LEARNING A SECOND LANGUAGE: GLOBAL PROCESSING AND WORD LEARNING IN INFANTS

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LEARNING A SECOND LANGUAGE: GLOBAL PROCESSING AND WORD LEARNING IN INFANTS

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The present set of studies explore how infants make their first breakthroughs into a second language. I approach this question by experimentally exposing monolingual children to a second language at different points in development in the first two years. The three studies examine how monolingual English-learning infants and toddlers (aged between 8 and 26 months) process and segment speech in an unfamiliar language (i.e., Spanish) and how they learn novel labels in this language. In this regard, I focus primarily on the cognitive and pragmatic mechanisms that might underlie these abilities.

Overall, these studies provide preliminary evidence that monolingual infants are able to process an unfamiliar language at a global as well as at a more refined level, while showing developmental differences in these abilities between 8 and 18 months. Second, this dissertation provides evidence of an emerging understanding of conventionality in a bilingual context in 19-month-old monolingual infants. Specifically, infants' word learning behaviors in a bilingual context suggest that they understand that a new language, or a 'communicative context', signals a distinct labeling norm, and this understanding might cue them to accept two labels, one in each language, for a single object. Finally, this dissertation also demonstrates that familiarity with a label in the first language might be a possible mechanism that facilitates learning the equivalent label in the second language.

BIOGRAPHICAL SKETCH

Born and brought up in India, Jui Bhagwat always loved books, language and people. Little wonder then that she chose to pursue psychology, particularly the psychology of how children learn language. After receiving a Bachelor of Arts degree in Psychology from Fergusson College in Pune (India) in 1999, Jui went on to get a Masters in Social Work from the Tata Institute of Social Sciences located in Mumbai. Enriched by her experiences while working with diverse groups of people all over India, and armed with new perspectives, Jui came to Cornell University in 2002 to pursue doctoral studies in the Department of Human Development. Jui received her PhD in Developmental Psychology in 2008, and is looking forward to continuing a life committed to learning, and the pursuit of knowledge.

For Amit

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CHAPTER 1

INTRODUCTION

1.1 Bilingualism and Early Second Language Acquisition

'Bilingual language acquisition' broadly refers to language development in children who grow up learning more than one language. Different researchers have proposed different criteria to define this phenomenon. For instance, bilingual language acquisition can be categorized into different kinds depending on *when* the child starts learning two or more languages (Meisel, 1989). While some propose that 'simultaneous acquisition' can include children who are exposed to both languages before the age of 3 or 4 years (Meisel, 2004), others believe that 'simultaneous acquisition' or 'bilingual first language acquisition' (BFLA) should include only those children who start learning the second language at birth or at most a month after birth. According to this cut-off, cases where regular exposure to the second language starts no earlier than one month after birth but before the age of two would fall under the category of 'bilingual second language acquisition' (De Houwer, 1995) or 'early second language acquisition' (e.g., Pearson, in press). However, there is often no clear line of division between these two types of bilingual development. It is not clear what the limits are of 'early' in early SLA, nor what the nature of second language learning is for the child learner (Pearson, in press).

At the same time, evidence from speech perception studies on the youngest infants supports the more stringent definition. Not only do newborn infants display a preference for their native language (Moon, Panneton-Cooper, & Fifer, 1993), but they are also able to discriminate between languages that differ in

rhythm (Mehler, Jusczyk, Lambertz, Halstead, Bertoncini, & Amiel-Tison, 1988). Between 6 and 12 months of age, infants show a decline in sensitivity to non-native speech sounds (Werker & Tees, 1984), while learning about the regularly occurring sound patterns in the native language (e.g., phonetic contrasts, rhythmic patterns, and combinations of sounds) that would help them to segment words from the speech stream in this language (see Jusczyk, 1997 for a review). In light of evidence that suggest that by the end of the first year, infants are becoming increasingly sophisticated processors of the native language, it makes sense to propose that in order to count as bilingual first language acquisition, the infant must have exposure to the two languages from birth onwards. If a second language is introduced anytime after the middle of the first year, it is highly likely that the perception of this second language will be influenced by experiences with the first language.

However, given the lack of sufficient evidence with bilingual children acquiring two languages from different points in development, the question of what qualifies as 'simultaneous acquisition' remains an open one. Whether bilingual development follows different trajectories depending on whether the child is exposed to both languages in the first, second or third year is an empirical question, and one that can only be answered by examining different groups of children (Genesee & Nicoladis, 2007). Specifically, the question of how infants learn a second language, after being exposed to another language (i.e., the first language) for the first few months in the first two years of life, is largely unexplored.

1.2 The Current Research Program

The present set of studies represents an attempt to answer this question by experimentally exposing monolingual children to a second language at different points in development in the first two years. Broadly, my research explores how infants make their first breakthroughs while learning a second language early in development. I approach this question through studies that examine how monolingual English-learning infants (between 8 and 26 months) process and segment speech, and how they learn novel labels in a language that is unfamiliar to them (i.e., Spanish). In doing so, I will primarily focus on the cognitive and pragmatic mechanisms that might underlie these abilities.

For instance, when first exposed to an unfamiliar language, infants must first learn to discriminate this language from the first language, and then learn how to segment the speech stream into meaningful units, such as words. The first study presented in this dissertation addresses this question. Later in development, when they are learning to map words onto referents, they must learn that each of the languages in their environment has a different 'way' of naming things, that is, infants in a bilingual context must learn that each referent can have two different names. The second study addresses how such an understanding develops when children are exposed to more than one language. The third study goes a step further, and examines how familiarity with certain object labels in the first language might play a role in learning the equivalent labels in the second language.

The study presented in Chapter 2 was broadly designed to explore infants processing of an unfamiliar language, both at a global level (i.e., do infants dis-

criminate between phrases spoken in English vs. Spanish?) and a more refined level (i.e., do infants segment the speech stream to identify a novel word?). We were also interested in developmental changes in these abilities in infants from the middle of the first year to the middle of the second.

The study presented in Chapter 3 asked whether whether young monolingual children would be able to learn two different labels for a single object, if each of these labels was presented in a different language. Specifically, one label was presented in a familiar (i.e., English) context and one was presented in an unfamiliar (i.e., Spanish) context. Broadly speaking, this study explored monolingual 19-month-old infants' understanding of the 'conventionality' of language when presented with an unfamiliar language. Conventionality refers to an assumption made by speakers of a language: the assumption is that speakers of a language represent a linguistic community and therefore speakers of a language share knowledge of the words of that language (Clark, 1988, 1990). However, in a bilingual context, one could say that there are two levels of 'conventionality'. The first level is an understanding that different languages signal different communicative systems, each with its own labeling norms, and the second level of understanding is that speakers of each language share knowledge of only that language. Chapter 3 examined the emergence of the first level of an understanding of conventionality in monolingual infants who were presented with a label in an unfamiliar context.

The study presented in Chapter 4 aimed to examined some of the mechanisms that underlie early word-learning for infants who are born into monolingual families but are gradually exposed to a second language from very early in development. We set out to examine one possible factor contributing to (or

a mechanism underlying) word learning in a second language. Specifically, we asked whether familiarity with a word and its meaning in the first language would influence infants' ability to learn the equivalent word (i.e., the translation equivalent) in the second language? The study examined the ability of monolingual, 19- and 25-month-old infants from English-speaking families to learn Spanish labels for two kinds of objects – familiar (i.e., objects for which infants have names in English) and novel (i.e., objects for which infants do not have names in English).

Overall, findings from these studies provide preliminary evidence that monolingual infants might indeed be able to process an unfamiliar language at a global as well as at a more refined level, while showing developmental differences in these abilities between the middle of the first and second year. Second, this dissertation provides evidence of an emerging understanding of conventionality in a bilingual context in 19-month-old monolingual infants. Specifically, infants' word learning behaviors in a bilingual context suggest that they understood that a new language (i.e.,'communicative context') signaled a distinct labeling norm, and this understanding cued them to accept two labels, one in each context, for a single object. Finally, this dissertation also empirically demonstrates that familiarity and experience with a label in the first language might be a possible mechanism that facilitates learning the equivalent label in the second language.

1.3 Overview of Dissertation

Chapters 2, 3 and 4 are presented in the form of empirical papers examining the specific issues outlined in the previous section.

In Chapter 5, I summarize the main aims and findings of the empirical studies that form the core of this dissertation. Next, I highlight the open questions that emerge from these findings, while proposing future directions that stem from these questions. For example, an idea that emerges from Chapter 2 is that similarities and differences between the properties of a bilingual infant's languages might play an important role in influencing how the infant processes these languages. Furthermore, these characteristics might differently affect language processing depending on the specific aspect of processing (e.g., language discrimination versus word segmentation) that is being examined. In line with this idea, I present some of the studies that have addressed this issue, and discuss the need to examine language processing in infants learning different pairs of languages.

Based on the findings from Chapter 3, I discuss the role of conventionality in a bilingual context, and present theoretical perspectives as well as evidence from bilingual children that might inform future research in this area. Based on the findings from Chapter 4, I propose a program of research that examines the how experience in the first language might influence learning different aspects of a second language (e.g., nouns versus verbs).

CHAPTER 2

DISCRIMINATING LANGUAGES AND SEGMENTING WORDS IN AN UNFAMILIAR LANGUAGE: EVIDENCE FROM 8- TO 18-MONTH-OLD INFANTS

2.1 Introduction

There has been a great deal of research on language discrimination in younger infants (see Nazzi & Ramus, 2003 for a review). Similarly, many studies have examined infants' ability to attend to elements in the speech stream in their native language. These 'elements' might be words (e.g., Jusczyk & Aslin, 1995), phrases (e.g., Soderstrom, Seidl, Kemler Nelson, & Jusczyk, 2003), or clauses (Nazzi, Kemler Nelson, Jusczyk & Jusczyk, 2000). However, we know little about how these processes unfold when an infant is faced with an unfamiliar language. The present study was broadly designed to explore infants processing of an unfamiliar language, both at a global level (i.e., do infants discriminate phrases spoken in English vs. Spanish?) and a more refined level (i.e., do infants segment the speech stream to identify a novel word?). We were also interested in developmental differences in these abilities in infants aged between 8 and 17 months.

Rhythmic (or prosodic) properties of a language may be the first cues that help infants to discriminate between languages. Rhythm is considered to be a result of specific elements (that differ from language to language) that recur at regular intervals, and thus establish temporal organization. For some languages (including most Romance languages such as French, Italian, and Spanish), these recurring elements are syllables, and thus these languages can be classified

as syllable-timed languages. For other languages (including most Germanic languages such English, German and Dutch), these recurring elements are the places where stress is placed (i.e., the rhythm is based on the inter-stress intervals), and these languages are classified as stress-timed languages. A third category comprises languages that have a rhythm based on the mora (e.g., Japanese and Tamil) (Abercrombie, 1967; Pike, 1945).

A vast body of research has documented infants' ability to discriminate languages based on rhythmic class, as well as developmental changes in this ability. For instance, newborn infants can discriminate languages from different rhythmical classes (e.g., Spanish from English) but not from the same rhythmical class (e.g., Dutch from English) (Mehler, Jusczyk, Lambertz, Halstead, Bertoncini, & Amiel-Tison,1988; Nazzi, Bertoncini & Mehler, 1998; Mehler & Christophe, 1995). By 2 months of age, although discrimination still appears to be based on the global prosody of languages (Christophe & Morton, 1998; Mehler et al., 1988), the native language starts gaining a special status (Dehaene-Lambertz & Houston, 1998; Mehler, Dupoux, Nazzi, & Dehaene-Lambertz, 1996). By 5 months, the increased sensitivity to the native language is more evident; 4- to 5-month-old monolingual infants can discriminate their native language from another language within the same rhythmical class, but cannot discriminate two unfamiliar languages, even from the 'native rhythmical class' (Bosch & Sebastián-Gallés, 2001; Nazzi, Jusczyk & Johnson, 2000). These findings have led researchers to propose that initially discrimination may depend on the global properties (i.e., the broad rhythmic characteristics of a language), but with increasing experience with the native language, infants get increasingly attuned to the specific properties of the native language (e.g., Nazzi & Ramus, 2003).

The global rhythm of a language not only influences infants' ability to discriminate between languages, but also has implications for the way both adults and children segment their native language (Cutler & Mehler, 1993; Mehler & Christophe, 2000; Mehler et al., 1996). Specifically, speakers of different languages have been shown to use distinct procedures to parse the speech signal. The syllable is the segmentation unit for speakers of syllable-based languages such as French, Spanish, Catalan and Portuguese (e.g., Mehler, Dommergues, Frauenfelder, & Segui, 1981; Sebastián-Gallés, Dupoux, Segui, & Mehler, 1992). Seakers of stress-based languages such as English and Dutch are guided by typical stress patterns in words which occur due to an alternation of strong and weak syllables, and they use this rhythm as a cue to mark the onsets and offsets of words, (Cutler, Mehler, Norris, & Segui, 1986; Cutler & Norris, 1988; Vroomen & de Gelder, 1995).

The current study was designed to be a preliminary step towards understanding the processes of learning a second language. First, we asked whether infants discriminate between their ambient language (i.e., English) and an unfamiliar language (i.e., Spanish). Second, we examined whether infants would be able to discriminate object-labels that were embedded in the unfamiliar language. Finally, we explored developmental differences in these abilities between 8 and 17 months.

First, we asked whether infants would discriminate between phrases spoken in English vs. Spanish. Based on evidence that the native language starts gaining special status for infants over the first year (e.g., Nazzi & Ramus, 2003), and on findings that young infants from both English- and Spanish- speaking families can discriminate the two languages (Bahrick & Pickens, 1988; Bosch

& Sebastián-Gallés, 1997; Moon, Panneton-Cooper,& Fifer, 1993), we expected 8-, 13-, and 17-month-old infants in the current study to succeed at the task of discriminating English from Spanish.

The second question we asked was whether infants would segment words or labels that were embedded in naming phrases, particularly in the unfamiliar language (i.e., Spanish). English-learning infants have been found to use a wide range of information that is present in the speech stream in order to segment words. By 7.5 months of age, not only are they able to detect words in speech (Jusczyk & Aslin, 1995), but they also demonstrate the ability to use stress to mark the boundaries of words (Jusczyk, Cutler & Redanz, 1993; Jusczyk, Houston, & Newsome, 1999). There is also some evidence that suggests that segmentation strategies in one language do transfer to the second language, at least when the two languages belong to the same rhythmic class. Nine-month-old English infants were also able to segment words from fluent speech in an unfamiliar language (i.e., Dutch) that is similar to English, in that it also follows a stress-based rhythm (Houston, Jusczyk, Kuijpers, Coolen, and Cutler, 2000). However, Canadian English-learning 8-month-olds could not segment words presented in Canadian-French (Polka & Sundara, 2003). Similarly, Tsay, Newsome and Jusczyk (as reported in Jusczyk, 2001) found that English-learning 7.5-month-old infants could not segment familiarized words from Mandarin Chinese.

Apart from rhythmic information, English-learning infants have been found to rely on a range of other cues to segment the speech stream. Between 6 and 9 months, infants become sensitive to 'phonotactic'[1] regularities (Jusczyk,

[1]Phonotactics refer to the constraints on the ordering of segments within and between the words of a language. For example, the sequence [nt] is found within the syllables of many English words, whereas the sequence [mt] is not. They constitute a potentially important source of

Friederici, Wessels, Svenkerud, & Jusczyk, 1993; Friederici & Wessels 1993), and by 9 months, they prefer to listen to novel words that contain sound clusters that occurred frequently as within-word clusters in English (eg., [ng]occurs in words such as long and sang) as compared to sound clusters that occur frequently as between-word clusters (e.g., [gt] does not typically occur within words but is more likely to occur across boundaries)(Mattys & Jusczyk, 2001; Mattys, Jusczyk, Luce & Morgan, 1999). Similarly, 10.5-month-olds can not only discriminate between similar sounding sequences such as "nitrates" and "night rates", but once familiarized with either of these sequences, they show a preference for a subsequent passage containing the familiarized version, indicating that they are sensitive to 'allophonic'[2] cues (Jusczyk, Hohne & Baumann, 1999).

Infants also use distributional regularities, such as 'transitional probabilities' to segment words from the speech stream. The transitional probability between two syllables that fall within a word is higher than between two syllables that occur across words. For instance, after being familiarized with an artificial speech stream that contained 3-syllable nonsense words, 8-month-olds recognized as novel those syllable sequences that did not occur within words but that had occured at word boundaries in the original speech stream (Aslin, Saffran, & Newport, 1998; Saffran, Aslin, & Newport, 1996). Infants can also combine distributional and rhythmic cues in order to segment speech (e.g.,Jusczyk, et al., 1999; Mattys, et al., 1999; Mattys & Jusczyk, 2001; Morgan, 1994; Morgan & Saffran, 1995). In fact, there is an increasing consensus that word segmentation should be viewed as an integrated process in which multiple cues interact and

information by providing cues about the likelihood of a given segment (or phoneme) occurring within a word or between words.

[2]Allophones are phonemes that have different phonetic realizations depending on their positions in words or syllables. For example, in "nitrates", [t] is asprirated, released, and retroflexed , while it may be unaspirated and unreleased or glottalized in "night rates"; [r] is largely devoiced in "nitrates" but voiced in "night rates".

compete for optimal parsing interpretations, instead of separate strategies acting independently (Jusczyk, 1999; Mattys & Jusczyk, 2001; Mattys et al., 1999).

One of the aims of the current study was to examine infants' ability to identify and discriminate word, specifically, object-labels. Therefore, the linguistic stimuli (i.e.,the naming phrases) were paired with a novel object. This object was referent of the label that was embedded in the phrases. One reason that object labels were used was to make the task more ecologically valid. Several studies have shown that American English-speaking mothers talk a great deal about objects while taking to their infants (Choi, 2000; Fernald & Morikawa, 1993; Tamis-LeMonda, Bornstein, Cyphers, Toda & Ogino, 1992; Tardif, Shatz, & Naigles, 1997). In light of these findings, we reasoned that the participants in the current study would be familiar with linguistic input provided in conjunction with a referent.

From a developmental perspective, the referential nature of the stimuli might play a differential role for the 13-month-olds as compared to the 17-month-olds. A number of word-learning studies, particularly those using audio-video recordings of stimuli, have shown that by approximately 18 months of age, infants are easily able to segment and learn novel words for objects presented in a variety of sentential contexts in their native language (e.g., Tan & Schafer, 2005; Trehub & Shenfield, 2007). In fact, there is also evidence that 17-month-old infants can interpret novel words embedded in a nonsense sentence frame as object names (Namy & Waxman, 2000). After receiving training with a familiar label embedded in a phrase composed of a string of nonsense words (e.g., 'Look! Shaylem bosher key!') 17-month-olds also interpreted a novel word embedded in the nonsense phrase as a label (e.g., 'Look! Shaylem bosher blicket!). A re-

cent study also specifically explored the link between word-segmentation in an artificial language and the ability to attach meaning to these newly segmented words (Graf Estes, Evans, Alibali, & Saffran, 2007). Seventeen-month-olds infants were first tested on their ability to segment words (i.e., syllable sequences with high transitional probabilities) from a stream of speech in an artificial language. Following successful segmentation, infants were presented with a word-learning task that entailed treating these segmented words as labels for objects. Results suggested that infants were indeed able to learn these words as labels for objects in the word-learning task. In contrast, they did not treat novel syllable sequences (that had not been words in the word-segmentation task), or syllable sequences that had low transitional probabilities (i.e.part-words) as acceptable labels. These findings suggest that infants are able to segment words from a stream of speech in an artificial language solely on the basis of statistical probabilities, and subsequently attach meaning to these 'words'. In light of these findings from studies using artificial language, we could expect infants to process a novel, natural language in a similar way.

Studies have also found developmental differences between word-learning abilities at 12 to 15 months and 17 months, with older infants showing more robust learning, while younger infants' learning was more susceptible to disruption by minor changes in how the comprehension is tested (Woodward, Markman, & Fitzsimmons, 1994), the naming contexts used tp present the words (Trehub & Shenfield, 2007), and the position of the word in the sentence (Fernald & McRoberts, 1993). Furthermore, studies examining recognition of familiar labels (e.g, 'dog', 'ball', and so on) have found age-related improvements in the speed and efficiency of processing these words between the ages of 15 months and 24 months (Fernald, Pinto, Swingley, Weinberg, & McRoberts, 1998).

In light of these findings, we expected to observe age differences in infants' ability to attend to the novel word in the current task. Specifically, for the 8-month-olds, the task might simply tap into their word segmentation abilities in which case, they should show evidence of segmenting the word from the speech stream. However, if the inclusion of the visual stimuli renders the task more referential, we might see differences in how the 13-month-olds and 17-month-olds perform at this task.

To recap, first, we asked whether infants discriminate between their ambient language (i.e., English) and an unfamiliar language (i.e., Spanish). Second, we examined whether infants would be able to discriminate object-labels that were embedded in the unfamiliar language. Finally, we explored developmental differences in these abilities between 8 and 17 months.

2.2 Method

Participants

Participants were 78 infants in three different age groups: 26 16- to 18- months ($M = 17.6, SD = 0.7, range = 16.5 - 18.7$); 28 12- to 14- months ($M = 13.2, SD = 0.6, range = 12.2 - 14.1$); and 24 7- to 9- months ($M = 8.5, SD = 0.6, range = 7.1 - 9.4$). All infants came from monolingual English-speaking families in the Ithaca area. An additional 15 infants were tested but excluded from the final sample due to fussiness and inattentiveness ($N = 8$); or not meeting the habituation criterion ($N = 5$); or not finishing ($N = 2$) .

Stimuli

The language stimuli consisted of short naming phrases in English and Spanish that were produced by a fluent English-Spanish bilingual female speaker. One of the following two novel words – 'modo' and 'feliz' – was embedded in these phrases. These words were chosen because they are phonotactically legitimate in both English and Spanish. The habituation and test stimuli consisted of six such phrases in English and Spanish. For instance, the English phrases were, *"Look, a modo...See, its a modo...Are you watching? This is a modo...Wow, its a modo. I like it. It is a modo...Ooh, how I like the modo"*. The equivalent Spanish phrases were, *"Mira, un modo...Ves, es un modo...¿Estás viendo? Es un modo...Wao, un modo. Me gusta...Es mi modo...Ay, que lindo el modo"*. These auditory stimuli were accompanied by visual recordings of two novel objects. The two objects were: 1) a colorful plastic toy that when expanded, resembled a ball, and when contracted, resembled a flower; and 2) a colorful mobile, made out of Modeling Magic, with six parts of varying shapes, which could be dangled and swung (See Figure 2.1). The word-object pairing was counterbalanced across participants.

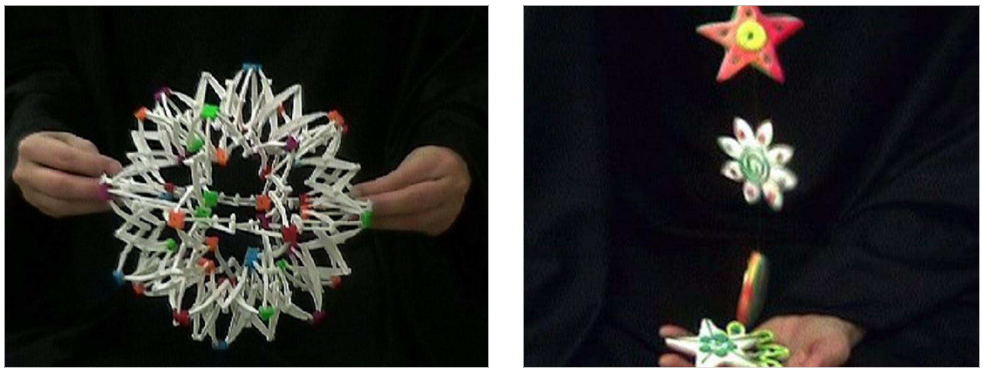


Figure 2.1: Stimuli objects

The audiovisual stimuli were recorded with a Canon digital video camera and edited using iMovie and Quicktime. Each event depicted a seated woman holding the novel object at about waist height, so that only her hands were visible. The woman was dressed in dark clothing which created a dark background against which the objects were presented. The video recordings depicted the toy being moved by the woman in tandem with the auditory stimuli. For the plastic ball, the video started with the ball being held in its contracted form so that it looked like a multi-dimensional 'star that was held by two of its tips. The video of the mobile started with the mobile held in a pile in the womans hands. From this point, the objects were moved in tandem with each phrase. As the first phrase was presented, the ball was expanded and then contracted back into the original position, whereas the mobile was held at its two ends, 'unfolded', and then brought back into a pile again. This alternating movement continued with each of the phrases that followed. The same six phrases were used for both habituation and test trials. Each habituation and test trial was 23 s long and consisted of six repetitions of the target word in in six different phrases. Habituation and test trials were identical.

Apparatus

The experiment was conducted in a quiet, dimly-lit enclosure within a larger room. The experimenter sat at a desk in the larger room, and controlled the presentation of the stimuli and recorded infants looking times, using the Habit X program (Cohen, Atkinson & Chaput, 2004) and a Macintosh G5 computer. The testing enclosure contained a 20-inch color computer monitor that was placed on a table at infants eye level and was about 127 cm from where the infant

was seated. A Panasonic camera under the monitor was linked to a VCR and monitor at the experimenters desk. This monitor allowed the experimenter to observe the infants and record their looking times during each trial.

Procedure

Infants were randomly assigned to the English or Spanish condition. After providing informed consent, parents completed the MacArthur Communicative Development Inventory Short-Form: Infant or Toddler Version (Fenson, Pethick, Renda, Cox, Dale, & Reznick, 2000). Infants and their parent were then taken to the testing room and infants were seated on their parents lap in front of the monitor. From the adjoining room, the experimenter began the testing session by initiating the Habit program. An attention-getter (a green circle that chimed as it expanded and contracted) was presented prior to each trial to direct infants attention to the monitor. Once infants attended to the monitor, the experimenter depressed one key on the computer keyboard to begin a trial. During habituation, infants viewed a single event, presented in English or Spanish, depending on the condition. For instance, the habituation event for an infant in the English condition would depict either the ball or the mobile paired the English naming phrases, embedded with either of the two novel words ('modo' or 'feliz'). The word-object pairings were counterbalanced across participants. Infants viewed the habituation event until their looking time across three consecutive trials decreased by 50% from their looking time during the first three habituation trials.

During the test phase, infants viewed three trials. In the familiar test trial, infants viewed the same event as during habituation. This test trial was included

as a baseline or comparison to infants looking to the novel test trials. In a second test trial, infants viewed the same object-label pairing seen during habituation, but with the label embedded in the different language (English or Spanish, depending on the habituation condition). A third test trial consisted of the same object seen during habituation, paired with the same language but with a new label. For example, an infant in the English condition might hear the following phrases during habituation: *"Look, a modo...See, it's a modo..."*and so on. Subsequently the infant would be tested with one trial (henceforth known as the 'novel language' trial) comprising the equivalent phrases in Spanish (e.g., *"Mira, un modo...Ves, es un modo...?"* and so on), and a second trial (henceforth known as the 'novel label' trial) comprising the same English naming as heard druing habituation but with a new label embedded within (e.g.,*"Look, a feliz...See, it's a feliz..."* and so on). Thus in the 'novel label' trial, the same object was now paired with a novel label. For each child, the novel object remained constant through habituation and testing. The order in which these three events were presented was counterbalanced such that half the infants viewed the familiar trial first followed by the novel language-trial, and the remaining infants viewed the trials in the opposite order. For all infants, the novel label-trial was always presented third and last. Finally, to establish inter-observer reliability, the looking times of a randomly chosen sample of 22 infants were coded offline. The average correlation between on-line and offline-looking time was .98 (range = .97 - .99), indicating high inter-coder reliability.

2.3 Results

Habituation Phase

Infants required an average of 9.85 trials to habituate ($SD = 3.83$). Since the target label was repeated 6 times in each trial, infants heard the label an average of 59.1 times. The first analysis compared infants looking times during the first 3 habituation trials to looking times during the last 3 habituation trials. A 2 (condition: English vs. Spanish) by 2 (trials: average of first three habituation trials vs. average of last three habituation trials)by 3 (age-group: 8 months vs. 13 months vs. 17 months) mixed-model ANOVA yielded a significant main effect of trials, $F(1, 72) = 932.81, p < 0.001, {\eta_p}^2 = 0.93$. Infants looked significantly longer during the first three trials, ($M = 18.38s, SD = 4.67s$) as compared to the last three trials ($M = 6.39s, SD = 2.24s$) of habituation. We also found a significant interaction of trial by age-group,$F(1, 72) = 5.75, p < 0.01, {\eta_p}^2 = 0.14$. The 17-month-olds looked longer during the first three habituation trials ($M = 20.67s, SD = 3.48s$) as well as the last three trials ($M = 7.11s, SD = 2.26s$) as compared with 13-month-olds (first three: $M = 16.23s, SD = 5.27s$; last three:$M = 5.92s, SD = 2.27s$) and 8-month-olds (first three: $M = 18.43s, SD = 3.98s$; last three:$M = 6.17s, SD = 2.09s$).

To ensure that infants did not meet the habituation criterion as an artifact, infants average looking time to the first three habituation trials was compared to their looking time to the familiar test trial in a 3 (age-group) x 2 (trials: average of first three trials vs. looking time to familiar test trial). Infants did look significantly longer at the first three trials as compared to the familiar test trial ($M = 7.19s, SD = 6.07s$), $F(1, 75) = 189.05, p < 0.01, {\eta_p}^2 = 0.72$.

Test Phase

Since factors such as the order in which the test events were presented, and the object-label pairing that each infant viewed during the experiment were counterbalanced across participants, our preliminary analyses included these variables as 'between-subjects factors'. These analyses did not reveal any effects of these factors, and they were excluded from the remaining analyses.

Next, infants' looking times were analyzed in a 2 (condition: English vs. Spanish) by 3 (test trial: familiar vs. novel language vs. novel label) by 2 (sex: male vs. female) mixed-model analysis of variance (ANOVA). This initial analysis failed to reveal any significant effects, $F(1, 72) = 1.63, ns$. Overall, infants had a mean looking time of 7.19 s ($SD = 6.07s$) to the familiar trial, as compared with 8.17s ($SD = 5.85s$) to the novel language-trial, and 7.53s ($SD = 5.48s$) to the novel label-trial. Closer inspection of the data revealed that some infants had unusually high looking times during the familiar test trial. A box-plot analysis of the looking times to the familiar trial showed that 10 infants were outliers. This finding was unexpected in light of the fact that this trial was identical to the habituation trial.

A histogram plotting infants' looking times to the familiar test event revealed a bimodal distribution with 10 infants showing high looking times (> 15 s) to the familiar event ($M = 21.65s, SD = 1.99s$) (See Figure 2.2). Of these infants, six were 17-month-olds, three were 13-month-olds, and 1 was an 8-month-olds. The mean looking time for the remaining infants ($N = 68$) was 5.06s ($SD = 2.46s$). This pattern of an unusually high looking time to the familiar test trial raised the question of whether these infants had truly 'habituated' to the event. As mentioned in the previous subsection, one way to determine

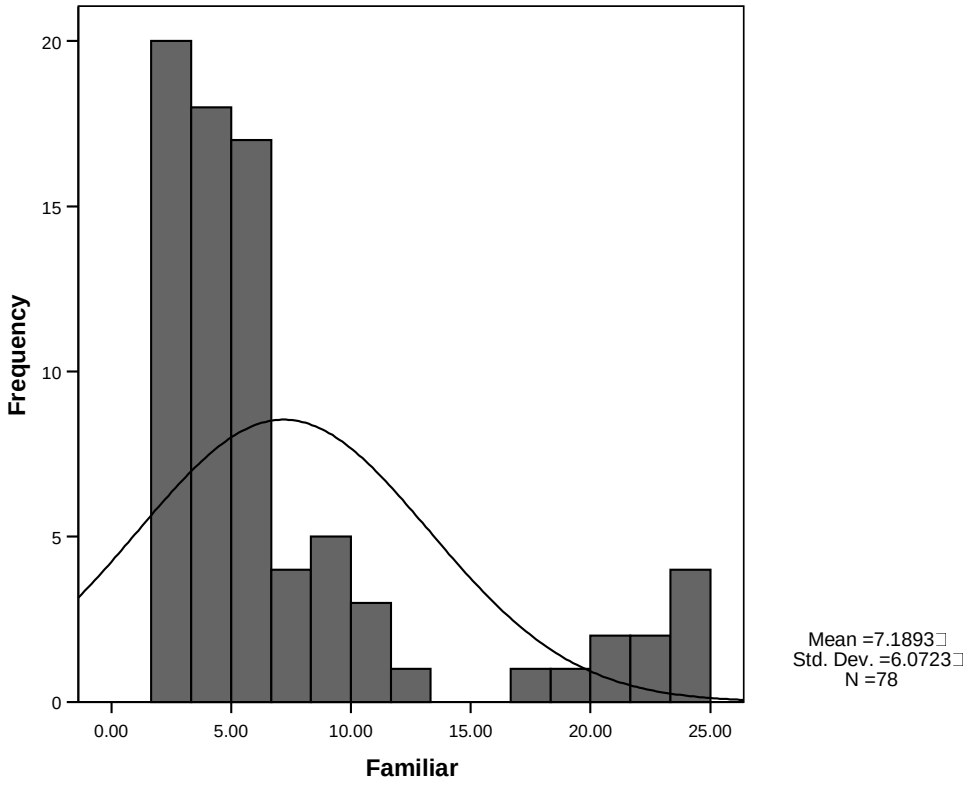


Figure 2.2: Histogram of infants' looking times to familiar test trial

the reliability of habituation is to compare the average looking time during the first three habituation trials to the familiar trial. If infants have habituated, we should see a significant difference between the first three habituation trials and the familiar trial as demonstrated earlier when all the infants were included.

In order to explore this possibility, we conducted a separate set of analyses for this group of infants comparing the average looking time during the first three habituation trials to the looking time to the familiar test trial. We included 'test-order' as a 'between-subjects' factor in this analysis in order to rule out the possibility that infants are more likely to show an increase in looking time to the familiar test trial if this trial *follows* the novel language test trial, and not the other way round. A 2 (test-order: familiar first vs novel first) x 2 (trials: aver-

age of last three trials vs. looking time to familiar test trial) ANOVA revealed no significant effects, $F(1, 8) = 0.5, ns$ with no difference between these infants' looking time during the familiar trial ($M = 21.65, SD = 1.99$) as compared to the first three habituation trials ($M = 19.5, SD = 5.1$). There was no interaction with test order.[3] Furthermore, since seven of the 10 infants had first been presented with the novel language-trial followed by the familiar trial, an independent samples t-test including all the infants ($N = 78$) confirmed that infants who received this test order did not show higher looking times to the familiar trial $t(77) = 0.48, ns$.

Since the familiar trial was meant to serve as the *baseline* or *comparison* test trial, extremely high individual looking times to this trial would inevitably influence the overall mean, and would likely result in potentially spurious results. For this reason, these ten infants were excluded from the following analyses. At the same time, wherever possible, an effort has been made to present separate analyses including and excluding these infants, in the hope that this strategy would help uncover the possible source of these high looking times to the familiar trial.

In the following analysis, looking times of the remaining infants ($N = 68$) was examined in a 2 (condition: English vs. Spanish) by 2 (sex: male vs. female) by 3 (age-group:8 months vs 13 months vs 17 months) by 3 (test trial: familiar vs. novel language vs. novel label) mixed-model analysis of variance (ANOVA). This analysis revealed a main effect of test trial with infants looking longer at the novel language-trial ($M = 7.77s, SD = 5.46s$), $F(1, 56) = 13.44$, $p < 0.01$, $\eta_p{}^2 = 0.19.$, and to the novel label-trial ($M = 7.21s, SD = 5.41s$), $F(1, 56) = 14.26$, $p < 0.01$, $\eta_p{}^2 = 0.2$, as compared to the familiar trial ($M = 5.06s, SD = 2.46s$). This

[3]Separate analyses did not reveal any effects of age group or condition.

analysis also revealed a significant interaction of trial by age-group for the novel label comparison, $F(1, 56) = 5.62, p < 0.01, {\eta_p}^2 = 0.17$. There were no interactions with sex or condition.

In order to explore the source of this interaction, each age group was examined separately.

Eight-month-olds Analysis of 8-month-olds' looking times did not reveal differing patterns when the infant with a 'familiarity preference'($N = 1$) was included as compared to when this infants was excluded. For this reason, analyses including this infant are presented.

A 2 (condition: English vs Spanish) by 2 (sex: male vs female) by 3 (test trial: familiar vs novel language vs. novel label) ANOVA revealed a significant main effect of trial, with infants looking significantly longer at the novel language trial ($M = 8.57s, SD = 6.67s$), $F(1, 20) = 7.46, p < 0.01, {\eta_p}^2 = 0.27$, and to the novel label trial ($M = 7.39s, SD = 5.95s$) as compared to the familiar trial ($M = 5.13s, SD = 4.17s$), $F(1, 20) = 4.28, p = 0.05, {\eta_p}^2 = 0.18$.

Although there was no interaction of condition, since infants in the current study came from English-speaking families, and had had no previous experience with Spanish, we conducted planned comparisons to explore differences in infants' ability to discriminate between languages and labels when habituated to the familiar language (i.e., English), as compared to an unfamiliar language (i.e., Spanish)(See Figure 2.3).

In the English condition, a 3 (test trial: familiar vs novel language vs. novel label) by 2 (sex: male vs. female) ANOVA revealed that infants attended sig-

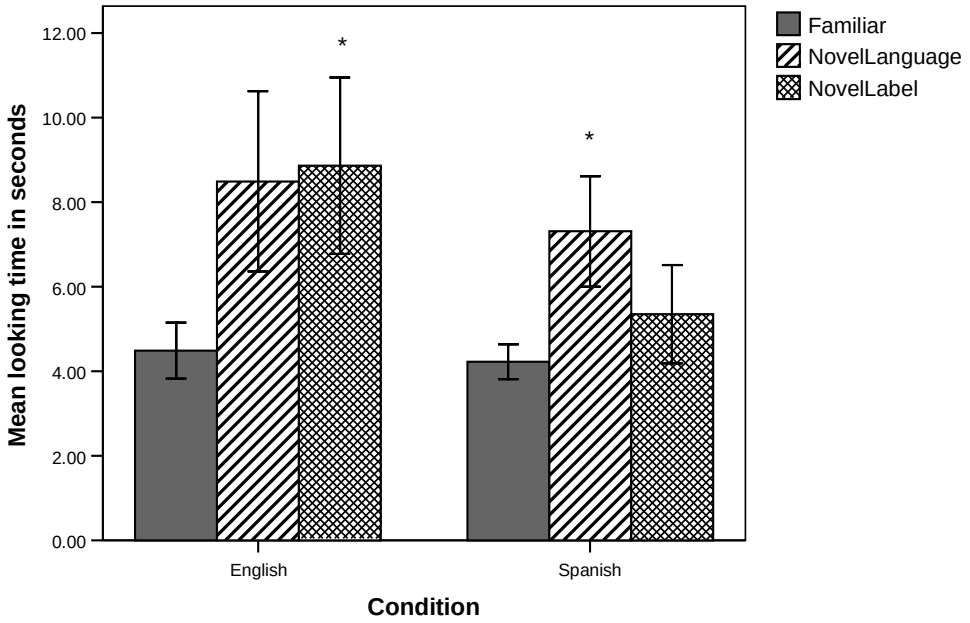


Figure 2.3: Mean looking times (+/- 1 SE)of 8-month-olds by condition

nificantly longer to the novel label-trial ($M = 8.86, SD = 7.21$) as compared to the familiar test trial($M = 4.49, SD = 2.29$), $F(1, 10) = 5.82, p < 0.05, \eta_p{}^2 = 0.37$. However, while infants also attended longer to the novel language-trial ($M = 8.49, SD = 7.39$) as compared to the familiar trial, this difference did not reach significance, $F(1, 10) = 3.25, ns$.

In the Spanish condition, a 3 (test trial: familiar vs novel language vs. novel label) by 2 (sex: male vs. female) ANOVA revealed that infants attended significantly longer to the novel-language trial ($M = 8.64, SD = 6.19$) as compared to the familiar test trial ($M = 5.77, SD = 5.49$),$F(1, 10) = 4.97, p = 0.05, \eta_p{}^2 = 0.33$. However, looking time to the novel label -trial ($M = 5.92, SD = 4.16$) was not significantly different from looking time to the familiar-trial, $F(1, 10) = 0.01, ns$.

Thirteen-month-olds Two sets of analyses were conducted – including all infants ($N = 28$), and also without the three infants who showed high looking

times to the familiar trial ($N = 25$). When these infants were excluded, a 2 (condition) by 2 (sex) by 3 (test trial) ANOVA revealed a marginally significant effect of test trial, $F(1, 21) = 3.2, p = 0.08, {\eta_p}^2 = 0.13$, with infants looking longer at the novel language-trial ($M = 7.8s, SD = 5.57s$) as compared to the familiar-trial ($M = 5.35s, SD = 2.86s$). Furthermore, this main effect was qualified by a significant interaction of trial by sex, $F(1, 21) = 4.52, p < 0.05, {\eta_p}^2 = 0.18$.

In order to examine this interaction, results of the male and female infants were analyzed separately. Separate 2(condition: English vs Spanish) by 3(test trial: familiar vs novel language) ANOVAs revealed that only the female infants looked significantly longer at the novel language-trial ($M = 9.75s, SD = 6.98s$) as compared to the familiar trial ($M = 4.55s, SD = 2.25s$), $F(1, 11) = 4.69, p = 0.05, {\eta_p}^2 = 0.3$. For the male infants, there was no significant difference between looking times to the novel language-trial and the familiar-trial, $F(1, 10) = 0.22, ns$.

Planned comparisons exploring infants' looking behavior in each condition revealed no significant findings for infants in the English condition, $F(1, 10) = 0.01, ns$(See Figure 2.4). In contrast, infants in the Spanish condition reliably dishabituated to a change in language ($M = 9.49, SD = 6.23$), indicating that they recognized their familiar language (i.e., English), $F(1, 11) = 5.47, p < 0.05, {\eta_p}^2 = 0.33$. Furthermore, this effect was qualified by a marginally significant interaction with sex $F(1, 11) = 4.18, p = 0.06, {\eta_p}^2 = 0.28$, indicating that the female infants provided stronger evidence of discriminating the languages (See Figure 2.5).

When the three infants with high looking times to the familiar were included, the same analysis as before showed that there was no longer a main

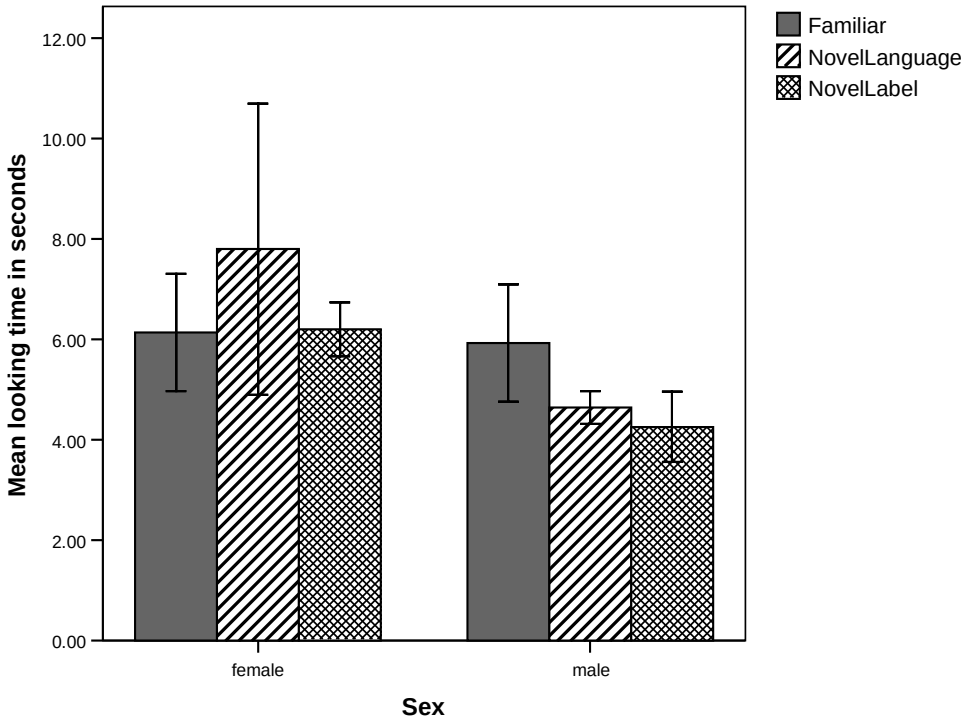


Figure 2.4: Mean looking times (+/- 1 SE) of 13-month-olds in the English condition by sex

effect of trial for the novel language trial but what emerged was a marginally significant interaction of sex by condition for this trial, $F(1, 24) = 4.23, p < 0.051, \eta_p^2 = 0.15$. While females in the Spanish condition discriminated to the novel language, female infants in the English condition did not show an increase in looking time to this trial, as compared to their looking time to the familiar trial. It should be noted that in this age-group, of the three infants who were outliers, two were females, and they both happened to be in the English condition, suggesting that these two infants were influencing the pattern of results, leading to the insignificant result for the English condition.

Nevertheless, the finding that was consistent across the two sets of analyses was that male and female infants showed different looking patterns, with the females dishabituating to the novel language (particularly in the Spanish

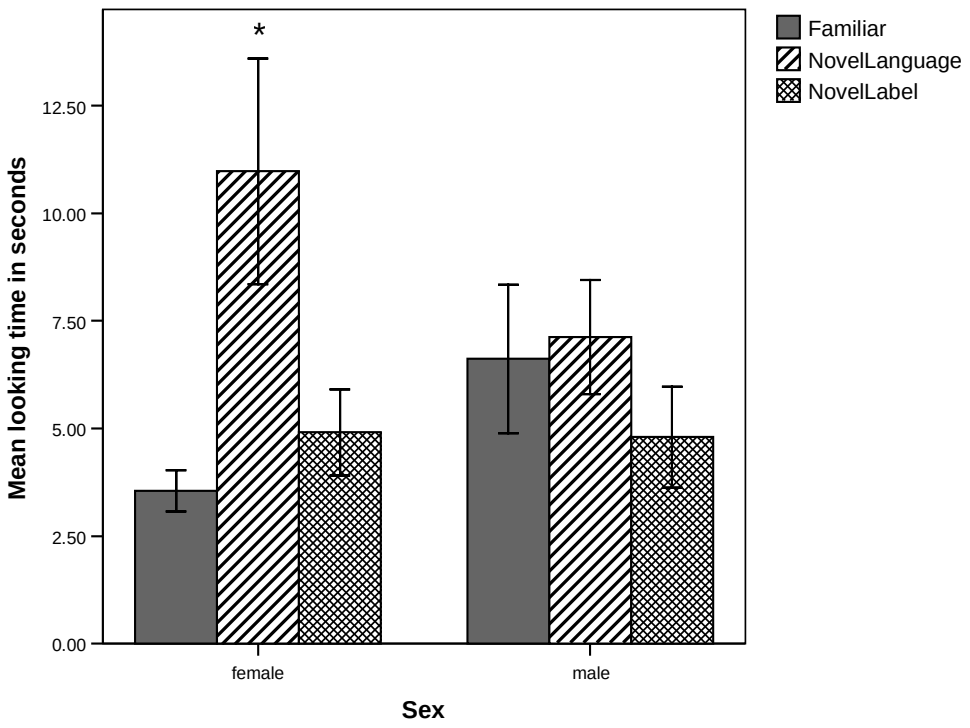


Figure 2.5: Mean looking times (+/- 1 SE) of 13-month-old in the Spanish condition by sex

condition), while the males did not. How could these sex differences be explained? It was possible that individual differences in infants' ability to recognize their native language and dishabituate to a non-native language might be mediated by vocabulary development, with a higher vocabulary predicting greater sensitivity. In light of findings from vocabulary studies that have demonstrated an advantage for females at this age (Fenson et al. 1994; Huttenlocher, Haight, Bryck, Seltzer, & Lyons, 1991; Reznick & Goldfield, 1992), it was possible that vocabulary differences between the sexes could account for the differences in performance. However, independent samples t-tests comparing vocabulary scores of all the male and female infants confirmed that there were no significant differences in comprehension, $t(26) = 0.12, ns$, or productive vocabulary, $t(26) = 1.03, ns$, between the sexes. Similarly, using vocabulary score as

a proxy for the level of language development in general, we combined results from males and females in a 2 (condition: English vs Spanish) by 2 (sex: male vs female) by 2 (test trial: familiar vs novel language) ANOVA, and included scores of productive and comprehension vocabulary as measured by the Infant Version of the MCDI Short Form as covariate. Including vocabulary as a covariate did not change the pattern of results, demonstrating that the interaction of sex and test trial could not be explained by vocabulary development.

Seventeen-month-olds This age group had the greatest number of infants ($N = 6$) who showed high looking times (> 15 s)to the familiar test trial. For this reason, separate analyses were conducted – one that included these infants($N = 26$), and a second that excluded these infants ($N = 20$). Including all infants, a 2 (condition: English vs Spanish) by 2 (sex: male vs female) by 3 (test trial: familiar vs novel language vs. novel label) ANOVA did not reveal any significant effects, $F(1, 22) = 0.13, ns$. The same analysis, excluding the infants with high looking times to the familiar trial, revealed a significant main effect of novel label,$F(1, 16) = 11.8, p < 0.01, {\eta_p}^2 = 0.42$, with infants looking longer at the novel label-trial ($M = 10.1s, SD = 6.32s$), as compared to the familiar trial ($M = 5.51s, SD = 2.45s$). The analysis also showed a marginally significant main effect of test trial for the novel language-trial, $F(1, 16) = 3.88, p = 0.06, {\eta_p}^2 = 0.2$, with infants looking longer at the novel language-trial ($M = 7.6s, SD = 4.9s$) (See Figure 2.6).

Planned comparisons across conditions revealed that in a 3(test trial: familiar vs novel language vs. novel label) by 2 (sex: male vs female) ANOVA , infants in the English condition looked longer to the novel label-trial ($M = 11.63, SD = 7.29$) as compared to the familiar -trial ($M = 5.46, SD = 2.36$),

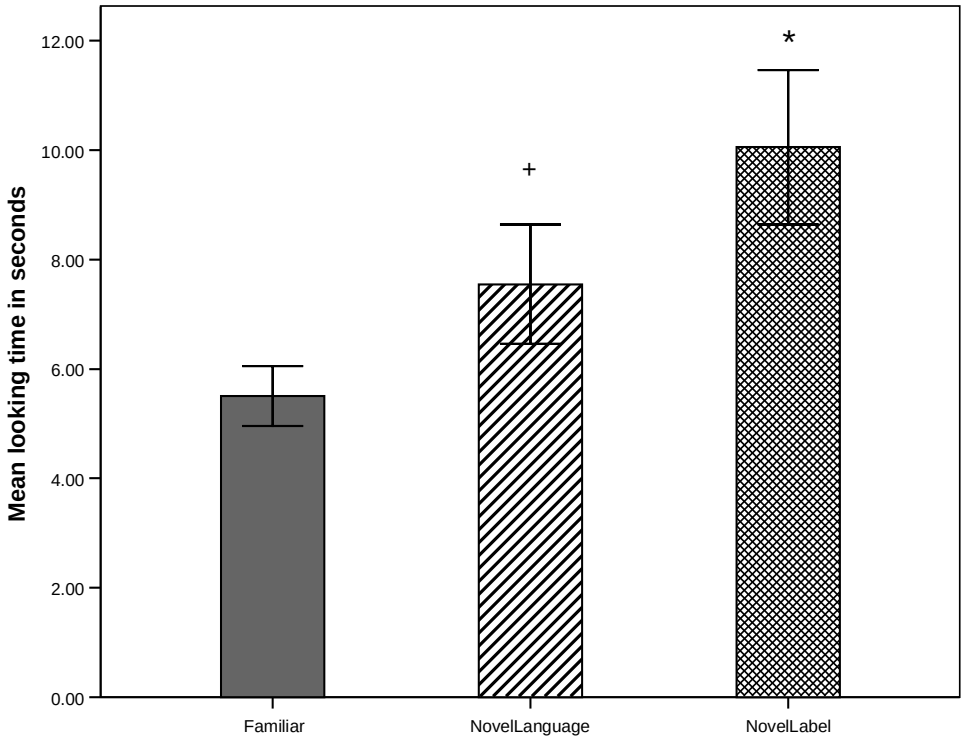


Figure 2.6: Mean looking times (+/- 1 SE) of 17-month-olds during test trials

$F(1, 8) = 6.41, p < 0.05, \eta_p^2 = 0.45$. This difference was marginally significant for the novel language-trial ($M = 8.22, SD = 4.83$), $F(1, 8) = 4.44, p = 0.06, \eta_p^2 = 0.36$ (See Figure 2.7).

In the Spanish condition, infants looked longer to the novel label-trial ($M = 8.48, SD = 5.06$) as compared to the familiar-trial($M = 5.56, SD = 2.66$), $F(1, 8) = 6.06, p < 0.05, \eta_p^2 = 0.43$. However, this effect was qualified by sex $F(1, 8) = 7.47, p < 0.05, \eta_p^2 = 0.48$. The female infants looked longer to the novel label-trial ($M = 12.85, SD = 4.72$) as compared to the male infants($M = 5.57, SD = 2.69$). Overall, infants in this condition did not look longer at the novel language-trial ($M = 6.88, SD = 5.11$) as compared to the familiar-trial, $F(1, 8) = 0.78, ns$ (See Figure 2.8).

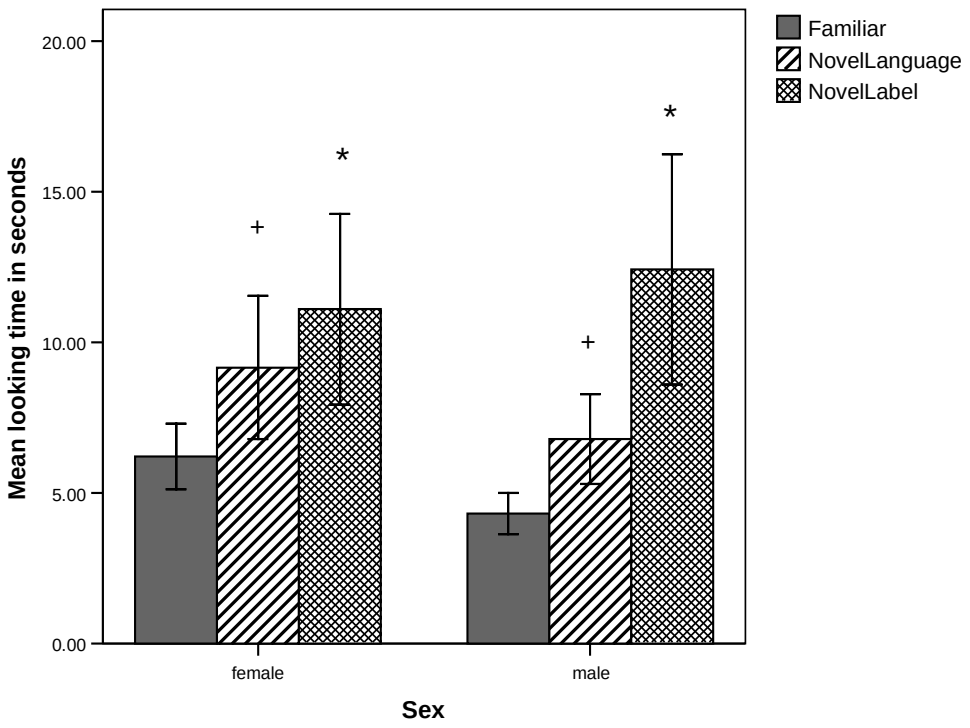


Figure 2.7: Mean looking times (+/- 1 SE) of 17-month-olds in the English condition by sex

High looking times to the familiar trial The finding that six 17-month-old infants (4 females) and three 13-month-old infants (2 females) demonstrated a preference for the familiar test trial (even after reaching the habituation criterion) remains unexplained.[4] Could vocabulary score (acting as a proxy for overall language development) explain the individual differences in infants' looking time to a familiar event? We compared the vocabulary scores of the infants that showed a preference for the familiar trial to the remaining infants. Separate analyses were conducted for each of the older age groups. Thirteen-month-olds with high looking times to the familiar trial did not differ from the remaining infants in comprehension vocabulary, $t(26) = 1.75, ns$ or in production vocabulary $t(26) = 1.05, ns$. Similarly, 17-month-olds with high looking times to the

[4]Of these nine infants, six were in the English condition and three were in the Spanish condition.

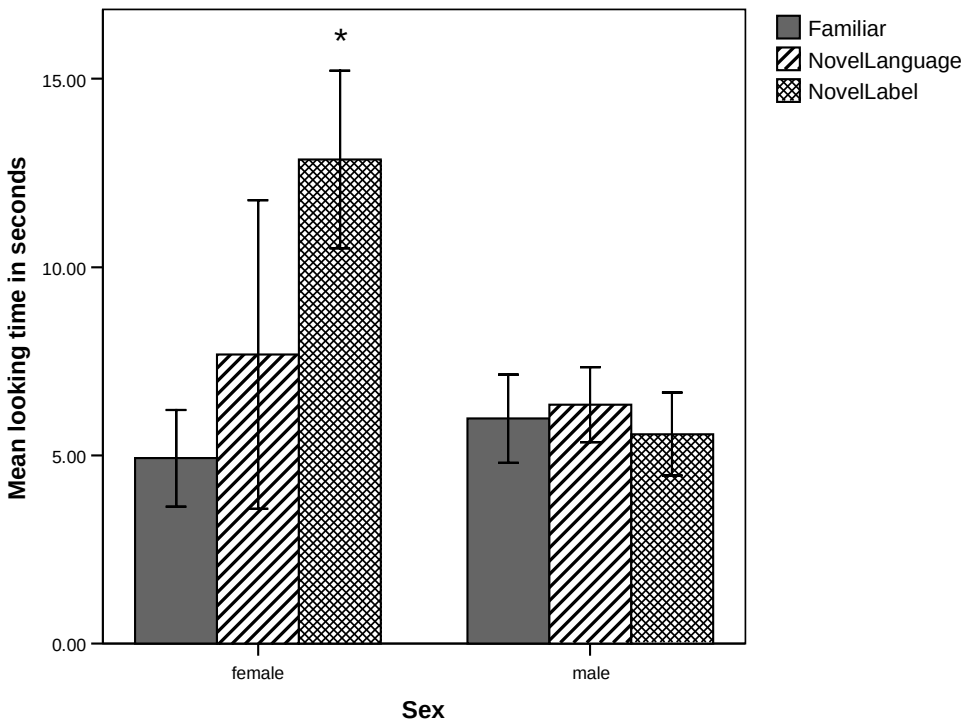


Figure 2.8: Mean looking times (+/- 1 SE) of 17-month-olds in the Spanish condition by sex

familiar trial did not differ from the remaining infants in production vocabulary, $t(24) = 1.74, ns$, indicating that vocabulary scores could not account for the differences in looking times.

2.4 Discussion

The current study was designed to be a preliminary step towards understanding how infants might make a breakthrough into a second language. First, we asked whether infants discriminate between their ambient language (i.e., English) and an unfamiliar language (i.e., Spanish). Second, we examined whether infants would be able to discriminate labels that were embedded in both the unfamiliar

language, as well as the ambient language. Finally, we explored developmental differences in these abilities between 8 and 17 months. With these aims in mind, monolingual 8-, 13-, and 17-month-old infants were habituated to a novel object paired with a novel label embedded in short naming phrases in either their ambient language (i.e., English) or a novel language (i.e., Spanish). Subsequently they were tested with two events, one which depicted the same object-label pairing as during habituation except that the label was embedded in a different language (either English or Spanish). In the second test trial a different novel label was paired with the original object, while the language remained the same as during habituation.

Overall, eight-month-old monolingual English-learning infants discriminated English from Spanish, both when they were habituated to naming phrases in English and tested with phrases in Spanish, and vice versa. However, infants at this age provided evidence of attending to the label embedded in the phrases, only when the label was embedded in English phrases. The results of the 13-month-olds revealed an effect of sex – in both the English and Spanish conditions, only the female infants provided evidence of discriminating the utterances in the two languages, while the male infants did not. Furthermore the females in the Spanish condition provided the strongest evidence of recognizing a change in language after being habituated to Spanish and then tested with English. Moreover, infants of neither sex showed evidence of attending to the label embedded in these utterances. In contrast, overall,the 17-month-olds, regardless of habituation condition, reliably discriminated between words. These infants also provided evidence of noticing a change in the language, although this difference was only marginally significant. At the same time, the results for this age group varied as a function of the habituation condition. Overall, infants

in the English condition noticed a change in both label and language, while in the Spanish condition, it was mainly the female infants that provided evidence of attending to these changes.

Eight-month-old infants The 8-month-old infants in the current study, after being habituated to either English or Spanish succeeded at discriminating these languages. These results extend findings from previous discrimination studies on younger infants using this specific pair of languages (e.g.,Nazzi, Jusczyk & Johnson, 2000; Bahrick & Pickens, 1988; Bosch & Sebastian-Galles, 1997). Eight-month-olds also discriminated between the two words that were embedded in English phrases, but did not provide evidence of discriminating between these labels when they were embedded in the Spanish phrases.

The findings from the English condition are consistent with studies that have shown that infants of this age can segment words from fluent speech in their native language (e.g. Jusczyk & Aslin, 1995). Based on previous findings regarding the cues that infants at this age can use to segment words in their native language (e.g. Jusczyk, Houston, & Newsome, 1999), it is possible that infants were relying on either stress or statistical information (or a combination of these cues) in order to segment these words, since both cues were available in the stimuli used in the current study. The target word 'modo' was pronounced with stress on the initial syllable and 'felice' was pronounced with iambic stress (i.e., stress on the second syllable); therefore, in both cases, even if infants only attended to the stressed syllables, 'mo' and 'lice', and not to the whole word (e.g. Jusczyk et al., 1999, Experiments 7, 8 and 9 for evidence of infants showing such a segmentation pattern), the same results would be obtained. Similarly, since both target words were bisyllabic, there was perfect transitional probabil-

ity between the two syllables of each word – the second syllable *always* followed the first, and attending to the co-occurrence between the two syllables of each target word would lead successful segmentation. This explanation is consistent with studies demonstrating 8-month-old infants' ability to use statistical cues to segment the speech stream (e.g., Aslin, Saffran, & Newport, 1998; Johnson & Jusczyk, 2001; Thiessen & Saffran, 2003; Saffran, Newport & Aslin, 1996). A final cue that could have facilitated segmentation is infants' tendency to attend to the ends of utterances (Aslin, 1999; Seidl & Johnson, 2006), suggesting that word-position could have played a facilitative role in infants' ability to segment words in the current study.

Seventeen-month-old infants The current findings with the 17-month-old infants are the first to demonstrate that monolingual English-learning infants at this age can segment words, specifically object-labels, embedded in short naming phrases presented in an unfamiliar language (i.e., Spanish). The finding that 17-month-olds were able to segment an object-label from a series of six phrases in a language with which they were completely unfamiliar suggests that they could have used a variety or combination of cues in order to segment the words.

Studies that have shown infants' ability to segment words from artificial language stimuli are particularly relevant (e.g., Aslin, Saffran, & Newport, 1998; Johnson and Jusczyk, 2001; Thiessen & Saffran, 2003; Saffran, Newport & Aslin, 1996). Using artificial language as an analogy to a natural but unfamiliar language, one can propose that infants might rely on regularities in the input (in this case, the input consists of the Spanish utterances), in order to segment words. Specifically, unlike in the English condition, 'modo' was pronounced with approximately equal stress on both syllables; therefore, stress was proba-

bly not a cue that would have been reliable for this word. For this reason, it is most likely that the high transitional probability between the two syllables was the factor that cued infants to the boundaries of this word. In contrast, similar to the English condition, 'feliz' was pronounced with iambic stress, and infants could have relied on either a stress or a statistical cue to segment this word. Although the current study does not allow us to draw definitive conclusions about the cues that infants used in order to segment these words, we can conclude that 17-month-old monolingual infants were able to attend to word-like units in the speech stream of an unfamiliar language.

Studies with 16- to 17-month-old infants have shown that infants at this age are able to extract word-like syllable sequences from a stream of speech in an artificial language solely on the basis of statistical probabilities (Chambers, Onishi & Fisher, 2003; Graf Estes, Evans, Alibali, & Saffran, 2007); Mattys & Jusczyk, 2001, Experiments 7 and 8). As seen with the 8-month-olds in the current study, the high transitional probability between the two syllables of each of the target words could have been an important factor that cued 17-month-old infants to the boundaries of each word.

Older infants have also been shown to rely on phonotactic cues to mark word boundaries in the familiar language (Mattys & Jusczyk, 2001; Mattys, Jusczyk, Luce & Morgan, 1999). Since the novel words used in the current study were phontactically possible in both English as well as Spanish, this aspect could have provided infants with an additional cue. Furthermore, as mentioned before, infants can also combine distributional and rhythmic cues in order to segment speech (e.g.,Jusczyk, et al., 1999; Mattys, et al., 1999; Mattys & Jusczyk, 2001; Morgan, 1996; Morgan & Saffran, 1995).

Although the current study does not allow us to point conclusively to the factors that enabled infants to succeed this task, it is possible that infants depended on the position of the word in the utterance. Infants at this age have been found to segment words more readily when they occur at the end of utterances (Fernald & Hurtado, 2006; Fernald, McRoberts, & Swingley, 2001), and it is possible that infants were able to rely on this cue. Finally, the fact that the target words were rhythmically and phonotactically possible in both English and Spanish, the high transitional probability between the two syllables of each of the words; and the high frequency with which they occurred relative to the other words in the utterances, all possibly played an important role in infants' ability to identify these words.

Infants' performance in the English condition is consistent with previous word-learning studies that have found that infants at this age are able to segment a word from fluent speech in their native language (e.g., Trehub & Shenfield, 2007). Due to the similarities between the English and Spanish stimuli, it is most likely that infants were relying on similar cues to segment the words in both conditions. Although results from the novel-language trial were only marginally significant, infants' looking times during this trial did suggest that they noticed a change in language.

Thirteen-month-old infants Findings from the 13-month-olds revealed a complex picture, with only the female infants in both the English and Spanish conditions discriminating the languages, while the male infants did not provide evidence of discriminating the languages in either condition. Moreover, the female infants in the Spanish condition provided the strongest evidence of

dishabituating to the novel language trial, suggesting that they recognized their ambient language (i.e., English) and showed a preference for listening to it.

In contrast, neither the males nor the females at this age provided evidence of discriminating the labels in either condition. These results stand in sharp contrast to findings from the 8-month-olds, and also differ from the 17-month-olds, particularly with regards to segmenting the target words.

Developmental differences How can the age-related differences in infants abilities be explained? The fact that none of the 13-month-old infants were able to segment a word from English utterances is surprising in light of the fact that word segmentation from the native language is a well-documented ability in infants starting from 8 months onwards (e.g., Jusczyk & Aslin, 1995; Jusczyk, Houston, & Newsome, 1999). However, findings from word learning and word recognition studies on infants in the second year have found age-related improvements in these abilities over the second year (Fernald, Pinto, Swingley, Weinberg, & McRoberts, 1998), and also suggest that, in the first half of the second year, infants' performance on these tasks is prone to disruption by contextual factors (e.g., Fernald, McRoberts, & Herrera, 1992; Trehub & Shenfield, 2007; Woodward, Markman, & Fitzsimmons, 1994). In the current study, the visual stimuli (i.e., the image of a novel object) presented in conjunction with the auditory language stimuli, might have been a source of distraction for the 13-month-olds infants and detracted from their attention to the specific features of the language stimuli.

A more intriguing possibility is that the potentially 'referential' nature of the task placed additional processing demands on infants' attention (Stager &

Werker, 1997). In the current study, the audio stimuli were presented concomitantly with the image of an object that was evidently the referent of the novel word. It is possible that the concomitant presentation of a novel object made this task into a referential one with the infants interpreting the recurring word-like unit that appeared at the end of the utterances as a label for this object. This task might have proved to be too difficult for infants at this age, with the result that they were unable to attend to a change in the label. This explanation is consistent with studies that have shown that 14-month-old infants fail to detect phonetic differences in minimally different words when the task also includes a referential component (e.g., Stager & Werker, 1997), although it should be noted that Stager and Werker (1997) found these effects for 14-month-old infants in a phonetic discrimination task, therefore a direct comparison is not possible. However, if this possibility were indeed true, Stager and Werker's (1997) argument that the increased attentional demands of a referential task can disrupt speech perception could explain the current findings.

Such an explanation seems more plausible when one compares the results of the 8-month-olds to the older infants in the current study. Recall that the 8-month-old infants discriminated English from Spanish, both when they were habituated to naming phrases in English and tested with phrases in Spanish, and vice versa. They also provided evidence of attending to the label embedded in the English phrases. It is possible that for infants at this age, who are not yet forming associations between labels and objects, the possible referential nature of the input was likely not a source of distraction. If the referential status of the target word is indeed the source of distraction, then, when the auditory input is presented in the absence of an object, 13-month-old infants should be able

to discriminate between the languages, as well as between the labels. This is a possibility that needs to be addressed in future research.

The finding that the male 13-month-olds in the English condition also failed to notice a change in language (i.e., a more global change in rhythm) is more difficult to explain, as is the finding that after being habituated to Spanish, these infants did not recognize a switch in language to English. These results suggest that these infants might have been fatigued by the time they reached the end of the habituation phase, although there was no significant difference between average number of habituation trials required by males and females to habituate. While previous studies have found gender differences in word-learning abilities at this age (Trehub & Shenfield, 2007; Werker, Cohen, Lloyd, Stager & Casasola, 1998; Woodward, Markman, & Fitzsimmons, 1994), it is unclear whether these differences in language discrimination abilities reflect more general language development. Vocabulary measures could not account for these differences in the current study, but it is possible that other measures of general cognitive ability (that may be only indirectly related to language development) might be able to account for these differences.

Conclusions To conclude, this study provides preliminary evidence that monolingual infants might indeed be able to process an unfamiliar language at a more global as well as at a more refined level. Naturally, these effects are qualified by developmental differences in infants' abilities with 8-month-olds proving to be better overall processors as compared to their older counterparts. However, since this task paired visual stimuli with the auditory stimuli, it is possible that this aspect of the task hindered the performance of the 13-month-olds. The ability of the 17-month-olds to attend to a word embedded in an un-

familiar language attests to the tendency of infants at this age of being particularly attentive to words that could potentially be labels. In fact, it is possible that the referential nature of the experimental stimuli actually facilitated 17-month-olds' ability to attend to the word-like unit that was the most likely candidate to be an object-label. Finally, the fact that the target words were rhythmically and phonotactically possible in both English and Spanish, the high transitional probability between the two syllables of each of the words; and the high frequency with which they occurred relative to the other words in the utterances, all played an important role in 17-month-old infants' ability to identify these words. One could conclude that high similarity between certain aspects of the first and second language might in fact help infants make a breakthrough into the second language.

CHAPTER 3

'LANGUAGE AS CONVENTION': EMERGING UNDERSTANDING IN 19-MONTH-OLDS

3.1 Introduction

When presented with new words, young children use a wide range of cues that are present in their environment in order to make inferences about the meanings of these words. In the absence of clear cues, infants tend to fall back on some default assumptions in order to make appropriate mappings between words and their referents (see Bhagwat & Casasola, 2008 for a review). One such tendency that seems to emerge at the earliest stages of word learning is that children often assume that new labels refer to unnamed objects. Specifically, when children are presented with two objects, one familiar and one novel, and are asked for the referent of a *novel* word, they map the novel word to the novel object (e.g., Markman & Watchel, 1988). Such a tendency to select the novel (i.e., unnamed) referent, has been called the 'disambiguation effect' (Merriman & Bowman, 1989). A number of different explanations have been proposed for the disambiguation effect. For instance, children might assume that referent-label mappings are mutually exclusive, i.e., objects can have only one name. This bias is known as the 'mutual exclusivity' constraint (Markman, 1989). It is also possible that children assume that novel words map to previously unnamed objects; this assumption has been called the 'novel name-nameless category' principle (N3C)(Golinkoff, Mervis,& Hirsh-Pasek, 1994).

Still others propose that children's sensitivity to pragmatic cues when learning new words can explain the disambiguation effect. A pragmatic explanation

predicts that children assign novel words to novel objects because they assume that knowledge of words is shared amongst speakers of a language. Such an assumption is called the 'principle of conventionality'. 'Conventionality' refers to an assumption made by speakers of a language: the assumption is that speakers of a language represent a linguistic community and therefore speakers of a language share knowledge of the words of that language (Clark, 1988, 1990). Thus when asked for the referent of a novel label by a speaker, children assume that the speaker is referring to something that has not been named yet. This assumption might stem from the belief that the speaker shares the knowledge about labels with the child, and if this speaker uses a new word, it must refer to something for which the child does not know the name. Thus the corollary to 'conventionality' is that children also assume that since the speaker is asking for the referent of an unknown label, this label must refer to an unnamed object. This second assumption is called the 'principle of contrast' (Clark, 1988; 1990). Preschoolers aged between 3 and 5 years (Diesendruck, 2005; Diesendruck & Markson, 2001), as well as infants as young as 24 months (Henderson & Graham, 2005) and 19 months (Graham, Stock & Henderson, 2006) have been shown to follow these conventions when faced with new words. To summarize, there seems to be a strong tendency in the youngest word learners to expect a specific referent to have a single label.

The current study asked whether whether young monolingual children would be able to learn two different labels for a single object, if each of these labels was presented in a different language. Specifically, one label was presented in a familiar (i.e., English) context and one was presented in an unfamiliar (i.e., Spanish) context. Such an experimental setting mimics real-life bilingual situations. Children learning two languages must learn a different label in each language

for any real-world referent. In fact, vocabulary studies demonstrate that young bilinguals do often have two different words, one in each language, for the same referent. These word forms, called translation equivalents or TEs (Deuchar & Quay, 2000; Nicoladis, 1998; Pearson, Fernández, & Oller, 1995; Quay, 1995), have been argued to be evidence that bilingual children are sensitive to the fact that they are acquiring two distinct languages, and that two words (one from each language) may refer to the same underlying semantic concept (Holowka, Brosseau-Lapré, & Petitto 2002). Similarly, experimental studies on the ability of bilingual children (between 3 to 8 years of age) to learn multiple labels for a single referent demonstrate that when the two labels are presented in the bilingual's two languages, these children are more likely to accept both labels (Au & Glusman, 1990,Study 4; Davidson, Jergovic, Imami, & Theodos, 1997; Merriman & Kutlesic, 1993; but see also Frank &Poulin-Dubois, 2002 for contradictory evidence with 2- and 3-year-old bilinguals).

The question that arises is - what are the mechanisms underlying infants' ability to learn words in bilingual contexts? Specifically, in bilingual contexts, what cues do infants rely on in order to interpret the meanings of new words? An understanding of languages as 'conventional systems' might play an important role in early word learning in bilingual contexts. As mentioned earlier, conventionality is the understanding that each language represents a linguistic community of speaker, all of whom share knowledge of the labels of that language. However, in a bilingual context, one could say that there are two levels of 'conventionality'. The first level is an understanding that different languages signal different communicative systems, each with its own labeling norms, and the second level of understanding is that speakers of each language share knowledge of only that language. This study examines the emergence

of the first level of an understanding of conventionality in monolingual infants who were presented with a label in an unfamiliar context.

Studies with bilingual children in the one- and early, two-word stages of development have shown that these children are able to use their languages differentially and appropriately with parents who habitually speak different languages with them (Genesee, Nicoladis, & Paradis, 1995; Nicoladis, 1998; Nicoladis & Genesee, 1996). Also, young bilingual children demonstrate similar sensitivity when interacting with strangers with whom they have had no prior experience (Genesee, Boivin, & Nicoladis, 1996). Furthermore, they are also able to make on-line adjustments to accommodate interlocutors' language preferences and/or abilities (Comeau, Genesee, & Mendelson, 2007; Comeau, Genesee, & Lapaquette, 2003; Comeau & Genesee, 2001) reflecting true bilingual communicative competence. The ability to use their two languages differentially, and to respond to the linguistic preferences or proficiency of unfamiliar interlocutors indicates that bilingual children do indeed have an understanding of their different languages representing different systems of communication. The question that arises is whether young monolingual children will be able to adjust their word-mapping strategies as a function of whether the speaker uses a familiar or an unfamiliar context to present the words.

In monolingual contexts, under some circumstances, children as young as two years do indeed learn a new, second label for a familiar object (i.e., an object for which they already have a name). For instance, when two-year-olds are explicitly taught a second label for a familiar object, and tested on their comprehension of this label, they show evidence of having learned the novel word as a second label for that object and that object category (e.g., Liittschwager & Mark-

man, 1994; Mervis, Golinkoff & Bertrand, 1994). Similarly, when 2-year-old children were given explicit directions to treat one novel word as a super-ordinate term to a second novel word, children easily accepted both labels as referring to the same object (Clark & Grossman, 1998). However, studies with infants younger than 2 years have found mixed results. For instance, Liittschwager and Markman (1994) found that unlike the 2-year-olds in their study, 16-month-olds resisted mapping a second label onto an already named object, that is, they showed evidence of abiding by the principle of mutual exclusivity. A more recent study found similar results with infants as young as 15 months (Markman, Wasow & Hansen, 2003).

To date, only one study has examined word learning across languages in monolingual children. Au and Glusman (1990) found that 3- to 5-year-old monolingual children were unwilling to accept two English labels for a single object but when they were told that they would be learning a 'new name for the toy in Spanish', children did learn a second label for an object that had already been labeled in English. However, little is known about how younger children who are at the earliest stages of lexical development would respond to a label presented in an unfamiliar language. We explored this question in Experiment 1. Specifically, we asked whether 19-month-olds would map two labels onto a single novel object when each label was presented in a different language (e.g., English and Spanish). Since our participants were monolingual infants from English-speaking families, if infants demonstrated differing mapping patterns across conditions, it would suggest that infants at this age differentiate between their native language and an unfamiliar language, while recognizing that 'naming rules' depend on the language spoken.

Moreover, studies that have examined infants' tendency to map a novel label onto an unnamed object instead of onto a familiar object (i.e., the disambiguation effect) in monolingual contexts, have found that this ability is related to the level of vocabulary development. For instance, Mervis and Bertrand (1994) found that of the 16- to 20-month-olds in their study, only those with higher vocabularies mapped a novel label onto an unfamiliar object over a familiar object. Infants with lower vocabularies were not more likely to choose the unfamiliar object over the familiar object when asked to find the referent of the novel label. Similarly, in a study by Graham, Poulin-Dubois and Baker (1998), 16- to 22-month-old infants were presented with a novel object along with two familiar objects and asked to choose the referents of familiar and novel words. The infants who consistently chose the novel object in the presence of a novel word had significantly higher productive vocabularies than those who did not. These results suggest that the emergence of the disambiguation effect in late infancy is related to productive vocabulary size rather than age.

Taking into account such findings, we were also interested in infants' word mapping preferences when faced with two novel labels for a single novel object, presented in the familiar language (i.e., English). Previous studies have shown that infants assume that a speaker(who was not present at the time of labeling) shares knowledge of that label (Graham, Stock & Henderson, 2006; Henderson & Graham, 2005). However, if a second speaker were to explicitly provide a new label for an already named object, could infants be led into believing that this second label was also an acceptable label (even though this object had already been named by another speaker)? Experiment 2 addressed this issue. In addition, since we followed the same procedure as in Experiment 1, except that both labels were presented in a single language (i.e., English), Experiment

2 also served as a control condition for Experiment 1. The current study was a first step in exploring infants' understanding of multiple languages as representing distinct linguistic systems and communities. Broadly speaking, we examined whether monolingual 19-month-old infants have an understanding of a language as conventional system. With this end, first we asked whether 19-month-old English-learning monolingual infants would map two label onto an object, if each of these labels was presented in a different language. Next, we examined whether infants would be willing to map two labels onto object if both labels were presented in a single language.

3.2 Experiment 1

In the first experiment, we examined monolingual, English-learning 19-month-old infants ability to accept multiple labels for the same referent, when the labels were presented in two different languages. If infants appreciate a change in language as a change in convention, then they should be willing to accept two labels as referring to the same object.

Since the participants in the current study were younger than those in previous studies, and because the task required monolingual children to identify a label from an unfamiliar language, we used a modified version of the typical disambiguation task. In a typical disambiguation task children are presented with (at least) two objects, one named (either a familiar object such as a cup, or a novel object that is explicitly named), and one unnamed object. Following this presentation, children are asked for the referent for a second, completely novel label. Children tend to assume that the second novel label refers to the

unnamed object. Crucially the unnamed object is never explicitly labeled with the second novel word. In the current study we followed a procedure that was previously used by Savage and Au (1996). Specifically, infants were presented with two objects, one was explicitly labeled, following which comprehension of this label was tested. Next, the same object was explicitly labeled with a second label, following which comprehension of this label was tested. We reasoned that such a task would impose minimal memory demands on the 19-month-olds in this study.

First, infants were presented with two labels, one of which was embedded in an English sentence frame and the other in a Spanish sentence frame. Each of the labels was presented by a different experimenter. The Spanish-label provider was a native speaker of the language, and also fluent in English, although care was taken to ensure that she spoke only Spanish in the presence of the infants, both before and during the experimental session. The Spanish label-learning task required infants to parse out the novel word from a short string of speech in an unfamiliar language in order to map the word onto the target object. There is some evidence that children do succeed on a similar task after being trained very briefly with a naming phrase consisting of nonce words. In a study by Namy and Waxman (2000), 17-month-old infants were first trained with a familiar label embedded in a nonsense phrase (e.g., 'Look! Shaylem bosher key!'), following which they were presented with novel label embedded in this nonce naming phrase (e.g., 'Look! Shaylem bosher blicket!'). Infants considered such a phrase as a naming phrase for the novel label, 'blicket'. Thus after a very brief training period, 17- month-old infants interpreted a novel word embedded in a novel sentence as an object name. These findings suggest that the 19-month-old infants in the current study should be able to identify a label from a naming

phrase in an unfamiliar language. Second, since our participants were English-learning infants from monolingual families, the comprehension tests for both the English and Spanish label were conducted in English.

3.2.1 Method

Participants

The participants for the study were 35 infants (18 boys and 17 girls), ranging in age from 17.53 to 20.97 months (M = 19.1,SD = 1.05). All participants were healthy, full-term and from English-speaking monolingual families. Participants were recruited by a letter provided to parents at the time of their child's birth. Once infants reached the appropriate age for the present study, parents were again contacted via letter and a follow-up phone call. An additional nine infants participated but were excluded from the final analysis either because they were fussy or inattentive during the training session (N = 5), or because they did not finish the experiment (N = 4). All infants received a t-shirt in appreciation.

Stimuli

Three novel objects were created for the training and testing phases (see Figure 3.1). The objects were designed to be equally interesting and sufficiently unusual to ensure novelty. One novel object was a mobile made of shiny plastic discs in bright colors, decorated with small stickers of stars, balloons and snowflakes. A second object was a transparent rubber tube, 24 cm in length,

Figure 3.1: Stimuli objects

with rubber caps at both ends. The tube was filled with water and contained colorful marbles and star-shaped sequins that floated up and down when the tube was rotated. The rubber caps on both ends were decorated with multi-colored twine in a rainbow pattern. A third object was a metal egg ring that was covered with multicolored ribbon. Hanging from the metal ring were Modeling Magic balls of various colors and patterns.

Both objects were novel to ensure equal saliency and ensure that neither object has been previously labeled. For the novel words, 'toma' and 'biru' (pronounced *beeru*) were chosen because these words are phonetically possible in both English and Spanish and were distinct from each other. The words were matched in syllable number and stress pattern. The words were embedded in short sentences in English and Spanish. The novel word was presented in a sentence-final position based on findings of parental speech (Aslin, Woodward, LaMendola, & Bever, 1996; Fernald & Mazzie, 1991; Tardif, Shatz & Niagles, 1997) and children's greater attention to object labels when in utterance-final, rather than utterance-internal, position (Fernald, McRoberts,& Herrera, 1992; Shady & Gerken, 1999). The phrases used for the English labeling session for the labeled target object were as follows:"Look [child's name]. A [novel label 1]! Wow, a [novel label 1]!" and, "[Child's name], you see? A [novel label 1]! Ooh, a [novel label 1]!" The phrases for the unlabeled control object were as follows:

"Look, [child's name]. You see this? Wow, I like it," and, "[child's name] do you see? See how cool! Ooh, I like it!" The language phrases for both novel objects were matched in their surface features, such as number of syllables, duration, and intonation. The phrases used for the Spanish labeling session were matched in their timing, duration, and prosody with the English phrases used in the first labeling session. For the labeled target object, the Spanish phrases were: *"Mira* [child's name]. *Un* [novel label 2]. *Wao, un* [novel label 2]" and, "¿[Child's name], *estás viendo? Un* [novel label 2], *Ooh, un* [novel label 2]". The phrases for the unlabeled control object were: *"Mira,* [child's name]. *Míralo...waoo, me gusta"* and,"¿[child's name], *estás viendo? ¡Que lindo!...Hmm, me gusta".*

Apparatus

The testing session took place around a wooden child-sized table. The child and parent sat on child-sized chairs on one side of the table. Two experimenters sat across from the child and parent at the two corners of the table. A Canon digital camera on a tripod was placed between the two experimenters, near the back wall of the room, and focused directly on the child.

Procedure

Infants were randomly assigned to view two of three novel objects during the two training and testing sessions. One object was the target (labeled) object and the other was the control (non-labeled) object. Which of the two novel objects was labeled and which served as the control object was counterbalanced across participants.

Each child sat at the child-sized table while two experimenters sat across the table from the child. Once the parent provided consent, they were asked to complete a language questionnaire, the MacArthur Communicative Development Inventory: Short Form Level II (Toddler Version) (Fenson et al., 2000). The parent sat next to the child but faced away from the table to prevent parental interference. While the parent was filling out the questionnaire, both experimenters interacted with the child in their respective languages. Thus the English-speaking experimenter spoke in English and the Spanish experimenter spoke to the infant in Spanish to establish that one interlocutor spoke only English and the other spoke only Spanish. This component was included in order to establish the distinction between the two speakers and their linguistic conventions. At the same time, as mentioned earlier, since it was the English speaker who ultimately conducted the comprehension tests for both the English and Spanish labels, the status of this speaker became that of an 'English-Spanish bilingual'.

Once the infant seemed comfortable with the experimenters, the experimental procedure started. Each infant participated in a familiarization phase; a pretest preference trial; a warm-up phase; the first labeling training followed immediately by the first label comprehension test; then the second labeling training followed by the second-label comprehension test; and finally, a post-test preference trial. Following Savage and Au (1990), infants heard the target object labeled with the first label by the first experimenter, and were then tested on their comprehension of this label. They then heard the other experimenter label the same target object with the second label, and were then tested on comprehension of this second label. For simplicity, the procedure is explained when the first label was provided in English and the second in Spanish, although order of the languages was counterbalanced across participants. In addition, whether

each experimenter attended to the target object first or the control object first also was counterbalanced across participants.

During the familiarization phase, the first experimenter (henceforth, E1) presented the child with one of the two novel objects. The child played with the first novel object for 15 s which was then replaced with the second novel object for another 15 s. Next, there was a pre-test preference trial to test for a priori preferences among the novel objects. In this trial, E1 held both objects, one in each hand, at 45 degree angles from her center and within reaching distance of the child. The child was asked "Which is your favorite? Which one do you like?" Once the child made a choice, he /she was allowed to play with that object for 10 s and then allowed to play with the alternate object for 10 s as well. Thus, the child had equal exposure to both the novel objects before the training phase began.

Next, the child participated in three warm-up trials to familiarize him or her with the nature of the experimental task. E1 presented three toys for which the parent had reported that the toddler comprehended the label (e.g., a toy horse, a toy cat, a toy dog). The child was allowed to examine these toys for 10 s. E1 then arranged the toys in a line in front of the child and asked the child for one of the toys (e.g., "[Child's name], where's the horse? Show me the horse"). If the child picked a toy, whether correct or incorrect, the experimenter smiled and said "thank you". This procedure was repeated with the remaining two toys. The table was then cleared of all of these toys.

After the warm-up trials, the first labeling phase began. E1 held up the two novel objects (shown during the familiarization phase and pre-test preference trial), one in each hand. She established eye contact saying, "Look, [child's

name]." E1 then looked at the target object and labeled it twice (e.g. "A toma! Wow, a toma!"). Then she looked back at the child and made sure that the child was attentive by saying, "[child's name] do you see?" Then she looked back at the object and labeled it two more times (e.g., "A toma! Ooh, a toma!"). Similarly, E1 drew the childs attention to the control object but did not provide a label for it: "Look, [child's name], You see this? Wow, I like it," and, "[child's name] do you see? See how cool! Ooh, I like it!" The amount of eye gaze used for the target versus control objects were matched exactly.

Immediately following the first labeling session, E1 tested the child's comprehension of the first label. During this first comprehension test, E1 placed the two toys on the table, equidistant from each other and from the child and asked, "Where's the [novel label 1]?" She let the child make a choice either by touching or pointing to the toy. Once the child provided a response, E1 said "thank you," regardless of the object chosen, and then removed the toys. This procedure was repeated until each child made a total of 3 clear choices. Each time, the left-right position of the target and control objects on the table was switched to ensure that children did not have a side bias. If the child picked or pointed to both toys together, the toys were retrieved and placed back on the table with the response, "Thank you, but which one is the [novel label 1]?" Such a response was not counted as a valid trial and E1 continued with the procedure.

Once the child completed his three choices, Experimenter 2 (henceforth E2) picked up the two objects for the second labeling phase. This time, E2 spoke in Spanish as she labeled the same target object (e.g. *"Mira* [child's name]. *Un biru...Wao, un biru*" and, "*¿*[Child's name], *ests viendo? Un biru...Ooh, un biru*"). For the control object, E2 used the following phrases, *"Mira,* [child's name].

Míralo...waoo, me gusta" and,"¿[child's name], *estás viendo? ¡Que lindo!...Hmm, me gusta"*. Once the second labeling session was complete, the child was tested on her comprehension of the second label by E1 in English. Specifically, E1 urged the child to 'Find the [novel label 2]', using the second label to request the target object. The comprehension test of the second label was conducted by E1 in English to ensure that the child understood the request and that any difference in response across the two testing sessions could not be due to the experimenter (E1 vs. E2) or the language (English vs. Spanish). The E1 took care to use the Spanish pronunciation of 'biru' while testing the infants comprehension on that label.

The final segment of the session was a post-test preference trial included to determine if there was a preference for one of the objects as a function of the whether or not it was labeled during the training session. E1 held up the two objects again and asked the child, "Which is your favorite?" and the object chosen by the child was recorded. The entire experimental session lasted approximately 15 minutes.

Scoring The first object that the infant touched in response to each comprehension question was recorded as the infant's choice. Each infant received four test trials for each label.

3.2.2 Results

Vocabulary measure Some studies with the youngest word learners have found links between infants' vocabulary development and their performance

on word mapping tasks. For instance, Graham, Poulin-Dubois, & Baker (1998) found that when 16- to 22-month-olds were presented with a novel object along with two familiar objects and asked to choose the referents of familiar and novel words, those infants who consistently chose the novel object in the presence of a novel word had significantly higher vocabularies than those who did not. Similarly, Mervis and Bertrand (1994) found that in a group of 16- to 20-month-olds, infants with higher vocabularies mapped novel nouns onto novel objects at a higher rate, compared with infants with lower vocabularies. Taking into account these findings, productive vocabulary scores were obtained via parental report, using the MCDI Short Form (Toddler Version)(Fenson et al., 2000). Infants had a median productive vocabulary of 27 words ($M = 30.06, SD = 20.77$). For the purposes of analyses, we divided infants into two groups, with infants having a vocabulary of and greater than the median, designated to the 'high vocabulary group' ($N = 17$), and those having lower scores, designated to the 'low vocabulary group' ($N = 18$).

Warm-up trials Of the 35 participants, 28 (80%) answered all warm-up questions correctly, 3 (8.6%) answered two, 2 (5.7%) answered one, and 2 (5.7%) were not able to answer any. Since a failure to answer the warm-up questions could be indicative of not understanding the test questions, results of the test trials were analyzed with and without these two infants. The exclusion of these infants did not alter the pattern of findings and therefore, they were included in all analyses that follow.

Pre-test preference trial In order to rule out the possibility of an a priori preference for one of the objects, infants' pre-test choices was analyzed sepa-

rately for each of the three possible object pairs. Chi-square analyses revealed that infants did not demonstrate a clear preference for any one object during the pre-test trials (all $ps > 0.1$).

Comprehension trials Preliminary analyses failed to find any significant effect of productive vocabulary, or the specific object pair and target object to which the infant had been assigned on infants' comprehension. For these reasons, these variable was not included in the following analyses.

The dependent measure was the number of trials, out of four, in which children selected the object that had been labeled. The first analysis of infants' performance on each comprehension test compared infants' performance to chance. Because there were 4 trials, chance responding was considered 2 out of 4 times. When tested on their comprehension of the first label, infants chose the target object an average of 2.8 times ($SD = 1.2$) out of the possible 4 times, a response rate that was significantly greater than expected by chance, $t(34) = 3.76$, $p < .01$. Similarly, when tested on their comprehension of the second label, infants chose the target object an average of 2.6 times ($SD = 1$) out of the possible 4 times, significantly greater than expected by chance, $t(34) = 3.53$, $p < .01$ (See Table 3.5). Thus, during each comprehension test, infants chose the target object significantly more often than would be expected by chance responding.

A second analysis compared childrens performance during the first versus second comprehension test (i.e., did children perform significantly better during the first than second comprehension test?), and explored whether childrens performance differed significantly as a function of which language was presented for each label (i.e. 'language order'). A 2 (sex: male vs. female) x 2 (language

order: English first vs. Spanish first) x 2 (label: first vs. second) mixed-model analysis of variance (ANOVA) did not reveal any significant main effects or interactions, $F(1, 31) = 0.66, ns$, suggesting that the number of target choices for the first label were not significantly different from the second label. These results are consistent with the comparisons against chance.

Nonetheless, since infants were presented with two labels, one in the familiar language (i.e. English) and one in a completely unfamiliar language (i.e., Spanish), we wanted to explore the possibility that hearing the first label in English may influence infants' comprehension of the second labeling session (in Spanish). Planned comparisons were conducted for each language order. When infants were presented with the English label first, they chose the target object an average of 3.2 times out of 4 ($SD = 0.8$), which was significantly above chance, $t(16) = 6.13, p < 0.005$. Similarly, when tested on their comprehension of the Spanish label as the second label, infants chose the target object an average of 2.8 times out of 4 ($SD = 1$), which was also significantly above chance, $t(16) = 2.64, p < 0.05$. In contrast, when infants were presented with the Spanish label first, they did not show evidence of choosing the target object above chance ($M = 2.3, SD = 1.4), t(17) = 1.03, ns$. Furthermore, when tested on their comprehension of the second, i.e. the English label, they chose the target object an average of 2.4 times out of 4 ($SD = 0.9$), which was marginally significant, $t(17) = 1.92, p = 0.07$ (See Table 3.1). Thus, there were differences in infants comprehension of the Spanish label as a function of whether it was presented first (i.e., before the English label) or second(i.e., after the English label)[1]. At the same time, however, these differences were not so marked as to yield any significant effects of language order and label in the ANOVA above.

[1]Infants in the two language orders did not differ significantly in their expressive vocabulary, $t(33) = 0.69, ns$

Table 3.1: Experiment 1: Mean number of target object choices across language order

	Label 1		Label 2	
	M	SD	M	SD
English-first (N = 17)	3.2*	0.8	2.8*	1
Spanish-first (N = 18)	2.3	1.4	2.4	0.9

* significantly different from chance (chance = 2) at p <0.05

A chi-square analysis comparing the number of infants that made 3 or more correct choices to those that made less than 3 correct choices on the test trials was conducted for each label. For the first label, a significant majority of infants, 25 out of 35, chose the target object 3 or more times, $\chi^2(1, N = 35) = 6.4, p < 0.05$. However, for the second label, although a majority of the infants (21 of the 35), chose the target object 3 or more times, this distribution was not significantly different from that expected by chance, $\chi^2(1, N = 35) = 1.4, ns$ (See Table 3.2).

Table 3.2: Experiment 1: Number of infants choosing target object 3 or more times

	Label 1	Label 2
> 3*	25	21
< 3	10	14

* distribution is significantly different from chance at p < 0.05

Since the difference in infants' performance across language orders likely contributed to this non-significant finding, chi-square analyses were conducted for each language order. Of the infants who were presented with the English label first and Spanish second, 15 out of 17 chose the target object 3 or more times for the English label, $\chi^2(1, N = 17) = 9.9, p < 0.05$; the corresponding distribution for the second (Spanish) label was 12 out of 17, $\chi^2(1, N = 17) = 2.9, p < 0.09$ (see Study2Tab3). Of the infants who were presented with the Spanish label first, 10 out of 18 chose the target object 3 or more times,$\chi^2(1, N = 18) = 0.2, ns$; and distribution for the second (English) label was at chance (9 out of 18).

Post-test preference trial Chi-square analyses conducted for each of the object pairs after the labeling and testing trials, in order to check for preferences for one of the objects within each pair did not suggest that infants were more likely to pick one object as compared to the other(all $ps > 0.08$). Because labeling an object can lead infants of this age to prefer that object over others (Baldwin & Markman, 1989), we wanted to rule out the possibility that infants' preference for the labeled object was driving them to choose this object on the test trials. If this was the case, then infants would also be more likely to chose the labeled and therefore, preferred object on the post-test trial. A 'same or different' score was computed for the post-test object choice. For instance, infants scored a 'same' on the post-test measure if their post-test choice was the same as the target object. If this choice was different from the target object (i.e., if they chose the control object instead), infants scored a 'different' on this measure. Analyses revealed that 13 infants (37%) chose the target (i.e. the labeled) object on the post-test trials as compared to 22 (63%) who chose the control (i.e. the non-labeled) object,

a difference that was not significant $\chi^2(1, N = 35) = 2.3, ns$.That is, when asked to 'pick the one that they liked' after both the training and test trials, infants were not more likely to choose the target object than the control object on the post-test trial.

3.2.3 Discussion

The results of Experiment 1 demonstrate that, as a group 19-month-old infants are able to learn two labels for a single object when each label is presented in a different language, English and Spanish. The results support the idea that, akin to the participants in the Namy and Waxman (2000) study, the 19-month-old infants in the current study were able to interpret a phrase in a novel language as a naming phrase and infer that the embedded label refers to the object. The findings are additionally striking when we take into consideration that there was a control unnamed object present during the labeling phase for both the Spanish label, as for the English label. In both cases, equal attention was brought to the control object without using an explicit label. Thus when children heard the Spanish label, the experimenter also drew their attention to the control object using short phrases in Spanish such as,*"Mira, míralo...waoo, me gusta. Estas viendo? Que lindo...hmm, me gusta!"*. Despite the presence of this control object, infants mapped the new label onto the target object and not the control.

The results can lead us to propose some possible mechanisms. When two speakers, each speaking a different language, explicitly provided two labels for a single object, 19-month-old infants did not necessarily assume that the object could have only one label. Instead, when tested on their comprehension of

each label immediately following the training, infants chose the target object at a rate significantly greater than that expected by chance, providing evidence of mapping both labels onto a single object. The willingness of these infants to accept these two labels can be attributed to two possible reasons. One possibility draws from the idea of conventionality and extends it to the bilingual situation that was created in this experiment. Evidence from studies using monolingual contexts suggests that 19-month-old infants have an understanding of conventionality, in the sense that infants understand that knowledge of labels is shared by all speakers of a language. However, in a bilingual context, the understanding of conventionality would require two levels of understanding – one, that different languages use different words, and two, that speakers of a language share knowledge that is specific to that language.

The current study does not allow us to conclude whether infants understood that Spanish and English are distinct languages, now can we say whether infants' understood that each of these languages represented different linguistic communities, such that knowledge of each label was shared only *within* that linguistic community.

However, these findings do suggest that infants are sensitive to the 'contexts' used in the communicative exchange. It appears that the infants in this study understood that a new 'communicative context' signaled a distinct labeling norm (or a 'naming rule'), and that if a second person used a different communicative context and used a new label, it was acceptable for both labels to refer to the same object. While we cannot say that infants' show a complete understanding of conventionality, in the sense that languages represent communities, we can say that infants understand that different communicative contexts

signal different labeling norms (or 'naming rules'). Thus we can conclude that the findings of this study do suggest that in a bilingual context, infants do have an understanding of conventionality at the first level, that is, infants seem to be sensitive to the fact that different languages use different words.

At the same time, whether or not infants mapped the Spanish label onto the target object depended on whether it was the first label presented or the second. When infants were presented with the English label first and the Spanish second, they were able to map both the English and the Spanish label onto the novel object. However, when infants were exposed to Spanish first, a different pattern of results emerged. Infants now showed no evidence of mapping the Spanish label onto the object but did map the English label onto the object. Thus, with a change in the language presentation order, 18-month-old infants demonstrated a change in the ability to form word-object associations, at least for the Spanish label. Why did infants map the Spanish label when it was presented after the English label but not when it was the first label? It is possible that the English labeling phase (i.e., labeling in the familiar language) likely served the same function as did the training phase for the infants in the Namy and Waxman (2000) study. Infants who were first presented with English followed by Spanish, were more likely to accept the second label in Spanish as compared to those infants who were presented with the Spanish label first and English second. Without a prior training phase in English, infants were unable to interpret the first labeling session when in an unfamiliar language.

A second possibility is that infants simply assume that different *speakers* have different labels to describe the same object regardless of the language they speak. Since there were two different speakers who explicitly provided two la-

bels, this cue might have been sufficient for infants to accept both labels. If this possibility holds, infants should demonstrate similar patterns if both labels are presented in one language, as long as a different speaker provides each label. The second experiment was designed to rule out this possibility and determine whether infants would map two labels onto a single object if each label was presented by a different speaker in a single language.

3.3 Experiment 2

The purpose of the second experiment was to determine if infants between 17.5 and 20.5 months of age would map two novel labels onto a single novel object when both labels were presented in English. As in the previous experiment, each label was presented by a different interlocutor. Thus, we attempted to teach the child a completely novel word (first label) for a novel object followed by a second novel label for the same object. In this experiment, both labels were presented in the infants own language (i.e., English). This procedure combines aspects of tasks used in previous studies. Thus two novel objects were used (e.g., Graham et al., 2006; Henderson & Graham, 2005), as well as two novel labels (Diesendruck & Markson, 2001), and infants were explicitly, albeit briefly, taught both labels. Finally infants' comprehension of both labels was explicitly tested by asking them for the referent of each label (e.g,*"Where is the toma?"* and *"Where is the biru?")*(Savage & Au, 1996).

While we expected 19-month-olds to easily map the first label onto the target object (e.g., Baldwin, 1993; Liittschwager & Markman, 1994; Woodward, Markman, & Fitzsimmons, 1994), the critical issue was infants performance on the

second label. If simply having two different speakers explicitly provide two different labels is sufficient for infants at this age to map both labels onto a single object, we would expect infants to map the second label onto the target object also. Such a pattern of results would bring into focus the role of explicit instruction (that was provided for both labels), as well as the fact that each label was presented by a different speaker. An alternative possibility that would be consistent with a disambiguation effect is that infants would choose the control object in response to the second label.

3.3.1 Method

Participants

The participants were 20 infants (9 males and 11 females), ranging in age from 17.43 to 20.63 months (M = 18.8, SD = 1.01). All participants were full-term at birth and from English-speaking monolingual families. Infants were recruited in the same manner as in Experiment 1. None of the infants who participated in Experiment 1 were recruited for the present experiment. Participants received a T-shirt, sippy cup, or bib in appreciation. An additional 6 infants were not included in the final analysis because they were inattentive during the training session.

Stimuli, Apparatus, and Procedure

We used the same stimuli and apparatus as Experiment 1. The procedure was identical to Experiment 1 except that both labels were presented in English. For

half the children, the first experimenter (E1) presented the first label and the second experimenter (E2) presented the second label. For the remaining infants, the order was reversed.

3.3.2 Results

Warm-up trials Of the 20 children that participated in this experiment, 15 (75 %) answered all three warm-up questions correctly, 4 (20%) answered two correctly, and 1 (5%) was not able to answer any correctly. As in Experiment 1, analyses were conducted with and without this infant, and because the pattern of findings did not change, the analyses are presented including this infant.

Pre-test preference trial In order to rule out the possibility of an a priori preference for one of the objects, infants' pre-test choices was analyzed separately for each of the three possible object pairs. Chi square analyses revealed that infants did not demonstrate a clear preference for any one object during the pre-test trials (all $ps > 0.2$).

Vocabulary measure Vocabulary was measured using the MCDI. Infants had a median expressive vocabulary of 18 words ($M = 20.35, SD = 12.05$). As in Experiment 1, infants were designated to 'high' ($N = 9$) and 'low vocabulary' ($N = 11$) groups on the basis of the median score.

Comprehension trials Preliminary analyses failed to reveal an effect of the object pair or the target object to which each infant had been assigned. For

this reason, these variables were excluded from the following analyses. As in Experiment 1, the first analysis compared the number of times to chance that infants correctly picked the target (labeled) object during the four comprehension trials for each label. For the first label, infants picked the target object an average of 3.15 ($SD = 0.67$) out of a possible 4 times, significantly greater than expected by chance, $t(19) = 7.67, p < .001$. On the other hand, for the second label, they picked the target object only 2.3 (SD = 1.26) times out of a possible 4 times, $t(19) = 1.06, ns$ (See Table 3.5). In order to test for the disambiguation effect, we examined whether infants instead chose the control object at a level above chance for the second label. However, a t-test examining this question revealed that infants in fact chose the control object at below chance levels, $(M = 1.35, SD = 0.93), t(19) = 3.1, p < 0.01$,indicating that they did not assume that the second label must name the unnamed object.

A second analysis compared childrens performance during the first versus second comprehension test while exploring whether childrens performance differed significantly as a function the order in which the two experimenters presented the labels (for half the participants E1 presented the first label while for the other half E1 presented the second label), or vocabulary development. A 2 (label: first vs. second) x 2 (order: E1 first vs. E2 first) x 2 (sex: male vs. female) x 2 (vocabulary group: high vs. low) ANOVA revealed a significant effect of label, $F(1, 12) = 11.39, p < 0.05, \eta_p^2 = 0.49$, indicating that infants chose the target object more often in response to the first label than to the second label. We also found a significant interaction of vocabulary group and sex, $F(1, 12) = 5.45, p < 0.05, \eta_p^2 = 0.31$. Since there was no effect of experimenter, this variable was excluded from the following analysis.

In order to explore the source of the interaction of vocabulary group and sex, we analyzed separately the results of the infants in the two vocabulary groups. The high vocabulary infants (> 18 words) chose the target object for the first label ($M = 3.4, SD = 0.72$) more often than for second label ($M = 1.8 SD = 1.36$), $F(1, 7) = 14.36, p < 0.01, \eta_p{}^2 = 0.67$. In contrast, there was no significant difference between the low vocabulary infants' choices for the first label ($M = 2.9, SD = 0.54$) as compared to the second label ($M = 2.6, SD = 1.12$), $F(1, 9) = 0.66, ns$ (See Study2Tab4). There were no effects of sex.

We followed this ANOVA with planned comparisons against chance. The high vocabulary infants (> 18 words) chose the target object for the first label ($M = 3.4, SD = 0.7$) more often than would be expected by chance, $t(8) = 5.9, p < 0.01$. In contrast, performance on the second label ($M = 1.8 SD = 1.4$) was not different from chance, $t(8) = 0.2, ns$. Although the 'low vocabulary' infants chose the target object mor often for both labels as compared to the 'high vocabulary' infants, comparisons against chance revealed that while the number of target choices on the first label was significantly different from chance ($M = 2.9, SD = 0.5$), $t(10) = 5.6, p < 0.05$; performance on the second label ($M = 2.6, SD = 1.1$) for these infants was only marginally significant, $t(10) = 1.9, p = 0.08$.(See Table 3.3).

In order to test for the disambiguation effect, we examined whether the 'high vocabulary' infants ($N = 9$) instead chose the control object at a level above chance. However, a t-test examining this question revealed that these infants' responses to this question were not different from chance levels, ($M = 1.55, SD = 1.13$), $t(8) = 1.18, ns$, indicating that they did not assume that the second label must name the unnamed object.

Table 3.3: Experiment 2: Mean number of target object choices across vocabulary groups

	Label 1		Label 2	
	M	SD	M	SD
High vocabulary (>18 words) (N = 9)	3.4*	0.7	1.8*	1.4
Low vocabulary (<18 words) (N = 11)	2.9*	0.5	2.6	1.1

* significantly different from chance (chance = 2) at p <0.05

A chi-square test comparing the number of infants that made 3 or more correct choices to those that made less than 3 correct choices on the test trials was conducted for each label (See Table 3.4). For the first label, 13 out of 20 infants chose the target object 3 or more times, $\chi^2(1, N = 20) = 9.8, p < 0.05$. In contrast, for the second label, 9 of the 20 infants chose the target object 3 or more times, $\chi^2(1, N = 20) = 0.2, ns$. In order to test for the disambiguation effect, we examined whether the infants that did not consistently chose the target object for the second label ($N = 11$), instead chose the control object at a level above chance. However, a t-test examining this question revealed that these infants' responses for the second label were not different from chance levels, $(M = 2.09, SD = 0.63), t(10) = 0.36, ns$, indicating that they did not assume that the second label must name the unnamed object.

Post-test preference trial Chi square analyses conducted for each of the object pairs after the labeling and testing trials, in order to check for preferences for one of the objects within each pair did not suggest that infants were more

Table 3.4: Experiment 2: Number of infants choosing target object 3 or more times

	Label 1	Label 2
> 3*	13	9
< 3	7	11

* distribution is significantly different from chance at $p < 0.05$

likely to pick one object as compared to the other (all $ps > 0.2$). As in Experiment 1, a 'same' or 'different' score was computed for the post-test object choice. For instance, infants scored a 'same' on the post-test measure if their post-test choice was the same as the target object. If this choice was different from the target object (i.e., if they chose the control object instead), infants scored a 'different' on this measure. Analyses revealed that 12 infants (60%) chose the target (i.e. the labeled) object on the post-test trials as compared to 8 (40%) who chose the control (i.e. the non-labeled) object, a difference that was not significant $\chi^2(1, N = 20) = 0.8, ns$. That is, when asked to 'pick the one that they liked' after both the training and test trials, infants were not more likely to choose the target object than the control object on the post-test trial.

Comparison with Experiment 1 If the differences between Experiments 1 and 2 are to be attributed to the language in which the two labels are presented (a single language versus two different languages), an analysis combining results from these two experiments should reveal significant effects of experiment. A 2 (label: first vs. second) x 2 (sex: male vs female) x 2 (experiment: same lan-

guage vs. different languages) x 2 (vocabulary group: high vs low)[2] ANOVA revealed a main effect of label, $F(1, 47) = 8.28, p < 0.05, {\eta_p}^2 = 0.15$ and experiment, $F(1, 47) = 4.07, p < 0.05, {\eta_p}^2 = 0.08$, indicating that infants' responded differently in Experiment 1 and 2 (See Table 3.5). We found no effects of sex or vocabulary group.

Table 3.5: Mean number of target object choices (out of 4) for Experiment 1 and Experiment 2

	Label 1		Label 2	
	M	SD	M	SD
Experiment 1 (N = 35)	2.8*	1.2	2.6*	1
Experiment 2 (N = 20)	3.1*	0.7	2.3	1.3

* significantly different from chance (chance = 2) at p <0.05

In a final analysis, a t-test comparing the vocabulary of infants in Experiment 1 with those in Experiment 2 revealed that the latter group had a significantly higher vocabulary than those in the current experiment, $t(52.96)$[3] $= 2.19, p < 0.05$. Could this difference in vocabulary account for the differences in infants' performance in the two experiments? However, recall that in Experiment 2, it was primarily the infants with higher vocabularies that did not show evidence of mapping the second label onto the target object. This pattern was in contrast to the pattern demonstrated by all the infants in Experiment 1 – these infants were at above chance levels in their choices of the target object, for both the

[2]Since we combined two experiments, we computed a 'common median vocabulary score' of 22 words for the two groups ($M = 26.5, SD = 18.5, range = 0 - 92$), and re-designated infants to common 'high vocabulary' ($N = 28$) and 'low vocabulary' ($N = 27$) groups.

[3]A corrected t-test was used because the two groups had unequal variances.

first and the second label. We first compared the vocabulary of the 'high vocabulary' infants in Experiment 2 ($M = 30.1, SD = 10.5$) to the vocabulary of all infants in Experiment 1 ($M = 30.06, SD = 20.77$). These two groups did not have significantly different vocabulary scores.

Next, we compared the performance on the second label of only the 'high vocabulary' infants in Experiment 2 ($M = 1.8, SD = 1.36$) to all infants in Experiment 1 ($M = 2.6, SD = 1$). A t-test found this comparison to be marginally significant, $t(42) = 1.76, p = 0.08$, indicating that even after controlling for vocabulary, infants in these two experiments were performing differently when asked to map a second label onto the target object. At the same time, recall that in Experiment 1, it was primarily the infants who were presented with the English label first who provided the strongest evidence of having mapped the second label onto the target object. For this reason, we compared the performance on the second label of these infants in Experiment 1($M = 2.7, SD = 1.03$) to the 'high vocabulary' infants in Experiment 2. However, again, the difference between their mean scores on the second label was still only marginally significant, $t(24) = 1.8, p = 0.07$

Thus, after controlling for differences in levels of productive vocabulary between the infants in each experiment, we still evidence of a difference in the trend of infants' performance across experiments. At the same time, since this analysis was found to be only marginally significant these findings must be treated with caution.

3.3.3 Discussion

Overall as a group, infants in Experiment 2 were at above chance levels in their choices of the target object for the first label, but they were at chance levels in their choices of the target object for the second label. These findings suggest that 19-month-old infants have difficulty mapping multiple labels onto a single object, when both the labels are presented in the same language. When faced with the task of learning two novel words for a novel object, 19-month-olds easily mapped the first label onto the target object, even when presented with two novel objects. In contrast, infants as a group provided no evidence of having mapped the second label onto the target object. When tested on their comprehension for the second label infants responded at chance levels, suggesting that they were unsure about the referent of the second label. These results are interesting because they are not entirely consistent with a pattern that would be predicted by the disambiguation effect, because infants did not simply assume that the second label referred to the control (unnamed) object. However, given the nature of the experimental set-up, where the target object was explicitly labeled using both labels, infants were presented with information that conflicted with the assumption regarding the referent of a second label that would be predicted by the disambiguation effect. Thus, it is perhaps not surprising that infants were unsure about the referent of the second label. In the face of conflicting information, infants showed a pattern that was, in fact, most consistent with a constraint-based account such as mutual exclusivity that predicts that infants assume that objects can have only one name (e.g., Markman, 1989).

At the same time, vocabulary development was found to play a role in infant's performance on the word mapping task. Infants with a higher expressive

vocabulary (> 18 words) showed a significant difference between the number of target choices on the first label as compared to the second label. In contrast, infants with a lower vocabulary (< 18 words)seemed to pick the target object at approximately the same rate for the first label (the target object was picked 2.9 times on average) as for the second label (the target object was picked 2.6 times on average). At first glance, these vocabulary effects seem consistent with other studies that have also found that infants with a higher vocabulary in this age group are more likely to show a disambiguation effect (i.e., they assume that a novel label stands for an unnamed object) as compared with infants with a lower vocabulary (Graham et al., 1998). However the 'high vocabulary infants did not choose the control object at above chance levels, as would be expected in a disambiguation effect. Similar results were found when we examined the choices made by all the infants ($N = 11$) that did choose the target object 3 or more times for the second label. These findings suggest that these infants were unsure about the referent of the second label and chose randomly between the target and the control objects. Indeed, these infants appeared to be operating under the assumption that objects can have only one name. In fact,it has been proposed that the vocabulary spurt (i.e., the marked increase in the number of words in childrens productive vocabularies) that occurs sometime in the middle of the second year, is enabled by the advent of constraints on word learning (Behrend, 1990; Markman, 1991; Mervis & Bertrand, 1994). By this reasoning, infants that demonstrate a constraint-based word learning strategy should also have higher vocabularies and vice versa. The vocabulary effects that we found in Experiment 2 are thus consistent with such a prediction.

Comparisons between Experiment 1 and 2 revealed that performance on the second label was significantly different in the two experiments. Thus when the

second label was provided (for an already named object) in a different language, infants were more likely to map it onto the target object as compared to when a second label was provided in the same language as for the first label. However, these findings were qualified by vocabulary development. When both labels were presented in English, infants with a lower vocabulary were more likely to map a second label onto the target object than infants with a higher vocabulary. Overall,the results of Experiment 1 and 2 when taken together provide some evidence that infants at this age are sensitive to the fact that an unfamiliar naming context signals a new label. Furthermore, the results suggest that infants did not simply assume that a new speaker signaled a new naming context, and therefore a new label; rather they seemed to be basing their assumptions on the communicative system (i.e., the language) that each speaker used. However, as mentioned earlier, these findings do not allow us to conclude whether infants assumed that each speaker represented a specific linguistic community and whether all speakers of that community shared the knowledge of the label with her.

3.4 General Discussion

The current set of studies explored the conditions under which infants would learn multiple labels for a single object. Specifically, in Experiment 1 we asked whether 19-month-old infants would map two novel labels onto a single novel object if each label was presented in a different language, English and Spanish. Indeed, when one label was presented in English and the other in Spanish, infants mapped both of these labels onto the same target object, although performance was stronger when the first label was in English than when the first

label was in Spanish. In Experiment 2, when presented with two labels in a single language (i.e., English) for the same object, while infants reliably mapped the first label onto the target object, they chose randomly when tested on their comprehension of the second label. Furthermore, the level of vocabulary development played a role in infants' performance on the second label. Specifically, infants with a higher productive vocabulary showed a tendency to resist mapping a second label onto the target object, a pattern that is suggestive of infants' reliance on a lexical constraint such as mutual exclusivity. In contrast the infants with a lower vocabulary in Experiment 2 showed approximately equivalent performance on both labels- that is, they were almost equally likely to map a second label onto the target object as they were to map the first label.

The results of Experiment 1 and 2 indicate that infants demonstrated different word-mapping patterns when the two labels were presented in different languages as compared to when they were presented in one language. Specifically, infants in Experiment 1 were willing to map both labels onto the same object, whereas infants in Experiment 2 showed evidence of mapping the first label but not the second. These results suggest that the bilingual situation created in Experiment 1 cued infants to accept two labels for a single object. However such an interpretation must be treated with caution because results of each of these two experiments were qualified by two separate factors.

In Experiment 1, whether or not infants mapped the Spanish label onto the target object depended on whether it was the first label presented or the second. When infants were presented with the English label first and the Spanish second, they were able to map both the English and the Spanish label onto the novel object. However, when infants were exposed to Spanish first, a differ-

ent pattern of results emerged. Infants now showed no evidence of mapping the Spanish label onto the object but did map the English label onto the object. Thus, with a change in the language presentation order, 18-month-old infants demonstrated a change in the ability to form word-object associations, at least for the Spanish label. Why did infants map the Spanish label when it was presented after the English label but not when it was the first label? It is possible that the English labeling phase (i.e. labeling in the familiar language) likely served the same function as did the training phase for the infants in the Namy and Waxman (2000) study. Thus, infants that were presented first with English followed by Spanish, were more likely to accept the second label in Spanish as compared to those infants who were presented with the Spanish label first and English second. Without this training phase, infants were unable to interpret the first labeling session when in an unfamiliar language. This finding calls into question an interpretation that infants were sensitive to the two 'languages' per se and therefore accepted the two labels. A more parsimonious explanation is that infants were able to draw on the first labeling session (that was conducted in the familiar language) to interpret the second labeling session that was conducted in an unfamiliar sentential context as a naming phrase.

In Experiment 2, as a group, infants reliably mapped the first, but not the second label onto the target. At the same time, the infants with a higher productive vocabulary showed the strongest pattern of consistently resisting mapping the second label onto the target object. However these infants did not choose the control object at above chance levels, as would be expected in a disambiguation effect , suggesting that these infants were unsure about the referent of the second label and chose randomly between the target and the control objects. Indeed, these infants appeared to be operating under the assumption that objects

can have only one name. These vocabulary effects are consistent with the proposal that a vocabulary spurt (i.e., the marked increase in the number of words in childrens productive vocabularies) that occurs sometime in the middle of the second year, is enabled by the advent of constraints on word learning (Behrend, 1990; Graham et al., 1998; Markman, 1991; Mervis & Bertrand, 1994). By this reasoning, infants that demonstrate a constraint-based word learning strategy should also have higher vocabularies and vice versa. The vocabulary effects that we found in Experiment 2 are consistent with such a prediction.

Results of Experiment 1 (particularly from the infants in the 'English-first' order) and Experiment 2 (particularly those with higher vocabularies) when taken together do suggest that infants interpreted the Spanish labeling context as an 'unfamiliar' context and assumed that it was acceptable for the target object to have one name in this context, and another in the familiar context (i.e., in English). These findings do suggest that infants are sensitive to the 'contexts' used in the communicative exchange. It appears that the infants in this study understood that a new 'communicative context' signaled a distinct labeling norm (or a 'naming rule'), and that if a second person used a different communicative context and used a new label, it was acceptable for both labels to refer to the same object.

This study does not allow us to conclude whether infants' understand that different languages represent different linguistic communities, nor can we say whether infants understood that Spanish and English are distinct languages, as adults understand them to be. However, these findings do suggest that infants are sensitive to the 'contexts' used in the communicative exchange. Thus, while we cannot say that infants demonstrated a complete understanding of

conventionality, in the sense that languages represent communities, the results do suggest that infants understood that different communicative contexts signal different labeling norms (or 'naming rules').

The results of Experiment 1 and 2 taken together are also consistent with the idea that young children's tendency to prefer a single label for an object (i.e., the disambiguation effect) should be viewed as a probabilistic bias and not an absolute constraint, such as mutual exclusivity (Markman, 1992). In the face of evidence that contradicts these assumptions (e.g., if an unfamiliar context is being used), children demonstrate flexibility in their word learning behaviors.

These results add to the literature by demonstrating that an unfamiliar language (or at least an unfamiliar naming context) might cue 19-month-old monolingual infants to accept multiple labels for a single object. Furthermore, these findings extend results from other studies that have shown the beginnings of conventional understanding in children (e.g., Graham et al., 2006), as well as studies with older children that show that 2-year-olds can and do use pragmatic information in guiding their word learning and can learn multiple labels for a single entity (e.g., Clark & Grossman, 1998; Henderson & Graham, 2005). Taken together, the results of the two experiments bring into focus infants' ability to adapt their word-learning strategies to the amount of information that is available in any word learning situation. These results are the first to demonstrate the beginnings of an understanding in infants that languages might represent distinct communicative systems, each with its own labeling norms.

CHAPTER 4

LEARNING LABELS IN A SECOND LANGUAGE: EFFECTS OF FAMILIARITY AND NOVELTY IN 19- AND 25-MONTH-OLDS.

4.1 Introduction

By the middle of their first year, most infants have acquired a productive vocabulary of about 50 words, and are rapidly adding new words to this repertoire on a daily basis (Fenson, Dale, Reznick, Bates, Thal, & Pethick, 1994). Studies using a variety of experimental procedures have lent support to this phenomenon of rapid word learning and shown that by 18 months of age infants can reliably map words onto referents in a variety of experimental settings (e.g., Baldwin, 1993; Hollich, Hirsh-Pasek, & Golinkoff, 2000; Houston-Price, Plunkett, & Harris, 2005; Tomasello, Strosberg, & Akhtar, 1996; Trehub & Shenfield, 2007; Woodward, Markman & Fitzsimmons, 1994). However, almost all of these studies have examined word learning in monolingual contexts with monolingual infants. We know little about the mechanisms that underlie early word-learning for infants who are born into monolingual families but are gradually exposed to a second language from very early in development. There has been relatively little research using experimental techniques on how word learning might take place such contexts. The current study is an exploratory study that examines infants' ability to learn words in the second language in such a situation. Specifically, the study asks whether monolingual, 19- and 25-month-old infants from English-speaking families can learn Spanish labels for two kinds of objects – familiar (i.e., object for which infants have names in English) and novel (i.e., objects for which infants do not have names in English).

Bilingualism is a highly complex phenomenon, and broadly speaking, 'bilingual language development' can be classified on the basis of when the two languages are learned relative to one another. As discussed in Chapter 1, generally, when both languages are acquired simultaneously from birth, the phenomenon is referred to as Bilingual First Language Acquisition or BFLA (Meisel, 1989). When children learn one language first, followed by another (i.e., sequentially), it is variously referred to as early second language acquisition (early SLA) (Pearson, 2007), or 'bilingual second language acqusition' (DeHouwer, 1995) depending on the point in development that exposure to the second language begins. However, there is often no clear line of division between these two types of bilingual development. It is not clear what the limits are of 'early' in early SLA, nor what the nature of second language learning is for the child learner (Pearson, 2007). Whether children who acquire two languages starting in their first, second, or third year are different kinds of dual language learners is an empirical question and one that can be answered through studies that examine whether these groups of children learn their two languages in different ways or at different rates as compared to children who learn from birth (Genesee, 2006). In the current study, we examined infants who had had no or minimal experience with a language other than English, prior to participating in this study. For this reason, we approached our monolingual participants as being early second language learners.

If the second language is learned after the child has already had some experience with the first language, a related question that arises is whether the second language is learned independent of the first language or whether it is is filtered through the structures of the first language. This question leads to important issues regarding the nature of the relationship between the two lan-

guages of a developing bilingual. First, are a bilingual child's two languages differentiated from the very beginning? And second, do the two languages develop autonomously or inter-dependently (Paradis & Genesee, 1996)? Contrary to earlier conceptualizations that bilingual children go through an initial stage where the languages are not differentiated, (the 'unitary language system hypothesis') (Volterra and Taeschner, 1978; see Genesee, 1989 for a review), several studies have shown that bilingual learners acquire language-specific properties of each of their target languages early in development (see Genesee, 2001; DeHouwer, 2005; Meisel, 2001 for reviews).

Other evidence supporting language differentiation comes from studies that show that bilingual children in the one- and early two-word stages of development are able to use their languages differentially and appropriately with parents who habitually speak different languages with them (Genesee, Nicoladis, & Paradis, 1995; Nicoladis, 1998; Nicoladis & Genesee, 1996); they demonstrate similar sensitivity when interacting with strangers with whom they have had no prior experience (Genesee, Boivin, & Nicoladis, 1996). The ability to use their two languages differentially, and to respond to the linguistic preferences or proficiency of unfamiliar interlocutors indicates that bilingual children do differentiate their languages. Furthermore, they are also able to make on-line adjustments to accommodate interlocutors' language preferences and/or abilities (Comeau, Genesee, & Mendelson, 2007; Comeau, Genesee, & Lapaquette, 2003; Comeau & Genesee, 2001), reflecting true bilingual communicative competence. Similarly, evidence that bilingual children produce words in each language for a single referent (also know as 'translation equivalents' or TEs)has been used to argue that bilinguals differentiate their languages (Patterson & Pearson, 2004). A number of researchers have reported that bilingual children

produce translation equivalents from the time they first begin to speak (Pearson, Fernández, & Oller, 1995) or at least by 8 months on (Deuchar & Quay, 2000; Lanvers, 1999; Nicoladis, 1998; Nicoladis & Genesee, 1996; Nicoladis & Secco, 2000; Quay, 1995).

As mentioned before, a related question is whether the two languages of a bilingual child develop inter-dependently or autonomously (Paradis & Genesee, 1996). There is evidence of interactions or transfer between the bilingual child's two developing languages. Numerous researchers have reported cross-linguistic transfer of specific features of one language onto the other in the course of bilingual development in the syntactic (Döpke, 1998, 2000; Hulk & Müller, 2001; Müller 1999; Müller & Hulk, 2001; Yip & Mathews, 2000), phonological (Paradis, 2001), and morphological domains (Nicoladis, 2002, 2003, 2006).

However, the question of transfer in lexical items has not been systematically examined. Vocabulary studies on bilinguals using English and Spanish MacArthur Communicative Development Inventories have revealed a range of patterns with regard to how closely growth in one language is related to growth in the other. For example, in studies of Spanish-English bilinguals between 10 and 30 months Pearson and colleagues (Pearson & Fernández ,1993; Pearson & Fernández, 1994; Pearson, Fernández, & Oller, 1995), found that most children were learning new words in each of their two languages; they lexicalized new concepts in both languages; they seemed to be learning both languages from the 'ground-up'. These children could be viewed as experiencing first language acquisition in two languages. For instance, once these children had more than 10 words in all, they knew some words in each language that they did not know in the other (i.e., singlets). Others appeared to be mediating their learning of

the second language through the first language; they learned almost no words in their second language that they did not already know in the first. Despite being exposed to both languages at birth, they seemed to be filtering the second language through the first, like a second language learner. On the basis of the extent of their exposure to the second language, these infants could be characterized as infant second-language learners.

Since the current study examined early second language learning, we asked whether previous experience with an object and its label in the first language would influence infants' ability to learn a label for that object in a second language. Specifically, we set out to examine one possible factor contributing to (or a mechanism underlying) word learning in a second language – that of familiarity. We asked whether familiarity with a word and its meaning in one language would influence infants' ability to learn the equivalent word (i.e., the translation equivalent) in the second language? Monolingual English-learning infants in two age groups (19 months and 25 months) were presented with Spanish labels for both familiar (e.g., 'el perro' for a toy dog; 'el coche' for a toy car; 'las llaves' for a set of toy keys) and novel objects (e.g., 'el cubo' for a plastic roller; 'el pito' for a rainbow-stick; 'la pina' for a rubber urchin) by a native speaker in an interactive paradigm. In a second experiment, infants were first taught the English label for a novel object, and then taught a Spanish label for that object.

Comprehension of the labels was tested using an inter-modal preferential-looking paradigm in which infants' comprehension of words is assessed by their visual fixation of an image that matches a sound. This procedure has been used extensively with children in this age group to assess comprehension of both familiar and newly -learned words (e.g., Golinkoff, Hirsh-Pasek, Cauley, & Gor-

don, 1987; Houston-Price, Plunkett, & Harris, 2005; Tan & Schafer, 2005; Trehub & Shenfield, 2007). Infants are taken to have learned a new word if they show a visual preference for novel objects that have been recently labeled in Spanish (or in English)when these objects are labeled during the test phase. We use 'comprehension' to mean infants' ability to match a verbal label, e.g., *dog*, to an appropriate referent, e.g., an image of a dog, rather than to a distractor, e.g., an image of a car.

Since our participants had had no or minimal experience with Spanish prior to participating in the study, a question that naturally arises is whether these infants could recognize the two languages as two 'linguistic systems'? While such a conclusion is beyond the scope of this study, a comparison of infants' performance across conditions and across experiments should provide some insights into their ability to learn new words in unfamiliar naming/labeling contexts.

Spanish was chosen as the second language primarily because it shares several important characteristics with English. Although Spanish is described as having a relatively free word order, it is common to use the Subject-Verb-Object (SVO) order in Spanish. This is also the canonical order of American English. For this reason, the Spanish stimuli in the current study followed the SVO order. This order was important for other reasons too. Since American English follows a SVO order, American English nouns often appear in utterance-final position. This is reflected in English speaking care-givers speech which contains more nouns in utterance-final position (Au, Dapretto, & Song, 1994; Goldfield, 1993). Moreover, research with a variety of languages, including English, have found that words appearing in utterance-final position in maternal speech to young children are salient in word learning(e.g., Tardif, Shatz & Naigles, 1997).

Furthermore, American mothers, in general, tend to place new words that they are teaching their children at the end of utterances (Aslin, Woodward, LaMendola, & Bever, 1996); they often focus on objects (Tamis-LeMonda, Bornstein, Cyphers, Toda, & Ogino, 1992; Fernald & Morikawa, 1993; Gopnik, Choi & Baumberger, 1996); they often request object labels and prompt for nouns (Goldfield, 1993); and they often ask noun-eliciting questions (Bornstein, Haynes, & Painter, 1998). In light of these findings, we reasoned that the American English-learning infants in the current study would benefit most from naming phrases with the object-label in the utterance-final position.

This study aimed to examine one possible factor contributing to (or a mechanism underlying) word learning in a second language. Specifically, we asked whether familiarity with a word and its meaning in the first language would influence infants' ability to learn the equivalent word (i.e., the translation equivalent) in the second language? The study examined the ability of monolingual, 19- and 25-month-old infants from English-speaking families to learn Spanish labels for two kinds of objects – familiar (i.e., objects for which infants have names in English) and novel (i.e., objects for which infants do not have names in English).

4.2 Experiment 1

4.2.1 Method

Participants

Participants were 29 full-term, normally-developing infants from monolingual English-speaking families in two age groups: 14 19-month-olds (7 females, 8 males), and 15 25-month-olds (8 females, 6 males). The mean age of the 19-month-olds was 19.28 months (SD = 0.57, *range* = 18.6 - 20.1 months), and of the 25-month-olds was 25.2 months(SD = 0.75, *range* = 24.3 - 26.4 months). An additional 9 infants were tested, but excluded from the analysis because they did not finish the training or testing procedure (N = 4), because they were premature by more than 5 weeks (N = 3), due to an experimental error (N = 1), or because they were growing-up bilingual (N = 1).

Stimuli

Training phase Since one of the objectives of the study was to compare infants' ability to learn labels for familiar and novel objects in an unfamiliar language, we used two sets of objects - one familiar set and one novel set, each comprising three objects. The three familiar objects were 1) a Beanie Baby®toy dog labeled in Spanish as *'el perro'*, 2) a plastic toy car labeled in Spanish as *'el coche'*, 3) a set of plastic toy keys labeled in Spanish as *'las llaves'* (See Figure 4.1). The three novel objects were 1) a plastic kitchen roller labeled as *'el cubo'*, 2) a plastic RainStick®with transparent sides and filled with little plastic beads

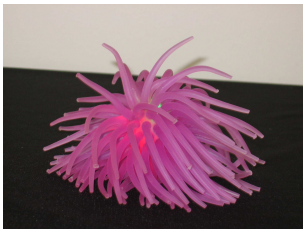
labeled as *'el pito'*, 3) a rubber sea urchin labeled as *'la piña'* (See Figure 4.2). Each child was assigned to two objects from each set. One of these objects was designated as the target object (and therefore, was the 'labeled' object), and the other object was designated as the control object.

(a) Dog

(b) Car

(c) Keys

Figure 4.1: Familiar objects



(a) Urchin

(b) RainStick

(c) Roller

Figure 4.2: Novel objects

The labeling phrases for the target object were, for example, *"Mira, es un perro. ¡Qué bonito el perro! ¿Te gusta el perro?"*, which translate as, "Look it's a dog! What a cool dog! Do you like the dog?". Equal attention was drawn to the control object during the training phase but it was not explicitly labeled. The phrases for the control objects were, *"Mira, lo que tengo. ¡Qué bonito esto! ¿Te gusta mucho?"*, which translate as, "Look, look at this one here. Wow, this is really cool! Do you like this one?". Two other familiar objects were also used as 'warm-up' objects - a rubber bath duck and a rubber ball. The phrases used for the warm-up objects were, *"Look it's a duck. Wow, this is a cool duck? Do you like this duck?"*. The corresponding control phrases were,*"Look at this one. Wow, this is really cool. Do you like this one?"*.

Testing phase Since we used the Inter-modal Preferential Looking Paradigm (IPLP) for testing infants' comprehension of the label, audio-video stimuli were created of the objects used during training. For each object (including the warm-up objects), a still video image was created. Short audio-visual clips were also created of the Spanish-speaking experimenter (who conducted the training sessions), and the English-speaking experimenter (who conducted the warm-up trials). For the Spanish experimenter, two types of clips were created - one clip for the baseline trials (the same clip was used for all the baseline trials), and six clips for the test trials (one for each test object). The test clips depicted the speaker (the face and shoulders were included in the frame) smiling at the camera and asking for the test objects in Spanish. For instance, the test phrases for the dog (*el perro*) were, *"¡El perro, el perro! ¿Dónde está el perro? ¡El perro!"*. The baseline clips were identical, except that in this case, the speaker drew attention to the objects without labeling them; for example, *"¡Qué lindo, qué lindo!*

¿Estás mirando tú? ¡Que lindo!". Similarly, two types of clips were created for the warm-up trials, depicting the English-speaking experimenter who conducted the warm-up phase. If the target warm-up object was the duck, the test phrases were, *"Look, a duck, look,a duck! Where is the duck? Look, a duck!"* The corresponding baseline phrases were, *"Look, how cool...look, how cool! Oh, wow do you see that? Look, how cool!"*

Apparatus

Training phase The training session took place around a wooden child-sized table in a quiet, well-lit, minimally furnished room . The child and parent sat on child-sized chairs on one side of the table. Two experimenters sat side-by-side, on the other side of the table, across from the child and parent. A Canon digital camera on a tripod was placed between the two experimenters, near the back wall of the room, and focused directly on the child.

Testing phase Since we used the Inter-modal Preferential Looking Procedure (IPLP) to test children's comprehension, the testing phase of the experiment was conducted in a different quiet, dimly-lit enclosure within a larger room. The experimenter sat at a desk in the larger room, and controlled the presentation of the stimuli using the Habit X program (Cohen, Atkinson & Chaput, 2004) and a Macintosh G5 computer. The testing enclosure contained three 20-inch color computer monitors (one positioned in the center, and one monitor each on either side of the center). These were at the infant's eye-level, enclosed in a black wooden frame that was approximately 127 cm from where the infant was seated. A Panasonic camera under the monitor was linked to a VCR

and monitor at the experimenters desk. This monitor allowed the experimenter to observe the infants and the VCR recorded infants' looking times and orientations during the session, which were subsequently coded off-line using the SuperCoder software program (Hollich, 2003).

Procedure

The training phase for each infant comprised two parts, one in which the familiar objects were presented, and the other in which the novel objects were presented. Half the infants were presented with the familiar objects first,followed by the novel object; the order was reversed for the remaining infants. For each set of objects, infants were randomly assigned to view two of the three objects, with one object designated as the target (i.e., the 'labeled'), and the other designated as the control (i.e., 'non-labeled') object. Which of the two objects was labeled and which served as the control object was counterbalanced across participants. For the familiar objects, we made sure to confirm with the parents that their child comprehended the labels for these objects, and for the novel objects, we confirmed that the child had not previously seen the objects.

The experimenters were careful to set up the appropriate language context while interacting with the infant before the experimental session began. Specifically, the Spanish experimenter was careful to speak only Spanish, and the English experimenter who would conduct the warm-up phase spoke only English. After obtaining informed consent, infants and their parents were taken to the training room. Each infant sat at the child-sized table and two experimenters sat across from the infant. Parents stayed in the room throughout the procedure but were instructed to remain neutral and not label any of the objects, and were

asked to fill the MacArthur Communicative Development Inventory Short Form Level II: Toddler Version (MCDI)(Fenson et al., 2000). Once the infant seemed comfortable with the experimenters, the experimental procedure started. Each infant participated in 1) a training phase, and 2) a test phase using the preferential looking paradigm.

Training phase The training phase consisted of three parts: 1) a warm-up trial; 2) the first labeling session, including a forced-choice task; and 3) the second labeling session, including a forced-choice task. Since the labeling sessions for the test objects were conducted entirely in Spanish, infants first participated in a warm-up trial in English to familiarize them with the experimental procedure. The English experimenter (henceforth E1) presented the infant with the warm-up toys (i.e., the rubber duck and the rubber ball), one at a time. The infant was allowed to play with each of these objects for a few seconds. Following this initial presentation, the E1 labeled the object that had been pre-designated as the target. This labeling was conducted in English(e.g., *"Look, it's a duck...yeah, it's a duck...do you like the duck?")*. Next, the E1 drew equal attention to the other object without labeling it (e.g.,*"Look, you see this...wow, this is cool...do you like it?")*. The order in which the target and control objects were presented was counterbalanced across participants. The primary purpose of the warm-up trial was simply to introduce a 'labeling context' in English. However, since infants were highly familiar with these objects and their labels, we included test trials for these objects during the preferential-looking phase, as a test of validity for the preferential-looking procedure.

The table was cleared of the warm-up objects, and the first labeling session started. The Spanish experimenter (E2) introduced the first pair of test objects

(recall that half the infants were presented with the familiar objects first, and the other half were presented the novel objects first). As before, the objects were introduced one at a time and the infant was allowed to play with each for a few seconds. The order in which the target and control objects were presented was counterbalanced across participants. Following this initial presentation, both objects were placed on the table, and after making sure that the infant was attending to the appropriate object, E2 labeled the target object (e.g.,*"Mira, es un perro. ¡Qué bonito el perro! ¿Te gusta el perro?"*), and drew attention to the control object (e.g.,*"Mira, lo que tengo. ¡Qué bonito esto! ¿Te gusta mucho?"*).

The labeling was followed by a forced-choice task. The forced-choice task was originally included as an additional measure of infants' comprehension of the labels. However, since the results from this task are not included in this paper, for the purposes of this paper, this task will be considered as having provided additional exposure to the labels. Furthermore, in this task, the comprehension questions were asked first in Spanish, followed by English. Although asking for the Spanish label in an English sentence frame was pragmatically inappropriate, we included it in order to address the possibility that infants might not understand the Spanish question at all. In this sense, the English question provided a cue about the referents of the labels to the infants.

The forced-choice task was conducted as follows: after the labeling, E2 left the room after saying *'chao'* or *'adios'* to the infant. The E1 then brought out a deep wooden box from under the table and pretended to 'hide' the object in the box. The box was kept on the table, but because it had high sides, the contents were not immediately visible. Next the E1 called out to the E2 by name and when she peeked in at the door, E1 gestured for her to come back in. The E2

came in, pretended to look for the objects for a few seconds, looked at the infant, pretended to be perplexed, and asked for the target object in Spanish(e.g.,"*¡El perro, el perro! ¿Dónde está el perro? ¡El perro!"*). This question was repeated once more, so the child had two chances to pick an object from the box and give it/show it to the E2. Following this routine that was conducted in Spanish, the E1 put back the objects in the box and asked for the referent in English (e.g., *"Where is the 'perro'?"*). This question was repeated once more.

This was followed by the second labeling session and a corresponding forced-choice task for the second pair of test objects. The procedure was identical to that followed for the first pair of objects. To re-cap, in a typical training session, infants heard each of the two Spanish labels 14 times (six times during the labeling, and eight times during the forced-choice task). Furthermore, infants heard each label twice more in an English context.

Test phase using preferential looking Immediately after the training phase, infants and their parents were taken to the other experimental room that was equipped with the three video monitors. The infant sat on their parent's lap facing the monitors. Parents were instructed to remain neutral and not talk or point towards the monitors during the procedure. For each infant, the order in which these trials were presented corresponded to the training order. Thus if infants had been presented with the familiar objects first followed by the novel objects, the test trials were also presented in this order.

For each object pair, infants saw a baseline trial followed by two test trials. Looking behavior during the baseline trial provided a baseline against which looking behavior during the test trials could be compared. Each infant saw nine

trials spread over three blocks: the **first block** (i.e., the 'warm-up' block) comprised three trials for the warm-up objects (including one baseline and two test trials); the **second block** comprised three trials for the first pair of test objects (one baseline and two test trials); the **third block** comprised three trials for the second pair of test objects (one baseline and two test trials). Each trial began with the experimenter (E1 for the warm-up trials and E2 for the test trials) appearing on the center monitor (the side monitors were blank), and asking for the object. This part lasted for 8 seconds, following which the center monitor went blank, and a pair of test objects appeared on the side monitors, one on each screen. This part lasted for another 8 seconds. Although each trial lasted a total of 16 seconds, infants' looking behavior was coded only during the latter part, when the images appeared on both monitors.

For the sake of convenience, the entire preferential-looking test phase is described for a hypothetical infant who was presented with the familiar objects first (assuming the 'dog' as the target, and the 'car' as the control) followed by the novel objects (the 'roller' as the target, and the 'urchin' as the control). Similarly, assume that for this infant, of the two warm-up objects, the ball was the target, and the duck was the control. The test phase started with the **warm-up block**. The baseline trial of the warm-up block started with an 'attention-getter' (a flashing, chiming green circle) that directed infants' attention to the center monitor. Next, the E1 appeared on the center monitor, saying the following, *"Look at that...look at that...oh wow, do you see that? Look at that!"*. As soon as this part of the trial ended, the center monitor went blank and the pair of warm-up objects appeared on the two side monitors, one on each side. While these stayed on the monitors, the same phrases that were said by the E1 before played in the background (this audio track was obtained by extracting the audio from the

original video clip). Thus while the images were on the side monitor, infants heard a second repetition of the general phrases. As soon as this baseline-trial ended, the attention-getter re-appeared on the center monitor, following which the first test trial for the warm-up objects started - the E1 appeared on the center monitor and asked for the target object, i.e, the ball(e.g., *"Look a ball...look a ball! Oh wow do you see that? Look, a ball!")*. As soon as this part of the trial ended, the images of the two warm-up objects appeared on the two side monitors, one showing the ball and the other showing the duck. As before, while these images were on, the same audio track played in the background (i.e., *"Look a ball...look a ball! Oh wow do you see that? Look, a ball!"*). The first test trial was followed by the second test trial which was identical to the first test trial.

The warm-up block was followed by the **first test block** (in this case, for the familiar objects). This block started with an 'attention-getter', followed by the baseline trial during which the E2 appeared on the center monitor, saying the following neutral phrases, *"¡Qué lindo, qué lindo! ¿Estás mirando tú? ¡Que lindo!"*. As soon as this part of the trial ended, the center monitor went blank and the two familiar objects (i.e., the 'dog' and the 'car')appeared on the two side monitors, one on each side. While these stayed on the monitors, the same phrases that were said by the E2 in the first part played in the background. As soon as this baseline-trial ended, the attention-getter appeared on the center monitor, following which the first test trial for this object pair started - the E2 appeared on the center monitor and asked for the target object, i.e, the dog(e.g.,*"¡El perro, el perro! ¿Dónde está el perro? ¡El perro!"*). As soon as this part of the trial ended, the two test objects appeared on the side monitors, while the same audio track played in the background. The first test trial was followed by the second test trial which was identical to the first test trial. The **second test**

block was identical to the first one, except that this time, the novel objects were presented.

The side on which the target objects appeared was counterbalanced across participants. All infants were assigned to one of two orders- half the infants were assigned to the 'right-left-right order', i.e, for the first block of test trials, the target was always on the right monitor, for the second block, the target was on the left monitor and for the third block, the target was on the right monitor. The other half of the infants were assigned to a 'left-right-left order'. The infant was video-taped during the entire test phase.

Coding

The videotaped sessions of infants' looking behavior during the test phase were transfered to a Macintosh computer and converted into QuickTime digital movies. Infants' looking behavior was coded off-line using the SuperCoder software program (Hollich, 2003). This program breaks down the test session at the rate of 29.97 frames per second, and allows a frame-by-frame analysis of infants' looking behavior. All test sessions were coded by an experimenter who was blind to the experimental conditions.

Based on previous studies that suggest that the ability to recognize words in a preferential-looking paradigm might be more accurately assessed using a measure of infants' first reaction to the word as compared to the total length of time that infants orient towards the referent (Fernald, Zangl, Portillo, & Marchman, 2008; Kedar, Casasola, & Lust, 2006), we used three different measures of

infants' looking behavior. The following measures were calculated from infants' looking behavior during the test session:

Latency Duration of time from the appearance of the two images to infants' initial fixation to the target image.

Duration of first look to target Length of infants' first look to the target.

Total looking time We calculated the total looking time to the target and the control during the baseline and test trials for each object pair. Then for each object pair, we compared the total looking time to the target during the baseline trial, to the total looking time to the target during each of the two test trials.

4.2.2 Results

Infants' looking times were analyzed separately for each of the three test blocks: warm-up trials, familiar object trials, and novel object trials. Recall that each block consisted of a baseline trial followed by two test trial that were identical to each other. In each block, we compared infants' looking behavior during the baseline trial to their looking behavior during each of the two test trials. Since looking time was coded in frames (1 second = 29.97 frames), we obtained looking time in seconds by dividing the number of frames by 29.97.

Warm-up trials

The objects used in the warm-up trials (a rubber duck and a rubber ball) were highly familiar to the infants and their performance on this trial was intended

to provide a measure of the validity of the preferential-looking procedure to test infants' comprehension of words. If infants looked reliably longer and/or oriented faster to images of these objects on hearing the relevant label as compared to when viewing the images with neutral phrases, it would indicate that infants recognize the word as the label for that referent.

Latency Recall that latency was defined as the duration of time from the appearance of the two images until infants' initial fixation to the target image. A 3 (trial: baseline vs. first test trial vs. second test trial) by 2 (sex: male vs. female) by 2 (age-group: 19-month-olds vs. 25-month-olds) mixed model ANOVA revealed that infants had significantly shorter latencies to the target object in the first test trial ($M = 0.4s, SD = 0.4s$) as compared with their latencies to the same object during the baseline trials ($M = 1.2s, SD = 1.2s$), $F(1, 25) = 10.79, p < 0.01, \eta_p{}^2 = 0.3$. The latencies to the second test trial ($M = 0.7s, SD = 0.9s$) were not significantly shorter as compared to the baseline, $F(1, 25) = 3, ns$. There were no effects of sex or age-group.

Duration of first look to target Duration of the first look to the target object was not significantly greater for the test trials as compared to the baseline trial.

Total looking time Infants looked significantly longer to the target object during the second test trial ($M = 4.3s, SD = 1.9s$) as compared to the baseline trial ($M = 3.4s, SD = 1.2s$), $F(1, 25) = 5.25, p < 0.05, \eta_p{}^2 = 0.2$. Looking times during the first test trial ($M = 3.9s, SD = 1.3s$), were not significantly different from baseline, $F(1, 25) = 2.37, ns$.

Familiar objects

Preliminary analysis revealed no effects of variables such as the order in which the objects were presented during training ('target first' or 'control first'),the order in which the trials were presented during the test phase('familiar first' or 'unfamiliar first'), or the 'target object'(dog vs. car vs. keys), on any of the measures of infants' looking behaviors. These variables were excluded from the following analyses.

Latency A 3 (trial: baseline vs. first test trial vs. second test trial) by 2 (sex: male vs. female) by 2 (age group: 19-months vs. 25-months) mixed model ANOVA revealed a significant effect of age-group for the first test trial, $F(1, 25) = 5.46, p = 0.05, \eta_p{}^2 = 0.18$. Furthermore, there was a significant three-way interaction of test trial, age-group and sex for the *second* test trial, $F(1, 25) = 4.42, p < 0.05, \eta_p{}^2 = 0.15$. Including productive vocabulary as a covariate continued to yield the significant three-way interaction, $F(1, 24) = 4.25, p = 0.05, \eta_p{}^2 = 0.15$, indicating that the age and sex effects persisted when vocabulary was held constant.

The two age groups were analyzed separately, with sex as a factor. For the 19-month-olds, a 3 (trial: baseline vs. first test trial vs. second test trial) by 2 (sex: male vs. female) ANOVA revealed a marginally significant main effect for the first test trial $F(1, 12) = 4.38, p = 0.058, \eta_p{}^2 = 0.27$, with infants showing shorter latencies to the target image during the first test trial ($M = 0.94, SD = 0.87$) as compared to the baseline ($M = 1.7, SD = 1.5$). Although for the second test trial, this difference did not reach significance for all the infants, we did find a significant interaction with sex, $F(1, 12) = 5, p < 0.05, \eta_p{}^2 = 0.29$, with

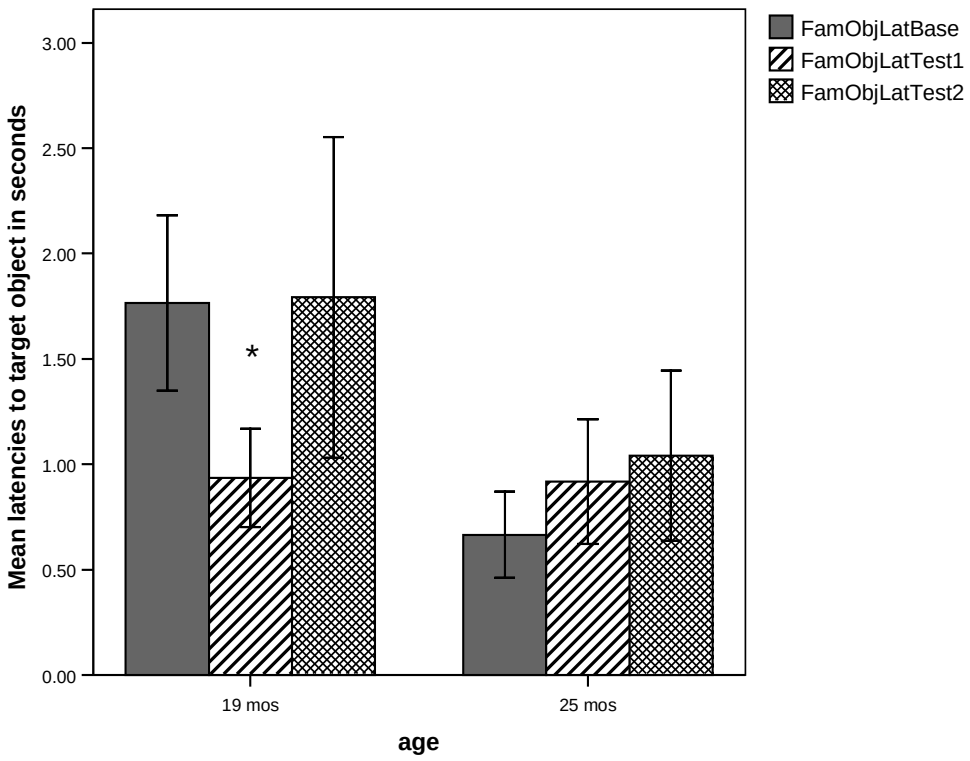


Figure 4.3: Experiment 1: Mean latencies to target object during familiar object trials.

the female infants continuing to show shorter latencies for the second test trial ($M = 0.68, SD = 0.57$) as compared to the baseline. In contrast, the male infants' latencies to the second test trial($M = 3.27, SD = 4$) were *higher* than the baseline. Although the females did have larger productive vocabularies ($M = 39.9, SD = 20.3$) as compared to the males ($M = 22.3, SD = 15.1$) , a t-test indicated that this difference was non-significant, $t(12) = 1.8, ns$.

Analyses for the 25-month-olds did not reveal any significant differences in latencies to the target object during the baseline trial as compared to the test trials.

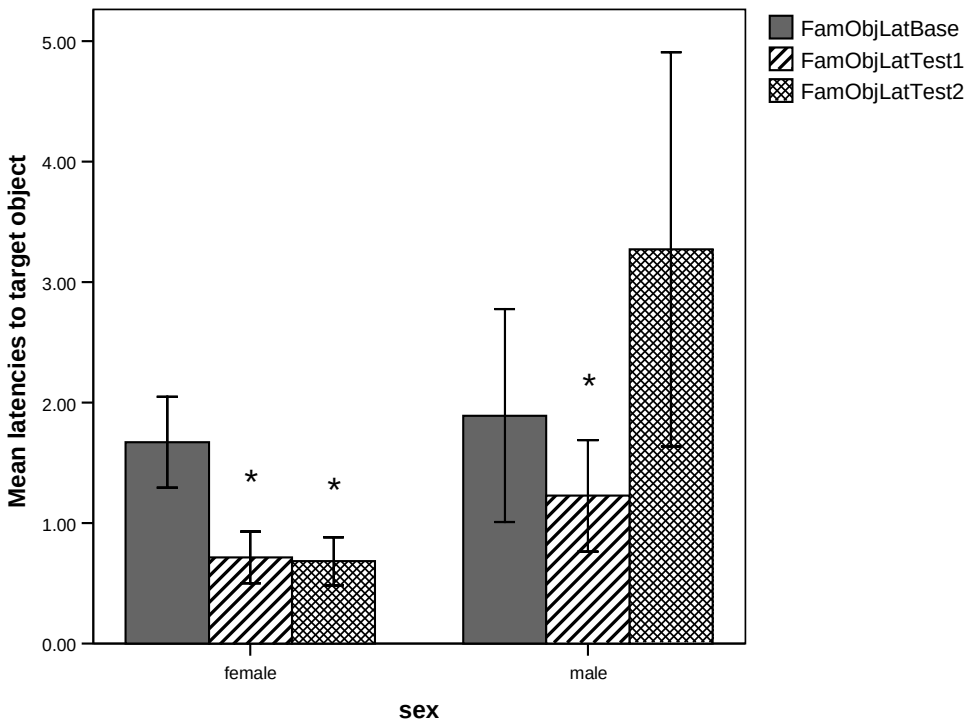


Figure 4.4: Experiment 1: Mean latencies to target object during familiar object trials for 19-month-olds (by sex).

Duration of first look to the target A 3 (trial: baseline vs. first test trial vs. second test trial) by 2 (sex: male vs. female) by 2 (age-group: 19-months vs. 25-months) mixed model ANOVA revealed a significant interaction of sex for the *second*, $F(1, 25) = 6.4, p < 0.05, \eta_p^2 = 0.2$, and a marginally significant 3-way interaction of age and sex for the *first* test trial, $F(1, 25) = 4.2, p = 0.05, \eta_p^2 = 0.14$. Including productive vocabulary as a covariate in an ANCOVA continued to yield the 3-way-interaction of age and sex,$F(1, 24) = 4.6, p < 0.05, \eta_p^2 = 0.16$, indicating that the age and sex effects persisted when vocabulary was held constant.

In order to examine this interaction, we analyzed separately the looking times for each age group. In a 3 (trial: baseline vs. first test trial vs. second test trial) by 2 (sex: male vs. female) ANOVA, we found no significant

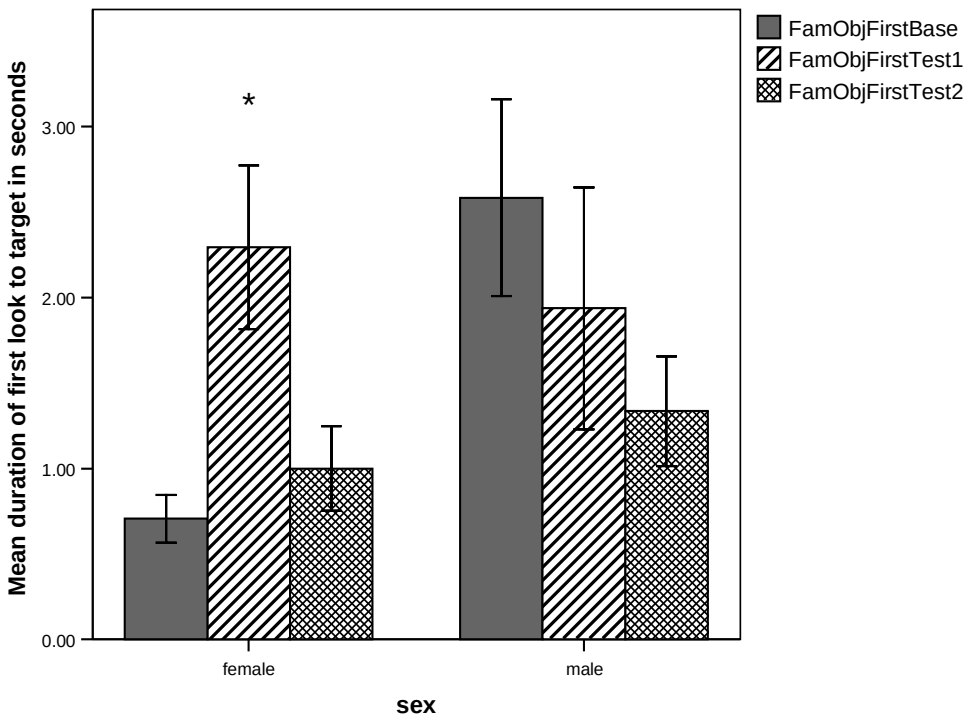


Figure 4.5: Experiment 1: Mean duration of first look to target object during familiar object trials for 25-month-olds (by sex).

effects or interactions for the 19-month-olds. In contrast, analyses with the 25-month-olds revealed a significant interaction with sex, $F(1, 13) = 7.65, p < 0.05, \eta_p{}^2 = 0.37$. Female infants looked significantly longer to the target object during the first test trial ($M = 2.3, SD = 1.2$) as compared with the baseline ($M = 0.71, SD = 0.37$), while male infants did not look longer during the first test trial ($M = 1.9, SD = 2$) as compared to baseline ($M = 2.58, SD = 1.63$) . In order to explore the possibility that vocabulary differences between male and female infants might explain the difference in looking behavior, we compared productive vocabulary of male and female 25-month-olds. Although the females did have larger productive vocabularies ($M = 66.1, SD = 19.4$) as compared to the males ($M = 49.8, SD = 22.5$) , a t-test indicated that this difference was non-significant, $t(13) = 1.5, ns$.

Total looking time We found no significant differences in infants' total looking time to the target images during the baseline trials as compared to the test trials.

Novel objects

Preliminary analysis revealed no effects of variables such as the order in which the objects were presented during training ('target first' or 'control first'), the order in which the trials were presented during the test phase('familiar first' or 'unfamiliar first'), or the test objects (roller vs. RainStick vs. urchin) on any of the measures of infants' looking behaviors. Further analyses did not reveal any significant differences in looking behavior between the baseline trials and the test trials. The only exception was a significant *decrease* in total looking time to the novel target object from the baseline trial ($M = 4s, SD = 1.8s$) to the second test trial ($M = 3.1s, SD = 1.4s$), $F(1, 28) = 6.15, p < 0.05, {\eta_p}^2 = 0.18$.

4.2.3 Discussion

In this experiment, we asked whether 19- and 25-month-old monolingual, English-learning infants would be able to map a Spanish label onto two kinds of objects - familiar objects for which they already knew labels in English(e.g., a toy dog, a toy car and toy keys); and novel objects for which they had no labels in English (e.g., a plastic kitchen roller, a transparent plastic tube filled with colored balls, and a rubber sea-urchin). Infants were first taught the Spanish labels for both kinds of objects, and then tested on their comprehension of these labels in a preferential-looking procedure. Comprehension was assessed using measures

of looking behavior, including length of time required by infants' to orient to the target object (i.e., latency), the length of the first look to the target object, and the total time that the infant spent looking at the target object during the entire trial.

Overall, the 19-month-olds and the 25-month-old females provided evidence of having mapped a Spanish label onto a familiar referent. The 19-month-olds showed shorter latencies to the target, while only the 25-month-old females looked longer on their first look to the target object. Thus for each age group, a different measure provided evidence of infants' ability to map a label in an unfamiliar object to a familiar object.

Although the 19-month-olds oriented faster to the target object on hearing the Spanish label, this trend was only marginally significant during the first test trial. However, on the second test trial the performance of the female 19-month-olds reached significance. Specifically, the female infants in this age group oriented reliably faster to the target during the second test trial. In contrast, the male infants oriented significantly *slower* on the second trial. This pattern in the male infants is indicative of fatigue. Furthermore, as a group, when assessed on other measures, such as the length of their first look to the target or total duration of looking time to the target, the 19-month-olds did not show significant patterns in their looking behavior. Overall, when measured on latency to orient towards the target object, 19-month-olds (particularly the females) showed shorter latencies, and this trend was strongest on the second test trial.

In contrast, 25-month-old did not show corresponding decreases in their average latency. However, this null finding could be reflecting a ceiling effect in their performance as indicated by their very short latencies to the target images during the baseline trials. Nevertheless, when the length of the first look to

the target was analyzed, the 25-month-old female infants did look significantly longer as compared to baseline trial. In contrast, the male 25-month-olds did not show this pattern. This difference between the male and female infants could not be accounted for by differences in vocabulary size. Some possible explanations for these differences are discussed in the General Discussion.

Prior to the trials discussed so far, infants were also tested on their ability to recognize familiar labels (e.g., /duck/ for a rubber duck and /ball/ for a rubber ball). Infants oriented reliably faster to the image of the target object on hearing the label (e.g., *"Where is the duck?"*) as compared to when they were presented with these images paired with neutral phrases (e.g., *"Do you see that?"*). Furthermore, while latencies were reliably shorter for the first test trial (and not the second), total looking time to the target object over the course of the entire trial was higher during the second test trial (and not the first). This finding indicates that infants' performance improved on the 'total looking time' measure, but deteriorated on the latency measure which is a measure of infants' first response. However, this pattern might be specific to objects that are highly familiar to infants, because as we will see in following sections, the 'total looking time' measure consistently failed to reveal any significant results. This methodological issue will be discussed further in the general discussion.

Overall, this experiment suggests that 19- and 25-month-old English-learning infants were able to identify a label presented in an unfamiliar language (i.e., Spanish)for a familiar object. However, infants did not provide any evidence of having mapped Spanish labels onto novel objects, suggesting that familiarity with a label and it's referent in the first language might play an important role in infants' ability to learn the equivalent label in a second language. If this

is the case, if infants are first taught the label for a novel object in the familiar language (i.e., English), they might then be able to learn the equivalent label in the unfamiliar language. In fact, such a finding would be consistent with the findings of Experiment 1 of the study presented in Chapter 3. Experiment 2 was designed to test this possibility.

4.3 Experiment 2

4.3.1 Method

Participants

Participants were 26 normally-developing infants from monolingual English-speaking families in two age groups: 14 19-month-olds (6 females, 8 males), and 12 25-month-olds(6 females, 6 males). The mean age of the 19-month-olds was 19 months (SD = 0.78, *range* = 17.6 - 20.1 months), and of the 25-month-olds was 25.38 months(SD = 0.61, *range* = 24.2 - 26.2 months). An additional 3 infants were tested, but excluded from the analysis because they did not finish the training or testing procedure (N = 1), or they were growing up bilingual (N = 1), or because they were fussy during the testing procedure (N = 1).

Stimuli and apparatus

The same stimuli and apparatus as Experiment 1 were used in the current experiment, except that this time, we used only the novel objects. Each object was

given a novel English label (e.g., the roller was referred to as the *'toma'*, the sea urchin was the *'modi'*(pronounced [mo-dye]), and the RainStick was the *'fipy'*). For instance, the English phrases that were used to label the objects were, *"Look, it's a fipy...wow, it's a cool fipy ...do you like the fipy?"* The corresponding phrases for the control objects were, *"Look, look at this one...wow, this is really cool...do you like this one?"*

Procedure

Since the question we addressed in this experiment was whether familiarity with an object and its label in the native language facilitates the ability to learn the equivalent label in a second language, infants were first taught a novel label for a novel object in English, and then taught a novel label for the same object in Spanish. Each infant participated in 1) a training phase (including a warm-up trial; two labeling sessions, one for each language; and 2) a test phase using the preferential looking paradigm.

Training phase The procedure was identical to Experiment 1, except that this time only the unfamiliar objects were used for both labeling sessions. Thus each infant was assigned to any two of the three novel objects (described in Experiment 1), with one object designated as the target and the other as the control, for both labeling sessions. The difference in the two labeling sessions was in the language that was used to present the label. For each infant, the training phase consisted of three parts: 1) a warm-up trial; 2) the first labeling session in English followed by a forced-choice task; and 3) the second labeling session in Spanish followed by a forced-choice task.

Since the only difference in Experiment 2 was that the objects were first presented in English, the English labeling session is described in detail for a hypothetical infant who was presented with the roller (as the target) and the sea urchin (as the control). After the table was cleared of the warm-up objects, the English labeling session started. As mentioned earlier, the first labeling session was *always* in English, followed by the second in Spanish. The English experimenter (E1) introduced the pair of novel test objects. The order in which the target and control objects were presented was counterbalanced across participants. As before,the objects were introduced one at a time and the infant was allowed to play with each for a few seconds. Following this pre-exposure, both objects were placed on the table, and after making sure that the infant was attending to the appropriate object, E1 labeled the target object first (e.g.,*"Look, it's a toma ...wow, it's a cool toma...do you like the toma")* and also drew attention to the control object (e.g.,*"Look, look you see this one...wow, this is really cool...do you like this one?"*).

The labeling was followed by a forced-choice comprehension test. After the labeling, E1 left the room after saying *'bye'* or *'see you'* to the infant. The E2 then brought out a deep wooden box from under the table and using gestures, pretended to 'hide' the object in the box. The box was kept on the table, but because it had high sides, the contents were not immediately visible. Next the E2 called out to the E1 by name and when she peeked in at the door, E2 gestured for her to come back in. The E1 came in, pretended to look for the objects for a few seconds, looked at the infant, pretended to be perplexed, and asked for the target object in English(e.g.,*"The toma, the toma! Where is the toma? The toma!"*). This question was repeated once more, so the child had two chances to pick an

object from the box and give it/show it to the E2. Unlike in Experiment 1, this routine was not followed by a second routine in another language.

This was followed by the Spanish labeling session. The procedure used here was identical to that used with the novel objects in Experiment 1.

Test phase using preferential looking The preferential looking test phase was identical to Experiment 1 except that after the warm-up block, the first test block was always in English, followed by second test block in Spanish.

The **English test block** is described in detailed, since the **Spanish test block** was identical to the the test block for the novel objects in Experiment 1. The baseline trial started with an 'attention-getter', following which the E1 appeared on the center monitor, saying the following neutral phrases, *"Look, how cool, look how cool! Do you see that? Look, how cool!"*. As soon as this part of the trial ended, the center monitor went blank and the two unfamiliar objects (i.e., the 'roller' and the 'urchin')appeared on the two side monitors, one on each side. While these stayed on the monitors, the same phrases that were said by the E1 in the first part played in the background. As soon as this baseline-trial ended, the attention-getter appeared on the center monitor, following which the first test trial for this object pair started - the E1 appeared on the center monitor and asked for the target object, i.e, the roller(e.g.,*"The toma, the toma! Where is the toma? The toma!"*). As soon as this part of the trial ended, the two test objects appeared on the side monitors, while the same audio track played in the background. The first test trial was followed by the second test trial which was identical to the first test trial. The **Spanish test block** was identical to the English one, except that it was conducted in Spanish.

4.3.2 Results

The dependent measures were the same as in Experiment 1: 1) latency to the target 2) duration of first look to the target, and 3) total looking time to the target. As before, results are presented for each block of test trials

Warm-up trials

Latency A 3 (trial: baseline vs. first test trial vs. second test trial) by 2 (sex: male vs. female) by 2 (age group: 19-month-olds vs. 25-month-olds) mixed model ANOVA revealed that infants had significantly shorter latencies to the target object in the first test trial ($M = 0.44, SD = 0.38$) as compared with their latencies during the baseline trials ($M = 1.1s, SD = 0.59s$), $F(1, 22) = 21.27, p < 0.001, \eta_p{}^2 = 0.5$. Similar results were found when the baseline trials were compared to the second test trial($M = 0.55s, SD = 0.55s$), $F(1, 22) = 12.02, p < 0.01, \eta_p{}^2 = 0.4$. There were no effects of sex or age-group.

Duration of first look to target Duration of the first look to the target object was not significantly greater for the test trials as compared to the baseline trial.

Total looking time to the target Infants looked significantly longer to the target object during the first test trial ($M = 4.9, SD = 1.2$) as compared to the baseline trial ($M = 3.8, SD = 1.2$), $F(1, 22) = 11.7, p < 0.01, \eta_p{}^2 = 0.35$. This difference did not reach significance for the second trial ($M = 4.1, SD = 1.7$), $F(1, 22) = 1.2, ns$.

English trials

Preliminary analysis revealed no effects of variables such as the order in which the objects were presented during training ('target first' or 'control first'), or the 'target object' to which infant was assigned (roller vs. RainStick vs. urchin), on any of the measures of infants' looking behaviors. Similarly, no effects for sex were found either. For this reason, these variables were excluded from the following analyses.

Latency A 3 (trial: baseline vs. first test trial vs. second test trial) by 2 (age group: 19-month-olds vs. 25-month-olds) mixed model ANOVA revealed a marginally significant effect of test trial for the second test trial, $F(1, 24) = 3.41, p = 0.07, \eta_p{}^2 = 0.12$. Infants had lower latencies for the second test trial ($M = 1.2, SD = 0.87$) as compared to the baseline ($M = 1.7, SD = 1.2$). For the first trial ($M = 1.4, SD = 0.88$), this difference did not reach significance, $F(1, 24) = 1.5, ns$. There were no effects of age-group.

Duration of first look to the target A 3 (trial: baseline vs. first test trial vs. second test trial) by 2 (age group: 19-month-olds vs. 25-month-olds) mixed model ANOVA revealed a significant effect of test trial for the first trial, $F(1, 24) = 4.62, p < 0.05, \eta_p{}^2 = 0.16$. The duration of infants' first look to the target during the first test trial($M = 2.68, SD = 2.45$) was greater than during the baseline trial ($M = 1.75, SD = 1.17$). This difference did not reach significance for the second test trial ($M = 2.02, SD = 2.07$), $F(1, 24) = 0.5, ns$. There were no effects of age-group.

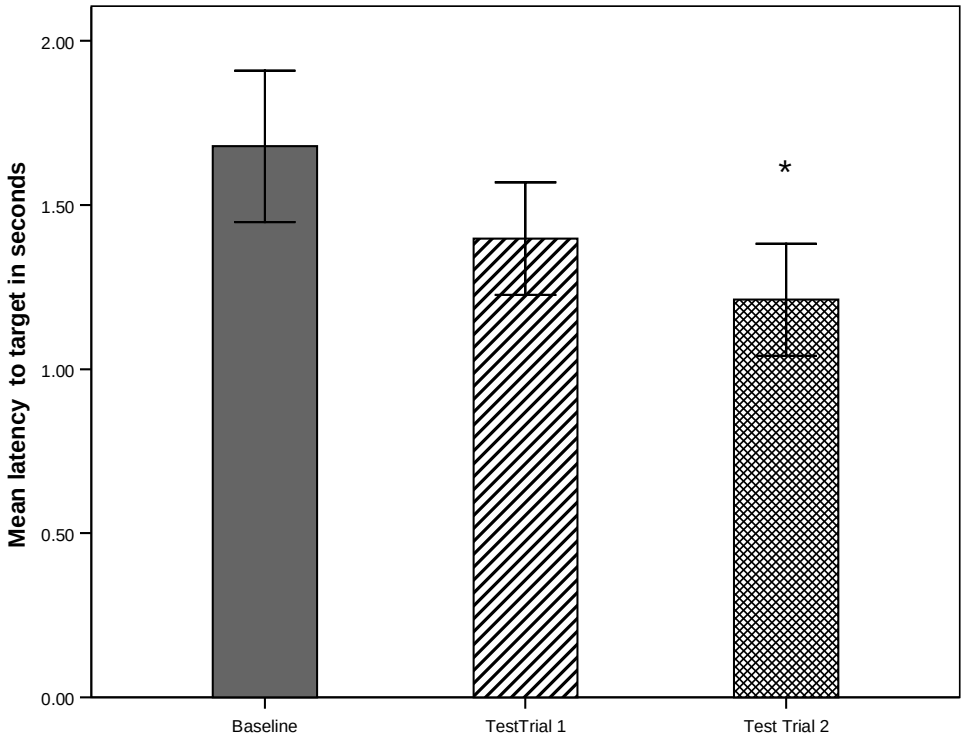


Figure 4.6: Experiment 2: Mean latencies to novel target object during English trials.

Total looking time to the target We found no significant differences in infants' total looking time to the target images during the baseline trials as compared to the test trials.

Spanish trials

Preliminary analysis revealed no effects of variables such as the order in which the objects were presented during training ('target first' or 'control first'), or the 'target object' to which infant was assigned (roller vs. rainstick vs. urchin), on any of the measures of infants' looking behaviors. For this reason, these variables were excluded from the following analyses.

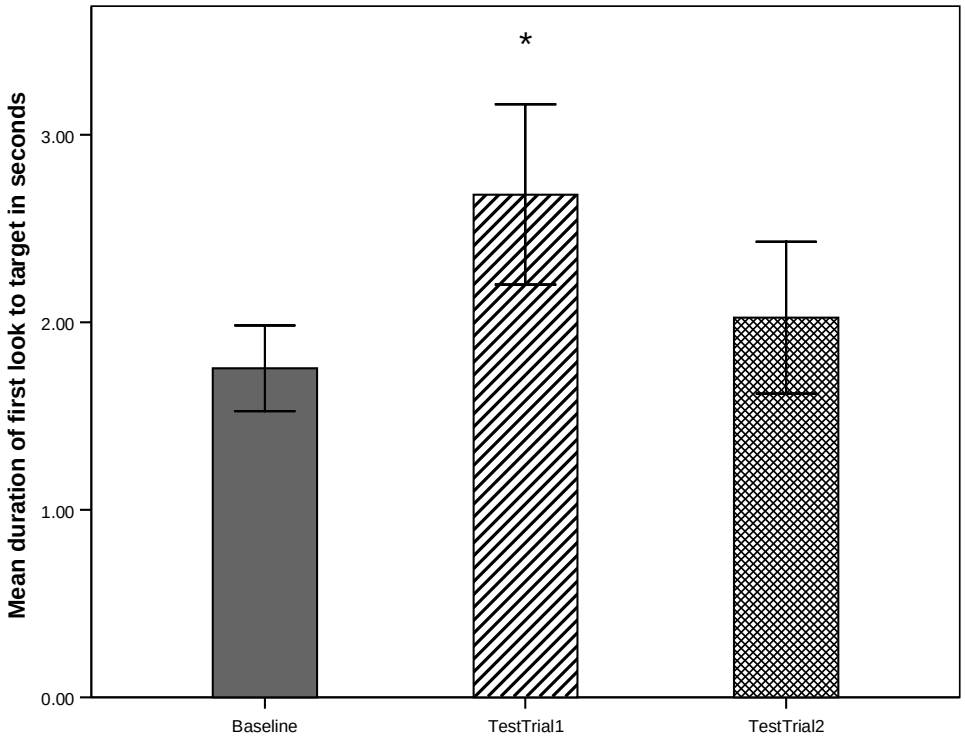


Figure 4.7: Experiment 2: Mean duration of first look to novel target object during English trials.

Latency A 3 (trial: baseline vs. first test trial vs. second test trial) by 2 (sex: male vs. female) by 2 (age-group: 19-month-olds vs. 25-month-olds) mixed model ANOVA revealed main effects for both the first $F(1, 22) = 10.82, p < 0.01, \eta_p{}^2 = 0.33$ and second test trials,$F(1, 22) = 8.2, p < 0.01, \eta_p{}^2 = 0.27$. We also found a significant 3-way interaction of age-group and sex for the first trial, $F(1, 22) = 7.89, p < 0.05, \eta_p{}^2 = 0.26$. An ANCOVA with productive vocabulary as a covariate continued to yield a significant 3-way interaction of age and sex, $F(1, 22) = 6.47, p < 0.05, \eta_p{}^2 = 0.25$, indicating that the age and sex effects persisted when vocabulary was held constant.

Separate analysis of the two age groups revealed that the 19-month-olds showed a marginal decrease in latency during the first test trial ($M = 0.9, SD = 0.6$) as compared to the baseline, ($M = 1.6, SD = 1.1$), $F(1, 12) = 4.47, p =$

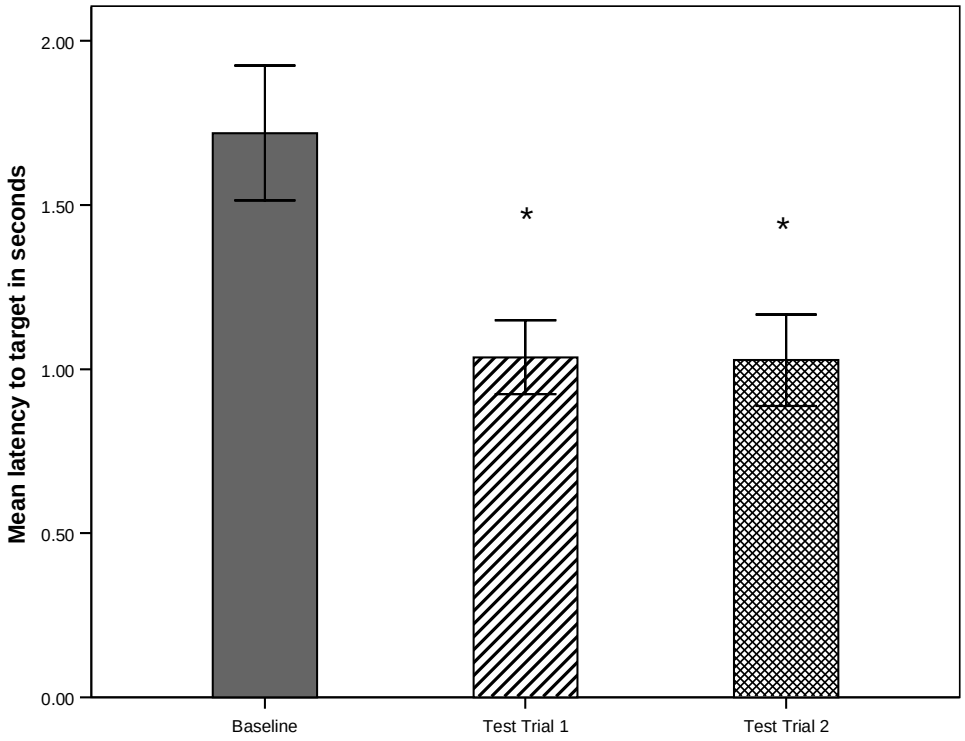


Figure 4.8: Experiment 2: Mean latencies to novel target object during Spanish trials.

$0.056, \eta_p^2 = 0.27$. This difference did not reach significance for the second test trial,$(M = 1.01, SD = 0.9)$,$F(1, 12) = 2.5, ns$.

The 25-month-olds showed different patterns for males and females. The female infants showed a significant decrease in latencies for both the first ($M = 1.1, SD = 0.5$) and second test trials ($M = 1, SD = 0.6$) as compared to the baseline,$(M = 2.5, SD = 1)$. In contrast, the latencies of the male 25-month-olds did not show any significant changes from the baseline ($M = 1.1, SD = 0.52$) trials to the first ($M = 1.2, SD = 0.37$) or second test trial($M = 1.05, SD = 0.41$). Productive vocabularies of male ($M = 69.2, SD = 25.9$) and female ($M = 74.5, SD = 13.5$) infants were not significantly different from each other, $t(10) = 0.4, ns$.

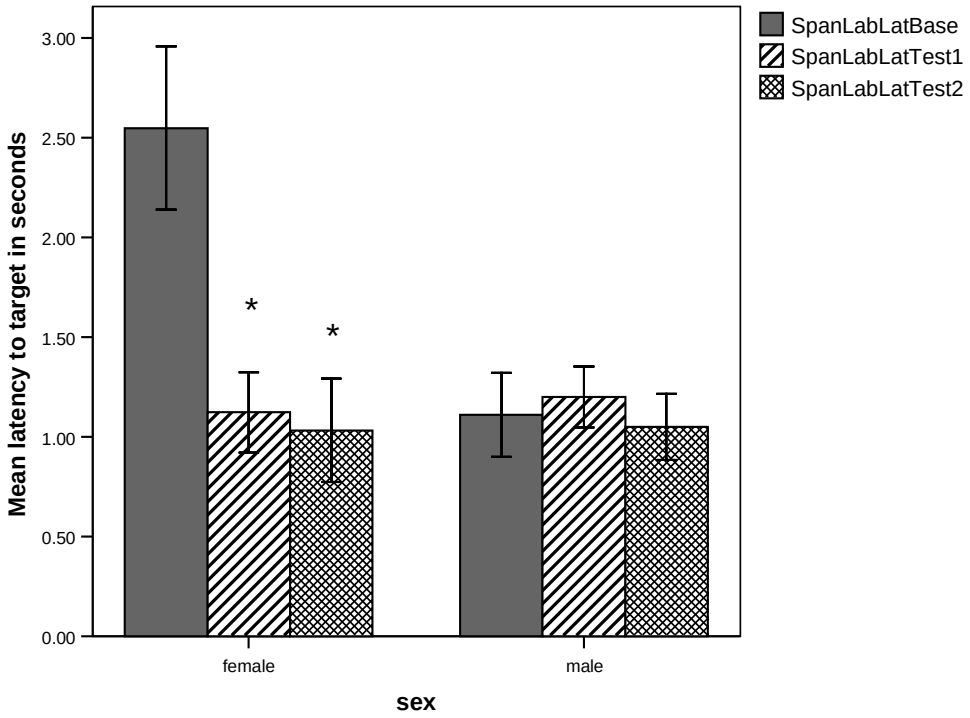


Figure 4.9: Experiment 2: Mean latencies to novel target object during Spanish trials for 25-month-olds (by sex).

First look We found no significant differences in the duration of infants' first looks to the target images during the baseline trials as compared to the test trials.

Total look We found no significant differences in infants' total looking time to the target images during the baseline trials as compared to the test trials.

4.3.3 Discussion

This experiment was designed to examine further the role played by familiarity with a label and its referent in the familiar language on 19- and 25-month-olds' ability to learn an equivalent label for the referent in a second language. Specif-

ically, we asked whether learning the name in English for a novel object would facilitate learning the equivalent name for that object in Spanish.

First, we examined infants' ability to map a novel label onto a novel object in the familiar language (i.e., English) after first being exposed to 6 repetitions of the word-object pairing in an interactive paradigm. Infants in both age groups oriented faster to the target object on hearing the label as compared to the baseline. Converging results were found on the 'duration of first look' measure. Infants' first look to the target object was significantly longer on hearing the label as compared with baseline. These results are consistent with other novel word-learning studies that have used a preferential looking paradigm (Hollich et al., 2000; Trehub and Shenfield, 2007). Furthermore, these results extend previous findings by demonstrating that after being exposed to a novel word-object pairing in an interactive paradigm, 19-month-old and 25-month-old infants can subsequently recognize these words when tested in a preferential-looking paradigm.

Results from the Spanish trials showed that after learning both an English and a Spanish label for a novel object, infants did indeed show evidence of having mapped both the labels onto that object. As a group, on hearing the Spanish label, infants oriented faster to the target object as compared to the baseline. These results are in contrast with the findings from the novel object trials of Experiment 1 where infants did not show any evidence of having mapped the novel label. We also found some effects of age and sex, with the 25-month-old females showing the strongest evidence of having mapped the Spanish label onto the target object. The 25-month-old females in Experiment 2 showed similar patterns as their counterparts in Experiment 1. In Experiment 1, the 25-month-

old females showed stronger evidence of having mapped a Spanish label onto a familiar object as compared to the males. As before, differences in vocabulary sizes between the male and female infants could not account for these patterns. Some possible explanations for these sex differences are discussed in the General Discussion.

As in Experiment 1, infants oriented faster to the warm-up objects (i.e. the rubber duck and the rubber ball) on hearing the labels for these objects as compared to the baseline trials. Converging results were found when the total looking time to the target objects during the test trials was compared to the baseline trials.

4.4 General Discussion

In this study we set out to examine whether monolingual English-learning 19- and 25-month-olds would be able to map Spanish labels onto referents after receiving brief exposure to the Spanish labels in an interactive session. Comprehension was assessed using an inter-modal preferential looking procedure. In Experiment 1, infants first participated in a training phase that was conducted entirely in Spanish by a native Spanish speaker. Using short naming phrases (e.g.,*"Mira, es un perro. ¡Qué bonito el perro! ¿Te gusta el perro?"*), labels were provided for two kinds of objects - familiar and novel. Overall, in Experiment 1, the 19-month-olds and the 25-month-old female infants provided evidence of having mapped a Spanish label onto a familiar referent for which they already had a name in English (e.g., 'dog', 'car', 'keys'). However, infants in neither age-group provided evidence of of having mapped a Spanish label onto a com-

pletely novel object for which they did not have a name in English (e.g., a plastic roller, a plastic transparent tube (RainStick), and a rubber sea urchin).

Experiment 2 was designed to explore whether learning a label for a novel object in thje first language (i.e., English) would facilitate infants' ability to map an equivalent Spanish label onto that object. Overall, infants did provide evidence of having mapped the Spanish label onto the novel object, with the 25-month-old female infants showing the strongest patterns of doing so. Taken together, these results suggest that learning a label for a novel object in the familiar (i.e., the first) language might facilitate infants' ability to learn the equivalent label for that object in a second language. While infants in Experiment 1 did not provide any evidence of having mapped the Spanish label onto the novel object, infants (particularly the 25-month-old females) were able to do so in Experiment 2.

Since the monolingual participants in the current study were considered as early second language learners, the current findings suggest that the development of the first and second language are indeed connected, at least at the level of lexical development. In fact the results are consistent with patterns of vocabulary development of some bilingual infants who was found to be mediating their learning of the second language through the first language; they learned almost no words in their second language that they did not already know in the first, as reported by Pearson and colleagues (e.g., Pearson & Fernández, 1994). These results suggest that if the second language is learned after the child has already had some experience with the first language, the second language might indeed be filtered through the structures of the first language.

Similarly, infants might have been using prior knowledge of their first language (i.e., English) to guide them in identifying labels and mapping them onto referents. Specifically, similarities between word order in English and Spanish, and the fact that the labeling phrases used in this study conformed to the naming phrases most often heard by the middle-class English-learning participants might have provided important cues about the referential nature of the Spanish phrases. In a study examining lexical and grammatical development of English-Spanish bilingual children, Conboy and Thal (2006) found a relation between number of words produced exclusively in English at approximately 30 months, and length of utterances in Spanish. One explanation that was offered for this finding is that contextual cues provided by Spanish input facilitated the learning of words in English (i.e., some form of cross-linguistic structural bootstrapping). Linguistic contextual cues are not likely to facilitate word learning across languages when there are differences in the validity of cues across such languages, such as word order, but this might be possible when cues are similar across languages, especially if words in one language are code-switched into the other language. A child accustomed to hearing Spanish utterances with English guest words might be able to use his or her knowledge of Spanish sentence-level cues to learn those English words (Conboy & Thal, 2006). Similarly, a monolingual English-learning child who is hearing Spanish for the first time might be able to use word-order cues from English in order to make first guesses about word meanings in Spanish.

Taken together, the findings from the current study are the first to empirically demonstrate that familiarity and experience with a label-referent mapping in the first language might be possible mechanisms that facilitate learning the equivalent label-referent mapping in the second language. At the same time,

the possibility remains that each of these mechanisms- 'familiarity' with a label in the first language on the one hand, and 'experience' with an object on the other, play different roles in infants' ability to learn the equivalent labels in a second language. The current study does not permit us to disentangle the possibly independent effects of each of these factors. Similarly, it is still unclear exactly how prior knowledge scaffolds new learning in this context. Future studies might aim to uncover specific mechanisms that mediate the relationship between experience in the first language and learning a second, as well as examine separately the effects of familiarity and experience.

We also found age and sex differences in infants' performance. In Experiment 1, it was the female infants at both age groups who provided the strongest evidence of having mapped Spanish labels onto familiar objects. Similarly, in Experiment 2, although all infants were able to map an English label onto the a novel object, it was again the 25-month-old females who provided the strongest evidence of having mapped a Spanish label onto a novel object.

How can these sex differences be explained? Several vocabulary studies (Bauer, Goldfield, & Reznick, 2002; Fenson et al., 1994; Huttenlocher, Haight, Bryck, Seltzer, & Lyons, 1991; Reznick & Goldfield, 1992), as well as experimental studies on word learning (e.g. Trehub & Shenfield, 2007; Werker, Cohen, Lloyd, Stager, & Casasola, 1998; Woodward, Markman, & Fitzsimmons, 1994) have documented an advantage for females, particularly in the early stages of language development. However the possible factors that could account for the sex differences remain unclear. In order to propose possible factors in the current study, it might be useful to examine some of the cues in the word-learning situation that infants could have recruited in order to form the word-object map-

pings. Factors that have been found to play a role in early word learning include object salience, and social cues, such as speaker intent and eye gaze (e.g., Akhtar & Tomasello, 2000; Hirsh-Pasek, Golinkoff, & Hollich, 2000; Hollich, Hirsh-Pasek, & Golinkoff, 2000). In the current task, several different social cues converged to establish reference - the speaker always looked at (and often touched) the object that was being labeled, and always established joint attention with the infant before labeling. One explanation for the male infants' failure to form the word-object mappings in much the same way as the females is that the male infants were not able to rely on these social cues in the face of the ambiguity that was (possibly) created when the speaker spoke an unfamiliar language. On the other hand, female infants might have been successful in recruiting these cues in order to form word-object mappings. Studies show that female infants tend to demonstrate greater social interest and sensitivity (e.g., Gunnar and Donahue, 1980; Lutchmaya and Baron-Cohen, 2002; McClure, 1980). It has been suggested that this factor might help to explain sex differences that have been found in vocabulary development in infants and toddlers (Bauer, Goldfield, & Reznick, 2002; Fenson et al., 1994; Huttenlocher et al., 1991; Reznick & Goldfield, 1992). It is possible that the ability to recruit the social cues might account, at least partly, for the differences in performance between male and female infants on this task. Further analyses that examine infants' gaze during the training phase in detail might help to shed light on this question.

Similarly, object salience might have played a role in whether or not infants formed a word-object mapping. The same object might vary in its salience for male and female infants. Although we did use three different objects for each of the conditions, differences in the effects of salience on word learning were not

apparent or clear on account of our small sample sizes. Further conditions that use either fewer objects or larger samples might help to address this possibility.

Experiment 2 also demonstrated that 19- and 25-month-old infants were able to map a novel label onto a novel object, and recognize the word-object mapping when subsequently tested in a preferential-looking paradigm. These results are consistent with previous findings that have shown that infants at these ages are able to learn novel word-object pairings that are presented in sentential contexts(Hollich, Hirsh-Pasek & Golinkoff, 2000; Trehub & Shenfield, 2007). The current findings also extend the Trehub and Shenfield (2007) and the Hollich et al (2000)results by demonstrating infants' ability to form novel object-word mappings after first being trained in an interactive paradigm and subsequently tested in a preferential-looking paradigm.

From a methodological perspective, these results suggest that the ability to recognize words in a preferential-looking paradigm, might be more accurately assessed using a measure of infants' first reaction to the word as compared to the total length of time that infants orient towards the referent (see Fernald, Zangl, Portillo, & Marchman, 2008 for a similar argument). Other word-recognition studies with infants at these ages in a preferential-looking paradigm have found patterns of looking behavior that would support similar conclusions (e.g., Kedar, Casasola, & Lust, 2006). Moreover, during the familiar object trials in Experiment 1 of the current study, infants' recognition of the Spanish label was inferred on the basis of two different measures. Specifically, the 19-month-olds showed shorter latencies to the target, while the 25-month-old females looked longer on their first look to the target object. Together these find-

ings highlight the role played by measurement techniques in assessing word learning and word recognition abilities in infants at these ages.

Overall, this study contributes to the current word-learning and early bilingualism (and second-language acquisition) literature in several important ways. First, this study suggests that learning a label for a novel object in the familiar (i.e., the first) language might facilitate infants' ability to learn the equivalent label for that object in a second language. This finding could have implications for second language education for young learners - an approach that emphasizes the need to 'build-up' on prior knowledge and experience in the first language might prove to be effective. This is a question that needs to be empirically tested in educational settings such as preschools and child care centers. Second, the study reveals certain individual differences in infants' ability to learn labels in a second language. Further research into the sources of these differences might shed light on the possible mechanisms, such as ability to rely on social cues, that play a role in language learning that takes place in both bilingual and monolingual contexts.

Table 4.1: Diagrammatic representation of Intermodal Preferential Looking Procedure

Trial Type	**Audio**	**Left Monitor**	**Center Monitor**	**Right Monitor**
Attention Getter	Chiming bell		Attention Getter	
Warm-Up Baseline	*"Look at that!..."*			
Warm-Up Baseline	*"Look at that!..."*			
Warm-Up Test Question	*"...Where is the duck?..."*			
Warm-Up Test Trial	*"...Where is the duck?..."*			
Attention Getter	Chiming bell		Attention Getter	
Test Objects Baseline	*"Que lindo!..."*			
Test Objects Baseline	*"Que lindo!..."*			
Test Trial Question	*"...Donde esta el perro?..."*			
Test Trial 1	*"...Donde esta el perro?..."*			

CHAPTER 5

SUMMARY AND CONCLUSIONS

5.1 Summary

The present set of studies explore how infants make their first breakthroughs while learning a second language, early in development. I have approached this question by experimentally exposing monolingual children to a second language at different points in development in the first two years. The studies presented in this dissertation examine how monolingual English-learning infants (aged 2 years and less) process and segment speech, and how they learn novel labels in a language that is unfamiliar to them (i.e., Spanish). In doing so, I have primarily focused on the cognitive and pragmatic mechanisms that might underlie these abilities.

Overall, these studies provide preliminary evidence that monolingual infants might indeed be able to process an unfamiliar language at a global as well as at a more refined level, while showing developmental differences in these abilities between the middle of the first and second year. Second, this dissertation provides evidence of an emerging understanding of conventionality in a bilingual context in 19-month-old monolingual infants. Specifically, infants' word learning behaviors in a bilingual context suggest that they understood that a new language (i.e.,'communicative context') signaled a distinct labeling norm, and this understanding cued them to accept two labels, one in each context, for a single object. Finally, this dissertation also empirically demonstrates that familiarity and experience with a label in the first language might be pos-

sible mechanisms that facilitate learning the equivalent label in the second language.

5.1.1 Processing an Unfamiliar Language

Aims The study presented in Chapter 2 was broadly designed to explore infants processing of an unfamiliar language, both at a global level (i.e., do infants discriminate phrases spoken in English vs. Spanish?) and a more refined level (i.e., do infants segment the speech stream to identify a novel word?). First, we asked whether infants discriminate between their ambient language (i.e., English) and an unfamiliar language (i.e., Spanish). Second, we examined whether infants would be able to discriminate object-labels that were embedded in the unfamiliar language. Finally, we explored developmental differences in these abilities between 8 and 17 months.

With these aims in mind, monolingual 8-, 13-, and 17-month-old infants were habituated to a novel object paired with a novel label embedded in short naming phrases in either their ambient language (i.e., English) or a novel language (i.e., Spanish). Subsequently they were tested with two events; the first test trial depicted the same object-label pairing as during habituation except that the label was embedded in a different language (either English or Spanish). In the second test trial a different novel label was paired with the original object, while the language remained the same as during habituation.

Main findings Overall, eight-month-old monolingual English-learning infants discriminated English from Spanish, both when they were habituated to

naming phrases in English and tested with phrases in Spanish, and vice versa. However, infants at this age provided evidence of attending to the label embedded in the phrases, only when the label was embedded in English phrases. The results of the 13-month-olds revealed an effect of sex – in both the English and Spanish conditions, only the female infants provided evidence of discriminating the utterances in the two languages, while the male infants did not. Furthermore the females in the Spanish condition provided the strongest evidence of recognizing a change in language after being habituated to Spanish and then tested with English. Moreover, infants of neither sex showed evidence of attending to the label embedded in these utterances. In contrast, overall,the 17-month-olds, regardless of habituation condition, reliably discriminated between words. These infants also provided evidence of noticing a change in the language, although this difference was only marginally significant. At the same time, the results for this age group varied as a function of the habituation condition. Overall, infants in the English condition noticed a change in both label and language, while in the Spanish condition, it was mainly the female infants that provided evidence of attending to these changes.

To conclude, this study provides preliminary evidence that monolingual infants might indeed be able to process an unfamiliar language at a global as well as at a more refined level. Naturally, these effects were qualified by developmental differences in infants' abilities. However, since this task paired visual stimuli with the auditory stimuli, this aspect of the task might have hindered the performance of the 13-month-olds. The ability of the 17-month-olds to attend to a word embedded in an unfamiliar language attests to the tendency of infants at this age to be particularly attentive to words that could potentially be labels. In fact, it is possible that the referential nature of the experimental

stimuli actually facilitated 17-month-olds' ability to attend to the word-like unit that was the most likely candidate to be an object-label. Finally, the fact that the target words were rhythmically and phonotactically possible in both English and Spanish, the high transitional probability between the two syllables of each of the words; and the high frequency with which they occurred relative to the other words in the utterances, all played an important role in infants' ability to identify these words. One could conclude that high similarity between certain aspects of the first and second language might in fact help infants make a breakthrough into the second language.

5.1.2 Learning Words in an Unfamiliar Context

Aims The study presented in Chapter 3 asked whether whether young monolingual children will be able to adjust their word-mapping strategies as a function of whether the speaker used a familiar (i.e., English) or an unfamiliar (i.e., Spanish) context to present the words. Broadly speaking, this study explored monolingual 19-month-old infants' understanding of the 'conventionality' of language when presented with an unfamiliar language. Conventionality refers to the assumption made by speakers of a language: the assumption is that speakers of a language represent a linguistic community and therefore speakers of a language share knowledge of the words of that language (Clark, 1988, 1990). However, in a bilingual context, one could say that there are two levels of 'conventionality'. The first level is an understanding that different languages signal different communicative systems, each with its own labeling norms, and the second level of understanding is that speakers of each language share knowledge of only that language. This study examined the emergence of the first

level of an understanding of conventionality in monolingual infants who were presented with a label in an unfamiliar context.

With this end, in Experiment 1, infants were presented with two labels for a single novel object, one of which was embedded in an English sentence frame and the other in a Spanish sentence frame. Indeed, when one label was presented in English and the other in Spanish, infants mapped both of these labels onto the same target object, although performance was stronger when the first label was in English than when the first label was in Spanish. In Experiment 2, when presented with two labels in a single language (i.e., English) for the same object, infants reliably mapped the first label onto the target object. However, their tendency to map the second label onto the target object was influenced by their level of vocabulary development. Some infants (those with a higher productive vocabulary) resisted mapping a second label onto the target object, a pattern that was suggestive of infants' reliance on a lexical constraint such as mutual exclusivity. In contrast, infants with a lower vocabulary showed approximately equivalent performance on both labels- that is, they were almost equally likely to map a second label onto the target object as they were to map the first label.

Main findings The results of Experiment 1 and 2 indicate that infants demonstrated different word-mapping patterns when the two labels were presented in different languages as compared to when they were presented in one language. Specifically, infants in Experiment 1 were willing to map both labels onto the same object, whereas infants in Experiment 2 showed evidence of mapping the first label but not the second. These results suggest that the bilingual situation created in Experiment 1 cued infants to accept two labels for a single object.

These results suggest that infants interpreted the Spanish labeling context as an 'unfamiliar' context and assumed that it was acceptable for the target object to have one name in this context, and another in the familiar context (i.e., in English). These findings do suggest that infants were sensitive to the 'contexts' used in the communicative exchange. It appears that the infants in this study understood that a new 'communicative context' signaled a distinct labeling norm (or a 'naming rule'), and that if a second person used a different communicative context and used a new label, it was acceptable for both labels to refer to the same object.

This study does not allow us to conclude whether infants' understand that different languages represent different linguistic communities, nor can we say whether infants understood that Spanish and English are distinct languages, as adults understand them to be. Thus, while we cannot say that infants demonstrated a complete understanding of conventionality, in the sense that languages represent communities, the results do suggest that infants understood that different communicative contexts signal different labeling norms (or 'naming rules').

5.1.3 Learning Object-Labels in a Second Language

Aims The study presented in Chapter 4 was an exploratory study into the mechanisms that underlie early word-learning for infants who are born into monolingual families but are gradually exposed to a second language from very early in development. We set out to examine one possible factor contributing to (or a mechanism underlying) word learning in a second language – that of familiarity and experience. We asked whether familiarity with a word and its mean-

ing in the first language would influence infants' ability to learn the equivalent word (i.e., the translation equivalent) in the second language? Specifically, the study asked whether monolingual, 19- and 25-month-old infants from English-speaking families could learn Spanish labels for two kinds of objects – familiar (i.e., object for which infants have names in English) and novel (i.e., objects for which infants do not have names in English).

Main findings Monolingual English-learning 19- and 25-month-olds received brief exposure (from a native-Spanish speaker) to Spanish labels for the familiar and novel objects in an interactive session, following which comprehension was assessed using an inter-modal preferential looking procedure. In Experiment 1, infants first participated in a training phase that was conducted entirely in Spanish by the native Spanish speaker. Using short naming phrases (e.g.,*"Mira, es un perro. ¡Qué bonito el perro! ¿Te gusta el perro?"*), labels were provided for two kinds of objects - familiar and novel. Overall, in Experiment 1, the 19-month-olds and the 25-month-old female infants provided evidence of having mapped a Spanish label onto a familiar referent for which they already had a name in English (e.g., 'dog', 'car', 'keys'). However, infants in neither age-group provided evidence of of having mapped a Spanish label onto a completely novel object for which they did not have a name in English (e.g., a plastic roller, a plastic transparent tube (RainStick), and a rubber sea urchin).

Experiment 2 was designed to explore whether learning a label for a novel object in the first language (i.e., English) would facilitate infants' ability to map an equivalent Spanish label onto that object. Overall, infants did provide evidence of having mapped the Spanish label onto the novel object. Taken together, these results suggest that learning a label for a novel object in the familiar (i.e.,

the first) language might facilitate infants' ability to learn the equivalent label for that object in a second language. While infants in Experiment 1 did not provide any evidence of having mapped the Spanish label onto the novel object, infants were able to do so in Experiment 2.

Taken together, the findings from this study are the first to empirically demonstrate that familiarity and experience with a label in the first language might be a possible mechanism that facilitates learning the equivalent label in the second language.

5.2 Open Questions and Future Directions

5.2.1 Processing a Second Language

Language discrimination

Open questions Findings from Chapter 2 suggest that the specific rhythmic and segmental properties of the two languages that an infant is acquiring either simultaneously or sequentially would play an important role in how the infant learns to process these languages. Based on evidence that early discrimination of languages is closely related to the rhythmic category to which each language belongs, it has been proposed that newborns simultaneously exposed to languages belonging to different rhythmic categories should be able to tell apart these sound systems at an early age; newborns exposed to languages with more similar prosodic structures would face a rather different starting point, with perhaps a later differentiation (Sebastián-Gallés & Bosch, 2005).

In addition, recent studies on 4.5-month-old monolingual Spanish and Catalan infants have demonstrated that while these infants discriminate between these two languages, they did not show evidence of discriminating Spanish from Italian, a language that belongs to the same rhythmic class as Spanish and Catalan (Bosch & Sebastián-Gallés, 2001; Bosch and Sebastián-Gallés, 2000). In contrast, Spanish-Catalan bilingual 4.5-month-olds can discriminate between the maternal language (either Spanish or Catalan) and Italian (Bosch & Sebastián-Gallés, 1997). Clearly an explanation that goes beyond rhythmic class is needed to understand these results. These findings have been interpreted in terms of the specific frequency and distribution of vowels in the fluent speech of these three languages: Italian and Spanish show a more similar distribution of vowel sounds than Catalan, and it is possible that the infants in these studies might have been relying on the vowel cues in order to discriminate these languages. Such a possibility emphasizes the importance of other cues, apart from rhythmic cues, in infants' ability to discriminate certain pairs of languages.

Word Segmentation

Open questions Findings from Chapter 2 suggest that the similarity between certain aspects of English and Spanish might have helped the monolingual English-learning infants segment the target words from the Spanish phrases. Specifically, the fact that the target words were rhythmically and phonotactically possible in both English and Spanish could have played an important role in infants' ability to identify these words. One could conclude that high similarity between certain aspects of the first and second language might in fact help infants make a breakthrough into the second language.

As mentioned previously, the global rhythm of a language not only influences infants' ability to discriminate between languages, but also has implications for the way both adults and children segment their native language (Cutler & Mehler, 1993; Mehler & Christophe, 2000; Mehler, Dupoux, Nazzi, & Dehaene-Lambertz, 1996). Specifically, speakers of different languages have been shown to use distinct procedures to parse the speech signal. The syllable appears to be the segmentation unit for speakers of syllable-based languages such as French, Spanish, Catalan and Portuguese (e.g., Mehler, Dommergues, Frauenfelder, & Segui, 1981; Sebastian-Galles, Dupoux, Segui, & Mehler, 1992). Speakers of stress-based languages such as English and Dutch are guided by typical stress patterns in words which occur due to an alternation of strong and weak syllables, and they use this rhythm as a cue to mark the onsets and offsets of words, (Cutler, Mehler, Norris, & Segui, 1986; Cutler & Norris, 1988; Vroomen & de Gelder, 1995). The question is how the characteristics of the specific pair of languages that an infant is learning interact, and how these interactions influence the way that the infant processes these languages.

Related work: Studies on monolingual and bilingual adults Patterns of perceiving and segmenting speech might be acquired very early in development, with long-term implications. For instance, French monolingual adults have difficulty perceiving the position of stress in artificial words, while Spanish speakers do not (Dupoux, Christophe, Sebastián-Gallés, & Mehler, 1997; Dupoux, Peperkamp, & Sebastián-Gallés, 2001). This effect has been attributed to the fact that Spanish words have lexical stress whereas French words do not. What is interesting is that many Spanish-French bilinguals who have learned

Spanish from birth also have difficulty perceiving stress in artificial words (Peperkamp, Dupoux, & Sebastián-Gallés, 2002).

Similarly, monolingual Spanish speakers show a facilitative effect in processing Spanish after listening to other languages that belong to the same rhythmic group, such as Catalan, Italian or Greek, but not after listening to languages such as English and Japanese that belong to other groups (Sebastián-Gallés, Dupoux, Costa, & Mehler, 2000). Similar findings emerge for English speakers who showed greater processing advantages after listening to Dutch as compared to French (Pallier, Sebastián-Gallés, Dupoux, Christophe, & Mehler, 1998). Similarly, when tested on such tasks, Catalan-Spanish bilinguals showed advantages after listening to either of these two languages and then processing the other. In contrast, English-French bilinguals (even those who were highly proficient but who had learned the second language in childhood and not at birth) did not show these advantages (Pallier et al., 1998). This effect has been attributed to the fact that Spanish and Catalan belong to the same rhythmic class and this similarity facilitates transfer, while English and French belong to different classes, thereby restricting any transfer.

When performing a syllable detection task, French monolinguals are faster when they are required to detect a syllable that coincides with the initial syllable of the target word (Mehler, Dommergues, Frauenfelder, & Segui, 1981). In contrast, English speakers do not show a syllable advantage effect; they are equally fast or slow when the syllable to detect coincides with the first syllable of a word as when it doesn't (Bradley, Sánchez-Casas & Garcia Albea, 1993; Cutler, Mehler, Norris, & Segui, 1983; 1986). However, when highly-balanced adult French-English simultaneous bilinguals were tested in a syllable-identification

task, participants either behaved like English monolinguals (no syllabic effect in English or French), or they showed a syllabic effect for French but not for English, depending on each participant's dominant language (Cutler, Mehler, Norris, & Segui, 1989, 1992).

Taken together these studies indicate that patterns of perceiving and segmenting speech might be acquired very early in development, with long-term implications. Furthermore these studies also highlight how similarities and differences between the specific pair of a bilingual's languages play a critical role in how language processing strategies are learned.

Related work: Studies on monolingual infants Studies with English-learning infants have shown that 7.5 month-old infants are able to use stress to mark the boundaries of words and are better at recognizing troachic words (i.e., words with a 'strong-weak' pattern) in fluent speech than iambic words (i.e., words with a 'weak-strong' pattern) possibly because at this age infants may be treating strong syllables as marking the onset of new words (Jusczyk, Cutler and Redanz, 1993; Jusczyk, Houston, and Newsome, 1999). Similar results have been found with 7.5- to 9-month-old infants who are learning Dutch, another stress-based language (Houston, Jusczyk, Kuijpers, Coolen, and Cutler, 2000; Kooijman, Hagoort and Cutler, 2005; Kuijpers, Coolen, Houston and Cutler, 1998). What is most interesting is that 9-month-old English infants were, in fact, also able to segment words from fluent speech in Dutch (Houston et al., 2000).

A recent study on French-learning infants demonstrated that a syllable-based segmentation strategy appeared to emerge sometime between 8 and 12 months(Nazzi, Iakimova, Bertoncini, Fredonie, & Alcantara, 2005). A study by Polka and Sun-

dara (2003) found that while French-Canadian 8-month-olds were able to segment bisyllabic words in both Canadian-French and European-French (Canadian French tends to have syllables that are longer in duration, and has more intonational variation than the Canadian variety), these infants did not show evidence of segmenting words from the Canadian-English, and neither could Canadian-English infants segment words from Canadian-French. Similarly, Tsay, Newsome and Jusczyk (as reported in Jusczyk, 2001) found that English-learning 7.5-month-old infants could not segment familiarized words from Mandarin Chinese.

These results taken together suggest suggest that while segmentation strategies in one language do transfer to the second language when the two languages share certain properties, the story might be quite different when the languages do not share these properties. More generally, evidence suggest that language processing in bilinguals is a complex interplay between age of exposure, the amount and quality of exposure, the bilinguals proficiency in each language, the degree to which one language is dominant as compared to the other, and specific properties of the languages in question. In order to understand how infants might make a breakthrough in a second language, it is important to take into account the specific pair of languages that is being acquired.

Future directions

Based on such findings, there is a definite need to examine language discrimination in infants who are acquiring different pairs of languages. Findings from these studies could shed light on the varied cues that both monolingual and bilingual infants might rely on in order to segment the speech stream, and

provide insights into the exact nature of the mechanisms underlying language discrimination and more generally, language processing in both bilingual and monolingual infants.

While similarities in languages might have one set of implications for global language discrimination, similarities might have entirely different implications for more specific processing such as word segmentation.

5.2.2 Conventionality and Bilingualism

Findings from Chapter 3 show that monolingual English-learning infants performed differently on a word-learning task when two labels were presented for a single object in two different languages as compared to when they were presented in a single language. Specifically, infants were more likely to map both labels onto the target object when one label was presented in English and a second was presented in Spanish, as compared to when two labels were presented in a single language (i.e., English). These results suggest that presenting the labels in two different naming contexts led children to accept two labels.

It should be noted that this study does not allow us to conclude whether infants had a true understanding of conventionality in a bilingual context, in the sense that each speaker represented a linguistic community, and that knowledge of a label would be shared only *within* the community. However, the results do suggest that infants recognize an unfamiliar naming context as a distinct communicative context, and that two different contexts signal that it is acceptable for a single object to have two different labels. In this sense, they do have a

sense of languages (or at least naming contexts) as being distinct communicative contexts.

Thus, Chapter 3 sheds light on one aspect of conventionality, viz., the understanding that different languages signal different communicative systems, each with its own labeling norms. However, conventionality also implies that speakers of a language share knowledge of the words of that language. There is evidence that even the youngest word learners demonstrate this sensitivity when interpreting novel words presented in a single language (Graham, Stock, & Henderson, 2006; Henderson & Graham, 2005; see also Diesendruck & Markson, 2001; Saylor & Sabbagh, 2004; Saylor, Sabbagh & Baldwin, 2002 for similar findings with 3 and 4 year olds). However a 'true' understanding of conventionality in a bilingual context would require an additional layer of understanding in addition to the one that we have demonstrated in Chapter 3. Specifically, apart from understanding that different languages signal different communicative contexts, children would also need to understand that knowledge of labels that are used within a communicative system would be *shared* by all members of that communicative system. In this sense, children would need to have an understanding of conventionality within a *community* of speakers.

There is evidence of such an understanding in bilingual pre-schoolers. For instance, Diesendruck (2005) found that bilingual 3-year-olds had different expectations about a speaker who was 'monolingual' versus 'bilingual'. Children in this study assumed that two bilingual speakers who were both present during the labeling session would use the same word (i.e., the 'conventional' form) to refer to a particular object, whereas a speaker monolingual in a different language would not necessarily know the conventional form. Thus children's ex-

pectations about speakers' knowledge of novel words were influenced by the linguistic status of the speaker. Based on these results, Diesendruck (2005) proposed that 'children's inferences about the referent of a new word in a multilingual context might not be so much dependent on the number of languages being used, but more dependent on the number of languages(or words)believed to be *known* by the speakers.' Preschoolers might already be basing their inferences about new words 'not so much on the number of languages that are used being used, but more on the number of languages believed to be *known* by the speakers'(Diesendruck, 2005). An implicit understanding of the knowledge state of the speaker is necessary for such an interpretation. In other words, such an understanding taps into 'theory-of mind' understanding in children. Based on evidence that children under the age three years have a limited understanding of the knowledge states of others, it is unlikely that young children (under the age of three years) rely on such a sophisticated understanding of others' knowledge states while learning new words (see Sabbagh & Henderson, 2007 for a review).

In fact, Sabbagh & Henderson (2007) go on to propose that limitations in theory-of-mind understanding are precisely what allow younger children to operate under conventionality, because they assume that everybody else knows the words that they do, leading to word-learning behavior that seems in accordance with conventionality. But if this hypothesis were to be applied to bilingual contexts, it would predict that young children would always be in error in such situations because they would wrongly assume that all speakers share the same knowledge. This possibility seems particularly unlikely in light of evidence that bilingual children in the one- and early two-word stages of development are able to use their languages differentially and appropriately with par-

ents who habitually speak different languages with them (Genesee, Nicoladis, & Paradis, 1995; Nicoladis, 1998; Nicoladis & Genesee, 1996); they demonstrate similar sensitivity when interacting with strangers with whom they have had no prior experience (Genesee, Boivin, & Nicoladis, 1996). Furthermore, two and a half year old bilingual children are also able to make on-line adjustments to accommodate interlocutors' language preferences and/or abilities (Comeau, Genesee, & Mendelson, 2007; Comeau, Genesee, & Lapaquette, 2003; Comeau & Genesee, 2001).

Future directions

The open question then is – how can these opposing proposals and findings be reconciled? Naturally, bilingual children benefit from their unique experiences but the fact that they do use their languages differentially, even while speaking to strangers suggests that it is the language that is being spoken in a context that cues them to make appropriate language choices, even in situation that they have not previously experienced. Future studies might track the development of this ability, as well as the mechanisms underlying this ability, in bilingual and monolingual children.

5.2.3 Word Learning in a Second Language

The findings from Chapter 4 are the first to empirically demonstrate that familiarity and experience with a referent and its label in the first language might be a possible mechanism underlying infants' ability to learn the equivalent label in a second language.

The important question is: *how* does prior linguistic experience in the first language scaffold learning in a second language? Future studies might aim to uncover specific mechanisms that mediate the relationship between experience in the first language and learning a second. Furthermore, future studies might attempt to disentangle the effects of 'familiarity' with a label in the first language on the one hand, and 'experience' with the object on the other. These questions can be approached from the broader perspective of the role played by language in cognitive development. In the realms of object categorization(see Waxman , 2004 for a review), and spatial categorization (see Bowerman & Choi, 2001 for a review), labels have been found to facilitate the formation of categories by possibly drawing infants' attention to commonalities between different exemplars of a specific category (e.g., Casasola, 2005; Casasola & Bhagwat, 2007). Similarly, is it possible that lexicalization of a concept in the first language might make that concept more salient and accessible for further processing?

Future directions

One way to explore further the relationship between experience in the first language and learning a second language would be to examine whether a similar facilitative effect is evident in learning words apart from object-labels, such as verbs and other action words.

There has been extensive research on the nature of noun- versus verb-learning in early language development. The main motivation for this interest is the fairly robust finding that young children's vocabularies tend to be dominated by nouns (see Gentner, 1982 for a review; see also Bornstein, Cote, Maital, Painter, Park, Pascual et al., 2004 for more recent cross-linguistic data). Several expla-

nations have been proposed for this finding. One possibility is that early nouns tend to encode concepts that might be more concrete and hence more accessible , whereas verbs and other action words usually label events such as, actions, motions, and spatial locations. These events tend to comprise components such as manner (the way in which something moves), instrument (the means by which it moves), path (the direction in which it moves) and result (the outcome of the movement). Furthermore, because a single action can have several components, it can be encoded differently depending on which component is given precedence or salience. In fact, different languages *do* encode actions and events differently. For example, English typically encodes manner of motion in the verb (e.g., 'walk') and path in the preposition (e.g., 'up'), while Spanish often encodes path of motion in the verb (e.g., 'ascender') (Talmy, 1975).

In light of these cross-linguistic differences, Gentner and Boroditsky (2001) proposed that verb-learning might be harder, because a child who is faced with the task of mapping a label onto a verb must not only isolate the word, but must also learn the specific encoding patterns of his/her language. Although it is unclear what predictions such a proposal would make for early second language acquisition (Sendeker, Geren, & Shafto, 2007), one possibility is as follows: if an action is encoded similarly in the first and second language, and if the child knows the verb for this action in the first language, then the child should be able to simply map the equivalent verb in the second language onto this action. However, if the encoding patterns differ, the child would have to learn the new encoding pattern and accordingly map the verb onto that action. This possibility can be empirically tested by teaching both kinds of verbs in a second language to young children who already know the equivalent verbs in the first language.

An empirical examination of verb-learning in a second language would draw on other theoretical perspectives as well. For instance, in light of evidence that young children are able to use syntactic information present in sentential contexts to learn the meanings of novel verbs (Gertner, Fisher, & Eisengart, 2006; Naigles, 1990, 1996; Naigles & Kako, 1993; Naigles, Bavin, & Smith, 2005), we might expect children to learn verbs (and other action words) in an unfamiliar language, provided the second language shares the relevant syntactic properties (such as word-order) with the first language.

5.3 Concluding Remarks

Overall, these studies provide preliminary evidence that monolingual infants might indeed be able to process an unfamiliar language at a global as well as at a more refined level, while showing developmental differences in these abilities between the middle of the first and second year. Second, this dissertation provides evidence of an emerging understanding of conventionality in a bilingual context in 19-month-old monolingual infants. Specifically, infants' word learning behaviors in a bilingual context suggest that they understood that a new language (i.e.,'communicative context') signaled a distinct labeling norm, and this understanding cued them to accept two labels, one in each context, for a single object. Finally, this dissertation also empirically demonstrates that familiarity and experience with a label in the first language might be a possible mechanism that facilitates learning the equivalent label in the second language.

To conclude, the experiments presented in this dissertation represent an exploratory study into some of the cognitive and pragmatic mechanisms that un-

derlie early second language acquisition. By experimentally exposing monolingual children to a second language at different points in development in the first two years, this research explores how infants make their first breakthroughs into a second language early in development.

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