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The Relationship between Alternate Language Exposure and English Comprehension in Infants

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Most language acquisition research to date focuses on monolingual infants. In American society there is a burgeoning population of bilingual families where infants must learn the nuances of two languages simultaneously. To extend understanding of language development to this population, research specific to bilingual infants is needed. This study investigates 19-20 month old infants' abilities to understand English when exposed to varying levels of alternate languages, including Hebrew, Hindi, Italian, Japanese, Korean, Portuguese, Punjabi, Serbo-Croatian, Spanish, and Urdu. Participants included 26 babies whose language exposure consisted of at least 99% English, and 22 babies exposed to English and at least 15% of an alternate language. Infants' English noun comprehension was measured using the Intermodal Preferential Looking Paradigm. During a four minute session, infants' gazes were tracked while they looked at simultaneous images, one of which corresponded to a spoken English noun. Before or afterwards, parents identified which of the 16 trial words they believed their infants were able to understand and say. Comparisons were made through two-tailed t-tests that assumed unequal variances. Results showed that infants whose daily language exposure consists of 15-39% of an alternate language understood more English nouns than infants exposed to 40-90% of an alternate language and more than monolinguals. Comparisons of parental reports of infants' speech similarly showed that infants exposed to higher levels of alternate language said fewer English nouns than infants exposed to lower levels of alternate language and fewer than monolingual infants. Validity of parental reports was evaluated through comparisons of parental estimations and experimental results. Monolingual parents reported higher levels of English comprehension than infants showed in the experimental task, while parents of bilinguals did not demonstrate this effect. Possible explanations for these results are discussed in light of past research and implications for English acquisition of bilingual children are considered.

Keywords: bilingualism, infants, language comprehension, Intermodal Preferential Looking Paradigm, lexical developmental norms, parent report validity

Introduction

Despite the increasing prevalence of bilingual families in the United States, little language research has investigated the influence of alternate language exposure on infants' abilities to learn English. This topic is of central importance in the United States, where many infants are exposed to two languages from birth because their parents chose to raise them bilingual. According to the National Center for English Language Acquisition and Language Instruction Education Programs, there were an estimated 5.2 million bilingual children in the United States in 2005, representing a 61.4% increase since 1994 (Goldstein & Fabiano, 2007). Furthermore, bilingualism has been shown to be advantageous to children in later development (Allman, 2005; Bialistok, 2001), which may lead to an increase in families' desire to expose their infants to two languages from birth. This rapid growth of bilingual families in the United States emphasizes the crucial need to understand bilingual language development. Research investigating language acquisition in monolingual infants does not appropriately describe acquisition in bilingual infants, since simultaneous learning of two languages may cause cognitive burden, thereby delaying infants' lexical acquisition (Pearson, Fernandez, & Oller, 1993; Umbel & Oller, 1995). A delay in learning English could impede communication and learning of social cues during infancy in the United States. Little past research has examined bilingual infants' comprehension of English at the critical age of 19-20 months, which follows infants' early vocabulary learning but precedes a rapid burst in vocabulary development (Hoff, 2009). Examining language comprehension is important to determine how two languages influence understanding of words during the early period of language development.

Language Development is Unique in Bilingual Infants

Past studies have shown that language development in bilingual infants is distinct from development in monolingual infants (Bosch & Sebastian-Galles, 2003). These findings emphasize the need for research specific to bilingual infants to better understand language development in this population. Beyond increasing linguistic knowledge, this will serve multiple purposes in education, parenting, and healthcare. Such research will help to better inform parents of trends associated with bilingual development so they can make educated decisions as to when they want to expose their children to two languages and how much exposure they want to provide. Secondly, it will help parents and health care professionals to establish developmental lexical norms for bilingual infants so that appropriate development for this age group can be determined and monitored.

Bilingual infants typically have one predominant language (Slowiaczek & Pisoni, 1986) and it is possible that they are unable to identify as many words in a single language as their monolingual peers. Monolingual children often outperform bilingual children on vocabulary tests (Ben Zeev, 1977b; Doyle, Champagne, & Segalowitz, 1978; Verhallen & Schoonen, 1993; Vermeer, 1992). Furthermore, research indicates that bilinguals infants show decreased ability in word discrimination than their monolingual peers. Ben Zeev

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proposes that bilinguals understand fewer words in both languages than monolinguals do in their single language since bilinguals shoulder the additional burden of learning two labels for each word (Ben Zeev, 1977b). Increased difficulty in language comprehension could lead to difficulties in acquisition, sorting, and differentiation of vocabulary in the two languages (Doyle, Champagne, & Segalowitz, 1978).

Despite these potential delays in comprehension of the primary language, bilingual infants may benefit from early exposure to multiple languages. They are able to recognize earlier than their monolingual peers that objects can have multiple names, thereby improving linguistic development due to their understanding of language as a symbolic reference system (Marian, Faroqi-Shah, Kaushanskaya, Blumenfield, & Sheng, 2009). However, improved linguistic ability does not necessarily correspond to better performance on early vocabulary assessments. After their first 6 months, infants often lose the capacity to universally distinguish phonemes and only retain this ability in languages to which they are regularly exposed (McCardle & Hoff, 2006).

Implications for English Language Acquisition

In the United States, the predominant language is English. Thus, it is especially important for bilingual infants to develop appropriate comprehension of English so that they can learn academically and socially from English-speaking peers and educators. Language development research shows that phonetic differences between other languages and English can make it more difficult to distinguish English phonemes. For example, the consonants /r/ and /l/ are not contrasted in Japanese, thus making it more difficult for those learning Japanese to distinguish between these consonants in English (McCardle & Hoff, 2006). This poses an extra challenge for infants growing up in a Japanese-English environment, where predominance in Japanese over English may impede ability to distinguish English words.

This study focuses on level of any alternate language exposure on English comprehension as this is an understudied factor. Although many immigrant families may raise their infants in an environment with high levels of alternate language exposure, as first generation immigrants age, their children may choose the level of alternate language to which they want to expose their infant. Thus, level of alternate language exposure is a becoming a more critical factor that must be further explored. Past research investigating bilingualism often focuses on children learning English as a second language. This study distinguishes between children who are exposed largely to alternate language at home and those exposed to low levels of alternate language while still utilizing English as their primary language.

If level of alternate language exposure has an influence on English language acquisition, it is crucial that this is determined and that parents and clinicians are made aware, as early native speech perception has implications for later language abilities. There is evidence that better discrimination of native language at 7 months corresponds with accelerated language learning capacity later in life, whereas better non-native language discrimination at 7 months corresponds with reduced language ability later (Kuhl, Conboy, Padden, Nelson, Pruitt, 2005). Other studies also suggest a link between speech perception in early development and later language ability. 6 month olds who performed better on the head-turning procedure, a standard measure of speech perception, showed more advanced word understanding, word production, and phrase understanding at later ages (Tsao, Liu & Kuhl, 2004). While native language discrimination at 6 months correlated with increased language acquisition at a later age, the parents' socioeconomic variables such as parental income, profession, and education, did not. This implies a significant role for early speech perception of the native language in child language development.

Assessing Parental Awareness of Infant Language Comprehension and Production

Determining whether or not to raise one's infant in a bilingual or monolingual environment can be an easy decision for some families and a more difficult one for others. Immigrants to the United States may arrive having much more advanced proficiency in a language other than English. In this case, they may communicate primarily in an alternate language out of necessity. On the other hand, many bilinguals and monolinguals living in the United States have the ability to raise their infants either bilingual or monolingual and must decide which environment they want for their infants. Thus, it is important that parents be well-informed of patterns related to alternate language exposure so they can make the best decision for their families.

Several studies have assessed parental awareness of their infants' language comprehension and production. The MacArthur Inventory parental report showed strong validity in a study on vocabulary and grammar in monolingual Spanish-speaking toddlers (Thal, Jackson-Maldonado, Acosta, 2000). This study aims to assess the validity of parental reports in identifying bilingual and monolingual English comprehension at 19-20 months. This is done through comparison of experimental data and parental report regarding infants' understanding and production of the 16 English nouns tested. Furthermore, this study compares parental reporting of parents of bilinguals and monolinguals and parents of bilinguals exposed to different levels of alternate language. This aims to discern any differences that alternate language exposure has on parental awareness of their infants' language development.

Studies often employ parental reports to assess children's comprehension or production of language. In research dealing with infants, parental reports are a heavily relied upon tool due to difficulty in measuring speech and language at this age. Law and Roy identify parental report as one of the three major approaches to assess language in young children (Law & Roy, 2008).

Children often exhibit stranger anxiety that makes them unwilling to cooperate with researchers (Chiat & Roy, 2007), and thus parental assessment is a useful way to gather data about infants' language capabilities. Furthermore, parents communicate with their infants on a daily basis in a natural environment, allowing them to potentially describe their child's genuine performance better than it could be captured by a single experiment (Law & Roy, 2008). On the other hand, it is possible that parents are biased in their perceptions of their infants' abilities and overrate their abilities. This study assesses the validity of its parental report measure by comparing parental responses with the experimental results.

Hypothesis and Motivation for this Study

Until this study, no research has investigated the influence of level of alternate language exposure on English comprehension in bilingual 19-20 month olds. Infants typically reach the 50 word production milestone at 18 months and the 100 word production milestone between 20 and 21 months (Hoff, 2009). After this age, vocabulary development rapidly increases. Thus 19-20 months provides an ideal age for measuring English noun comprehension, after a substantial amount of vocabulary is typically learned and before the burst that occurs after 21 months.

We initiated this study in order to increase knowledge about the influence of alternate language development on English acquisition. It aims to provide parents with empirical results in order to assist them in their decisions regarding language exposure during their babies' infancies. Parents and clinicians want to ensure happy and healthy development of their children and patients, and an awareness of developmental norms and language exposure trends will help them to create environments best suited for this goal.

Method

One experiment consisting of three studies was conducted in order to gain a better understanding of the effects of alternate language exposure on primary language acquisition, to compare parental reporting of parents of bilingual and monolingual infants, and to assess the validity of parental reports for both groups. Participant information is detailed below, and procedures are described. The use of two assessment tools, the Intermodal Preferential Looking Paradigm and the MacArthur Bates Communicative Developmental Inventory, is rationalized and their validity is discussed.

Participants

Twenty-six monolingual infants who were exposed to at least 99% English on a daily basis served as a control group. An additional twenty-two infants were exposed to both English and an alternate language. All infants were between 18 months and 25 days and 20 months and 5 days old, were single birth full term (38-42 weeks gestation), and had no known hearing problems.

We recruited participants using a public database which lists infants in Rhode Island and Massachusetts. Families were called by phone and were told about the study procedure. Those interested volunteered to participate to help increase understanding of alternate language development. All experiments took place in the Brown University Infant Lab and involved one visit. Before beginning the experiment, all parents signed consent forms and most completed short optional demographic surveys. Before or after the study, parents were given a parent report form to identify which of the trial words they believed their infant could understand or say in English or in an alternate language. All but one parent report form were collected resulting in 26 completed forms for monolingual infants and 21 completed forms for bilingual infants. Following the study, subjects did not receive monetary compensation, but each received a gift—either a t-shirt, book, or toy—as a token of appreciation.

The alternate languages investigated include Hebrew (1), Hindi (1), Italian (1), Japanese (2), Korean (1), Portuguese (5), Punjabi (1), Spanish (8), Serbo-Croatian (1), and Urdu (1). Despite its unique linguistics, American Sign Language was not included as an alternate language in this study because infants learning this language are not exposed to alternate spoken vocabulary that may conflict with English vocabulary, as is the case with the other alternate spoken languages investigated. Exposure levels were self-reported by parents. Parents were encouraged to estimate and report a specific percentage of alternate exposure to the best of their abilities, but if a range was reported, the average of the minimum and maximum of the range was used to establish an alternate language exposure percentage.

Data from three monolingual and one bilingual baby were discarded due to fussiness or equipment malfunctioning. One monolingual baby was unable to be tested due to uncontrollable crying. For a second monolingual baby, data was discarded because one of the screens was not turned on during the experiment. Damaged video recording of one bilingual and a third monolingual rendered their results unable to be coded. All discards were made prior to coding. Two bilingual babies were coded but their results were not included in the study as each had only 10% of alternate language exposure, and only results of infants with 15% or more alternate language exposure were analyzed. This percentage parameter was set to ensure enough difference from the monolingual control group.

Intermodal Preferential Looking Paradigm (IPLP)

Infants' eye gaze was measured using the Intermodal Preferential Looking Paradigm, a method developed by Golinkoff et al. in 1986 to test infants' lexical and syntactic comprehension. Golinkoff used this method to gauge comprehension of nouns, verbs, and word order. Only comprehension of nouns is tested in the present study. This method calls for minimal motor movement of the infant, which we attempted to achieve by having infants sit in their parents' laps, facing two 51 cm television monitors at 55 degree angles. A speaker was hidden behind the monitors. Figure 1 shows the experimental setup, in which infants sit 70cm away from the screens in a sound-treated testing room. A closed-circuit video system was used to monitor the subjects, and digital recordings were kept for later offline-coding. Before each trial begins, a light centered between both screens flashes in order to focus the infants' attention on a half way point between either screens. During a four minute session, the infants were shown two pictures simultaneously on neighboring screens. The salience portion of each trial consisted of a four second period without sound in which both images appeared on the screens. Infants were expected to familiarize themselves with both images during this trial. It also served as a control for an infant's natural preference of one image over another. Following a one second period in which both screens are dark, the center light resumed flashing until the experimenter determined that the subject was centrally fixated. Then a single sound stimulus like "Where is the horse?" was played at a 70dB conversation level, followed immediately by a four second long test portion in which the same images as the salience portion appeared on the same screens. The stimulus corresponded to only one of the two pictures.

Before entering the procedure room, parents were instructed to keep their infants on their laps and to wear noise-

cancellation headphones that played music in order to prevent them from hearing the phrases and in any way influencing their infants' gazes. The experimenter was able to communicate with the parents through the headphones, while watching a video recording of the infant and parent from the coding room. Parents who attempted to talk to their infants during the procedure were asked to avoid interfering. Only one parent was allowed in the room with the child; all other accompanying relatives or friends were allowed to watch the trials through the video monitor in the experimenter's room where they could in no way influence the infant's performance. For a few highly fussy infants, the procedure was paused and infants were allowed a break or toy to soothe them before the procedure resumed. Although the experimenter coded the infants' gazes during the procedure, a more meticulous frame-by-frame coding was completed after the procedure and only these codes were analyzed.

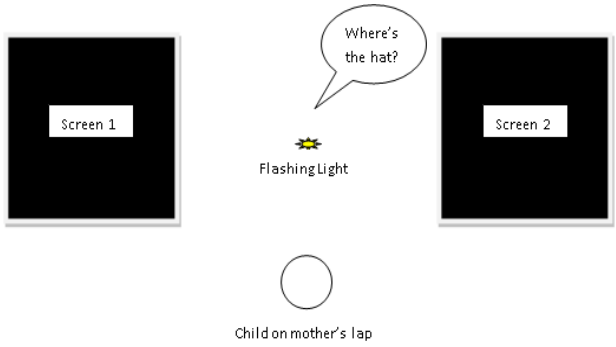

Figure 1: Experimental Set-up

Once trials began, infants often gazed back and forth at each screen, sometimes settling on a screen. During the test trial, longer gaze at the picture corresponding to the noun in the recorded question is often interpreted as increased recognition and understanding of the noun (Kouider, Halberda, Wood, & Carey, 2006; Kearns, 2009). The IPLP shows the two corresponding images over a short period of time, and it has been consistently confirmed that infants show preference for the screen corresponding to the spoken word through quicker and longer looking times. Hollich et al. (2000) reports that in no studies performed in their laboratories have children ever shown increased preference for the distractor stimulus. This suggests that the IPLP has high validity in measuring comprehension through increased looking times. Hollich et al. supports this interpretation in light of the ecological validity of the IPLP, as parents often direct their infants' attention to a stimulus with a question such as "Where is the horse?" in a manner similar to this paradigm. At the end of each trial, the center light resumed flashing, bringing the infants' attention to the center.

The IPLP does not require infants to point to stimuli as eye gaze is the sole determinant of word understanding. This allows the infants' understanding to be judged by only linguistic ability without the additional need for motor involvement (Shipley, Smith & Gleitman 1969; de Villiers & de Villiers, 1973; Shatz, 1978; Bloom & Lahey, 1978). Golinkoff et al. determined that infants' cooperation during the IPLP is high, as the infants in their 3 original IPLP experiments looked at the screens during 95% of the trials.

MacArthur-Bates Communicative Development Inventories Lexical Development Norms for English

Infants were shown a series of 16 salience and experimental trials. Words for the trials were selected using the MacArthur-Bates Communicative Development Inventories Lexical Norms for English**.** The validity of the MacArthur-Bates Communicative Development Inventory (CDI) has been supported by several studies. Heilmann et al. found that use of the CDI resulted in correct identification of 30 month olds with low and normal language skills (Heilmann, Weismer, Evans, 2005). The CDI has shown to be a valid measure of infant vocabulary comprehension at 12 and 18 months (Bates, Bretherton & Snyder, 1988; Ring, Erin & Fenson, 2001; Thal, O'Hanlon, Clemmons, & Fralin, 1999; Law and Roy, 2008). Our study participants were 19-20 months old, and the maximal age included in the CDI is 16 months. All words selected were lexical development norms known to at least 48.6-79.2% of 16 month olds. This higher end range was used to ensure that 19-20 month olds with normal language development would know a majority of the words presented. Percentages of comprehension for each word used in the study are shown in Table 1. All words selected had one or two syllables and were recorded by the same voice at a consistent speed and conversation-level volume. Color images of each word were paired together by similarity of visual appeal and the same pairs were used for all participants. Across trials, each picture appeared twice: once as the target item and once as the distractor. Pairing of pictures within trials was random.

Table 1: Sixteen words were selected from the MacArthur-Bates Communicative Development Inventories. Table 1 lists the lexical developmental norm percentages for these words in 16 month olds.

Word	Lexical Developmental Norm Percentage
Airplane	66.7
Apple	73.6
Bear	50
Blanket	72.2
Block	69.4
Bread	48.6
Bubble	61.1
Duck	79.2
Fish	51.4
Flower	68.1
Horse	59.7
Hand	63.9
Hat	61.1
Spoon	75
Stroller	65.3
Window	56.9

Coding

The Metcalf Infant Lab Video Coder was used for off-line coding of the trials. The experimenter watched slow-motion videos of each trial and pressed one of four keys depending on the direction of the infants' gaze during the trial. Coding started at the onset of the first trial. C (center) indicated that the infant was looking at the center light during the start of the trial, A (away) indicated that the infant did not look at either screen, E (left) indicated that the infant looked at the left screen, and R (right) indicated that the infant looked at the right screen. After coding, values for each trial frame were represented as D (Distractor), T (target), or A (away) on an Excel spreadsheet.

Trials in which the infants did not look at either Distracter or Target during both the Salience and Test trials were discarded. 0-3 trials were discarded for most infants; the maximum number of trials discarded was six.

Analysis

All comparisons made in each experiment were between two groups, either between monolingual and bilingual infants, or between bilingual infants with different levels of language exposure. Two-tailed t tests assuming unequal variances were used for each analysis in Studies 1 and 2. ANOVA was not used because only two-way comparisons were made. Although the bilingual and monolingual groups had similar sample sizes (n=27, n=22, respectively), some analyses compared infants with 40% or more alternate language exposure (n=11) and infants with less than 40% of alternate language exposure (n=9) to the monolingual group (n=26). Due to the discrepancy of these sample sizes, unequal variances were assumed. Part 3 compares parental report to experimental results, thus the sample sizes of each variable are equal as each infant has one parental estimation and one experimental proportion. Comparisons for this experiment were made using two-tailed t tests assuming equal variances.

Table 2 lists the proportion of target views versus distractor views in monolingual and bilingual infants. Infants are arranged in the table in order of increasing percentage of looks to the target image.

Study 1: English Comprehension

In each trial, the number of frames in which the infant viewed the target were counted and divided by the total number of frames in which either target or distracter was viewed. The salience proportion was subtracted from the test proportion to yield the proportion of times infants looked at the target during the test trial more than they did during the salience trial. The resulting proportions of times looked at target were converted to percentages of actual number of views, and these are reported and compared to parental report data in Study 3. Significant findings in Study 1 can be seen as follows.

Table 2: This table lists the percentage of alternate language to which bilinguals were exposed. It then presents the raw data for percentage of looking at the target vs. the distractor for both bilingual and monolingual infants.

Percentage of Target views of Infants Exposed to an Alternate Language	Percentage and Identity of Alternate Language	Proportion of Target views of Infants Exposed to Only English
10.0	40% Spanish	26.7
33.3	60% Japanese	33.3
36.4	50% Urdu	50.0
38.5	50% Punjabi	50.0
42.9	45% Italian	53.8
42.9	90% Korean	53.8
50.0	45% Hebrew	53.8
56.3	15% Portuguese	53.3
56.3	30% Spanish	61.5
57.1	55% Portuguese	61.5
60.0	25% Spanish	62.5
62.5	50% Spanish	62.5
68.8	40% Portuguese	63.6
68.8	15% Spanish	64.3
68.8	33% Serbo-Croatian	66.7
68.8	40% Portuguese	66.7
75.0	25% Hindi, 5% French	66.7
78.6	75% Portuguese	68.8
78.6	25% Portuguese	69.2
91.7	55% Spanish	71.4
92.9	25% Spanish	73.3
93.3	20 % Spanish	75.0
93.8	35% Japanese	76.9
		78.6
		80.0
		81.8

Study 1A- Comparison of Looking to Target in Bilinguals with High and Low Alternate Language Exposure

Bilingual infants exposed to the lower level of alternate language showed significantly more looking to target than those exposed to a higher level of alternate language ($t(23)= 2.859$, $p=.009$). The mean proportion for infants with higher alternate language exposure was .524 and the mean for infants with lower alternate language exposure was .744. Figure 2 plots the proportion of looking to target for both monolingual and bilingual infants.

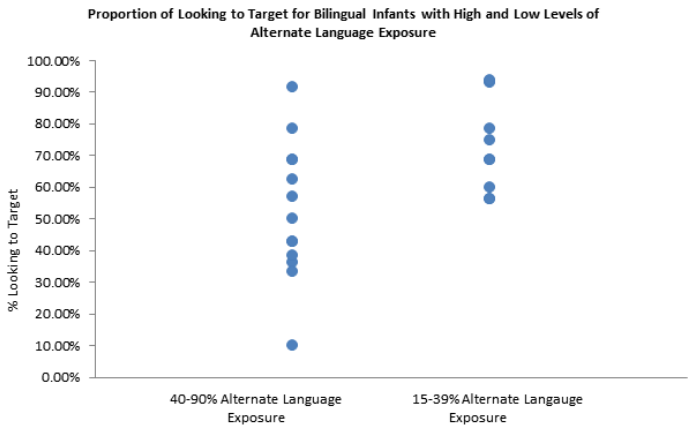

Figure 2: Proportion of looking to target in bilingual infants. Bilinguals exposed to the lower level of alternate language showed significantly more looking to target than those exposed to a higher level of alternate language (t(23)= 2.859, p=.009).

Study 1B- Comparison of Looking to Target in Monolinguals and Bilinguals with Low Alternate Exposure.

Infants who were exposed to 15-39% of an alternate language showed significantly more looking to target than infants exposed to only English (t(37)= 2.157, p = 0.048). The mean proportion for bilinguals with low alternate language exposure was .744 and the mean for monolinguals was .627. Figure 3 plots the looking to target proportions for both monolingual and bilingual infants.

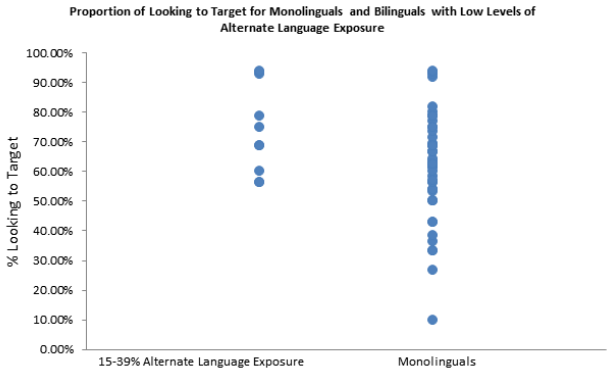

Figure 3: Proportion of looking to target in monolinguals and bilinguals exposed to low levels of alternate language. Bilinguals showed significantly more looking to target (t (37) = 2.157, p = 0.048).

Study 1 Discussion

Significant differences were observed when level of alternate language exposure was taken into account in Study 1A. 19-20 month olds who hear 40%-90% of a language other than English on a daily basis looked less to target on average than did infants exposed to 15-39% of an alternate language. This finding has implications for parents who want to raise their children in a bilingual environment but are not sure how much English or alternate language they should speak to maximize English comprehension and development of secondary language skills. For parents who have chosen a bilingual environment, they must further consider the amount of alternate language to which they expose their infants. Delay does not imply permanent deficiency, as past research has shown that bilingual children often catch up to their monolingual peers. Whereas a bilingual environment provides the opportunity for infants to learn multiple languages, high levels of alternate language exposure may impede learning of the primary language. In the United States, the primary language is often English, and delayed learning of English vocabulary can make it more difficult for children to understand English speakers. For infants who attend preschool with primarily English speaking staff and children, this could pose a challenge. The author does not aim to dissuade parents from raising their infants in a predominantly bilingual environment. Research shows that bilingual infants are able to perceive phonetic differences in their first several months of life, but soon lose their ability to discriminate phonemes of languages to which they are not regularly exposed (McCardle, Hoff, Erike, 2006). Bilingual infants also show increased ability of novel-word learning tasks compared to their monolingual peers (Kaushanskaya & Marian, 2009a). Furthermore, there is empirical evidence associating bilingualism with increased meta-cognitive ability, superior divergent thinking, and better perceptual and classification performance (Bialystok, 2001; Cummins, 1976; Diaz, 1983, 1985). Thus, for long term retention of a second language, it may be advantageous to expose children to a second language during infancy. Although high alternate language exposure during infancy may result in poorer English comprehension at this age, by middle school monolinguals and bilinguals show equivalent verbal ability and intellectual abilities (Baker & Jones, 1998; Cook, 1997; Hakuta, 1986). Nevertheless, appropriate ability in English during infancy may be necessary for learning and socialization with primarily English-speaking peers, as well as appropriate academic placement in early childhood.

Contrary to past bilingual research (Carrow, 1972), Study 1B found that infants exposed to less than 40% of an alternate language showed a significant increase in looking to target as compared to monolinguals. This surprising result needs to be further investigated with a larger sample size of bilingual infants exposed to a small percent of alternate language and a large percentage of English. If this finding holds true, it suggests that exposure to a small amount of alternate language (15-40% in this study) may improve comprehension in the primary language. Although past research has linked bilingualism to more flexible learning (Mehler and Kovacs, 2009), and earlier ability to understand metalinguistic concepts (Bialystok, 1988), no research to date has found a link to increased comprehension of the primary language. Such a link may encourage more parents to teach their children a small percentage of an alternate language without fear of inhibition of primary language acquisition.

Study 2A: Comparison of Parental Reports Regarding English Production in Bilinguals with High and Low Alternate Language Exposure

Parents of bilingual infants exposed to the lower level of alternate language reported significantly more English production than parents of infants exposed to a higher level of alternate language (t(21)= 2.837, p = .016). The mean number

of words reported to be produced by bilinguals with low alternate language was 8.778 and the mean number of words reported to be produced by bilinguals with higher alternate language exposure was 2.167. Figure 4 plots the number of trial words that parents report their infants to produce.

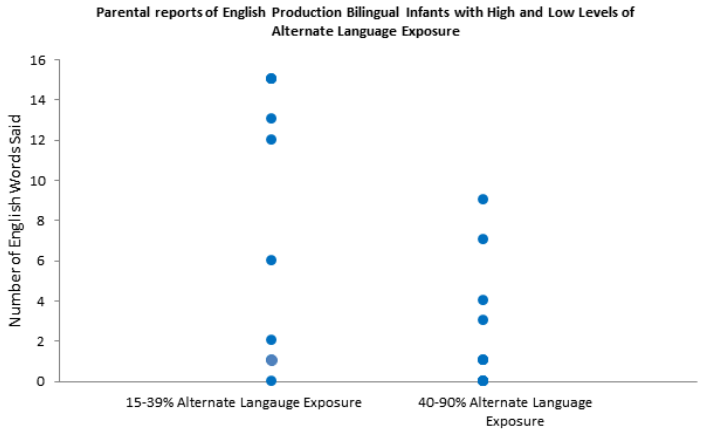

Figure 4: Parental reports of their infants' abilities to say any of the 16 trial words in English. Comparison of bilinguals exposed to high and low levels of alternate language exposure ($t(21)= 2.837$, $p = .016$).

Study 2B: Comparison of Parental Reports Regarding English Production in Monolinguals and Bilinguals with High Alternate Language Exposure

There was a significant difference in parental report of English production ($t(28)= 3.720$, $p = .001$) between bilinguals who are exposed to high levels of alternate language and monolinguals. Bilinguals with high alternate language exposure were reported to say an average of 2.167 words and monolinguals were reported to say an average of 7.444 words. Figure 5 plots the number of trial words that parents report their infants to produce.

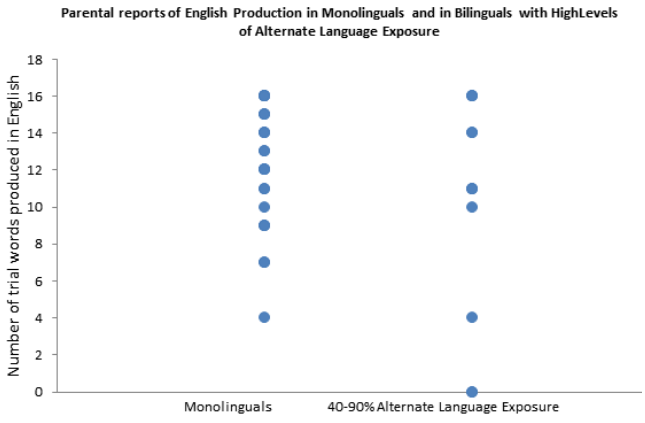

Figure 5: Parental reports of their infants' abilities to say any of the 16 trial words in English. Comparison of monolinguals and bilinguals exposed to high levels of alternate language shown. Parents of monolinguals reported significantly more English noun production ($t(28)= 3.720$, $p = .001$).

Study 2 Discussion

Parents of bilinguals with high alternate language exposure reported that their children could say significantly fewer words than were reported for monolinguals or bilinguals exposed to low levels of alternate language. A possible explanation for these results is that at 19-20 months of age, monolingual and bilingual infants show more differences in English production than they do in English comprehension. Past research has also indicated reduced language production in bilinguals (Byers, Gollan, Emmorey, 2009; Rodriguez-Fornells, van der Lugt, Rotte, Britti, Heinze, Munte, 2005).

Although words were chosen based on lexical norms, it is possible that parents of monolinguals or bilinguals taught their infants' different words and that different word sets may yield different results. A lengthier word set would thus be more informative, but the word set must be of the appropriate length to prevent infants from growing tired and inattentive during the procedure.

Summary of results from studies 1 and 2

Overall, studies 1 and 2 showed relatively consistent results. Study 1 revealed that bilinguals who have low alternate language exposure have better comprehension than bilinguals with high alternate language exposure and monolinguals. Study 2 relied on parental reports of English production, and revealed that bilinguals who have high alternate language exposure say fewer English nouns than do monolinguals or bilinguals with low alternate language exposure.

Study 3: Validity of Parental Reports

Validity of the parental report measure was assessed by comparing parents' responses to the experimental data. Parental reports were separated based on whether parents had monolingual or bilingual infants. The total words parents believed their children understood in English were compared with the total words infants correctly identified in the experiment. For the parental reports, the number of words parents believed their infants to understand was divided by 16 to create a percentage representing the fraction of trial words understood. This was compared to the percentage of words correctly understood during the experimental trials. Using percentages helped eliminate the effects of fussiness or bias towards one picture during the experiment, as any trials in which the infants did not look at both pictures during the salience trial were eliminated. Parents of monolinguals reported comprehension of a significantly greater number of words than infants actually understood in the experiment ($t(52)= 3.011$, $p = .004$), but this was not true for parents of bilinguals ($t(42)=1.077$, $p = .288$). Bilinguals were reported to understand an average of 68.869% of the English words, but only understood an average of 59.508% of words during the experiment. Monolinguals were reported to understand an average of 77.404 % of English words, but only understood an average of 62.908% of words during the experiment. Figure 6 shows parental estimates of comprehension and the number of words understood in the experiment.

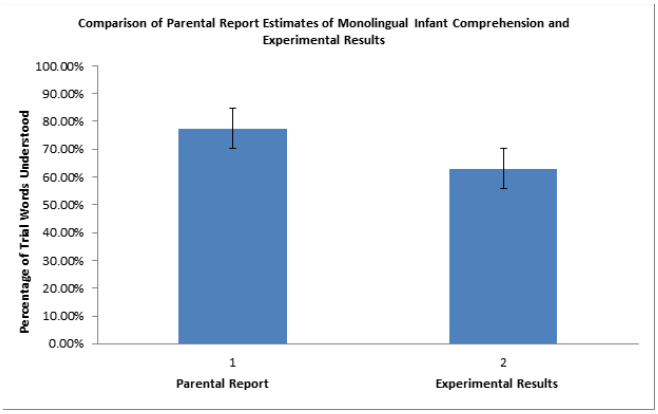

Figure 6: Comparison of parental report estimates of monolingual infant comprehension and the infants' experimental results ($t(52)= 3.011$, $p = .004$).

Study 3 Discussion

Comparisons of parental report estimates and the experimental results of monolingual and bilingual infants showed significantly higher estimations of number of trial words understood by monolingual infants. These results question the validity of parental report measures as useful, accurate techniques of assessing infant language comprehension. As parental reports are used often in research, and are relied upon significantly in infant studies where subjects themselves cannot complete self-reports, the reasons for these results and possible implications must be considered. However, much past research supports the validity of the IPLP (Golinkoff, Hirsh-Pasek, Cauley, & Gordon, 1987), suggesting that it is more likely that the increased parental reports of comprehension are overestimations than that the experimental procedure underestimated infants' English comprehension.

Alternatively, European Americans have been shown to display a higher self- enhancement bias (Heine, Lehman, Markus, Kitayama, 1999). For example, their self-ratings are more positive than the ratings of objective observers. If more of the monolingual infants have a European American background, it is possible that their parents rated their English production higher than would have an objective observer. On the other hand, other populations such as Asians have been shown to have a more moderate self-enhancement bias. If the bilingual group contained a greater proportion of Asians than the monolingual group, this may have contributed to parents' overall more accurate assessments for this group.

Contrary to this assumption, there are several reasons why infants may in fact underperform during the experimental procedure, thereby lowering the number of trials in which they showed successful understanding of the trial words. Infants may experience stranger anxiety when introduced to the experimenter, causing initial fussiness at the trial starts (Chiat & Roy, 2007). Similarly, some infants may suffer separation anxiety if one of their caregivers or siblings is not allowed to enter the testing room with them. When the testing room becomes dark, infants may experience fear due to the darkness or claustrophobia of the small room. Some infants may not like being restricted to their parents' laps and may resist by fussing or trying to get away, often moving their gazes from the screens. Any gazes beyond the screens are not coded and thus would be interpreted as lack of comprehension of the word. Furthermore, infants may comprehend words but choose to look at the screen not corresponding to the word for a higher proportion of frames in the test trial than the salience trial. In this case, infants' gazes result in an interpretation of lack of comprehension of the word. However, many of these factors were accounted for in the comparison between parental reports and experimental results. Parental estimations of words understood were divided by 16 to create a proportion representing the fraction of trial words understood by the infants. In the experimental procedure, all trial pairs in which the infants did not look at both pictures in the salience trial were discarded, as it was assumed that fussiness or fixation with one picture rendered the trial an inaccurate assessment of English comprehension. The number of correctly recognized words was then divided by only the total trials included, thus eliminating trials in which infants showed fussiness or unwarranted bias. This formula of comparison reduces the likelihood that the above factors unduly influenced the experimental results.

Despite these possibilities for experimental error, the results nevertheless show a significant overestimation in monolingual reports and not in bilingual reports. Thus it is necessary to consider that this overestimation is a result of error or bias in parental report and to examine what this implies in terms of parental awareness of language proficiency. Past research studies have found evidence of parental overestimation or underestimation (Zimmerman, Pogarsky, 2011), or that factors such as parental education or intelligence may unduly influence reports (Feldman et al., 2000).

Conclusions and Considerations

Bilinguals exposed to high levels of alternate language showed significantly less looking to target images than bilinguals exposed to low levels of alternate language. Past research has shown that bilingual children catch up to their monolingual peers by age 4 (Hoff, 2012). Nevertheless, appropriate ability in English during infancy may be necessary for learning and socialization with primarily English-speaking peers and for appropriate academic placement in early childhood.

Whereas past research has found bilinguals to have worse English comprehension than monolinguals (Carrow, 1972; Ben Zeev, 1977b; Doyle, Champagne, & Segalowitz, 1978), there has been little research contrasting low and high levels of alternate language exposure. In this study, bilinguals exposed to low levels of alternate language showed longer looking times than monolinguals. This finding has implications for parents who want to raise their children in a bilingual environment while maximizing both English comprehension and development of secondary language skills.

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