes for over imitation. This section covered the literature on the social function of over imitation and the literature on its ability to facilitate the understanding of causal relationships in depth. A third strain of research that links over imitation to the acquisition and maintenance of normative and ritualistic behavior will be described in chapter 8. In conclusion, over imitation, which appears to be culturally universal, has the potential to be a major factor in passing on complex cultural conventions from one generation to the next – one imitates or learns a convention as a whole and only gradually begins to understand the role that each component of the convention plays.

## **Chapter 2: *Verbal Imitation***

Despite the large body of research on the imitation of actions, work on verbal imitation that goes beyond mimicry is scarce. Because language is a productive system, that is, a speaker can say something that has never been said or heard before, for imitation to be a useful learning mechanism in the acquisition of language, it has to be a more sophisticated process than just rote copying or mimicry. If “imitation” is interpreted as a verbatim repetition of what one has heard before, then it cannot be useful in acquiring a productive system such as language. Hence, after providing a brief historical overview that helps explaining why imitation was originally not thought by all to be a good mechanism for learning language, this section proceeds to review studies that show that verbal imitation involves the same social-cognitive skills as imitation in the instrumental domain and to provide evidence for over imitation in the verbal domain.

### **2.1 EARLY RESEARCH ON VERBAL IMITATION AND MIMICRY**

With the exception of researchers who have been investigating imitation from a low-level, learning-theoretic perspective (see Kymissis and Poulson, 1990 for an overview) the mainstream of earlier work in language acquisition has described the impact of imitation on language acquisition as restricted to early stages. As Snow (1981) reported, different researchers' verdicts on its role range from "an epiphenomenon of language acquisition that makes no contribution to development" (Ervin, 1964; Rodd and Braine, 1970) to accounts that give imitation at least partial credit for parts of children's language development, e.g., as supporting vocabulary acquisition (Rogdon and Kurdek, 1970; Ramer, 1976), or as contributing partially to the acquisition of morphology and

syntax in a small subset of children (Bloom, Hood and Lightbown, 1974; Moerk, 1977). The former accounts that completely rule out imitation as a mechanism in language acquisition base their argument on the large individual variance in imitation in children. They assume that only a subset of children learn language or parts of language via imitation. The latter accounts that attribute a small role in the acquisition of language to imitation base their assumption on the idea that children imitate syntactic structures when they are not yet able to produce them spontaneously. A few accounts have regarded imitation as a mechanism that goes beyond mimicry and contributes significantly to children's learning of language (Clark 1977; 1978; Moerk and Moerk 1979), but they support their claims with data from as few as two children.

As with imitation in the instrumental domain, a problem with the investigation of imitation of language is that there are various different definitions of imitation based on how much of the original utterance is retained in the child's reproduction and on when the reproduction occurs temporally. Bloom et al. (1974) define imitation as an utterance which repeats part or all of a model's utterance, does not change the model's utterance except by reduction, and occurs within five utterances of the model's utterance. Ervin (1964) stated that verbal imitation is 'an overt, immediate repetition of the model which shows no deviation from the model except reduction'. Folger and Chapman (1978) define it as the repetition of at least one content word of a model within the next conversational turn and within five utterances. Moerk (1977) defines it as an utterance that is wholly contained within that of the model, showing no deviation except from reduction or assimilation due to the child's own rules and occurring as the first utterance of the child after hearing the model's utterance. Moerk and Moerk (1979) define verbal imitation as an utterance that closely resembles a phrase that was uttered in the vicinity of the child

and previously rare or absent in the child's speech. Ramer's (1976) definition describes it as an utterance in which the child produces all or part of an immediately preceding utterance by a model with no change except for deletions. Finally Rodgon and Kurdek (1977) describe it simply as complete or partial reproduction of the modeled utterance.

Snow, in her 1981 study, distinguished among three types of imitation: Exact imitation, reduced imitation and expanded imitation. In exact imitation the child accurately reproduced the model's utterance given its phonological capabilities. Reduced imitation refers to reproductions that contain at least one content word of the model's utterance. Expanded imitation describes replications of at least one stressed content word found in the model's utterance plus one word or morpheme that was not in the original utterance. Snow studied a corpus that contained utterances from everyday interactions with one child from age 1;10 to 3;0. She compared each utterance to the two preceding utterances by the adult model in order to classify them according to the above-described categories of imitation.

Snow found that almost 50% of the child's utterances fell into the three above-mentioned categories of imitation (with the other half not falling into these categories and thus being classified as non-imitation). As the child grew older, a decrease in reduced imitation was observed, while exact imitation increased. This was attributed to the fact that when the child grew older he or she was able to fully imitate utterances that previously could only be replicated partially due to short-term memory limitations. Finally, with increasing age Snow found an increase in expanded imitation. The child would more often incorporate imitated chunks creatively to form adjective-adjective and noun-noun combinations, wh-questions and attempts at complex syntactic constructions. Snow's results thus suggest that, by contrast with the assumptions of much previous

research, imitation does not just play a fringe role in language acquisition, but might be a central process in children's syntactic development as well as in their vocabulary acquisition.

## **2.2 MODERN RESEARCH ON (NON-MIMICRY) VERBAL IMITATION**

Despite the work of Snow and others (see Speidel and Nelson, 1990 for a collection of relevant articles), it still took almost two decades until a new generation of scientists started revisiting imitation and the potentially major role it plays in language acquisition. To date studies investigating verbal imitation as a central learning mechanism in language acquisition are still scarce. The first studies on the subject, Over and Gattis (2010) and Bannard, Klinger and Tomasello (2013), investigate whether verbal imitation goes beyond mimicry and thus is actual (blind or insightful) imitation per the definition given in the initial section. Both studies investigate whether children use similar social-cognitive abilities in verbal imitation as in imitation in the instrumental domain.

In their study, Over and Gattis (2010) explored whether in verbal imitation children imitate correct utterances with greater accuracy than ungrammatical ones, analogous to them imitating intentional actions at a higher rate than accidental ones (see Carpenter, Akhtar and Tomasello, 1998) and 'fixing' failed attempts by reproducing the intended outcome of a model's action rather than exact bodily motions (Meltzoff, 1995).

Over and Gattis (2010) asked the child to "Say what I say" and uttered sentences with ungrammatical repetition (experimental condition) and grammatical sentences (control). Children turned out to show a greater rate of exact copying when the sentence uttered by the model was grammatical. They corrected the ungrammatical sentences. One

interpretation of these data is that children are guided in their correction of ungrammatical sentences by the intention that they infer from the model. A simple alternative explanation would be that they did not actually correct the ungrammatical sentences but simply did not notice the repetitions.

In a second experiment, Over and Gattis had three-year olds imitate sentences with either grammatical or ungrammatical repetitions. If children failed to recognize the repetitions they would omit them from both grammatical and ungrammatical sentences. If they corrected ungrammatical sentences, they should omit repetitions more frequently when they are ungrammatical. The children behaved in line with the latter hypothesis, imitating grammatical repetitions more frequently than ungrammatical ones.

It is possible that children's tendency to correct ungrammatical sentences is not entirely due to their grammatical knowledge, but also based on their preference for copying the perceived intention behind an utterance. To further explore whether the children's verbal imitation behavior is guided by their perceived intention of the model, a third experiment was undertaken. Here Over and Gattis compared children's imitation of ungrammatical sentences by an apparently intentional agent to the imitation of the same sentences by an apparently unintentional model. Perceived intentionality was varied by using objects as models that either had a face (a plush frog) or no face (a box) and by whether they would engage in contingent social interaction with the child (the frog did this, the box did not). Children were significantly more likely to exactly replicate the box's utterances than those of the intentional agent. Analogously they were more likely to correct the intentional agent's sentences than those of the box. The findings of Over and Gattis thus suggest that children are able to use intention reading in their imitation of the

utterances of a model and that perceived intentionality plays a key role in the verbal imitation.

Bannard, Klinger and Tomasello (2013) investigated, among other factors, the role of intention reading in verbal imitation. In a series of studies on German monolingual children, Bannard, Klinger and Tomasello (2013) explored when three year olds would imitate novel words in utterances produced by adult speakers. In one study we investigated whether children would take into account the adult speaker's intentions when imitating an utterance. In a game where it was their goal to obtain the same objects, child and experimenter took turns in requesting objects presented by a game master. The experimenter always went first and always preceded the object's familiar label with a novel adjective (e.g., "Could you please give me the *dilsige* duck"). We found that children were less likely to reproduce a redundant adjective when the speaker indicated gesturally that he did not intend to produce it than when it was produced intentionally. These results are in line with Carpenter, Akhtar and Tomasello's (1998) findings that children imitate instrumental actions that are intentional more often than those that are accidental and that children also show a higher rate of imitation for intentionally produced verbal material than for accidentally produced verbal material. This adds support to the notion that, as with their imitation of instrumental actions, children appear to make use of intention reading in their verbal imitation.

In another experiment Bannard, Klinger and Tomasello explored whether children would take the functional context of an utterance into account when imitating a speaker. Here again, experimenter and child would request objects from a game master (e.g., "Could you please give me the *dilsige* duck"). Instead of marking the adjective as accidental via gesture, its necessity was modulated via manipulation of the functional



context, that is, the objects presented by the game master. Bannard, Klinger and Tomasello found that children imitated the novel adjective selectively. They imitated it with significantly higher frequency when the game master presented two different instances of the same object (e.g., a plain plastic flower and a plastic flower covered with stickers), making the adjective necessary to distinguish between the two, than in a control where the game master presented only a single plain object (e.g., plain plastic flower only), rendering the novel word redundant. These results suggest that, in addition to intention reading, children also take into account the functional context of an utterance to determine which words need to be imitated and which can be omitted.

Despite some similarities, this study differs significantly from Gergely et al.'s work on rational imitation of instrumental action. Bannard, Klinger and Tomasello's one object condition does not require the adjective to identify the referent and is thus somewhat analogous to Gergely et al.'s hands free condition – additional verbal material is not required by the context of the utterance. In the two-object condition, context justifies the experimenter's use of the novel adjective; it is necessary to unambiguously identify the referent. The experimenter is therefore in a sort of a verbal hands tied condition. However, the child is also presented with two objects. Thus, the context of the child's utterance also requires the adjective and therefore puts the child into a verbal hands tied condition as well. This becomes particularly relevant with respect to the order effects (increasing imitation in the one object condition in later turns) that Bannard et al. found in addition to the greater imitation in the two-object condition. The result seems to reveal two separable effects. First, context – the presence of an additional object in the two object condition – requires an adjective and thus increases imitation compared to the one object condition. Second, the experimenter's repeated use of the adjective in the one

object condition, where it is not required by the context, reinforces their intentionality in producing it, similar to how the experimenter's use of the unusual head push highlighted his intentionality in Gergely et al.'s study, producing the above-mentioned increase of imitation in later one object trials.

Similar to work on the imitation of instrumental actions, the studies of imitation in the verbal domain found consistent patterns of over imitation. In the study that tested whether children would differentially imitate intentional versus accidental parts of an utterance, they still imitated the novel word at around 52% when it was gesturally marked as a slip-of-the-tongue (versus 70% in a control without such marking). In the study that tested whether children would take into account the relevance of a novel word within the functional context of the utterance, 56% of the participants imitated the novel word when it was redundant (versus 81% when it was required by the context).

Thus, in those cases when the novel word was redundant within the functional context of the utterance or even marked as accidental, children still imitated it more than 50% of the time. Therefore, the findings from Bannard, Klinger and Tomasello provide evidence that in the imitation of verbal material, children use the same social-cognitive skills (intention reading, rationality judgments) and display over imitation, as they do in the learning of instrumental actions.

### **2.3 OVER IMITATION IN THE VERBAL DOMAIN**

Similar to their behavior in instrumental imitation tasks, humans over imitate in verbal tasks. This verbal over imitation might have purposes that are similar to those of over imitation in the instrumental domain: Language is a human cultural convention and potentially the most important one. Over imitation allows to transmit language from one

individual to another and also allows humans to engage in that convention, that is, communicate with one another, even when not every single part of an utterance is understood. When, for instance, a cook buys ingredients for a meal, using the exact terminology stated in the recipe will result in the vendor selling him the correct ingredients. The cook does not need to know the precise meaning of each part (e.g., scaloppini veal) of his request, to successfully obtain the required items.

There is also evidence that suggests that verbal (over) imitation, like its instrumental counterpart, may serve to establish affiliation with others. Branigan, Pickering and Cleland (2000) report that in a joint picture description task, a participant adopted the experimenter's syntactic constructions in his or her dialogues. Similar effects have been shown by Garrod and Anderson (1987), Garrod and Clark (1993) and Garrod and Doherty (1994) on the word level: when describing abstract mazes, either in terms of paths between two points, or as column-row indices, participants adopted similar lexical descriptions. Although in the above-described studies a distinction between imitation and over imitation does not apply, they suggest that imitation of language can serve a social purpose. It then follows that the imitation of verbal material that is not necessary in the context of solving a task, e.g., as seen in Bannard, Klinger and Tomasello (2013), where children imitated unnecessary adjectives at a high rate, could partially serve to establish social affiliation.

While over imitating people we interact with allows for establishing affiliation, like it does in the instrumental domain, it has an additional purpose that is unique to the verbal domain: facilitating communication. When interlocutors use similar syntax and especially similar vocabulary, that is, form referential pacts (Matthews, Lieven and Tomasello, 2010), information transmission becomes more efficient.

## **2.4 CONCLUSION ON VERBAL IMITATION**

The current section gave a historical overview of research on verbal imitation and then reviewed recent studies that show that imitation in the verbal domain involves social-cognitive abilities such as intention reading and rationality judgments of the context of an utterance. Given that it is a much more complex process than rote copying, we can assume that imitation might play a major role in language acquisition. Additionally the studies reviewed in this section found that humans imitate more verbal material than necessary – like in the instrumental domain, we over imitate when we imitate language. While it seems that imitation in the verbal and the instrumental domain are processes that make use of the same underlying cognitive abilities and they both display over imitation, no work has been undertaken on whether verbal imitation varies across cultures and languages. The present research aims to fill that gap. Hence the following sections provide a background on cultural differences in the world in general and between western and Chatino culture in particular with emphasis on child rearing. Thereafter referential expressions will be discussed. They are the type of expressions that are the most relevant to the experiments undertaken.

### **Chapter 3: *Ethnography and the Cross-cultural Perspective***

Cross-cultural work in child development, the present research being no exception, compares how differences between cultures can lead to differences in behavior. That means that in order to devise experimental studies that can make the effects of cultural differences visible, one needs to first understand where the investigated cultures lie along agreed upon dimensions. Then one identifies traits that have the potential to lead to developmental differences. This chapter first provides a general overview of characteristics along which cultures can be classified. Then child rearing, the cultural practice most relevant to the present work is discussed, before moving on to position Chatino culture in a cultural spectrum as a whole and with respect to child rearing practices.

#### **3.1 CLASSIFICATION OF CULTURES**

In the past a common way of classifying cultural groups around the world was by using the Gemeinschaft-Gesellschaft continuum first proposed by Tönnies (1887, 1957). A Gesellschaft (German for society) is a society that is large in scale, urban, has a complex system of differentiated economic roles, complex technology, internal heterogeneity and regular contact with the outside world. The individuals in a Gesellschaft are educated in a complex school system and are wealthy through commerce and the accumulation of money and goods. Their social relations are mostly fleeting and with independent strangers. Gesellschaften can be found in most of the western world, including large parts of Europe and North America.

The Gesellschaft prototype contrasts with Gemeinschaft. A Gemeinschaft (German for community) in general has opposite attributes than the Gesellschaft. It is typically a rural, small-scale community with minimal division of labor, as most people work on the surrounding fields. They use mostly simple technology and have only basic education. A community is self-contained with limited interaction with the outside world. Its economy is defined by subsistence activities and people have a lower income than in a Gesellschaft. Their social relationships are interdependent with kin and are long lasting. Although this way of classifying cultures is still used in some modern-day research (e.g., Greenfield, 2009), it has elsewhere received criticism (Brint, 2001). One significant obstacle is that the binary extremes it relies on are hardly found in today's world. While most indigenous cultures have attributes of a Gemeinschaft, many aspects of these cultures do not fit that stereotype well, because they, for instance, have ample contact with the outside world, have access to technology and discovered ways of making a living apart from agriculture. The same does also apply for cultures that are closer to the Gesellschaft prototype: Although most industrial Western cultures display many aspects of a Gesellschaft, there are differences in the degree to which state-of-the-art developments are available, in particular when it comes to modern infrastructure such as the internet and public transportation. In the present work, we use the terms Gesellschaft and Gemeinschaft as reference points, but still give a detailed account of the cultures investigated with respect to the parameters encompassed by the Gesellschaft-Gemeinschaft scheme.

Where a particular culture is positioned according to these parameters is correlated with the way children are raised in that culture (e.g., Lieven, 1994; Gaskins, 2000; Lancy, 2007). Because most of the places where quantitative research in child

development is nowadays undertaken are modern, industrialized, western societies, one can easily be under the impression that the way parents interact with children in the western industrialized world is universal across cultures. The following subsection describes how child rearing practices can be very different across cultures and, since a major part of the present research is concerned with the acquisition of language, it puts emphasis on how these differences could affect verbal development.

### **3.2 AN OVERVIEW OF CHILD REARING PRACTICES ACROSS CULTURES**

Most of our knowledge of child development in general and language acquisition in particular is based on data from European language speakers, and predominantly the English-speaking middle-class. In that society parents coordinate and supervise their child's activities. Mother and father spend great amounts of time in one-on-one interactions with the child. These interactions are child-centered and pedagogical in nature. Further parents talk to their child in a special, simplified and clearer way with a different tone of voice, called motherese or child-directed speech (Snow, 1972; Pine, 1994; Lieven, 1994; Gaskins, 2000; Lancy, 2007).

This focus on the western middle-class has long led to the assumption that the above-described child rearing practices might be the norm all around the world and might even be a requirement for healthy child development. Such an assumption has, however, also long been subject to critique (Wolfenstein 1955, Manson 1975, Lieven, 1994). Ethnographic research of a large sample of cultures shows, however, that western child rearing is quite the opposite of the norm, and that only very few societies in the world display the parental behavior described above or parts of it (Barry and Paxson, 1971).

The only non-western cultures that display such child rearing with relative consistency are egalitarian foraging societies (Whiting and Pope-Edwards, 1988). Among them are the Yahgan of Tierra del Fuego, the Garo from Bengal, the Eipo of Western New Guinea and the Himba of Southwest Africa. In the cultures of the Trobriands, the Wogeo from Papua New Guinea, and the Rotuman from Fiji, mother and father participate in the child-centered activities as summarized in Lancy (2007). The rarity of western-like child rearing is supported further when taking into account that the above examples mostly discuss parent-infant interaction. For toddlers and older children, western-like parent-child interaction is even less common (Parin, 1963)

In many non-western cultures, children are not primarily raised by their parents, but by their peers. It is also their (older) peers from whom they receive much of the maintenance support they need. Weisner and Gallimore (1977) found that in a sample of almost 200 cultures, 40 percent of infants and 80 percent of toddlers were taken care of by older siblings rather than their mother or father. Parents do not monitor their children or structure their experiences. They only provide what help is actually needed. Children do sometimes partake in adult work, but the goal of this is not so much to motivate the children at the cutting edge of their abilities, but rather to help the parents with those processes that they are competent at. When no help is needed, children are expected to find something to do with their peers or on their own. In general children are expected to be more independent than in western cultures, parents provide social orientation rather than interaction and believe that child development is a process that happens by itself (Parin, 1963; Ochs, 1985; Rogoff, Mistry, Güncü and Mosier, 1993; Gaskins, 2000, 2006).



In terms of child-directed speech, in non-western cultures, children are often not directly addressed by adults, although it has been suggested that special forms of speech that are meant for children exist in such cultures, albeit that these are all very different from motherese. For example, some cases parents speak for their children, by lifting them up and speaking in a high-pitched voice (Schieffelin, 1985), or they address them directly, but not with the goal of fostering communication, but rather to quiet the child by using a “lowered voice, monotonic, ‘crooning’ speech”, as Pye (1986) describes Quiche Mayan mothers. Instead of being addressed by their parents, it is common for non-western children to receive orders and warnings from their older peers, telling or forbidding them to do something. Although this controlling language is more terse than what children hear in dyadic interactions with their caregivers, commands and interdictions have a very transparent relation to the child and the immediate situation and might thus provide the child with a good amount of information (Lieven, 1994).

Studies indicate that cultural factors that contribute to the lower rate of parent-child interaction common in most cultures are unassisted infant mortality (high infant mortality rate leads to less time and attachment invested in children), infanticide in order to conserve resources, the assumption that a quiet baby is a happy baby that leads to reduction of playful stimulating interaction, the belief that too much interaction can interfere with the child’s inborn character, parents working longer hours and generally larger numbers of children. A higher rate of parent-child interaction, on the other hand, is motivated by circumstances opposite to the ones described above. Further, the living conditions in contemporary western societies, that is, infants and toddlers living isolated from their peers in single parent or nuclear households, the decrease in family size and a

sinking demand in child labor lead to an increase in parent-child interaction and supervision (Lancy, 1996; Trevarthen, 1983).

In addition to the evidence suggesting that intensive parent-child interaction is mostly a western trait and not typical for the vast majority of cultures, there is further evidence suggesting its occurrence is also contingent on social class. Research suggests that it actually mostly occurs in the middle and upper classes of western societies, but much less in the lower classes and subcultures (Heath, 1983). In the United States of America, for example, ethnographers found a drastic reduction or absence of the middle-class parent-child interaction described at the beginning of the section in lower class households (Ward, 1971; Heath, 1990). Similarly, a reduction or absence of motherese is found in the lower strata of society (Heath, 1983).

Given that dyadic interaction between parent and child and motherese as found in western middle-class cultures is the exception rather than the rule, it appears that they are likely not a requirement for healthy child development, but might rather be a means to prepare children for success in academic settings and eventual participation in the information economy (Lancy, 2007).

The present work sets out to compare verbal imitation behavior in western and Chatino culture. Hence the following section gives more detailed insights into the culture and child rearing of the Chatino community of Santa Lucia Teotepec, where parts of the experiments were conducted, as well as aspects of the Chatino language.

### **3.3 THE CHATINO CULTURE OF SANTA LUCIA TEOTEPEC**

The Chatinos are an indigenous population that traditionally inhabited small parts of the Sierra Madre del Sur mountains that lie between the valley of Oaxaca and the

Pacific coast. It has been argued that they occupied the lower Rio Verde Valley prior to the arrival of Mixtecs (Joyce, 2010). They are spread out across various small communities, one of which is Santa Lucía Teotepec, where part of the data for the present research was collected. Teotepec is a community in the southeastern part of the Chatino region at about 1200 meters above sea level. In 1957, Teotepec was divided by a violent massacre and subsequent civil war (Greenberg, 1989; McIntosh, 2015). These events caused half of the people of Teotepec to relocate and establish their own community Cerro del Aire, which, in turn, caused Teotepec to lose its municipal status. It is now part of Santos Reyes Nopala and currently has a population of 1400.

The language spoken in Teotepec is Teotepec Chatino, a variety of Eastern Chatino, which is an Otomanguean language. Its default word order is VSO, it has a complex tone system and adjectives occur post-nominally and are an open class that covers a wide range of semantic features. Many speakers are also bilingual in Spanish. The language is endangered (see McIntosh, 2015 for more details).

The economy of Teotepec is mainly based on agriculture (corn, beans, chilies, century plant, avocado, cotton, fruits, sugar cane and coffee) and raising cattle on a small scale. The work skills of the population are homogeneous, with most people being proficient at activities that are crucial in the community, such as building houses and working on the fields (Wauchope and Vogt, 1969; Greenberg, 1989; Rasch, 2002, McIntosh, 2015). Some of the men work as laborers in nearby towns such as Puerto Escondido and it is also not uncommon that men go to the United States for some years to work (McIntosh, 2015). As is common in Mesoamerican cultures, family relations play an important role that is also reflected in the topography of the community. Children are desired and related families usually live in the same areas (Wauchope and Vogt, 1969).

While there is very little literature on child rearing in Chatino communities or let alone Teotepec, the literature notes that aspects of Chatino culture are, with some variation, relatively similar to that of broader Mesoamerican culture, as Wauchope and Vogt (1969, p. 317) note: “All of the Indian groups of the southern Mexican highlands participated originally in the basic Middle American culture but varied widely in the degree of elaboration”. In the same vein, child rearing in Teotepec is, with some variation, comparable to other communities in Mesoamerica. In order to provide a background on child rearing in Teotepec, I will thus draw from the literature on child rearing in Mesoamerica and comment on it based on my experience in Teotepec when necessary.

As mentioned in the previous sub-section, child rearing in Mesoamerica is very different from that in western cultures. From toddlerhood on, children are primarily cared for by older peers from their extended family - “Children are expected to care for younger children”, as Wauchope and Vogt’s (1969, p. 345) statement about Zapotec culture shows. They take part in adult activities, but the reason for this is not for them to have fun, but to help the adults. Parents believe that chores make children competent and motivated and children take pride in contributing to the household. In their free time they are expected to spent time with their peers or on their own and their play consist of manipulating objects and large motor play and often resembles adult activities: “...growing up is a period during which family work responsibilities are gradually acquired. Play partners in dispersed populations are usually relatives, and play activity is often child imitation of adult behavior. Girls become expert tortilla makers by the age of eight” (Wauchope and Vogt, 1969, p.357). Adults do not frequently engage in play and discourage it, if it interferes with work in the household (Shneidman, Gaskins and

Woodward, 2015). Children receive little supervision from their parents (Parin, 1963; Ochs, 1985; Rogoff, Mistry, Güncü and Mosier, 1993; Gaskins, 2000, 2006; Wauchope and Vogt, 1969, p. 397). My experience in Teotepec allows me to confirm the points made by the literature. I observed young boys and girls do chores around the house and run small errands on a regular basis. Older children would also help with work on the fields. When there was no work to be done, children played with their peers in the neighborhood, without supervision from their parents. In general, if supervision was needed, it would come from older peers, rather than the parents. Most children over 3 years of age that I tested during my time in Teotepec would show up to the experiments accompanied by older siblings. Apart from parents of older children who expressed interest in my research, only parents of three-year old children came to the field lab with their children.

There is not much dyadic play, that is child-centered play between caregiver and child with a pedagogical focus, in Teotepec. This again reflects the general literature on Mesoamerican cultures. Sheidman, Gaskins and Woodward (2015) state that Mayan caregivers rarely directly address infants in a pedagogical way. That is, they rarely follow-in on the infants' attentional focus or engage in object play (de Leon, 1998; Gaskins, 1999, 2006; Pye, 1986; Rogoff, 2003). Infants observe the examples of others performing actions instead (Gaskins, 1999; Gaskins and Paradise, 2010; Shneidman and Goldin-Meadow, 2012), such that observational learning is emphasized more than child-directed teaching (Shneidman, Gaskins and Woodward, 2015). Further, Mesoamerican adults usually have less experience in settings of formal schooling than western adults (Rogoff, 2003). This is important, because such formal schooling makes adults assume a learning model where the learner is taught directly, which, in turn, leads to parents

engaging in child-directed pedagogical behavior more frequently, as shown in recent research (Correa-Chavez and Rogoff, 2009). These findings support Wauchope and Vogt's observation that Mesoamerican parents have less formal schooling. They report that for Chatinos "The greater part of the education is informal and consists of training the children for their adult duties" (p. 365). It follows that Mesoamerican parents, but also lower-class parents from western societies engage in less dyadic-play with their children than western middle and upper-class parents. Mesoamerican children thus receive much of their language input not from one-on-one interactions with their parents but from overhearing - Shneidman and Goldin-Meadow (2012) found 18-month old Mayan children hear nearly 60% of their total language input in overheard and not child-directed speech, compared to 30% for infants from large families in the United States. Again, my experience in Teotepec confirms these statements about dyadic caregiver-child interaction in Mesoamerican cultures. I saw children watch adults and older peers do work and at times they would receive orders. Such communication was, however, not child-centered as it is in western cultures. Also mothers carried infants around by strapping them to their own body while doing daily chores, as is common practice in other Mesoamerican cultures as well (de Leon, 2005, p.137 and Wauchope and Vogt, 1969, p. 397, on Mixtecs: "The child spends most of its first two years wrapped in the folds of a rebozo, on a woman's or child's back, lying on a petate or in a wood or cloth cradle.")

But despite the close physical proximity, I observed very few dyadic interactions or child-centered communications. The only exception to this was the time shortly before and during dinner. The family that I stayed with would gather in the dining room and young children would be around too. The parents and the teenagers of the family would

then engage in play with the smaller children. For roughly 30 to 45 minutes they would ask them questions, tease them and play with them and their toys. Albeit the Chatinos seem to spend much less time with their children in dyadic interactions, it has to be noted that the adult-child interaction that I observed in Teotepec was very cordial and respectful, while less controlling than in western cultures. What Gaskins (1996, 2006) eloquently stated matches my observations in Teotepec perfectly: "... There is a matter-of-fact assessment and acceptance of children for who they are and how they act. Development is not seen as requiring the construction of a special world of childhood; rather, it is seen as occurring within the world of ongoing work and other family activities."

The hypothesis of the present work is that such cultural differences in the amount of dyadic caregiver-child interaction lead to differences in verbal imitation behavior. A detailed argument of why we believe this could account for cross-cultural differences in verbal imitation, preceded by an overview of referring expressions will be presented in the next chapter.

## Chapter 4: *Adjectives and Referring Expressions*

In this chapter referring expressions are described. We introduce a distinction between the contrastive and descriptive use of adjectives. We propose that cross-cultural differences in dyadic caregiver-child interaction affect use and exposure to adjectives and particularly lead to a difference in the relative experience with contrastive and descriptive uses, and discuss how this might lead to differences in verbal imitation behavior.

### 4.1 CONTRASTIVE AND DESCRIPTIVE USE OF ADJECTIVES

Adjectives are mainly used in two ways, the first being *descriptive* use. An adjective serves a descriptive function when it describes a property of an object that is already known to be the topic of conversation. The second use of adjectives is the *contrastive* function, whereby adjectives help to narrow down the space of potential referents for a reference.

The term *reference* stands for the relation between a linguistic element and an entity in the world. A referring expression is thus the linguistic form used to denote an entity. It can present itself in various ways: as a modified noun phrase ("the little dog"), indefinite noun phrase ("a dog"), deictic expression ("there"), personal pronoun ("she") or even non-verbally as pointing or staring. When the referent is particularly salient and unambiguous, the referring expression only needs to contain minimal information (e.g., in a context where there is a single dog, it is sufficient to say "a dog"). When the referent is less accessible the referring expression needs to be more informative ("the big black dog"). One common way across languages to make referring expressions more informative is through the contrastive use of adjectives. The adjective used in a referring



expression increases the informativeness of the referring expression by narrowing down the space of potential referents of the reference. Talking about “the big black dog” rules out all dogs that are not big or black as potential referents.

Because the primary function of language is communication, reference is central to language - the speaker needs to inform the listener what entity in the world (referent) he or she are talking about. Thus reference is a joint activity between speaker and listener. The speaker assesses the knowledge state of the listener and tailors his or her utterance accordingly in terms of informativeness and specificity. Context dependent use of referring expressions has been the subject of experimental studies. Ford and Olson (1975) investigated whether children's referring expressions reflect the context of an utterance. In their experiment, objects were presented in arrays such that, depending on the array, one, two or three critical features and the contrastive adjectives denoting them were required to identify the target. One child described which block covered a gold star to another child who then tried to find its location. The speaker could observe the performance of the listener. Their child participants (5.5 and 7.5 years old) formed different referring expressions when the same object was presented in different contexts. Information content of the referring expressions increased with the rising information demands of the task/array.

While the study of Ford and Olson (1975) and others (e.g., Whitehurst, 1976) focused on the adaption of referring expressions contingent on the visual array they are presented in (how many distractors were present and how many features were needed to unambiguously specify the referent), Matthews, Lieven, Theakston and Tomasello (2006) investigated the effects of the state of information of the listener. In one study they investigated the effect of the perceptual availability of referents to the listener on

referring expressions in children. They manipulated how much information the addressee had about the referent and whether the child was aware of the state of information of the addressee. They found that although two year-olds' referring expressions did not vary with differently informed addressees, three and four year-olds' referring expressions were more informative when the addressee had less information about the referent. This supports the notion that social-cognitive abilities such as theory-of-mind play a role in the construction of referring expressions. Older children who are more advanced in perspective taking are better able to tailor their utterances to the listeners' demands than younger children. In a second experiment Matthews et al. report similar effects when manipulating whether the referent was mentioned in prior discourse. Even two year-olds were more informative when there was no previous discourse about the referent.

In addition to the effects of visual context and the child's assessment of the state of knowledge of the listener, research suggests that the way in which caregivers use referring expressions has an impact on the child's use of referring expressions. This will be discussed in the next subsection.

## **4.2 VARIANCE OF ADJECTIVE USE IN REFERRING EXPRESSIONS**

As previously established, reference is a social activity in which the speaker uses words to describe an entity and tailors his or words in a way that enables the listener to unambiguously identify the entity that is being referred to. Research has explored several factors in such interactions that could lead to a difference in the use of referring expressions in the learner. Whitehurst (1976) investigated how a model's ability to be informative and non-redundant in his or her use of reference would impact children's production skills.

One hypothesis is that a child might learn to avoid producing insufficiently informative references due to their own frustrating experience with ambiguous messages. Conversely, the child might learn to add sufficiently informative or even redundant communication to their repertoire. The opposite prediction would be that a child will adopt an adult's poor style of reference, not taking into account the effects on him or her as a listener, either because he or she is unable to induce the structure of informative reference from incomplete examples or due to a general tendency to imitate (see chapter 1). In one of Whitehurst's (1976) studies the child participants (4-9 years old) went through twenty-four listening trials, half of which occurred prior to the task and the other half in between experimental blocks. On those listening trials the experimenter described an object within an array and it was the child's task to point to the correct object. Participants were divided into a group that listened to sufficiently informative and non-redundant references (i.e., references that contained contrastive adjectives that allowed the listener to unambiguously identify the referent), and another group that listened to an adult producing insufficiently informative references (using descriptive adjectives that do not add any information which would help in unambiguously identifying the referent). After the listening trials it was the child's turn to produce a referring expression to point out an object in an array to the adult. Whitehurst found that receiving insufficiently informative referring expressions in the listening trials led to a significantly lower amount of references (both informative and non-redundant) produced by the children in the production trials. Being exposed to a good model, producing informative, non-redundant referring expressions lead to a higher tendency for the children to produce references of similar quality in the production trials. These results suggest that being exposed to well-

formed referring expressions leads to a better understanding of reference that affects the child's own production of referring expressions.

In a similar way the experience that children have with the two different uses of adjectives, descriptive (describing a property of or an attitude towards an already identified referent; e.g., “look at that huge house”, “look at that ugly house” when there is only one house there) and contrastive (narrowing down the space of referents in a referring expression; e.g., “look at the huge house” when there are two houses, one of which is huge) could influence their own understanding of adjectives and reference. While the most discussed function of adjectives is the contrastive one (Dale and Reiter, 1995), Karmiloff-Smith (1979) suggests that young children from a western culture, due to the dyadic caregiver-child interaction that they often participate in, learn the descriptive function of adjectives first. Karmiloff-Smith tested children from Geneva, Switzerland in an age range from 3 to 10 years. Her task involved 12 opaque bags that each contained four objects. Four bags contained four entirely different objects each. Four bags contained two different and two identical objects each. Finally, four bags contained two different objects and two similar objects with a different color each. The experimenter presented the child participant a bag and then asked the child to close his or her eyes. The experimenter then removed an object from the bag. The child was then allowed to look again and was asked ‘Which one did I hide?’ In the younger children (three and four years), Karmiloff-Smith found that their use of adjectives in their responses were not very discriminative with respect to whether the adjectives were descriptive or contrastive. Three year olds used a high number of adjectives to describe single objects, although they used adjectives more when they had to talk about an object out of a pair of two. Four year olds used adjectives about the same amount of times when

the adjective was required as when it was not required. At five years and older, children showed a clear distinction between the two contexts, with much greater adjective use when the adjective was required. These results suggest that young western children (three and four years old) are mostly using adjectives in the descriptive function (they don't take into account context and do not differentiate based on context). Older children are able to take into account context and use adjectives in their contrastive function.

She explains these findings by the fact that western children, such as the ones from Geneva, Switzerland that she studied, spend a lot of time in dyadic caregiver-child interactions with a pedagogical focus. Since these interaction usually involve obvious and known referents, Karmiloff-Smith argues that they foster the understanding of descriptive adjectives. Western parents and children spend time together in a restricted environment (e.g., the play area in the living room) with the same referents being present each time. In these situations there is little ambiguity about what the referent central to the interaction is, such that adjectives in referring expressions serve the purpose of drawing attention to interesting properties of the referent and teaching the children new words. Hence children from western culture, who participate in a lot of dyadic interactions, first become familiar with the descriptive use of adjectives and then at five years of age start understanding the standard case, contrastive use of adjectives, and establishing reference. This would not happen to this extent in cultures where dyadic interactions between caregiver and child are more rare. This point is discussed in the following section.

### **4.3 REFERENTIAL ADJECTIVE USE BY CHILDREN ACROSS CULTURES**

Karmiloff-Smith's findings suggest a hypothesis that, besides the default contrastive use of adjectives in reference, children from a western culture with ample amounts of dyadic interactions in the same environment, from an early age, have exposure to adjectives being used descriptively. They engage in frequent pedagogically focused dyadic interactions with their caregivers in the same environment (e.g. play room), talking about the same obvious referents over and over again and thus gain much experience with using descriptive adjectives in order to refer to already mutually salient properties of objects that are already known to them.

As discussed in section 3.2, dyadic caregiver-child interaction in the same environment is very rare outside of the middle and upper classes of western culture. In many non-western cultures, including that of the Chatinos of Teotepec investigated in the present research, such dyadic caregiver-child interaction with a pedagogical focus is rare. Children spend time mostly among their peers and in a dynamic environment. They are involved in adult work activities, but the focus does not lie on teaching the children, but rather on having them contribute to the household. Adults do not usually engage in play with the children and discourage it when it interferes with the household chores. Parents believe that children develop best when adults do not supervise their activities and plan their experiences in detail, as documented by Shneidman, Gaskins and Woodward (2015), Parin (1963) and Gaskins (2000, 2006).

This means that, unlike western children, they do not encounter the same scenes and objects over and over again. The focus of communication is thus establishing reference, that is, making it known what one is talking about, which is best achieved

through the contrastive use of adjectives (the *green* house, not the *red* house). Additionally interacting more with peers than adults further results in those interactions being less pedagogical - peers will use words to refer to things rather than to consciously enhance other children's vocabulary. These differences in the amount (and manner) of dyadic caregiver-child interaction could lead to less exposure and familiarity with adjectives used in a descriptive function in non-western children, like the Chatinos of Teotepec.

While we expect Chatino children to have the same understanding of contrastive use of adjectives as western children, we expect that their lack of exposure to descriptively used adjectives could lead to differences in understanding the descriptive usage of adjectives. We propose that this might influence their verbal imitation.

### **SECTION 3: EXPERIMENTS**

The aim of the present work is to determine whether, how and why cultural differences impact verbal imitation across cultural groups. To investigate this four experiments have been carried out.

Experiment 1 was in the first instance conducted on English-speaking children from the USA and Chatino-speaking Chatino children from Santa Lucia Teotepec, Oaxaca, Mexico. Because English, like German, is a language with pre-nominal adjectives, and Chatino has post-nominal adjectives, culture is not the only dimension on which the two groups differ. Potential differences in imitation behavior could thus be due to this grammatical difference and potential memory effects arising from it, that is, post-nominal adjectives are easier to remember (Gupta, 2005). To be able to rule out this explanation, a group of French-speaking children from Geneva, Switzerland was additionally tested. French, like Chatino, is a language with post-nominal adjectives and Swiss culture, like American and German culture, is a western large-scale society.

The insights gained from Experiment 1 allowed for formulating a more refined hypothesis to be tested in Experiments 2 and 3, which were conducted in Chatino culture. Then Experiment 4 was created to test the account arising from the first three experiments.



## **Chapter 5: *Experiment 1***

Experiment 1 adopts the paradigm introduced by Bannard, Klinger and Tomasello (2013). It was designed to explore the effects of the informational demands of the communicative context of an utterance on the imitation of novel adjectives produced by an adult model. We were particularly interested in the presence of cross-cultural variation of over imitation and age effects. In the game that we devised to test this, it was the goal of the child and first experimenter (E1) to request a series of similar objects from a game master (E2). E2 would hold up an object or pair of objects and E1 would request one and receive it. The child's objective was then to obtain the same object as E1 via verbal request. In his requests, E1 would always add an adjective-like novel word to the real name of the object. In a two-object condition, two instances of an everyday object (one bearing slight modifications) were presented, and upon request E1 was handed the modified one, while in the one object condition only a single object was presented. We repeated both conditions 4 times and counterbalanced order. In the one-object condition, the adjective was redundant, while in the two-object condition it was necessary for the game master to determine which of the two objects the player referred to. We were interested in when the child would use the "adjective", and when it would get filtered out, as well as in potential over imitation and in the developmental trajectory of all these behaviors.

To check whether any potential differences are domain-specific, the experiment had an instrumental component (after Horner and Whiten, 2005) in which children would imitate actions performed on an either opaque or transparent, but otherwise identical, puzzle-box by an adult model. The model's demonstration involved using a stick to perform actions relevant to the end goal of retrieving a ball from a compartment within

the puzzle-box, and irrelevant actions whose execution did not contribute to that end goal. After the demonstration the experimenter handed the stick over to the child and announced that it was his or her turn. The experimenter then left the room and it was the child's turn to play with the box. This procedure was repeated over three trials. Half of the participants were tested in the above-described conditions (one quarter with the opaque, the other quarter with the transparent apparatus), while the other half was tested in respective control conditions, where no demonstration was given and the experimenter simply handed the child the stick, saying "See what you can do with this." We measured the child's actions performed on the apparatus.

## **5.1 METHOD**

### **5.1.1 Participants**

For the Chatino group, we tested twenty-nine typically developing, Chatino-speaking children. Their ages ranged from 3 to 10 years. The children were native speakers of Chatino. Those who attended elementary school (ages six and older) also spoke Spanish. The children were tested in our field lab in Santa Lucía Teotepec, Oaxaca, Mexico. The experimenters conducting the study were local Chatino high school graduates who had previously received extensive training in conducting both linguistic and psychological research. Parental consent was obtained in all cases.

For the Texas group, thirty-one typically developing, English-speaking children were included in the study. Their ages ranged from 3 to 10 years. The children were native speakers of American English and generally monolingual. One additional child was tested, but not included due to fussiness. The children were tested in the Austin Child

Language Lab at the University of Texas at Austin. Parental consent was obtained in all cases.

For the Swiss group 39 typically developing, French-speaking children were included in the study. Nineteen of the children were five years old; the other twenty were 9 years old. The children were native speakers of Swiss-French and generally bilingual in a variety of other languages. Parental consent was obtained in all cases.

Age	Chatino	Texas	Geneva
3	2	4	
4	4	4	
5	3	4	19
6	6	4	
7	4	4	
8	3	4	
9	3	4	20
10	3	3	

Table 1: *Children that participated in Experiment 1 across cultures by age*

### 5.1.2 Materials and Design for the Verbal Part

We used eight different items that we expected would be familiar to Chatino and Texan 3-year-olds and Swiss 5-year-olds, such as a plastic flower, a rubber duck and a spoon. Each item existed in a plain and a modified version. The modifications were designed to make it hard to describe them with a single Chatino, English or French

adjective. For example, the modified version of the spoon had cloth-covered, worm-like wires pasted on.

Our novel words were all one (Chatino) or two (English, French) syllables long, occurred at a position where adjectives would occur in Chatino, English or French, and followed the phonotactic norms for Chatino, English and French adjectives (e.g., kl7en(r), tun(r); wassy, snibby, sabé, fibé). Details of all adjectives and items can be found in the appendix.

### 5.1.3 Procedure for the Verbal Part

E1 and the child as the players and E2 as the game master sat on opposite sides of a mat. They played a game that required the child and E1 to request objects from E2. If they met the game's objective to collect the same objects, they were allowed to put them into a cardboard box, decorated as a treasure chest. E1 would always go first and the child second, to ensure that the child would always have to selectively imitate E1's request in order to obtain the same object.

The experiment had two conditions. In the one object condition (functioning as a control) the game master held up a single plain object for a short period of time, declared that it was E1's turn and then concealed the object. E1 then requested that object and in his request followed up the object's label with a novel adjective (e.g., "ta chin7 skwe kto ka-X tun-B kwa 7yan" / "Give me the egg <adjective>"<sup>2</sup> for the Chatino group, "Could you please give me the bribby cup" for the Texas group and "Tu pourrais me donner la

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<sup>2</sup> Leipzig Glossing Rules:

ta            chin7   skwe kto   ka-X tun-B kwa 7yan  
POT.give a.little egg hen ( ADJ ) that of.1sg  
"Give me the egg <adj>"

fleur mitue?” for the Swiss group). E1 then received the requested item and the game master presented (and then concealed) a second instance of the object before announcing that it was the child’s turn.

In the two-object condition the game master held up two instances of each object simultaneously, one plain and one bearing a modification, declared that it was E1’s turn and then concealed the objects. E1 uttered his request and followed up the object’s label with a novel adjective (e.g., “ta=chin7 skwe=kto ka tun kwa 7yan” / “Give me the egg <adjective>” for the Chatino group, “Could you please give me the bribby cup” for the Texas group and “Tu pourrais me donner la fleur mitue?” for the Swiss group) and thereupon received the modified object. The game master then presented a second set of both the plain and the modified object and announced that it was now the child’s turn. Regardless of condition, and whether they imitated the adjective or not, the child always received the same object as E1. After they both had the same object, they were allowed to store them in the treasure chest. If the child hesitated to ask for an object, E1 encouraged him or her to speak (e.g., “What do you want?” or “Just ask.”). If the child still did not ask, E2 also said, “You can just ask me for it.” Each child went through eight trials, alternating between choice and control conditions. Items always occurred in the same order and were arranged in sets of two. The two conditions were fully counterbalanced across items within sets. This means that the participants were divided into the following groups:

- (1) One-object condition in trial 1, 3, 5 and 7; two-object condition in trial 2, 4, 6 and 8
- (2) Two-object condition in trial 1, 3, 5 and 7; one-object condition in trial 2, 4, 6 and 8.

#### **5.1.4 Warm-up Procedure for the Verbal Part**

In order to familiarize the child with the game, we went through a series of warm-up trials. First we made sure that the child knew the basic labels of the objects used in the game. E1 showed the child the plain version of each item and asked whether he or her knew what it was called. If the child did not respond promptly or provided a false label, E1 corrected the child and asked him or her to repeat the correct label.

Afterwards, E1 showed the child the treasure chest. He explained that they could store items that they had previously collected in the chest, but that in order to open the chest, they had to obtain matching items. To illustrate the rules of the game, E2 then proceeded to present a series of three familiar items (airplane, key, dice) that could be requested by E1 and the child. After the single objects, E2 presented four pairs of familiar objects that could be differentiated via an adjective (big/small ball, long/short thread, red/blue block, dark/light bird; in the Texas and Swiss groups we used a dark/light frog instead of bird). E1 requested the small ball, the short thread, the blue block and the light bird. If the child picked a different object than that picked by the experimenter in any of the trials, E1 would praise the child for asking, but would at the same time lament that they did not have same items and therefore the rules did not allow them to place them in the treasure chest. Finally, E1 would suggest that, even though it was against the rules, they could still put them in the treasure chest, but had to be careful to pick matching items in future trials.

If the child asked for the matching item right away, E1 contently explained that this was a very fortunate choice, since it would enable them to store their matching items in the treasure chest. He also explained that they would not have been able to so, if the child had picked the other object.

The warm up concluded with two trials of single modified items (an egg with pieces of grey cloth glued to it and a toy horse with pieces of green plastic leaves). In his request, E1 produced a novel adjective in addition to the basic label of the respective item. Upon receiving the item, he would talk about how well the object displays the fictional quality described by the novel adjective, producing the novel adjective an additional two times. The goal of this part of the warm up was to make it easier for the children to understand that the novel adjective could be use to describe features of the modified objects.

### **5.1.5 Transcription and Coding for the Verbal Part**

We coded for four different types of response: production of a bare noun (“Could you give me the duck”), reproduction of the novel adjective and noun (“Could you give me the wassy duck”), production of a familiar adjective and noun (“Could you give me the shiny duck”) and production of a paraphrases (“Could you give me the duck with the shiny things on it”). While some of the western children used familiar adjectives and some of the older (seven years and above) western children used paraphrases, the only types of responses that we observed in Chatino children were bare noun and reproduction of the novel adjective and noun. Responses were coded as “replication” in cases where the child produced the novel adjective or a phonologically similar form (e.g., “7en” for “ty7en”; “bibby” for “bribby”). Responses in which the child did not reproduce the adjective (i.e., no phonological information was added to the determiner and object-name) were coded as “bare noun”.

When the child failed to produce a request in the first experimental trial, we repeated that condition. In coding, however, the child’s response for that trial was then

coded as a missing data point. If the child did not produce a request in other trials than the first, no repetition of the trial took place and response was coded as a missing data point.

For the Chatino data these criteria gave a total of 3 missing data points out of a total of 224 trials. The data were coded by a Chatino research assistant at the field site. A second Chatino research assistant further coded data for a randomly chosen 32% of trials. Agreement between coders was 100%.

For the Texas data these criteria gave us 2 missing data points out of a total of 248 trials. The data were coded by a research assistant and another research assistant coded a randomly chosen 25% of the trials for reliability. Agreement between coders was 98.4%,  $\kappa = .96$ . For the Swiss data these criteria gave us 8 missing data points out of 312 trials. Agreement between the first coder and a reliability coder who coded a randomly chosen 25% of the trials was 99%,  $\kappa = .983$ .

### **5.1.6 Materials and Design for the Instrumental Part**

Following Horner and Whiten (2005), we used two structurally identical 8 cubic inch plastic boxes, one transparent and the other opaque. The topside of each box had a round one-inch hole, protected by a bolt, with a metal hook on one end, which could be removed to expose the hole. The front of the box had a round two-inch hole that lead to a downward sloping opaque tube inside the box. This hole was covered by a door, which was, in turn, protected by two small bolts (see below for more detail). A Ping-Pong ball covered with Velcro was placed at the bottom of the opaque tube, and could be retrieved by removing the two bolts and then opening the front door and then inserting an eight



inch wooden stick with Velcro attached to its top into the front hole and pulling out the reward.

### **5.1.7 Procedure for the Instrumental Part**

After a period of casual play (e.g., coloring books), E1 told the child participants that he wanted to play a game. E1 seated the child directly in front of the apparatus and told him or her to pay close attention, since it would be his or her turn soon. E1 then used the stick to perform a series of actions on the box:

(1) He tapped the left side of the top bolt, then the right side and then the left side again, before inserting the stick into the hook on the right end of the bolt to remove it and uncover the top hole. The Velcro end of the stick was used for this.

(2) He inserted the stick into the uncovered hole and pulled it out again. The non-Velcro end of the stick was used for this.

(3) He used the stick to tap the left side of the upper bolt that protects the door on the front face of the box, then tapped its right side and then the left side again, before pushing the bolt out with the stick. The Velcro end of the stick was used for this.

(4) He did the same as above with the lower bolt.

(5) He removed the door using his hand.

(6) He inserted the stick into the hole to retrieve the ball, nodded and contently said 'Oh!' The Velcro end of the stick was used for this.

As previously mentioned, the only actions relevant to retrieving the ball were removing the bolts that protected the door on the front face of the box and opening the door. Neither the actions performed on the topside of the box, nor insertion of the stick into the top hole were necessary to retrieve the reward. Performing actions with the stick

on the top bolt or the small bolts protecting the door had no benefit over removing these parts by hand. With regards to retrieving the ball, it did not matter whether the bolts were pushed out by use of the stick or pulled out by hand.

At the beginning of the experiment, after E1's first demonstration, he would tell the child that he would do it again and that it would be the child's turn soon. Then, after E2 had reset the apparatus out of the child's sight, E1 repeated the above-described demonstration. He then repeated it one more time, before informing the child that it was his or her turn. To reduce effects of social conforming that might result in blind imitation, E1 left the testing room during the child's turn. After the child retrieved the ball (in all conditions with a demonstration) or after one minute (in the no demonstration cases), E1 returned, E2 reset the box and it was E1's turn again.

Following Whiten (1998) and Horner and Whiten (2005), each child saw the experimenter's demonstration three times in a row before it was his or her first trial. He or she then saw two additional demonstrations and two trials, such that the order of trials was: Demo > Demo > Demo > Trial 1 > Demo > Trial 2 > Demo > Trial 3.

The apparatus was presented in two conditions, opaque and transparent. In the opaque condition, no information about the causal relevance of the model's actions could be inferred: Participants could neither see the location of the ball, nor the effect of the stick inside the apparatus. Half of the Chatino participants were tested in the two conditions, while the other half of were tested in respective control conditions, where no demonstration was performed and the experimenter simply handed the child the stick, saying, "See what you can do with this." That means that Chatino participants were divided into the following four equally sized groups:

- (1) Opaque box, demonstration

- (2) Transparent box, demonstration
- (3) Opaque box, no demonstration
- (4) Transparent box, no demonstration.

All Texas and Geneva participants were tested with a demonstration. The reason for this was that neither participants tested in previous work (e.g., Horner and Whiten, 2005) nor our Chatino participants produced any of the actions when not receiving a demonstration. It was therefore already well established that children do not produce the actions when they do not receive a demonstration and thus testing children in a no demonstration condition would not have given us additional insights. That means that the Texas and Geneva participants were divided into the following two almost equally sized groups:

- (1) Opaque box, demonstration
- (2) Transparent box, demonstration

We observed what actions the children performed on the apparatus when it was their turn.

### **5.1.8 Transcription and Coding for the Instrumental Part**

In our coding we noted which of the actions demonstrated by E1 the child imitated in each trial. One point was awarded for each of the above-mentioned steps.

For the Chatino data, the responses were coded by a local research assistant. They were additionally coded by a research assistant who was blind to the goals of the study. A second research assistant then reliability-coded 25% of the data. Agreement between the two coders was perfect at 100%.

For the Texas data, the responses were coded by an RA who was ignorant of the purpose of the study. Additionally I reliability-coded 25% of the responses. Agreement between the two coders was perfect at 100%.

### **5.1.9 Analysis for the Verbal Component**

Following Bannard, Klinger and Tomasello (2013), we analyzed our data using logistic choice models, as is standard for studies in which the response is a choice between independent discrete options (Train, 2009). Because each child went through multiple trials, we used multilevel versions of the models in which participant was included as a random effect to the intercept(s). We used the Bayesian Markov Chain Monte Carlo (MCMC) methods of the JAGS software. Diffuse (non informative) priors were used for all parameters. We performed model comparisons using the Deviance Information Criterion (Spiegelhalter, Best, Carlin and van der Linde, 2002). Model selection was performed by comparing all possible combinations of predictors and interactions between predictors including a null model. We report the mean value as well as the lower and upper bounds of the 95% plausible intervals for each fixed parameter. In multinomial logistic regression, one response type is assigned to be the reference outcome and one then estimates how the different predictors affect the odds of seeing the other responses types relative to the reference class. Its interpretation is similar to that of multiple binomial logistic models. We made the bare noun response our reference class. The tables of model parameters thus contain an intercept 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 seeing that

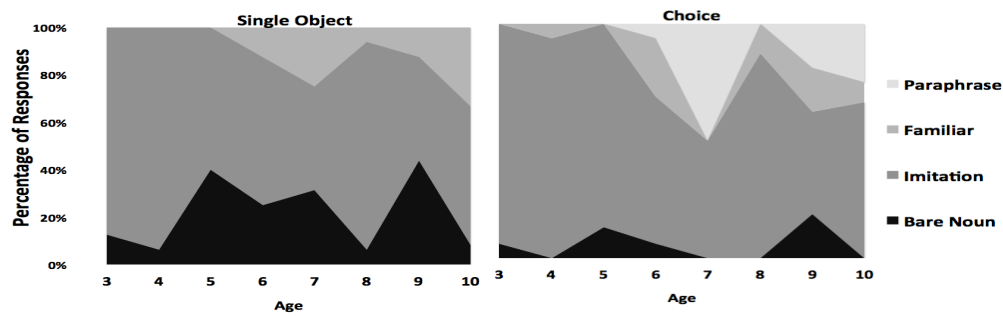
response. Age was grand mean centered for the Texas and Chatino samples (where we had a wide spread of ages) and factorialized for the Swiss sample.

## **5.2 RESULTS**

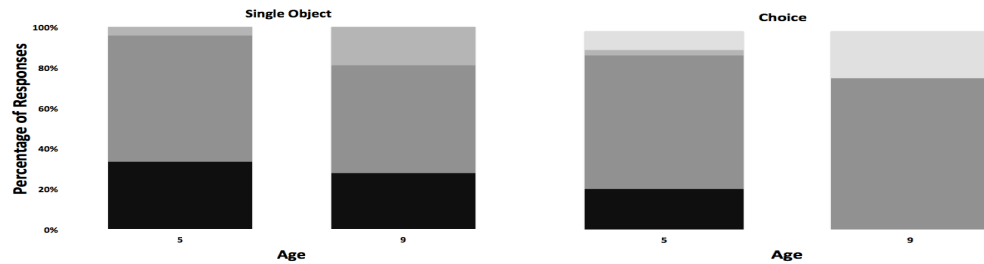
### **5.2.1 Results for the Verbal Component**

We summarize the results of the verbal component of Experiment 1 in Figure 1. The stacked area and stacked bar charts show the proportions of all four responses across trials in each condition. Comparing the single-object to the two-object condition across the three cultures, we see a clear pattern. The English-speaking and the French-speaking children produce a greater amount of bare noun responses in the one-object control, when the adjective serves no contrastive function, than they do in the two-object condition in which the adjective is required to identify the referent. Chatino children, however, show no such contrast and imitate the novel adjective at a 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 Lucia Teoteppec, Oaxaca, Mexico

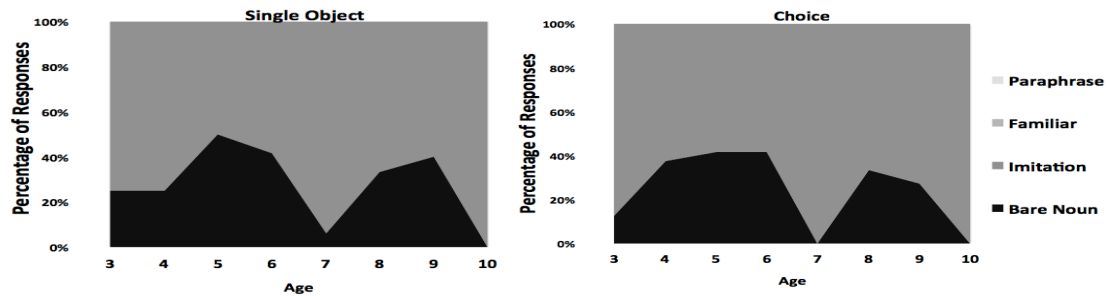


Figure 1: Percentage of Response Categories over Age in the Single Object and the Choice Condition for Children from a) Austin, Texas, USA, b) Geneva, Switzerland, c) Santa Lucia Teoteppec, Oaxaca, Mexico<sup>3</sup>

<sup>3</sup> Note that there appears to be a dip in the graph depicting the responses for Texas children at 8 years of age, as well as in the graph for Chatino children at 7 years of age. The most likely reason for this is individual variation due to the small sample size that is common for cross-cultural studies like this.

### 5.2.1.1 English-Speaking Children in Texas

In this group of children we found all four possible response types. We thus used a multinomial logistic regression model for the analysis. A model with condition and age as predictors, but without their interaction, offered the best fit to the data. The fixed effects can be seen in table 1. All three of the non-bare-noun responses (imitation, familiar adjective and paraphrase) were significantly more likely to occur in the two-object condition than in the one-object condition. Imitation rate was not significantly affected by age, but the rate of paraphrase responses increased significantly (and the rate of familiar adjective responses marginally significantly) with age.

		<i>Mean</i>	<i>95% Intervals</i>		<i>SD</i>	<i>pMCMC</i>
		<i>Estimate</i>	<i>Lower</i>	<i>Upper</i>		
Imitation	Intercept	2.595	1.968	4.649	0.930	<0.001
	Condition	2.075	0.892	3.414	0.641	<0.001
	Age	-0.240	-1.049	0.527	0.397	0.269
Other linguistic material	Intercept	-2.742	-5.398	-0.560	1.259	<0.005
	Condition	2.301	0.666	4.067	0.864	<0.003
	Age	0.659	-0.317	1.769	0.528	0.087
Paraphrase	Intercept	-98.122	-227.149	-10.055	77.54	<0.001
	Condition	97.3737	9.361	226.714	77.51	<0.001
	Age	0.9851	-0.161	2.364	0.645	<0.05

Table 2: *Summary of fixed effects for multi-level multinomial logistic regression analysis for verbal component of Experiment 1 for Texas participants (single-object condition coded as 0, choice condition coded as 1)*

### 5.2.1.2 French-Speaking Children in Geneva

A multinomial logistic regression model with condition and age and their interactions offered the best fit for the data. Table 2 shows the fixed effects. Imitation and paraphrase responses were significantly more likely in the two-object condition than in the one-object condition. Imitation rate decreased significantly with age in the one-object condition, but remained constant in the two-object condition. Neither the rate of familiar adjectives or paraphrases was significantly affected by age.

		<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	0.257
	Condition	1.076	-0.039	2.268	0.588	0.032
	Age	-37.739	-83.798	-9.815	21.16	<0.001
	Condition*Age	37.858	10.294	83.408	21.044	<0.001
Other linguistic material	Intercept	-6.817	-13.958	-1.363	3.196	<0.01
	Condition	0.694	-2.291	3.618	1.496	0.319
	Age	14.691	-64.030	74.024	39.766	0.248
	Condition*Age	-9.621	-67.909	68.556	39.586	0.302
Paraphrase	Intercept	-55.810	-112.306	-15.157	26.100	<0.001
	Condition	26.642	6.388	54.929	13.047	<0.001
	Age	-43.876	-167.307	35.706	55.048	0.327
	Condition*Age	41.597	-2.406	97.770	32.127	0.108

Table 3: *Summary of fixed effects for multi-level multinomial logistic regression analysis for verbal component of Experiment 1 for Swiss participants (single-object condition coded as 0, choice condition coded as 1)*



### ***5.2.1.3 Chatino-Speaking Children in Santa Lucía Teotepec***

Unlike the American and the Swiss children, the Chatinos produced only two different responses – bare noun and imitation. No combinations of predictors was found to improve the fit over a null model, indicating that the responses were unaffected by both age and condition.

### **5.2.2 Results for the Instrumental Component**

First we compared children's 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 ( $t(16) = -17.756$ ,  $p < 0.0001$ ). 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.

## **5.3 DISCUSSION**

The combined results of Experiment 1 present a striking picture. The children in Texas and Switzerland showed the same pattern as the German children tested in Bannard, Klinger and Tomasello (2013). They imitated the experimenter's novel adjective at a significantly higher rate when it had a clear communicative function (in the two-object condition) and were more likely to drop it otherwise as indicated by a lower rate of bare-noun responses and an increase in the three different imitation responses in the 2-object condition. The Chatino children, by contrast, did not show such

discrimination, showing a stable rate of bare noun and imitation responses across conditions. In the Texan and Swiss children the selectivity of imitation increased with age, albeit we also see a new phenomenon in the older children, the use of alternative phrasing in making their requests. In the Chatino group no changes in imitation rate or selectivity with age were found.

A simple explanation for these findings would be that the Chatino children generally show a different imitation behavior. This is, however, not the case, as we also tested all children in an instrumental imitation task, in which we observed no differences between the groups. Hence it is likely that the difference is specific to language. There are multiple possibilities for how language could affect imitation: Chatino children could generally display a different pattern of imitation in verbal tasks (e.g., more bare-noun responses), potentially because their language learning is observational rather than interactional. Secondly their abilities to read speaker intentions or infer the function of words might differ from that of the western children. Third and finally, it might be that the differences in imitation are due to cross-cultural differences in time spent in dyadic caregiver-child interaction that leave western and Chatino children with different degrees of knowledge about descriptive and contrastive adjectives. As previously suggested, the amount of dyadic mother-child interaction in a culture could impact the children's understanding of adjectives in reference. Learning language by imitation for a child means observing adults' utterances and then creatively recombining their elements afterwards. To do that efficiently, the child must figure out what part of the utterance refers to what entity in the world (Tomasello, 2003), which means constantly establishing reference. Children from western cultures, who are first exposed to the descriptive use of adjectives, could thus be more familiar with determining whether an unfamiliar adjective

helps in singling out a referent, that is, contrastive, or whether it is descriptive, that is, describes a property of an already known referent. Children from non-western cultures on the other hand might find this more challenging. Having been exposed mainly to the contrastive use of adjectives, they might have a propensity towards assuming that the adjectives serve a purpose in reference even if this is not the case.

This relates to our experiment as follows: When the experimenter uses an adjective in his or her request in the one-object condition, this adjective is redundant with regards to formulating a successful request. English- and French-speaking children, who through their mother-child play are used to encountering adjectives in non-contrastive contexts, are familiar with this scenario. They thus recognize the adjective as having no function (it does not describe a property of the object) and may omit it. The Chatino children on the other hand might not be very familiar with the descriptive use of adjectives and thus could expect the adjective to be contrastive and serve a purpose in the context. Since in the one-object condition they cannot infer that purpose, their safest strategy is faithful imitation. This account is in line with findings of over imitation in the instrumental domain where it has been suggested that children will assume that tasks have a hidden causal (Lyons, Young and Keil, 2007) or conventional (Kenward, Karlsson and Persson, 2011) structure when none is immediately apparent to them.

In order to further test this explanation, two additional experiments were conducted to test the explanation and rule out alternatives. Experiment 2 set out to confirm that Chatino children do not just generally display different imitation patterns in linguistic tasks. In Experiment 3 we checked that differences in imitation were not due to them having different social-cognitive abilities, such as for intention reading.

## Chapter 6: *Experiment 2*

In Experiment 1 we found that children from the USA and Switzerland selectively imitate a novel adjective at a higher rate when it serves a purpose in the functional context of the utterance compared to when it is redundant, as indicated by a lower rate of bare-noun responses and an increase in the three other responses in the 2-object condition. Chatino children did not show such selectivity. Our hypothesis is that this is due to cross-cultural differences in the use of adjectives and referring expressions. A simple alternative explanation would be that Chatino children in general behave differently when imitating verbal material. To rule out this possibility Experiment 2 was conducted. In Experiment 2, we paired a same-category condition, in which, just like in Experiment 1, two objects from the same category, one with modifications, one without, were presented with a different-category control condition, in which one modified item was presented alongside an unmodified distractor from a different basic level category. When the objects that are presented are from the same category, the adjective is essential in unambiguously determining reference. When a modified target was presented alongside an unmodified distractor from a different category only the bare noun was needed for unambiguously identifying the target. For the German children tested in Bannard, Klinger and Tomasello (2013) imitation rates of the novel adjective were lower in the different objects condition. Because the target object was identical (modified) in both cases, this difference cannot be attributed to any differences in motivation to describe. Instead their interpretation was that the child understood the situation and knew how to achieve unambiguous reference without using the adjective.

If, as we propose might be the case, the difference between the Chatino and the western children in Experiment 1 (discrimination between conditions by the western

children but not the Chatino children) is due to differing propensities to interpret adjectives as purely descriptive in purpose, then the Chatino children should show a discrimination between conditions in Experiment 2.

## 6.1 METHOD

### 6.1.1 Participants

We tested 22 typically developing, Chatino-speaking children. Their ages ranged from 3 to 10 years. The children were native speakers of Chatino and those of them who attended elementary school (ages six and older) also spoke Spanish. The children were tested in our field lab in Santa Lucía Teotepec, Oaxaca, Mexico. The experimenters conducting the study were local Chatino high school graduates who had previously received extensive training in conducting both linguistic and psychological research. Parental consent was obtained in all cases.

Age	3	4	5	6	7	8	9	10
Children	3	6	3	0	2	3	2	4

Table 4: *Children that participated in Experiment 2 across cultures by age*

### 6.1.2 Materials and Design

We used the same objects and adjectives as in Experiment 1. We introduced four new familiar objects that served as distractors in the four control trials. Details are given in the Appendix.

### 6.1.3 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.

### 6.1.4 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%.

### 6.1.5 RESULTS

We summarize the children's responses in figure 2, which again shows the proportion of each type of response for both conditions.

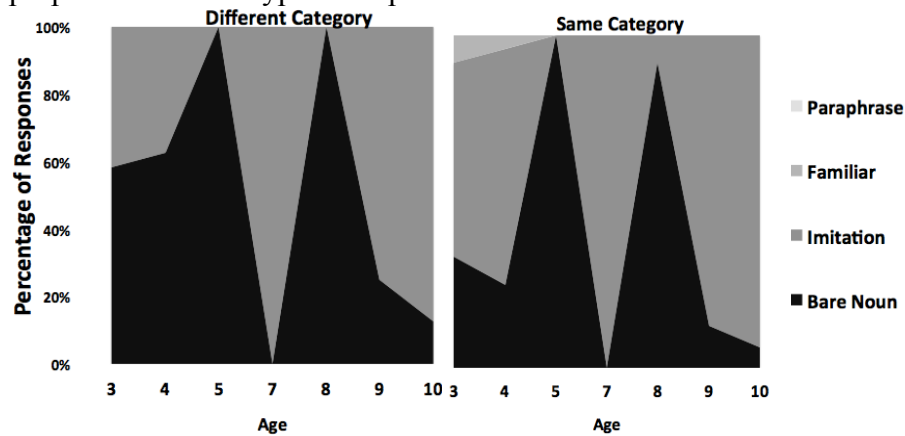


Figure 2: The proportions for each different response for each condition by age in Experiment 2<sup>4</sup>

<sup>4</sup> The graph depicting the responses from experiment 2 shows dips and peaks at 5, 7 and 8 years of age. This is again attributed to the limited sample size of the study.

As in our previous analysis we built a logistic choice model to analyze the data. Because all except for 2 responses in a single condition were either bare noun or imitation, rather than having to impute so many missing values for the paraphrase response, we simply discarded the three data points and performed a binomial logistic regression. A model with condition and age as predictors, but not their interaction was found to offer the best fit to the data. Imitation rate was significantly greater in the same category condition than in the different category condition and also marginally significantly increase with age.

		<i>Mean</i>	<i>95% Intervals</i>		<i>SD</i>	<i>pMCMC</i>
		<i>Estimate</i>	<i>Lower</i>	<i>Upper</i>		
Imitation	Intercept	-2.175	-5.012	0.422	1.380	<0.05
	Condition	1.600	0.585	2.686	0.531	<0.001
	Age	0.616	0.196	1.682	0.464	0.070

Table 5: *Summary of fixed effects for multi-level binomial logistic regression analysis for verbal component of Experiment 2 (different-category condition coded as 0, same-category condition coded as 1)*

### 6.1.6 DISCUSSION

In line with our predictions and unlike in Experiment 1 the Chatino children produce a clear difference between conditions in Experiment 2 and thus in this experiment exhibit a pattern that is similar to that of the German children tested in Bannard, Klinger and Tomasello (2013). This supports our suggestion that western

children's greater familiarity with the descriptive use of adjectives lead to the differences in results in Experiment 1. Their experience with a specific use of adjectives provides them with a better understanding of the experimenter's intentions and thus results in them using a different imitation strategy: When children have a good understanding of the adult model's motivation to produce the adjective, they can be selective in their imitation, when the adult's motivations are opaque, they resort to faithful imitation. Another potential explanation for the results so far is that Chatino children differ from western children in their theory-of-mind skills. The possibility that this could have caused the difference in imitation behavior across groups is explored in Experiment 3.



## **Chapter 7: *Experiment 3***

Similar to Experiment 3 in Bannard, Klinger and Tomasello (2013), this third experiment investigates whether Chatino children read an adult's intentions and use this information in deciding when to imitate in the same way that western children do. The situation we chose to test this is one in which they encounter accidental speech: slips-of-the-tongue. Our control condition was similar to the one-object control condition in Experiment 1. We paired it with an accident condition in which E2 presented a single plain object and E1 used an adjective in his request. Immediately after uttering the adjective E1 would indicate via gesture that he had misspoken and the adjective was unintentional.

In order 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). E1 demonstrated two actions on an object that activated an outcome (sound being played). E1 verbally and gesturally marked one of them as accidental and the other one as intentional. Then it was the child's turn and we observed whether they would selectively imitate the intentional actions.

### **7.1 METHOD**

#### **7.1.1 Participants**

We tested 17 typically developing, Chatino-speaking children. Their ages ranged from 4 to 10 years. The children were native speakers of Chatino and those who attended elementary school (ages six and older) also spoke Spanish. The children were tested in our field lab in Santa Lucía Teotepec, Oaxaca, Mexico. The experimenters conducting

the study were local Chatino high school graduates who had previously received extensive training in conducting both linguistic and psychological research. Parental consent was obtained in all cases. We used a within-subjects design. Each child participated in both the verbal and the instrumental part of the experiment.

Age	3	4	5	6	7	8	9	10
Children	0	2	3	2	1	4	3	2

Table 6: *Children that participated in Experiment 3 across cultures by age*

### 7.1.2 Materials and Design for the Verbal Component

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

### 7.1.3 Procedure for the Verbal Component

The requesting game was similar to the one used in Experiments 1 and 2, with a few critical differences. In both the control and the accident condition 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 some changes and additions to the warm-up. To introduce the slip-of-the-tongue gesture, when we checked if they knew the names of the test objects, we presented three additional items and E1 made use of the gesture after labeling these incorrectly. Afterwards he stated that he had misspoken and produced the correct label. During the four warm-up trials in which pairs of objects were presented, E1 requested

one item, but then used the gesture to indicate that he had misspoken, corrected himself and then requested the other item (“Give me the red . . . \*gesture\* blue brick”). The final two warm-up trials with single modified objects were left out.

#### **7.1.4 Coding for the Verbal Component**

We used the same coding scheme as in Experiment 1. We obtained a total of 136 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 25% while only having access to the audio tracks of the recordings and thus being blind to condition. Agreement between coders was 100%.

#### **7.1.5 Materials and Design for the Instrumental Action Component**

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

#### **7.1.6 Materials and Design for the Instrumental Action Component**

E2 put a randomly chosen object between himself on one side and E1 and the child on the other. E1 then stated that it was his turn to demonstrate how the object worked and performed the first action on the object and then verbally and gesturally marked it as either intentional or accidental. E2 activated the end result two seconds after E1 had performed the intentional action. E1 then displayed happiness over reaching the

end result. Then it was the child's turn and we observed their imitation of the actions previously demonstrated by E1. This was repeated once, resulting in us obtaining two data points per objects. The whole sequence was then repeated for the other five objects. The actions performed on an object occurred in one of the following sequences: 1. Intentional – Accidental, 2. Accidental – Intentional, 3. Intentional – Intentional. With six objects this resulted in each order occurring twice per participant. When the intentional – intentional order was used, E2 activated the end result two seconds after the second intentional action had been performed.

#### **7.1.7 Warm-up Procedure for the Instrumental Component**

E2 put the first warm-up object in-between himself and E1 and the child. E1 then stated that he would show how the object worked. He then performed the single action on the object in a very deliberate way, but without verbally or gesturally marking it as intentional. After E1 performed the action E2 activated the end result and E1 and the child shared happiness and excitement over it. Then the object was reset and it was the child's turn to perform the action. If he or she did not perform the action, it was demonstrated again. Hence we taught the child how to interact with the objects, but not to imitate intentional actions. Then the second warm-up object was presented. E1 performed two actions on this object before E2 activated the end result. Then the object was reset and it was the child's turn. If he or she did not perform the actions or performed only one action, E1 provided feedback until he or she performed both actions. During the warm-up, the first and second warm-up object afforded one or two actions respectively to not prime the child towards reproducing one or both actions.

### 7.1.8 Coding for the Instrumental Component

For each trial we coded whether the child imitated action one and two. Out of 432 trials, we obtained a total of 428 data points. The data were coded by a research assistant at the University of Texas at Austin. Another research assistant further coded data for a randomly chosen 25% of trials. Agreement between coders was 100%.

## 7.2 RESULTS

### 7.2.1 Results for the Verbal Component

The children's responses are summarized in figure 3, which shows the proportion of responses of each type for each condition.

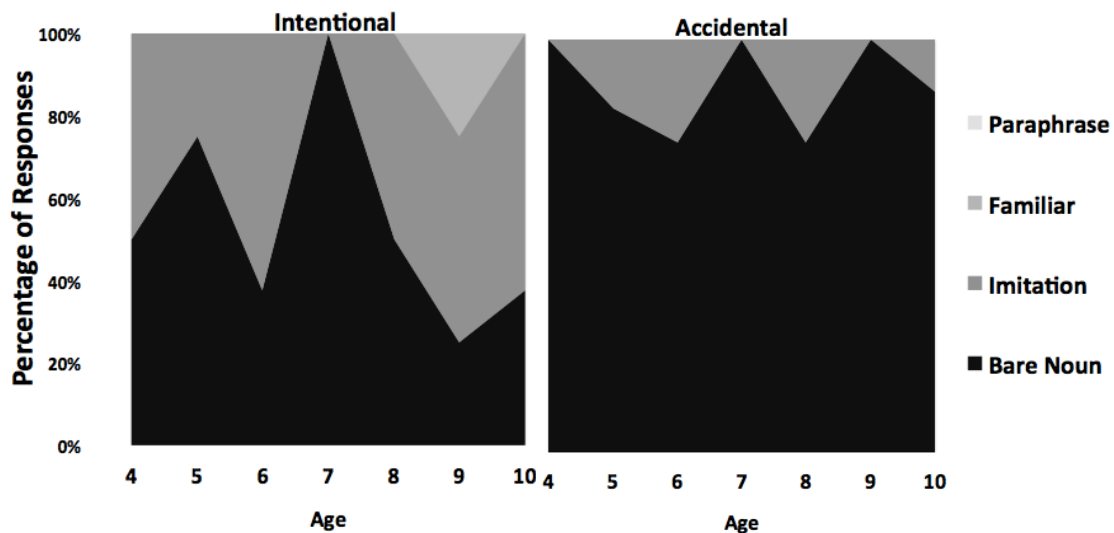


Figure 3: The proportions for each different response for each condition by age in Experiment 3

In order to analyze this data we again built logistic choice models. Because all except for 4 responses for a single child in a single condition were either bare noun or

imitation, rather than having to impute so many missing values for the paraphrase response, 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. It was not significantly affected by age.

		<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	<0.02
	Condition	-2.557	-3.823	-1.462	0.601	<0.001
	Age	0.273	-0.414	1.097	0.374	0.210

Table 7: *Summary of fixed effects for multi-level binomial logistic regression analysis for verbal component of Experiment 3 (intentional condition coded as 0, accidental condition coded as 1)*

### 7.2.2 Results for the Instrumental Component

We used 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. A model with condition, age and an interaction between the two offered the best fit for the data. The rate of imitation was significantly lower in the accident condition

than in the intentional condition. (log odds = -3.6733;  $z = -6.266$ ;  $p < 0.0001$ ). Imitation rate increased significantly with mean-centered age (log odds = 1.0840;  $z = 3.026$ ;  $p = 0.003$ ), but this increase was significantly lower in the accidental condition than in the intentional condition (log odds = -0.5899;  $z = -2.424$ ;  $p = 0.016$ ).

### **7.3 DISCUSSION**

The patterns of results observed for the verbal component of Experiment 3 are the same as those for German-speaking children. The results of the instrumental component were the same as reported in Carpenter, Akhtar and Tomasello (1998). Our results thus suggest that, just like their western counterparts, Chatino children prefer to imitate words and actions that are intentional compared to those that are accidental. We can thus rule out differences in intention reading abilities as an explanation for the findings in Experiment 1. Our alternative hypothesis, based on the results from the first three experiments, is thus that imitation is strongly determined by “opacity”. If a situation is opaque and the learner is unaware of the function of each action and word they observe a model perform or utter, the safest strategy is to imitate (see Background section 1.5 on Why Do Humans Over Imitate). Only if the purpose of actions and words is clear, are we able to decide which actions or words are not relevant to the end result of a task and omit them selectively. Whether this claim can be supported in general, that is, independent of domain, is explored in Experiment 4.

## **Chapter 8: *Experiment 4***

As over imitation can serve to transmit, maintain and evolve cultural conventions (Nielsen, 2012). Further, over imitation can be used to express affiliation to (e.g., Nielsen and Blank, 2011) and to acquire causal information about the objects and actions involved (e.g., Lyons, Young and Keil, 2007). While the causal knowledge theory and social affiliation theory are supported by experimental evidence, they do not fully explain some very basic findings. Going back to one of the first studies documenting over imitation and the research that follows up on it exemplifies this.

Horner and Whiten (2005) found over imitation in 3 and 4 year old children and follow-up studies showed that the older participants get, the more they over imitate (McGuigan, Whiten, Flynn and Horner, 2007), with adults reaching the level of “super copiers” (McGuigan, Makinson and Whiten, 2011). The literature explains this mostly by arguing that humans get a better social and casual understanding as they develop. Their increased social awareness leads to higher imitation rates to express affiliation and their better causal understanding leads allows them interpret seemingly irrelevant actions as intentional. Thus their imitation rate increases.

This seems sensible when looking at children, but the notion that adults will copy almost 100% of clearly unnecessary actions to socially affiliate with an experimenter that they have no relationship with and will likely not see again after the experiment seems unintuitive at best. Similarly the notion that an adult with elaborate knowledge of the world would imitate the above-mentioned actions on a puzzle box in order to enhance his or her causal knowledge about the real world warrants skepticism.



The points made above gain additional relevance when looking at the instructions that the participants received in the experiments in question. Before the model demonstrated the sequence of actions, the participants were told “watch me closely, because it is going to be your turn soon”. We propose that these instructions suggest that the goal of the task is to imitate the experimenter faithfully and that this is an important reason for why over imitation was found in those studies. In fact, in the debriefing of the McGuigan, Makinson and Whiten (2011) study, participants stated that they were under the impression that faithful imitation of the model was the goal of the game.

This proposal is supported by the findings of recent work investigating whether the way in which a task is framed (verbally) has an impact on human (over) imitation. Legare, Wen, Herrmann and Whitehouse (2015) classify the frame of a task as either instrumental or ritualistic. In an instrumental frame the “physical-causal basis of an action is in principle knowable, even if it is currently unknown”, that is the learner can in theory figure out what physical effect each action has and how it contributes to the physical goal of the task. In a ritualistic frame, in contrast, “the rationale for interpreting a sequence of actions is not in principle knowable from the perspective of physical causality and instead is based on social conventionality”. This means that figuring out the meaning of individual actions will be much harder for the learner as their meaning is opaque. It might even be impossible, if the action demonstrated is purely a cultural convention and the (social) goal is indeed to replicate the whole sequence of actions faithfully. Experimental studies confirmed that verbal instructions can indeed lead to such a conventionalist interpretation of the task. When the instructions framed the task as something conventional, e.g., by the model saying “this is how she always does it”, children’s imitation rate increased (Herrmann, Legare, Harris and Whitehouse, 2013;

Legare, Wen, Herrmann and Whitehouse, 2015; Clegg and Legare, in press). Further even more subtle cues can lead to such a conventional interpretation. When the start and end points of a movement are the same, humans appear to interpret the movement/actions themselves as the goal of the task and imitate the movements and actions at a higher rate than when start and end point are different (Schachner and Carey, 2013; Legare, Wen, Herrmann and Whitehouse, 2015)<sup>5</sup>.

We propose that when instructions are given that frame a task such that the elements that constitute the task become opaque, that is the meaning of each individual element with respect to the outcome is hard or impossible to determine, humans imitate faithful. When, in contrast, the instructions help understanding how each element relates to the outcome, that is the function of the elements is clear, imitation will be selective and imitation rate will be lower. We investigated this in Experiment 4, manipulating opacity, the presence of a clearly defined goal and the amount of effort that imitating unnecessary actions would take. In this experiment, an experimenter played a simple board game with the participant. From a start point two paths led to a goal. As is common for board games, the paths were divided into little squares. For one third of trials both paths had the same length (and number of squares), for the second third one path was two thirds the length of

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<sup>5</sup> This account that over imitation could be a response to seeing normative conventions as summed up by Kenward (2012) finds support in more recent studies. When a sequence of actions is framed as conventional (e.g., by highlighting the method of performing unnecessary actions), children complain about a puppet not over imitating unnecessary actions more than when an instrumental frame is applied, e.g., by highlighting the goal of an action (Keupp, Behne and Rakoczy, 2013; Keupp, Behne, Zachow, Kasbohm, Rakoczy, 2014).

the other and for the last third one path was one third the length of the other. The experimenter always went first (and on the unequal paths trials took the longer path to the goal). Afterwards it was the participant's turn. We tested three groups of participants. The first group was tested in the transparent condition, in which the goal of the game was clearly defined (i.e., the experimenter stated that the goal is to get the Lego men to the destination). The other two groups were tested in two different opaque conditions. In the opaque-baseline condition, no goal was defined. Finally, in the opaque-attend to means condition, the participants were again not told a goal but received instructions (similar to those used in previous work on over imitation) that directed them to pay attention to the means used by the experimenter. This opaque-attend to means condition might thus be the closest to the situation that Chatino children faced in Experiment 1: the situation is opaque to them, and even though no explicit goal is stated, there may be a hidden social goal (here: attend to the means, in experiment 1: keep the conversation going).

In line with our previously explained findings and hypothesis, we predict that participants will imitate the model and take the long path in the opaque conditions, because of the possibility that taking the short path leads to not achieving the hidden social goal. We predict that this inference that there is a hidden social goal will be more available to participants when they are told to pay attention to the means used. Thus we expect to see the highest rate of imitation in the opaque-attend to means condition. For the opaque-baseline condition imitation behavior would be contingent on whether participants are naturally predisposed to assume that there is a hidden social goal, even when no clues alluding to this are given. Younger learners (children), would be more likely to have such a predisposition than experienced learners (adults). We thus predict higher rates of imitation for children than for adults. In the transparent condition where

the goal and rules are known and it is thus clear that there is no benefit from taking the long path and that no penalty is connected with taking the short path, we predict that participants will not imitate and thus that they will take the short path where available.

## 8.1 METHOD

### 8.1.1 Participants

For the adult group we tested 48 English-speaking undergraduates from the University of Texas at Austin. Participants were recruited through the Linguistics Department Subject Pool and consent was obtained in all cases. For the child group we tested 45 English-speaking children (ages six to ten) from Austin, Texas, USA. For each age we tested nine children. One child had to be dropped due to fussiness, meaning that 44 children are included in our analyses. Table 8 illustrates the children included in the respective age groups and conditions.

Age	Transparent	Opaque-baseline	Opaque-atm
6	2	3	3
7	3	4	2
8	4	2	3
9	3	2	4
10	3	3	3

Table 8: *Children included in Experiment 4 by age and condition. This was a between-subjects design*

### 8.1.2 Materials and Design

We used eighteen different boards and fully counterbalanced the ratio of the length of the two paths (1:1, 2:3, 1:3), the side on which the longer path was (left, right) and theme (Forest, Desert, Space). Each ratio occurred six times per participant. The order of the boards was randomized. The different themes were implemented to make the boards look more interesting for children, but had no impact on the mechanics of the game. Additionally we used Lego structures as the goals for each map (castle, ruins, space ship) and two Lego men as tokens for the players.

### 8.1.3 Procedure

The procedure was the same for adult and child participants. The experimenter sat in front of the first board and the participants on the right side. The instructions given in each condition can be seen in the table below:

#### Transparent condition

Instructions: “We’re gonna play this level now. It is our goal to get our men to the castle/ruins/space ship and there are only two rules. Rule number one is that you have to stay on the path and rule number two is that you can only take one square at a time.”

Effect: Excludes an interpretation of the rules that there is a hidden goal to the game.

#### Opaque-baseline condition

Instructions: “We’re gonna play this level now. Let’s try to stay on the path and only take one square at a time. It’s my turn.”

Effect: Neither guides towards nor excludes an interpretation of the rules that there is a hidden goal to the game.

#### Opaque-attend to means

Instructions: “We’re gonna play this level now. Let’s try to stay on the path and only take one square at a time. Watch me closely, because it’s gonna be your turn soon. It’s my turn.”

Effect: Guides the participant towards the possibility that the game might have a hidden goal.

Table 9: *Summary of the conditions of Experiment 4*

After stating the instructions, the experimenter then put his or her Lego man on the starting square and used the long path to get to the goal (in those cases in which both paths were the same length, the path they took was predetermined and counterbalanced). Then they switched seats and it was the participant’s turn. We observed whether the participant took the long path or the short path. Afterwards the experimenter said that they would now play the next level and the above was repeated for all eighteen boards. If a participant asked whether they were allowed to use either path, they were told “Do what you think.”

#### **8.1.4 Coding**

For each trial an undergraduate research assistant coded the path ratio, the side of the shorter path, the theme, the path taken by the experimenter and the path taken by the participant. A subset of 25% of the adult trials and 25% of the child trials were reliability-coded by a second coder. Agreement was at 100% for both participant groups.

## 8.2 RESULTS

The responses for adults and children are summarized in figure 4, which shows the proportions of imitation responses in the three conditions across the three different path ratios.

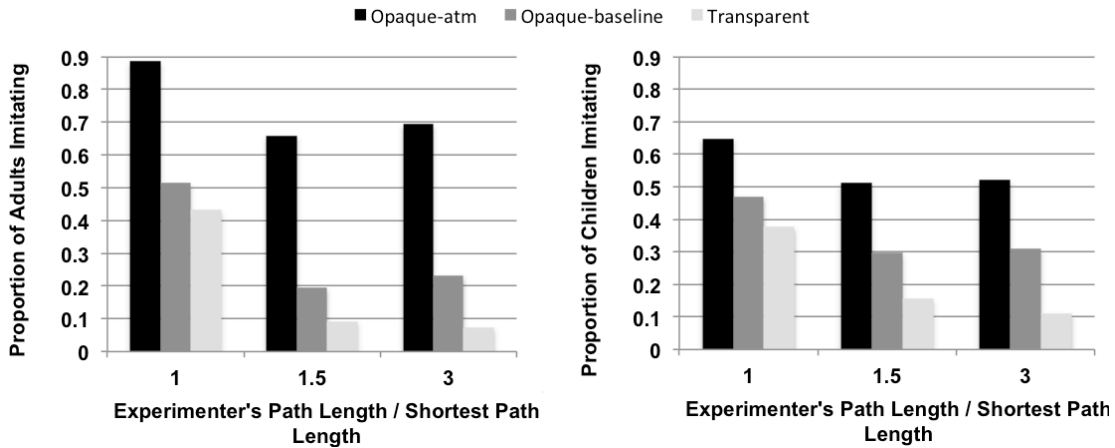


Figure 4: Proportions of imitation responses in the opaque-attend to means, opaque-baseline and transparent condition across path length ratios for adults (left) and children (right) in Experiment 4

We built logistic choice models to analyze the data, and used the same model selection criteria as for Experiments 1-3. The variables considered were condition, ratio (centered so that a ratio of 1:1 would be the baseline), trial (centered so that trial 1 would be the baseline) and, for children, mean-centered age and their respective interactions. We included participant as a random effect on the intercept. For adults, a model with condition, ratio and an interaction of the two as fixed effects offered the best fit to the data. For children a model with condition, ratio, an interaction of the two and trial as the three fixed effects offered the best fit for the data. Figure 5 shows the mean log odds and the 95% confidence interval (or more specifically, the Bayesian credible interval) for

condition and ratio pairs for children and adults. A significant difference between two condition-ratio pairs exists (at  $\alpha = 0.05$ , two-tailed) when the confidence interval of one pair does not overlap with the mean of the other pair.

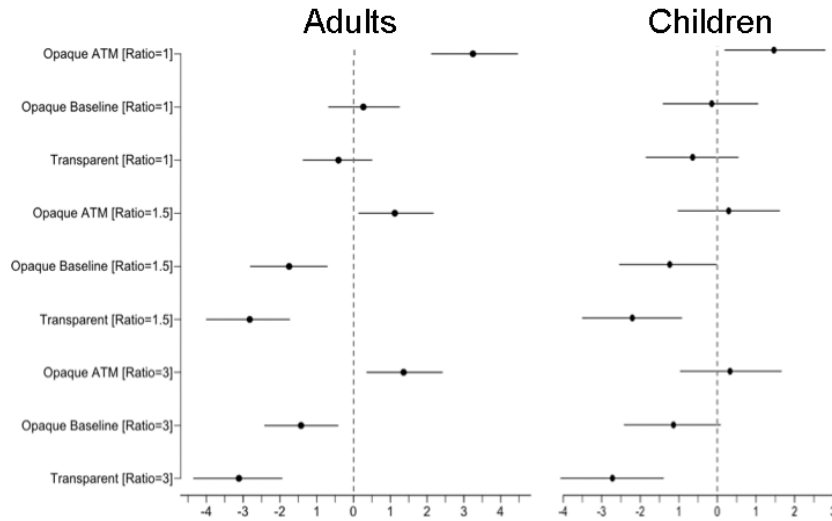


Figure 5: Mean and confidence intervals for the all combinations of condition and ration in experiment 4 for adults (left) and children (right) in Experiment 4

The model for the adult data shows that when ratio is 1, imitation rate is the highest in the opaque-atm condition (mean log-odds: 3.221). It is significantly higher in the opaque-ATM condition than it is in the opaque-baseline (mean log-odds: 0.282,  $p < 0.00005$ ) and the transparent condition (mean log-odds: -0.436,  $p < 0.00005$ ). There is, however, no significant difference between opaque-baseline and transparent. When ratio is 1.5, imitation rate in the opaque-atm condition is the highest (mean log-odds: 1.093), again significantly higher than in the opaque-baseline (mean log-odds: 1.738,  $p < 0.00005$ ) and the transparent condition (mean log-odds: -2.853,  $p < 0.00005$ ). There is also a significant difference between the opaque-baseline and the transparent condition ( $p < 0.03$ ). When ratio is 3, the imitation rate in the opaque-atm condition is the highest



(mean log-odds: 1.338) and is significantly different from the opaque-baseline condition (mean log-odds: -1.410,  $p < 0.00005$ ) and the transparent condition (mean log-odds: -3.143,  $p < 0.00005$ ). Imitation rate in the opaque-baseline condition is also significantly higher than in the transparent condition ( $p < 0.002$ ).

For the child data, the model shows that when ratio is 1, imitation rate is the highest in the opaque-atm condition (mean log-odds: 1.516). Imitation rate is significantly lower in both the opaque-baseline (mean log-odds: -0.096,  $p < 0.01$ ) and the transparent condition (mean log-odds: -0.643,  $p < 0.00005$ ). There is no significant difference between the opaque-baseline and the transparent condition. When ratio is 1.5, imitation rate is the highest in the opaque-atm condition (mean log-odds: 0.345) and it is significantly higher than in both the opaque-baseline (mean log-odds: -1.187,  $p < 0.02$ ) and the transparent condition (mean log-odds: -2.199,  $p < 0.00005$ ). There is a marginally significant difference between the opaque-baseline and the transparent condition ( $p < 0.1$ ). When ratio is 3, imitation rate is the highest in the opaque-atm condition (mean log-odds: 0.381). It is significantly lower in the opaque-baseline condition (mean log-odds: -1.093,  $p < 0.02$ ) and in the transparent condition (mean log-odds: -2.716,  $p < 0.00005$ ). Also, imitation rate is significantly higher in the opaque-baseline condition than in the transparent condition ( $p < 0.005$ ). Finally, there is an effect of trial (mean log-odds = -0.044, 95% CI [-0.082, -0.007], SE = 0.000,  $p < 0.02$ )

### **8.3 DISCUSSION**

This experiment supports the hypothesis that the decision of whether to imitate or not is contingent on two things: the opacity of the function of the element that is to be imitated and the implied presence of (hidden) social goals.

In both adults and children we saw that there is a low rate of imitation when the situation was transparent, but a greater amount of imitation when the situation was opaque. The highest rate of imitation was seen when the participants were told to pay attention to the means that the experimenter used, a result that we attribute to the suggestion of a hidden goal. Further for both adults and children the ratio of path lengths had an impact on imitation rate. An increase in ratio resulted in a decrease in imitation. This decrease is stronger when the situation is transparent (and mechanistic efficiency is the only thing to take into account) and weaker when the situation is opaque.

These findings support the main claim: Humans are more willing to chose the mechanistically more efficient strategy when the goals are clear and do not require deviating from efficiency. They are less willing to do so when the context leaves it open as to whether the mechanistically more efficient strategy might result in a failure to achieve a hidden (social) goal. In line with the above, the effect of path length ratio varied between conditions. When the situation is transparent, choosing a much shorter path brings with it benefits in terms of mechanistic efficiency, but no penalties. When the situation is opaque, taking a much shorter path still is the mechanistically more efficient strategy, but the risk of not achieving a hidden social goal becomes much higher as well and to a degree outweighs the benefits. Thus the increase in path ratio leads to a lesser decrease in imitation rate in the opaque conditions. Finally, there is a small effect of trial in children, meaning that they imitate slightly more in later trials.

## **SECTION 4: GENERAL DISCUSSION, FUTURE DIRECTIONS AND CONCLUSION**

### **Chapter 9: *General Discussion***

The present research set out to further our understanding of imitation as a social learning mechanism for both actions and language across cultures. Past research has shown that human imitation goes beyond dumb mimicry - using social-cognitive skills, such as intention reading, humans imitate selectively, copying necessary actions more than unnecessary ones and intentional ones more than unintentional ones (Meltzoff, 1995; Carpenter, Akhtar and Tomasello, 1998; Bannard, Klinger and Tomasello, 2013). Despite this selectivity humans are the only species that imitates redundant and accidental actions at a high rate - they over imitate (Horner and Whiten, 2005). Recent research has also begun to investigate imitation in a cross-cultural context and found that while the human tendency to over imitate appears to be universal, the rate at which such overly faithful imitation occurs varies across cultures (Nielsen and Tomaselli, 2010; Clegg and Legare, in preparation; Berl and Hewlett, 2015). Most of the research on imitation has, however, focused exclusively on the instrumental rather than the verbal domain.

In the present work we aim at providing a clearer picture of imitation, covering both the instrumental and the verbal domain, both selective imitation and over imitation and find the link between all of these traits of human imitation. In order to do so, we undertook a series of experimental studies. The first two experiments were recreations of experiment one and two of Bannard, Klinger and Tomasello (2013). The tasks consisted of an imitation game that explored (1) whether children would take into account a novel word's function in the context of the utterance and (2) whether they would take into account whether a word was intentionally or accidentally uttered when imitating.

Experiment 1 was conducted with a group of Chatino children from Oaxaca, Mexico, a group of American children from Austin, Texas, USA and a group of Swiss children from Geneva, Switzerland. Experiment 2 was conducted on a group of Chatino children. For each of the two studies, we conducted an analogous instrumental control study as well. Experiment 3 was a replication of experiment three of Bannard, Klinger and Tomasello (2013). In this experiment we tested whether, like the German children tested by Bannard, Klinger and Tomasello, Chatino children were able to use intention reading when imitating verbal material. From the insights gained through the first three experiments we were then able to propose a unified theory that predicts when humans imitate, regardless of domain (instrumental or verbal) and culture. We then tested that theory in final fourth experiment.

In Experiment 1 we found that English-speaking children from Austin, Texas, USA and French-speaking children from Geneva, Switzerland imitate novel adjectives selectively with respect to whether the novel word was required by the functional context. Chatino children on the other hand did not show such selectivity. The results of the French-speaking group from Geneva, Switzerland being in line with the Texas group rule out some explanations for these differences across groups. Firstly adjective position in the respective language does not impact imitation behavior - despite English having pre-nominal and French having post-nominal adjectives, children from the two languages behave similarly in our imitation task. Additionally bilingualism can also be ruled out as an explanation for the behavior observed in the Chatinos. Both Chatino children and Swiss children are bilinguals, yet the Swiss children patterned like the monolingual American children. In Experiment 2 where the novel adjective clearly had a contrastive function in one condition, but not in the other, Chatino children imitated selectively,

supporting our experience-based account. In a third experiment we ruled out another explanation, that Chatino children lacked the intention-reading capabilities required for selective imitation. This leaves us with the initial hypothesis that the difference in verbal imitation is due to the different ways adjectives are used in referring expressions across cultures.

These findings are of particular interest because, on the basis of evidence from instrumental tasks, it has been proposed that imitation behavior is universal across cultures. The present research shows that while this might be true in most cases of imitation in the instrumental domain, in the domain of language there is variability. We propose that this variability stems from the differences in expectations regarding speech acts that children from different cultures and languages have. It then seems plausible that language is simply a domain where there is a greater amount of cross-cultural variability in the acts performed and the means used to perform them than in the instrumental domain (e.g., removing balls from novel boxes) in which previous studies have been conducted.

Imitation being contingent on prior experience has important implications for general theories of imitation, as it helps provide an answer to the paramount question of when people imitate and when they do not. One possibility is that children over imitate when the model's motives for their actions are opaque to them. In the instrumental task of Experiment 1, the purpose of the actions on the box was opaque to all children and hence all children over imitated. On the linguistic task, by contrast, the English- and French-speaking children were able to attribute a descriptive function in one condition, but not in the other condition and hence they imitated selectively. The Chatino children who might

have not been familiar with the descriptive use of adjectives were unable to attribute such a function to the adjective in either condition and hence imitated in both conditions.

This means that humans, when they can see the function (or lack of function) of elements of an action or communication, are able to selectively drop the redundant elements. When they are unsure about whether an element serves a function or not, they imitate. This hypothesis was tested in Experiment 4 and is supported by the results. In the board game task, when the rules indicate that there is no benefit to imitating the experimenter and taking the long path, participants do not imitate and take the short path. When the rules leave it unclear and, more so when they guide the participant towards the assumption that taking the long path might be a social goal of the task, participants imitate and take the long path at a higher rate.

The explanation provided by this general theory of imitation for the results obtained from Experiment 1, 2 and 3 are as follows: While those studies show cross-cultural differences in verbal imitation, the underlying mechanism that decides whether humans imitate or not might be universal. Different degrees of experience with certain communicative situations determine whether the function of a word produced by a model will be opaque or transparent to the learner and, in turn, whether the learner will imitate that word or omit it. As shown in Experiment 4, this principle seems to not only hold across cultures, but also across domains.

The general theory proposed as a result of the four experiments that we conducted has several implications for language acquisition. In principle the language learner will faithfully imitate elements of an utterance that he or she does not yet understand. This allows for two things: (1) keep the social interaction going (fulfilling the social goal) despite limited knowledge and (2) retain those elements to figure out their meaning later

on his or her own. Hence our theory suggests a model of language acquisition that is inherently socially motivated, as the learner acquires new elements socially from others, but also requires the learner to do part of the learning on his or her own, when he or she has to relate them to the world.

In the context of language acquisition our theory is compatible with the idea of ‘form and function pairings’ found in modern usage-based approaches to grammar (Croft, 2001; Tomasello, 2003). This idea suggests that words and grammatical rules are not treated as two separate entities, but assumes that words are meaningful to the grammar of a language and vice versa. The grammar that the learner acquires is input driven and is build around and relies on detecting patterns in the input.

Tomasello (2003) describes the learning process in several steps. First a child is exposed to and learns an entire utterance (e.g., “Givemetheball”). He or she is able to use it with a high level of success in its limited context, that is, to obtain the ball. Then, upon receiving additional input containing parts of the phrase, the child starts figuring out the meaning of the larger parts that constitute the utterance (e.g., that “Giveme” is used to obtain an object and “theball” refers to the particular object that is wanted). Tomasello (2003, p.92) calls this process of linking elements of an utterance to elements of meaning in the world “blame assignment”. As the individual elements of the utterance are not yet fully understood, errors can happen at this stage. After being exposed to even more input, the child is finally able to understand the meaning of every single element of the utterance and can generalize and draw abstractions from it. This would, for instance, entail the use of requests like ‘Could you give her the cup’ that are constructed by combining some elements of the original utterance with segments from other input.

The idea that children first learn language in chunks (e.g., the first step of the learning mechanism outlined above), before they break it down into individual elements, receives empirical support from a recent study by Bannard and Matthews (2008). In their study, Bannard and Matthews had young children repeat the last word of a four-word sequence. They found that children are better at repeating the last word, when it, together with the first three words, forms a sequence that is high in frequency (“a drink of tea”), than when the resulting sequence is low in frequency (“a drink of milk”), supporting the idea that initially a whole sequence is learned, rather than individual words like ‘tea’ or ‘milk’.

Further support for the usage-based approach to grammar learning comes from research on the acquisition of the past tense in English. The English past tense contains regular forms, where applying rule-like behavior will lead the learner to the correct outcome (e.g., applying the “-ed” ending: play, play-ed), as well as irregular forms that cannot be predicted by the general rule (e.g., the past of “seek” is “sought” and not “seek-ed”). When learning the past tense, young children display an interesting trajectory of competence. At first, when they have just learned the past tense of very few verbs, they correctly inflect both regular and irregular verbs. Then, as they learn more verbs, they start to make mistakes. For instance, they overgeneralize the regular “-ed” inflection to irregular verbs (e.g., “go-ed”), even if they previously inflected that same verb correctly (went). Then finally they are able to generalize the regular endings correctly to the regular verbs and use the respective correct irregular forms with the irregular verbs (Berko, 1958; Erwin, 1964).

Neurocomputational research, albeit focusing on the underlying neural architecture of learning, offers a usage-based account of the behavior displayed by



children who are acquiring the English past tense (e.g., Westermann, 1998; Westermann and Ruh, 2009; but see Chomsky, 1957 and Pinker, 1999 for a different approach). The learner learns each form as a whole, that is “play” is learned separately from “played”, no segmentation or identification of the meaning of the individual segments (i.e., stem, inflectional suffix) takes place. Then, as the learner receives more input containing the regular past tense ending “-ed”, he or she begins to detect the segment in the phrases he or she hears and starts trying to generalize it to other verbs. This is when overgeneralization errors (e.g., “go-ed”) occur. This means that even though the underlying understanding of the learner is greater than previously (they have some knowledge to the effect that “-ed” is the past tense ending and that “play” and “kick” are stems), the attempt to generalize that knowledge leads to a higher rate of errors. Later, the learner has received enough input to know when he or she can use the “-ed” ending and when the verb inflects irregularly. The learner then has an (almost) complete knowledge of the past tense and can inflect a wide range of verbs correctly.

While the usage-based approach to learning certainly is very popular in the field of language acquisition, it may also offer an account of behavior observed in general developmental psychology, where similar patterns of learning occur. Supported by evidence from several linguistic and non-linguistic experiments, Karmiloff-Smith (1982) proposes that problem solving (learning) takes place in three distinct phases. These phases can be linked to stages of usage-based learning outlined above. In phase 1, the “procedural phase”, the behavior of the child is predominantly data-driven, that is, generated by the adaptation to external stimuli, and is success oriented, that is aimed towards achieving a goal. This first phase corresponds to the phase of usage-based learning in which entire sequences of words or actions are learned as a whole, with focus

on reaching the goal, but not on understanding the sequences individual components. Phase 2, the “metaprocedural phase”, is characterized by the behavior being generated internally rather than through external stimuli. In a sense the child is “figuring out” the task and mistakes happen more than in phase 1. This second phase corresponds to the phase in usage-based learning in which the learner attempts to break down the entire sequence into its elements and find the meaning of each element (blame assignment); the learner also uses some elements in other contexts, which leads to overgeneralization errors. Phase 3, “the conceptual phase”, introduces a “subtle control mechanism” that mediates between the afore-mentioned mechanisms, such that neither data from the environment, nor internal representations dominate the problem solving process. As in phase 1, very few errors happen, but the underlying mechanism is more complex and involves a greater understanding of the task that allows for generalization. The behavior in the third phase described by Karmiloff-Smith can be compared to the last stage of the usage-based model. The learner has segmented the sequence of words or actions and has a good understanding of the meaning of each individual element, so that the success rate is high and overgeneralization errors do not occur when using the elements in other contexts.

Our findings from experiment 1 to 4 suggest that it might be of value to view social learning (e.g., imitation) through a usage-based lens. In our imitation studies, when the learner is first confronted with a novel sequence of actions or words, he or she has no idea what the individual elements of that sequence mean. The learner is focused on producing the correct outcome and imitates the whole sequence. An example of this would be the participants in the opaque-attend-to-means condition of experiment 4, who imitated the model (took the long path) frequently, or the Chatinos in experiment 1, who

seemed to not make the assumption that the adjective in the one-object condition was unnecessary and thus displayed high rates of imitation across conditions.

Then, when the learner has received more input, he or she starts to attempt to segment the sequence and assign meaning to its components. In this stage errors can happen, e.g., the learner drops an element of the sequence that was in fact not redundant, but necessary. The success rate may be worse than previously, when a goal-oriented always-imitate strategy was used. An example of this taken from experiment 4 would be participants who sometimes imitate (take the long path) and sometimes innovate (take the short path).

Finally, when the learner has figured out the meaning of the individual elements, he or she knows when the imitation of an element is required and when he or she can be selective and omit unnecessary elements. This would, for instance, be the case in the transparent condition of experiment 4, where the participants are fully aware of the rules of the game and are able to see that taking the long path (imitating the experimenter) is unnecessary to reach the goal of the game. Similarly, western children in experiment 1 and Chatino children in experiment 2 and 3 are mostly aware of the meaning of the adjective and selectively and successfully omit it when it is not required by the context.

In conclusion, the present research offers new insights into imitation behavior that can be linked to and generalize previously proposed theories of language acquisition and learning.

## **Chapter 10: *Future Directions***

Our findings from experiment 1, 2 and 3 lead to the hypothesis that children imitate language (and actions) selectively, when the meaning of each element of an utterance (or action sequence) is clear to them. When the meaning of these elements is opaque to them, however, they imitate faithfully. We argued that Western children, who are familiar with the descriptive use of adjectives are able to imitate selectively in Experiment 1, while Chatino children, who are not familiar with that descriptive use of adjectives imitate faithfully instead. We suggest that the difference in understanding descriptive adjectives is due to differences in the amount of pedagogic dyadic caregiver-child interaction across cultures: Children growing up in western middle class households participate in unusually high amount of dyadic caregiver-child interaction that leads to them being exposed to descriptive adjectives frequently, opposed to Chatino children, who in their daily life mostly interact with their peers. Although this hypothesis is strengthened by the findings of experiment 4, the study that explicitly test this hypothesis, further quantitative work on caregiver-child interaction (or peer-child interaction) in Chatino culture and on the linguistic input that Chatino children receive is required.

The method that Gaskins (2000) used to study Mayan children lends itself to the task. It entails a quantitative analysis of both the macro and micro behavior of children. The macro analysis captures what time children allocate to what activities each day. To provide an adequate macro analysis Gaskins used a method called spot observation (Munroe and Munroe, 1971), in which the researcher takes a “snapshot” of what the children he or she is observing are doing every 5 minutes. This method would allow the researcher to obtain a good idea of how much time Teotepec Chatino children spend in dyadic interactions with their caregiver and in polyadic interactions with their peers. The

microanalysis would then be a detailed video-based corpus study of children interacting with their parents and children interacting with their peers. This would provide much useful information on the kind and amount of child-directed speech Chatino children receive and could also be used to quantitatively determine their exposure to adjectives in the descriptive and contrastive function (Shneidman and Goldin-Meadow, 2012). As the factors that would be investigated by such a study are contingent on the age of the children, an age range from at least 2 to 10 years should be studied.

While the above-described data collection and subsequent corpus creation and analysis would likely give strong support for the hypotheses put forward in the present research, they would also be a valuable resource for future research on child development and language acquisition in Chatino and, in the grand scheme of things, add to a growing body of work documenting the Chatino people and their culture.

## **Chapter 11: *Conclusion***

In conclusion, the present research set out to extend quantitative studies on human imitation to the verbal domain and to do so in a cross-cultural context. We compared verbal and instrumental imitation behavior of children of two western and one indigenous culture. In particular we were interested in whether imitation behavior varies across domains (instrumental and verbal) and cultures (western vs. indigenous). We found that despite showing similar patterns in some of the tasks, western and indigenous children displayed different behaviors: While western children imitated novel adjectives selectively (imitate when the adjective was necessary in the context of the utterance, omit it when it was not), indigenous Chatino children imitated faithfully throughout. Backed up by evidence from subsequent studies, we proposed that these differences arise from differences in time spent in dyadic caregiver-child interactions across cultures, which might have lead to Chatino children having less experience with adjectives used in their descriptive function (when they serve to highlight a property of a referent, rather than when they serve to establish reference). We propose a general theory of imitation, which states that when humans decide whether to imitate or to omit elements, their decision is contingent on the opacity of the situation. When the situation is clear to them and they know the role that each element of an utterance or a sequence of actions plays, they can omit unnecessary elements, which results in selective imitation. When the situation is opaque to them and they do not know the role of all of those elements they resort to a safety-first strategy of faithful imitation - this allows them to (1) fulfill the social goal of the interaction, which is to keep the interaction going, (2) to retain elements that they do not yet understand in order to resolve their meaning later on. What elements of an utterance or action are understood, is in turn determined by the experiences one has

growing up in one's respective culture. Evidence from our last study supported this theory in a more general context that goes beyond the verbal domain. The present research thus adds to the growing field of work on human imitation by providing quantitative evidence in the previously underexplored linguistic domain, but also puts forward the novel theory that opacity and hidden social goals are important factors in human imitation.

## Appendix

For Experiment one, two and three we used the following adjectives and items in Chatino:

st7a-K	Flower
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Mtun-X	Duck
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Kl7en-X	Shovel
---------	--------

kchin-X	Bottle
---------	--------

tin-X	Glasses
-------	---------

tun-X	Cup
-------	-----

lwu-X	Spoon
-------	-------

7en-X	Bucket
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Here ‘7’ stands for a glottal stop and ‘-X’ and ‘-K’ are relaxed tones.

In the warm-up we additionally used the following items: airplane, key, die, big/small ball, long/short thread, red/blue block, dark/light bird, egg, horse, as well as the following adjectives: ka-X tun-X, ta-X kan-X.

In Experiment 2 we also used four distractor objects: plate, plastic fork, pencil and comb.



For Experiment 1 with the Texas group we used the following adjectives and items:

pody	Flower
gorby	Duck
wassy	Shovel
truby	Bottle
renny	Glasses
bribby	Cup
jopy	Spoon
snibby	bucket

In the warm-up we additionally used the following items: airplane, key, die, big/small ball, long/short thread, red/blue block, dark/light bird, egg, horse, as well as the following adjectives: noppy, lumby.

For Experiment 1 with the Geneva group we used the following adjectives and items:

Geneva:

mitue	Flower
mané	Duck
chulé	Shovel

tarsie	Bottle
fibé	Glasses
patru	Cup
bruffie	Spoon
fatré	bucket

In the warm-up we additionally used the following items: airplane, key, die, big/small ball, long/short thread, red/blue block, dark/light frog, egg, horse, as well as the following adjectives: sabé, trossé.

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