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Andrea Takahesu Tabori
atakahes@wellesley.edu

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Investigating the Relationship between Age of Acquisition of a Second Language and Lexical
Retrieval Ability in Bilinguals

Andrea Takahesu Tabori

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Abstract

The current study investigated the relationship between age of acquisition (AOA) of a second language and lexical retrieval ability in bilinguals. This study compared the lexical retrieval ability of 30 English monolinguals, 25 early Spanish-English bilinguals (AOA birth to three years), and 17 late Spanish-English bilinguals (AOA four to nine years). Participants completed a picture naming task in English, a measure of non-verbal intelligence (Cattell Culture Fair Test), and a standardized measure of vocabulary size (PPVT-III). We predicted that both bilingual groups would experience more lexical retrieval difficulty on the picture naming tasks relative to monolinguals but that early bilinguals would experience less difficulty than late bilinguals.

Investigating the Relationship between Age of Acquisition of a Second Language and Lexical Retrieval Ability in Bilinguals

Lexical retrieval is the act of retrieving from memory the word that corresponds to a concept. Research has consistently found that compared to monolinguals, bilinguals have a disadvantage in lexical retrieval. Bilinguals take longer to name pictures both in their first and second languages compared to monolinguals (Ivanova & Costa, 2008). Corroborating bilinguals' difficulty retrieving words, other picture-naming studies have found that relative to monolinguals, bilinguals in different language pairs have more word retrieval failures (Gollan & Acenas, 2004; Gollan & Brown, 2006; Gollan & Silverberg; Pyers, Gollan, & Emmorey, 2008). These word retrieval failures, called tip-of-the-tongue (TOT) experiences, are characterized by a feeling of imminent recall and the inability to recall the word at the intended moment. Thus, picture-naming studies show that bilinguals have difficulty retrieving words from memory as shown by longer word retrieval latencies and the increased number of TOTs they experience.

Bilinguals' lexical retrieval difficulties can be understood as a consequence of how their two languages are represented. Models of lexical access generally agree that bilinguals have two lexicons, one for each language, as well as one conceptual store with non-verbal representations that are linked to the words of each lexicon (Paradis, 1973). Research also finds that, when communicating in one language, both of a bilingual's two languages are jointly activated (Rodriguez-Fornells, van der Lugt, Rotte, Britti, Heinze, & Münte, 2005; Thierry & Wu, 2007). When trying to retrieve the word for a concept in one language, bilinguals experience joint activation of the words corresponding to the concept in both languages. Having words jointly activated in both languages creates the need for a language selection mechanism to select the word in the target language for retrieval. There are several theorized models of lexical access and

each one deals with the process of selecting a word in the target language in a slightly different way. This paper focuses on two models of lexical retrieval.

Models of Lexical Retrieval and TOTs

The *language-specific* lexical selection model posits that while both lexicons are activated during lexical retrieval, the language selection mechanism only considers words from the target language as candidates for selection (Costa & Caramazza, 1999). The most highly activated word in the target language is then retrieved. According to this model of lexical retrieval, retrieval failures occur when the word with the highest level of activation does not reach a sufficient level of activation (Caramazza & Miozzo, 1997). This account does not explain under which circumstances words fail to reach a high enough level of activation to be successfully retrieved. Hence, this account does not specify when word retrieval difficulties such as TOTs arise. However, a related TOT account called the *weak links hypothesis* expands on this model to explain when TOTs would occur in more detail.

The *weak links hypothesis* states that TOTs occur when lexical representations are weak due to low frequency of use (Gollan & Acenas, 2004; Gollan & Silverberg, 2001). In the case of bilinguals, who split their language production time between two languages, the cumulative frequency spent using each language must be lower than that of monolinguals, who spend all of their time communicating in one language. Because bilinguals use each of their languages less often than do monolinguals, bilinguals have weaker representations of words of each of their languages compared to monolinguals. Their weaker representations subsequently lead bilinguals to have greater difficulty retrieving words from memory, as shown by an increased TOT incidence. Thus, the *weak links hypothesis* expands on the *language-specific* model by specifying frequency of use as the underlying cause of insufficient activation of words that lead to TOTs.

The *inhibitory control* model (ICM) states that bilinguals consider the lexicons of both of their two languages as candidates for selection during lexical retrieval. Translation equivalent words for a concept are linked to the same semantic representation, and each word has a language tag denoting the language. During lexical access, both lexicons are simultaneously activated and compete for selection (Green, 1998). In order to retrieve the word in the target language, the language selection mechanism suppresses or inhibits words in the non-target language. The word in the target language that was not inhibited is then retrieved. Therefore according to this model, bilinguals actively inhibit one language when producing the other. Supporting this idea, studies find that relative to monolinguals, bilinguals have an enhanced cognitive ability to inhibit distracting or misleading information (Bialystok, Craik, & Luk, 2009; Emmorey, Luk, Pyers, & Bialystok, 2008). This cognitive control advantage has been found in bilingual children (Barac & Bialystok, 2012; Carlson & Meltzoff, 2008) as well as adults (Bialystok, Craik, & Luk, 2008).

The ICM considers lexical retrieval errors to be a manifestation of competition between languages. Because bilinguals have two words for most concepts, when trying to retrieve the word in one language, the word from the other language competes for selection, making lexical retrieval more difficult than it would be for monolinguals, who only have one word for most concepts. Competition between languages is thus thought to lead to a greater TOT incidence in bilinguals. Neurological evidence supports the notion that competition between languages underlies lexical retrieval in bilinguals (Abutalebi & Green, 2007). In particular, an fMRI study found that TOT experiences involve increased activation of the anterior cingulate cortices (ACC) and left prefrontal cortex (PFC) (Maril, Wagner, & Schacter, 2001). The PFC is involved in response selection and inhibition while the ACC is involved in attention and conflict monitoring

(Abutalebi & Green, 2007). These substrates may work together to help bilinguals to select a language and inhibit the other during lexical retrieval. Thus according to the ICM, TOTs are a result of the competition between languages during lexical retrieval.

Lexical Retrieval Models and Age of Acquisition Effects

The *weaker links hypothesis* suggests that lower frequency of use leads to weaker representations, which leads to lexical retrieval difficulties such as TOTs. Evidence suggests a relationship between frequency of language use and age of acquisition of a second language, such that bilinguals who acquired their second language early in life (*simultaneous bilinguals*) tend to use their two languages with similar frequency, whereas later exposed bilinguals (*sequential bilinguals*) tend to use their first language to a greater extent. Supporting this idea, a study that compared early and later-exposed Spanish-English bilingual children's outcomes in the Head Start Program found that 83% of children exposed to English before the program had mothers who spoke to them in English equally or more than in Spanish (Hammer, Lawrence, & Miccio, 2008). On the other hand, only 32% of children who were exposed to English when they entered the program had mothers who spoke to them in English equally or more than in Spanish. These results suggest that children who acquired their second language later on in life have less exposure to English in their environment than children who acquired English earlier in life.

If earlier bilinguals have more balanced exposure to each language compared to later bilinguals, who tend to have more exposure to their first language, then the weaker links hypothesis would predict that earlier bilinguals should have better lexical retrieval than later bilinguals. This prediction stems from the fact that later bilinguals tend to use their second language with less frequency than earlier bilinguals, which leads later bilinguals to form weaker representations of words in their second language. Due to their weaker lexical representations,

later bilinguals' should experience more lexical retrieval difficulties and have more TOTs than early bilinguals.

The ICM associates age-of-acquisition effects on lexical retrieval with bilinguals' inhibitory control abilities. The ICM regards TOTs as lexical retrieval difficulties resulting from competition between languages. This competition during retrieval is thought to be resolved by an inhibitory language selection mechanism (Green, 1998). Supporting this idea, bilinguals who were exposed to their second language by the age of four have significantly better inhibitory control abilities than bilinguals who acquired their second language between the ages of six and ten (Luk, De Sa, & Bialystok, 2011). Additionally, a study found that bilinguals with better inhibitory abilities also performed better on a proactive interference lexical retrieval task (Bialystok & Feng, 2008). These findings suggest that earlier bilinguals will have an advantage in lexical retrieval relative to later bilinguals due to their superior ability to suppress the non-target language during lexical retrieval.

Current Study

The current study investigated the relationship between age of acquisition of a second language and lexical retrieval ability in that language. We compared the performance of early and late Spanish-English bilinguals on a picture-naming task that induced TOT experiences. In the picture-naming task, having more TOT experiences indicates weaker lexical retrieval abilities. In line with previous findings, we predicted that both bilingual groups would have more TOTs than monolinguals. In addition, we predicted that early bilinguals would have better lexical retrieval abilities and fewer TOTs than late bilinguals. This study also explored whether the age of acquisition effect on lexical retrieval could be accounted for by competition from

translation equivalent words as proposed by the ICM model or by frequency of language use as proposed by the *weak links hypothesis*.

Method

Participants

Seventy-two participants completed this study. Of these, 30 participants were English monolinguals, 25 were early Spanish-English bilinguals (age of acquisition of English between 0 and 3 years), and 17 were late Spanish-English bilinguals (age of acquisition of English between the ages of 4 and 9). Participants were recruited from highly selective northeastern undergraduate institutions and were compensated for participation by receiving either course credit or a payment of ten dollars.

Prior to the testing session, participants completed an online language questionnaire, which was used to verify that potential participants met participation requirements. To qualify for participation in this study, bilingual participants had to (1) have acquired both Spanish and English by the age of nine, (2) have acquired Spanish either before or simultaneously with English, (3) not be highly proficient in languages other than English and Spanish, and (4) not use languages other than Spanish and English regularly in everyday life. In order to participate in this study, English monolinguals had to (1) have acquired English as a first language, (2) not have had exposure to languages other than English during childhood, (3) not be highly proficient in a language other than English, and (4) not use a language other than English regularly.

Procedure

Participants were tested individually for approximately one hour in a quiet room. All participants completed three tasks in the following fixed order: (1) picture-naming task, (2) Cattell Culture Fair Test, (3) Peabody Picture Vocabulary Test III (PPVT-III), and (4) a language

background questionnaire. In addition, bilinguals provided Spanish translation equivalents for the English words from the picture-naming task.

Picture-naming task. This task was adapted from Gollan and Acenas (2004) and included 60 black and white images depicting low-frequency nouns (*mean word frequency* = 2.02, *SD* = 2.63). The word frequency of the items was determined by using the Max Planck Institute of Psycholinguistics' CELEX Lexical Database, which displays the number of times a word appears out of a million words. We excluded items with cognates in most Spanish dialects such as *teléfono*, because cognate words have been shown to facilitate lexical retrieval in bilinguals (Gollan & Acenas, 2004). All test items with the exception of two (*hedgehog* and *hamper*, which were replaced with new pictures) were selected from a set of 79 pictures previously piloted on a group of fifteen English monolinguals to ensure that participants recognized the name of the object depicted (for a list of names and images of test items see Appendix A).

The pictures were presented in a fixed random order via a Powerpoint presentation displayed on a computer monitor. Each picture was presented individually at the center of a slide with a white background. The Powerpoint presentation was programmed to follow every pictured item with a blank slide after 15 seconds. Blank slides were then followed by the next test item. All participants completed the picture-naming task in English. At the beginning of the task, participants were told what a TOT is, given instructions to name the pictures in English, and asked to let the experimenter know if they were in a TOT state (script of task instructions in Appendix B).

When participants successfully retrieved the target word, the experimenter advanced the slideshow to the next item. If the participant struggled to name the picture and did not mention

having a TOT, the experimenter asked the participant if he or she was experiencing a TOT. The experimenter encouraged the participant to try to remember the target word until the 15-second time limit passed, and the picture was replaced by a blank slide. The experimenter then asked the participant, "If I tell you the word, do you think you might know it?" After the participant responded with yes or no, the experimenter gave the participant the name of the target word and asked whether the word provided was the one the participant was trying to retrieve ("Is *anvil* the word you might have been looking for?"). The experimenter then asked the participant, how well the target word was known ("Do you know the word *anvil* well, do you recognize it, or do you not know it?").

In addition to naming the pictures in English, bilingual participants were asked to provide the Spanish translation equivalent of each English word from the picture-naming task. In this part of the task, participants were given the English word and asked to provide the Spanish translation equivalent ("What is the Spanish word for *anvil*?"). If the participant did not know the Spanish translation equivalent, the experimenter said the Spanish word and asked how well the participant recognized the word. For coding purposes, participants were videotaped during the English portion of the picture-naming task.

Coding. Participants' responses were coded according to Gollan and Brown (2006) in terms of pre-resolution and post-resolution of word retrieval. For pre-resolution coding, participants' responses were coded either as: GOT, TOT, Pre-DK, or NTOT. A GOT was an immediate successful retrieval. A response was coded as a pre-resolution TOT when participants did not retrieve the target word, but said they would know it if it was given to them, or if they initially experienced a TOT, but ultimately retrieved the word. When participants said they would not know the word if they heard it, their responses were scored as a Pre-DK. If

participants were unable to retrieve the target word and were not sure whether they would know the target word or not, their response was coded as an NTOT.

For post-resolution scoring, responses were coded as one of the following: posTOT, negTOT, notGOT, or Post-DK. Responses were coded as posTOTs if participants experienced a TOT and were able to retrieve the target word within the 15-second time limit. If participants did not retrieve the word, but later said that they knew the target word and had been looking for that word, their response was also coded as a posTOT. If participants first said that they were experiencing a TOT, but when given the target word, said that they were not looking for that word, their responses were coded as negTOTs. If participants failed to retrieve the target word, said they would not know the word, but later said they did know the word though it did not come to mind, their responses were coded as notGOTs. Whenever the participants said they did not know the target word after hearing it, their response was coded as a Post-DK.

Cattell Culture Fair Test (Cattell & Caltell, 1973). The Cattell Culture Fair Test is a timed pattern-completion task administered on paper. The test consists of four subtests. In the first test, participants selected one of six alternatives to complete a series. In the second test, participants were presented with five shapes and selected the two that differed from the other three. In the third test, participants were shown a matrix with several figures and one blank slot inside. Participants were asked to select one item to fill in the blank slot and complete the matrix. In the fourth test, participants were shown one target example and asked to select one of the five choices that duplicated the conditions of the target example. The first three tests were completed in three minutes and the last test was completed in two and a half minutes.

Peabody Picture Vocabulary Test III (Dunn & Dunn 1997). This test measures the comprehension of English vocabulary. The experimenter presented the participant with a set of

four pictures on a page and said a word. The experimenter then asked the participant to point to the picture corresponding to the word given by the experimenter.

Language Background Questionnaire. This questionnaire asked participants to provide information regarding language use, proficiency, and general background information (Appendix C).

Results

The descriptive statistics for the three participant groups on the background measures are displayed in Table 1. There were no significant differences between the three groups in terms of age, years in college, English proficiency, and Cattell score. There was a main effect of group on English age of acquisition (AoAE), such that late bilinguals had significantly later AoAE than both monolinguals and early bilinguals. There was no significant difference between monolinguals and early bilinguals' AoAE. There was also a main effect of participant group on the percentage of daily English use, with monolinguals using significantly more English than early and late bilinguals, who used English equally. In terms of childhood use of English, early bilinguals spoke significantly more English as children than did late bilinguals. There was a main effect of group on PPVT scores, such that late bilinguals had significantly smaller vocabularies than monolinguals. Monolinguals and early bilinguals did not differ from each other in vocabulary size and there was a marginally significant difference between early and late bilinguals' PPVT scores, with late bilinguals having smaller scores ($p = .052$). The number of participants who were Spanish-dominant, English-dominant, or balanced bilinguals is reported in Table 2.

First, we conducted One-Way ANOVAs comparing monolinguals to early bilinguals and early bilinguals to late bilinguals. We compared the three groups on each of the different post-

rate response types from the picture-naming task: GOTs, negTOTs, posTOTs, notGOTs, and Post-DKs. In addition, we compared the three groups on the proportions of resolved and unresolved TOTs. Given that participants' have different vocabulary sizes and unequal opportunities to experience TOTs, we also computed the proportion of "True TOTs," which reflects TOT incidence while controlling for opportunities to have TOTs (Gollan & Brown, 2006).¹ These statistical comparisons are summarized in Table 3.

In accordance with our predictions, group comparisons showed that monolingual participants had significantly more GOTs than did early bilinguals, and early bilinguals had significantly more GOTs than did late bilinguals. With the exception of negTOTs, which did not differ among the three groups, the number of notGOTs and posTOTs, which reflect retrieval difficulties, was significantly lower in monolinguals than in early bilinguals, and early bilinguals also had significantly fewer of these responses than did late bilinguals. Post-DK comparisons showed that late bilinguals knew significantly fewer words from the picture-naming task than did early bilinguals. In addition, there was a significant difference between the number of Post-DKs in monolinguals and early bilinguals, with early bilinguals knowing significantly fewer words than monolinguals. These results confirm the necessity of calculating the proportion of True TOTs because the different groups differed on the number of words they knew from the picture-naming task, and therefore they had different opportunities to experience word retrieval difficulties. Comparisons for the proportion of True TOTs showed the same pattern as the comparisons for posTOTs: monolinguals had a significantly lower proportion of True TOTs compared to early bilinguals, and early bilinguals had a significantly lower proportion of True TOTs than did late bilinguals. However, the True TOTs comparison found a stronger effect of

¹ The formula for the proportion of True TOTs is the number of TOTs divided by the sum of posTOTs and GOTs.

group ($p < .0001$) than did the posTOTs comparison ($p = .04$). TOT resolution rate was significantly higher for early bilinguals than for late bilinguals, but did not differ between monolinguals and early bilinguals.

Since the three language groups differed on PPVT scores, and since vocabulary size has been shown to affect lexical retrieval ability (Bialystok, Craik, & Luk, 2008), ANCOVA comparisons between monolinguals and early bilinguals and between early and late bilinguals were conducted by including PPVT score as a covariate. When controlling for PPVT score, the same pattern emerged as when not controlling for PPVT score with the exception that TOT resolution rate was not significantly different for the two bilingual groups as it had been in the comparisons without PPVT as a covariate. However, the difference between these two groups approached significance ($p = .058$).

Though initial comparisons between the three groups revealed equivalent Cattell scores, we wanted to ensure that non-verbal intelligence did not account for the lexical retrieval differences found among groups. Thus, we conducted the same analyses controlling for both PPVT and Cattell scores. All analyses showed no difference than the pattern of results found previously when controlling for PPVT score, suggesting that any differences in non-verbal intelligence did not play a role in the lexical retrieval performance.

In addition to investigating the incidence of the different response types and resolution rates, we were also interested in the number of Spanish intrusions that occurred during the picture-naming task. The number of intrusions produced by the two bilingual groups is summarized in Table 4. Twenty percent of early bilinguals produced at least one Spanish intrusion during the task, and thirty-five percent of the late bilingual participants produced at least one Spanish intrusion. A t-test comparing the two groups on the number of intrusions found

no significant difference between the number of intrusions produced by the two bilingual groups $t(40) = 1.62, p = .20$.

In order to investigate the mechanism driving the age of acquisition effect in early and late bilinguals, we explored two possible explanations for this phenomenon. One possible explanation is that early bilinguals' superior inhibitory control abilities (Luk, De Sa, & Bialystok, 2011) help them perform better than late bilinguals on lexical retrieval tasks. Alternatively the difference in the amount of English use between early and late bilinguals may underlie the age of acquisition effect, such that early bilinguals tend to use more English than late bilinguals. Early bilinguals' more frequent use of English means that they have stronger representations of English words, which make lexical retrieval easier relative to late bilinguals.

To evaluate the inhibitory control explanation, we investigated the role of translation equivalents in lexical retrieval. If inhibitory control is the underlying mechanism driving the age of acquisition effect, we might expect that earlier bilinguals would be better able to resolve lexical retrieval difficulties that arise from having two words for one concept better than late bilinguals would be. The number of Spanish translation equivalents known by each bilingual group out of fifty-nine items is summarized in Table 5. A One-Way ANOVA comparing the number of translation equivalents known by each group showed there was no significant difference between the number of Spanish translation equivalents known by early and late bilinguals $F(1, 38) = 2.19, p = .15$. Since we were interested in determining whether having a translation equivalent made lexical retrieval more difficult for late bilinguals, we conducted paired-samples t-tests comparing the number of GOTs, posTOTs, and the proportion of True TOTs experienced by each participant group when participants knew a Spanish translation equivalent versus when they did not know one. If semantic competition between languages was

the cause of the age of acquisition effects, we would expect to find that early bilinguals would be better able to resolve competition for words for which they have Spanish translation equivalents. Our results showed that for both early and late bilinguals, there was no significant difference in the number of GOTs, posTOTs, and True TOTs experienced when they knew a Spanish translation equivalent versus when they did not know a translation equivalent. These results suggest that an inhibitory control difference between the two bilingual groups does not account for the age of acquisition effect on lexical retrieval.

To explore whether the age of acquisition effect was due to a difference in the amount of English used by each bilingual group, we conducted Spearman correlations to investigate the relationship between AoAE, English use in childhood, current daily English use, and lexical retrieval ability. The correlations are summarized in Table 6. Consistent with the idea that bilinguals have different levels of second language use according to their age of exposure, our results showed a significant negative correlation between AoAE and English use in childhood ($\rho = -.43, p < .01$). Childhood English use significantly correlated with the number of GOTs, Post-DKs, posTOTs, and proportion of True TOTs. Current English use did not correlate with any lexical retrieval responses.

Table 1
Means, standard deviations, and statistics comparing characteristics of age, years in college, AoAE, English proficiency, PPVT-III Scores, and Cattell Scores

Participant or analysis type	Age		Years in College		AoAE		English Proficiency		% Daily English Use		% English use in childhood		PPVT-III B		Cattell	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Monolingual (N = 30)	19.63	1.16	1.96	1.29	0	0	6.95	0.28	98.79	1.86	-	-	120.43	11.00	25.5	4.27
Early bilingual (N= 25)	20.19	1.81	2.02	1.12	0.32	0.90	6.77	0.53	81.13	10.13	51.40	11.95	118.44	12.00	24.54	4.45
Late bilingual (N =17)	20.13	1.47	1.85	1.03	4.79	1.85	6.91	0.22	78.82	15.16	38.00	18.76	109.94	8.00	24.35	3.30
One-Way ANOVA	<i>df</i>	(2, 67) ^a	(2, 67) ^a		(2, 68)		(2, 67) ^a		(2, 67) ^a		(1, 39)		(2, 66) ^b		(2, 68)	
	<i>F</i>	1.16	0.10		131.54		1.60		32.46		8.03		4.96		0.65	
	<i>MSE</i>	2.25	1.38		1.07		0.14		91.52		226.35		118.27		16.95	
	η_p^2	0.03	<.01		0.79		0.05		0.49		0.17		0.13		0.02	
	<i>p</i>	0.33	0.9		<.001		0.21		<.0001		<.01		0.01		0.53	

^aData from one monolingual not available
^bData from two monolinguals and one late bilingual not available

Table 2
English dominant, Spanish dominant, and balanced bilinguals in three groups

Participant group	Dominance		
	English	Spanish	Balanced
Monolingual (N = 30)	30	0	0
Early bilingual (N= 25)	20	1	4

Table 3

Means, standard deviations, and statistics comparing groups for each response type

Participant or analysis type	GOT		negTOT		notGOT		posTOT		Post-DK		propSRTOT		propURTOT		propTrue TOTs	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Monolingual (N = 30)	39.27	6.00	1.67	1.30	1.43	1.23	14.8	5.42	1.73	1.39	0.55	0.15	0.45	0.15	0.27	0.10
Early bilingual (N = 25)	33.16	8.92	1.84	2.21	2.6	2.08	18.16	6.20	3.16	2.04	0.56	0.23	0.41	0.22	0.36	0.14
Late bilingual (N = 17)	22.18	9.79	2.82	3.47	4.18	2.74	22.24	5.94	7.6	4.96	0.39	0.18	0.61	0.18	0.52	0.16
Monolingual vs. early bilingual	<i>df</i>	(1, 53)	(1, 53)		(1, 53)		(1, 53)		(1, 53)		(1, 53)		(1, 53)		(1, 53)	
	<i>F</i>	9.12	0.13		6.50		4.75		9.48		0.07		0.76		7.53	
	<i>MSE</i>	55.76	3.13		2.86		32.02		2.93		0.04		0.03		0.01	
	η_p^2	0.15	0.002		0.12		0.08		0.15		0.001		0.01		0.12	
	<i>p</i>	<.01	0.72		0.01		0.03		<.01		0.79		0.39		<.01	
Early bilingual vs. late bilingual	<i>df</i>	(1, 40)	(1, 40)		(1, 40)		(1, 40)		(1, 40)		(1, 40)		(1, 40)		(1, 40)	
	<i>F</i>	14.17	1.26		4.48		4.52		16.08		6.67		9.97		11.32	
	<i>MSE</i>	86.15	7.75		5.61		37.16		12.34		0.05		0.04		0.02	
	η_p^2	0.26	0.03		0.10		0.10		0.29		0.14		0.20		0.22	
	<i>p</i>	0.001	0.27		0.04		0.04		<.0001		0.01		<.01		<.01	

Table 4

Means, standard deviations comparing bilingual groups on the number of Spanish intrusions

Participant group	Spanish Intrusions	
	<i>Mean</i>	<i>SD</i>
Early bilingual (N = 25)	0.24	0.52
Late bilingual (N = 17)	1.35	3.39

Table 5

Means and standard deviations of Spanish-translation equivalents known in each group

Participant group	Spanish translation equivalents	
	Mean	SD
Early bilingual (N= 25)	26.80	9.26
Late bilingual (N = 16)	31.75 ^a	12.13

^a Data from one late bilingual not available.

Table 6

Spearman correlations between AoAE, English use in childhood, current English use, and lexical retrieval responses

	1	2	3	4	5	6	7	8	9	10	11	12
1. AoAE	1.00											
2. Daily English use in childhood	-0.43**	1.00										
3. Daily current English use	-0.45**	0.23	1.00									
4. GOT	-0.54**	0.44**	0.14	1.00								
5. notGOT	0.40**	-0.26	-0.05	-0.53**	1.00							
6. negTOT	0.15	-0.10	-0.10	-0.34**	0.19	1.00						
7. post-DK	0.47**	-0.38**	-0.19	-0.78**	0.39**	0.25*	1.00					
8. posTOT	0.40	-0.36*	-0.19	-0.87**	0.30*	0.02	0.53**	1.00				
9. propSRTOTs	-0.35**	0.28	0.18	0.37**	-0.27*	-0.50**	-0.60**	-0.36*	1.00			
10. propURTOTs	0.35**	-0.28	-0.20	-0.37**	0.27**	0.50**	0.60**	0.36*	-1.00**	1.00		
11. prop True TOTs	0.48**	-0.46**	-0.16	-0.96**	0.41**	0.17	0.70**	0.93**	-0.52**	0.52**	1.00	
12. Spanish intrusions	0.20	-0.09	0.04	-0.35*	0.27	0.16	0.39*	0.20	-0.25	0.25	0.31*	1.00

Notes. * $p < .05$ (two-tailed); ** $p < .01$ (two-tailed); *** $p < .001$ (two-tailed)

Discussion

We replicated the finding that monolinguals have fewer lexical retrieval difficulties compared to bilinguals (Gollan & Acenas, 2004; Gollan & Brown, 2006; Gollan & Silverberg, 2001; Pyers, Gollan, & Emmorey, 2008). The results further showed an age of acquisition effect on lexical retrieval in bilinguals. Compared to late Spanish-English bilinguals, who were exposed to English between the ages of four and nine, Spanish-English bilinguals who were exposed to English by the age of three had fewer TOT experiences. Not only did early bilinguals have fewer TOTs than late bilinguals, but they also had significantly more immediate correct retrievals (GOTs) and were also more likely to retrieve the target word once already in a TOT state. Early bilinguals also experienced significantly fewer notGOTs, or failures to retrieve a known word.

Our results also replicated the age of acquisition effect on vocabulary size: early bilinguals have larger vocabularies than late bilinguals (Luk, De Sa, & Bialystok, 2011). Moreover, we replicated the finding that early bilinguals have equal vocabulary sizes to monolinguals. With regards to the items in the picture-naming task, early bilinguals also had larger vocabularies than did late bilinguals as reflected by the lower number of items that they did not know.

Previous studies investigating lexical retrieval and vocabulary have found that vocabulary size mediates lexical retrieval performance in some tasks. For example, Bialystok, Craik, and Luk (2008) found that monolinguals outperformed bilinguals on a verbal fluency task and that bilinguals had smaller vocabularies than monolinguals. When they compared monolingual and bilingual groups' performance on the verbal fluency task while statistically controlling for vocabulary size, the difference in lexical retrieval performance disappeared. Given that the two

bilingual groups differed in vocabulary size, we conducted ANCOVAs to determine whether differences in lexical retrieval remained after taking vocabulary size into account. Controlling for PPVT score, the main effect of group on GOTs, notGOTs, TOTs, True TOTs, Post-DKs remained. While early bilinguals tended to have bigger vocabularies and a higher proportion of self-resolved TOTs than late bilinguals, when controlling for vocabulary size both bilingual groups had equal TOT resolution rates. One way to explain this finding is that PPVT scores reflect the frequency of words known (e.g. a participant with a high PPVT score is familiar with more low-frequency words than someone with a lower PPVT score). And, the ability to resolve TOTs may depend on word frequency, such that TOTs for higher frequency words may be easier to resolve than TOTs for lower frequency words. Though early bilinguals were better at self-resolving TOTs than late bilinguals, this skill may have been due to the fact that they knew more low frequency words. Thus when PPVT scores are statistically controlled and the effect of early bilinguals' familiarity with low frequency words removed, there was no difference between the two groups' TOT resolution rate. Since most of the results were unaffected after introducing vocabulary size as covariate, differences in vocabulary size between early and late bilinguals cannot account for the age of acquisition effect on lexical retrieval.

We considered two additional explanations for the age of acquisition effect. One account is derived from the inhibitory control model (Green, 1998), and the finding that early bilinguals have an enhancement in inhibitory control relative to late bilinguals (Luk, De Sa, & Bialystok, 2011). This account posits that bilinguals have an enhancement in the ability to inhibit due to the constant practice of having to inhibit the non-target language in order to produce the other. According to this account, having words for one concept in different languages leads to competition between these translation equivalents during lexical retrieval. Competition between

languages is thought to lead to word retrieval difficulties (Green, 1998). If competition between languages leads to word retrieval errors, TOTs should be more common in words for which bilinguals have translation equivalents. The inhibitory control account for the age of acquisition effect on lexical retrieval would have been supported if early bilinguals had fewer TOTs when they had no translation equivalent because there was no direct competition between two highly similar alternatives. However, our results showed no difference in TOT rate when early and late bilinguals knew a translation equivalent in Spanish compared to when they did not. Thus, our data do not support the inhibitory control account, which depends on semantic competition for the age of acquisition effect on lexical retrieval.

In order to capture competition between languages, we also recorded the number of Spanish intrusions produced by early and late bilinguals. If, as research has previously found, early bilinguals have better inhibitory control than late bilinguals, we might expect them to have fewer Spanish intrusions during the picture-naming task. Our results showed that there was no difference in the number of intrusions produced by early and late bilinguals. This null finding could be attributed to both bilingual groups having equal levels of competition between their two languages. Thus competition between languages cannot account for the age of acquisition effect on lexical retrieval in bilinguals. Although the task was administered by a fluent Spanish-English bilingual, all task instructions were given in English. As such, participants of all types may have felt that they should not speak in Spanish.

We also examined whether the frequency of English use can account for the age of acquisition effect. According to the weak links hypothesis (Gollan & Acenas, 2004; Gollan & Silverberg, 2001), bilinguals have more TOTs than monolinguals because they use each of their two languages less frequently than monolinguals. Lower frequency of use leads to weaker

representations of words in their two languages, which makes lexical retrieval more difficult. To determine whether the age of acquisition effect is driven by the amount of language use, we compared early and late bilinguals' current daily English use and English use in childhood. Though the weak links hypothesis discusses cumulative English use as the cause of the lexical retrieval disadvantage in bilinguals and does not differentiate between childhood language use and current English use, we considered these two factors separately since literature on child bilingualism suggests that early and late bilinguals differ on the amount and type of language exposure in the home (Hammer, Lawrence, & Miccio, 2008; Place & Hoff, 2011). While the two groups did not differ on their current daily English use, early bilinguals reported significantly higher English use in childhood than late bilinguals did.

These results are consistent with the literature on child bilingualism showing that earlier exposure to a second language is associated with greater second language use. A previous study of Spanish-English bilingual children found that compared to children who were exposed to English upon school entry at age three, bilingual children who were exposed to English at home tended to have mothers who spoke to them in English more frequently (Hammer, Lawrence, & Miccio, 2008). Bilingual children who were exposed to English at home, also tended to use more English to talk to their mothers. Research has also found that Spanish-English bilingual two-year-olds who have two native Spanish-speaking parents have significantly lower exposure to English, and more exposure to Spanish than children who have at least one parent who is a native English speaker (Place & Hoff, 2011). In other words, having no exposure to English from parents before school entry is associated with lower English use in the home. These findings suggest that the amount of exposure to and use of a second language is related to the age at which one acquires a language. Specifically, early exposed bilinguals, who acquired English at

home, seem to use English more than bilinguals who were first exposed to English at school. The weak links hypothesis would explain early bilinguals' better lexical retrieval ability in terms of the association between early exposure to a second language and more frequent English use. Supporting these findings, we found that there was a strong negative correlation between AoAE and childhood English use; the younger your exposure, the more English you used throughout childhood.

In order to further explore the relationship between AoAE, language use, and lexical retrieval ability, we conducted Spearman correlations between these variables and all responses on the picture-naming task. Correlations showed that higher English use in childhood was associated with lower retrieval difficulties. Current daily English did not correlate with any word retrieval responses. Thus our results show that the age of acquisition effect on lexical retrieval can be accounted for by English use in childhood.

In order to understand how lower English use in childhood can lead to lexical retrieval difficulties that extend into adulthood, we must understand how language input in childhood affects the phonological representations of words. Phonology is crucial to word learning, especially during the first year of life. During this period of language development, a combination of perceptual biases and linguistic input allows children to pay attention to phonological features of their native language (Werker & Yeung, 2005). Though children can initially discriminate sounds from all languages, by the end of the first year they undergo a *functional reorganization*, through which they become attuned to and are able to discriminate only sound contrasts from the language(s) to which they have been exposed. Moreover, research suggests that infants' early speech perception abilities guide their subsequent word learning. In a longitudinal study of English monolingual infants, researchers found that infants' native

language phonetic discrimination abilities at 7 months of age predicted word production at 18 months (Kuhl, Conboy, Padden, Nelson, & Pruitt, 2005). Eleven-month-olds' native language phonetic discrimination ability was also associated with their receptive vocabulary size (Conboy, Sommerville, & Kuhl, 2008). Under the Native Language Neural Commitment theory (NLNC), researchers propose that early phonological development alters the way that children come to perceive sounds. By having early exposure to their native language, children's brains become attuned to the statistical and acoustical properties of that language, thereby developing a neural commitment to the sounds of their native language (Kuhl, et al., 2005).

These studies of monolingual children have implications for age of acquisition effects on bilingual lexical retrieval. Most of the early bilinguals in this study had been exposed to English simultaneously with Spanish at birth (with the exception of three of the twenty-five early bilinguals). The advantage that the early bilinguals had relative to late bilinguals can be explained by the fact that bilinguals were exposed to their second language as a native language within the first year of life, which is crucial for phonological development. Applying the NLNC theory to bilingual children, we can say that by having early exposure to English, early Spanish-English bilinguals developed native phonological categories for English which became neurally ingrained, rendering their phonological representations for words superior to those of late bilinguals. Similarly, other researchers have proposed that late bilinguals' more well-formed phonological categories of their first language interfere with the perception of the sounds of their second language (Tsukada, Birdsong, Bialystok, Mack, Sung, & Flege, 2005).

The infant studies relating phonological discrimination to word learning provide a way for us to construct a developmental story about the relationship between age of exposure and lexical retrieval ability in adult bilinguals. However, since these studies were conducted with

monolingual children and within a short window of time (within the first two years of life), it remains unclear whether the phonological categories from childhood remain stable and continue to affect word learning beyond childhood in bilinguals. Some studies relate age of acquisition of a second language to phonological discrimination in adults, but these studies have age of acquisition groups that are not comparable to the ones' in the current study. For example, early bilinguals have been defined as bilinguals who acquired their second language between 7 and 9 and later bilinguals as having later age of exposure (Flege, Yeni-Komshian, & Liu, 1999; Tsukada, Birdsong, Bialystok, Mack, Sung, & Flege, 2005). Moreover, some of these studies found that bilinguals with ages of exposure between 7 and 9 have native-like phonological discrimination of native vowel and consonant contrasts, which is inconsistent with our proposal that bilinguals exposed beyond age three have non-native phonological representations of words that lead to lexical retrieval difficulties.

In order to determine whether exposure to a second language within the first year of life has lasting effects on phonological perception and lexical retrieval ability, future studies should be conducted on adult bilinguals. Most importantly, to determine whether exposure to a second language during and beyond the first year of life leads to differences in phonological representations, an effort should be made to conduct studies with age ranges that are less widespread for early and late bilingual groups.

The present study was the first to investigate how the age at which bilinguals acquire their second language affects their ability to retrieve words. Our findings indicate that early exposure to a second language (prior to age three) is associated with better lexical retrieval ability than late exposure to a second language (ages four to nine). This study also explored possible explanations for the age of acquisition effect. The inhibitory control account, which

would predict that earlier bilinguals have better lexical retrieval abilities than late bilinguals when faced with competition from a translation equivalent, was not supported. Early and late bilinguals did not perform differently on the lexical retrieval task depending on whether they had a translation equivalent or not. Supporting the *weak links hypothesis*, we found that early bilinguals' superior lexical retrieval performance can be accounted for by their more frequent English use in childhood.

Being exposed to a second language early in childhood might result in more native-like abilities to perceive the sounds of the second language. While bilinguals exposed to their second language in the first year of life were able to acquire the sounds of their two languages as native, bilinguals exposed beyond the first year may not have native-like phonological categories in their second language. Late bilinguals' less native-like phonological categories may have lasting effects on how their second language is accessed during speech production, resulting in more lexical retrieval difficulties.

Our results show that early exposure to a language is associated with better language processing, as shown by early bilinguals' better lexical retrieval ability during word production compared to late bilinguals. And, the association between childhood English use and lexical retrieval ability is striking in that it demonstrates the influence of language use in childhood on how well bilinguals are able to process their second language in adulthood.

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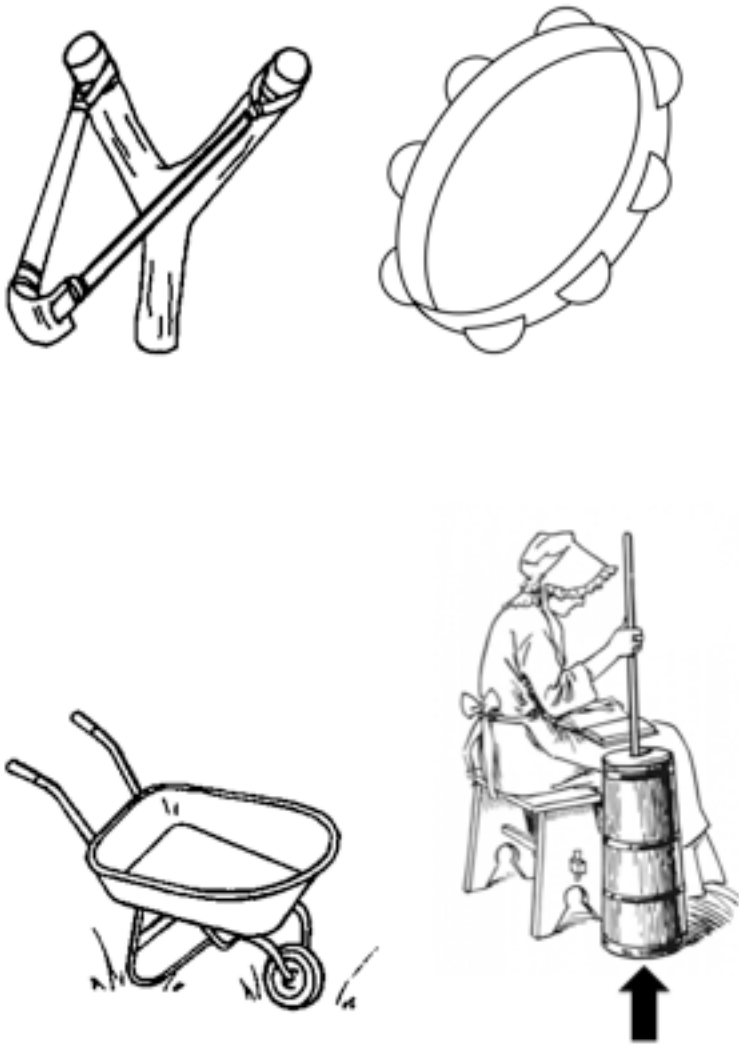
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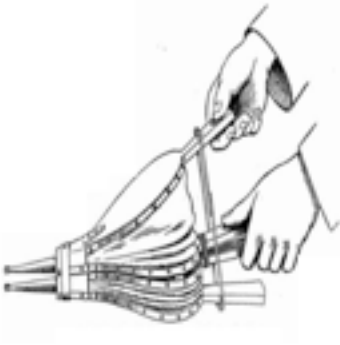
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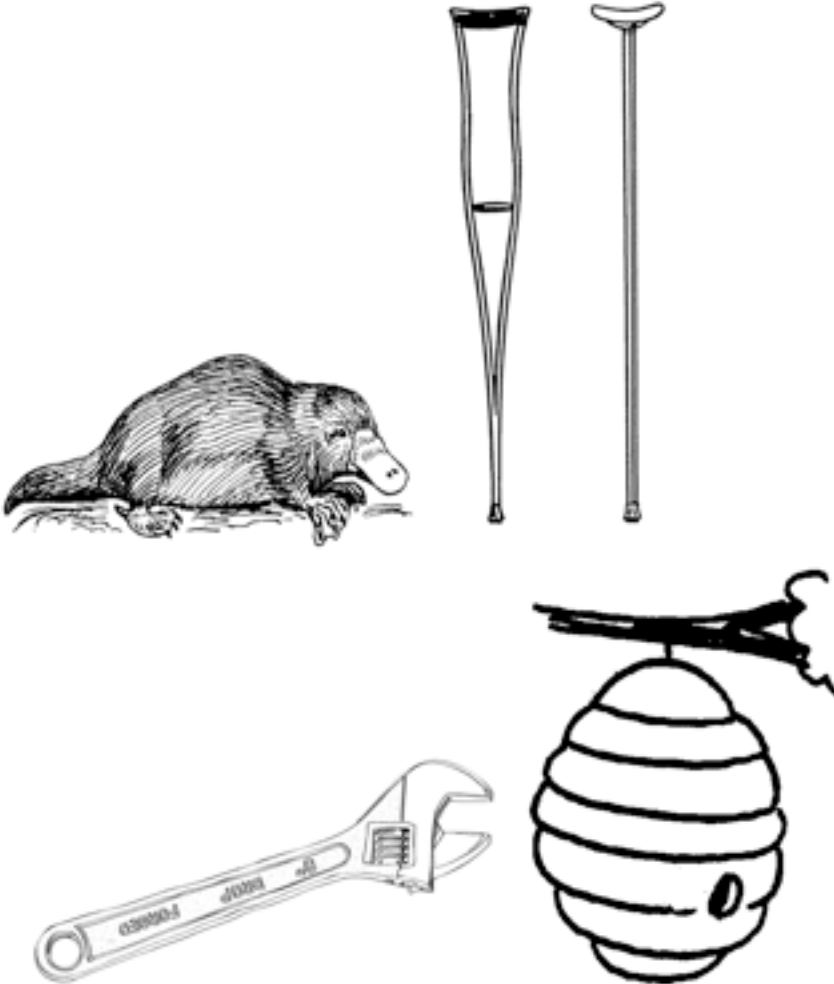
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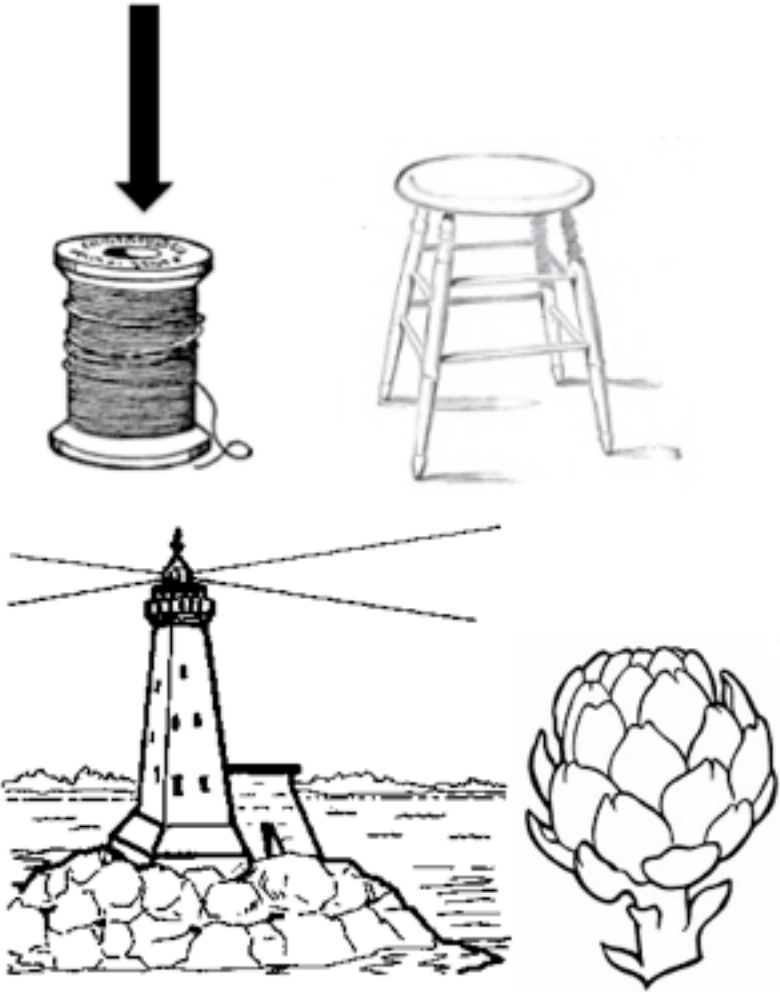
Appendix A**Final set of items and images**

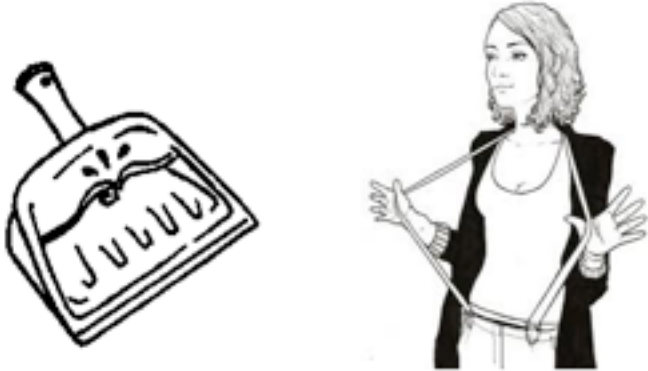
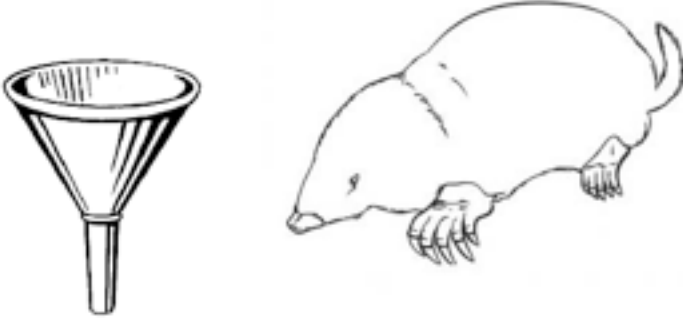
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<i>hedgehog</i>	<i>flipper</i>	<i>goat</i>
<i>scarecrow</i>	<i>sled</i>	<i>plunger</i>
<i>windmill</i>	<i>sickle</i>	<i>wheelbarrow</i>
<i>slingshot</i>	<i>whisk</i>	<i>scaffold</i>
<i>record player</i>	<i>scroll</i>	<i>pitchfork</i>
<i>artichoke</i>	<i>scythe</i>	<i>easel</i>
<i>tambourine</i>	<i>tadpole</i>	<i>flask</i>
<i>shutters</i>	<i>butler</i>	<i>churn</i>
<i>platypus</i>	<i>gavel</i>	<i>dustpan</i>
<i>stool</i>	<i>propeller</i>	<i>funnel</i>
<i>caterpillar</i>	<i>crutches</i>	<i>lighthouse</i>
<i>thimble</i>	<i>corkscrew</i>	<i>vine</i>
<i>hut</i>	<i>doorknob</i>	<i>mole</i>
<i>shoehorn</i>	<i>hive</i>	<i>anvil</i>
<i>bellows</i>	<i>spool</i>	<i>clippers</i>
<i>pantry</i>	<i>suspenders</i>	<i>hoof</i>
<i>compass</i>	<i>jellyfish</i>	<i>lantern</i>
<i>pliers</i>	<i>stork</i>	<i>raccoon</i>
<i>Cheese grater</i>	<i>gazebo</i>	<i>popsicle</i>

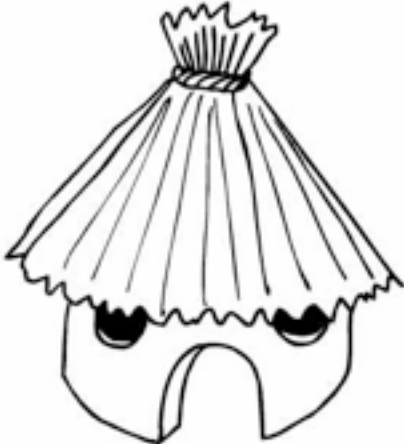
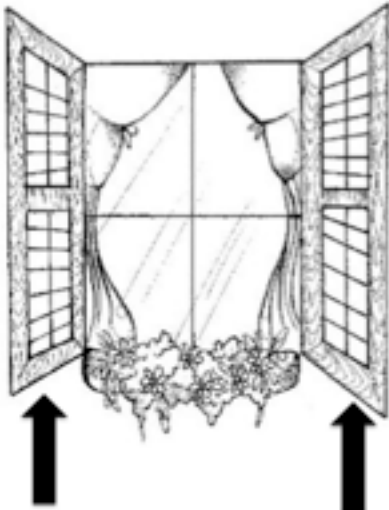




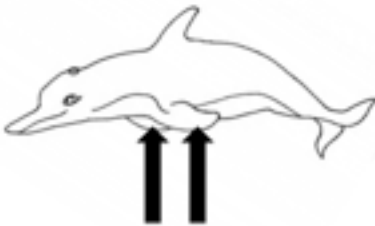


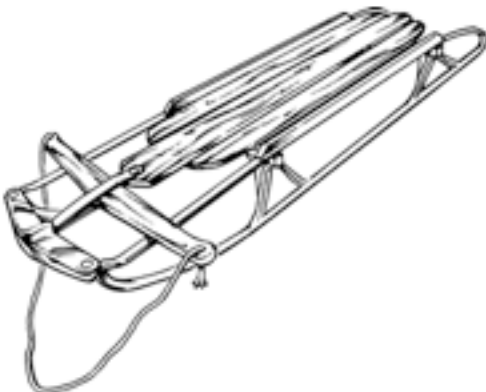


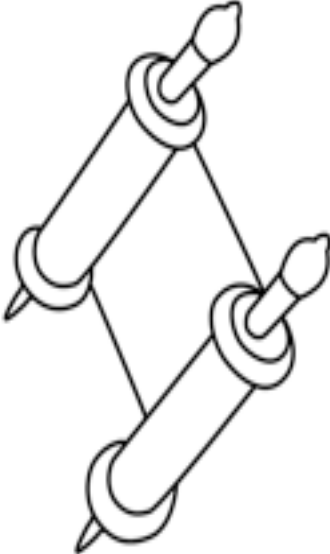
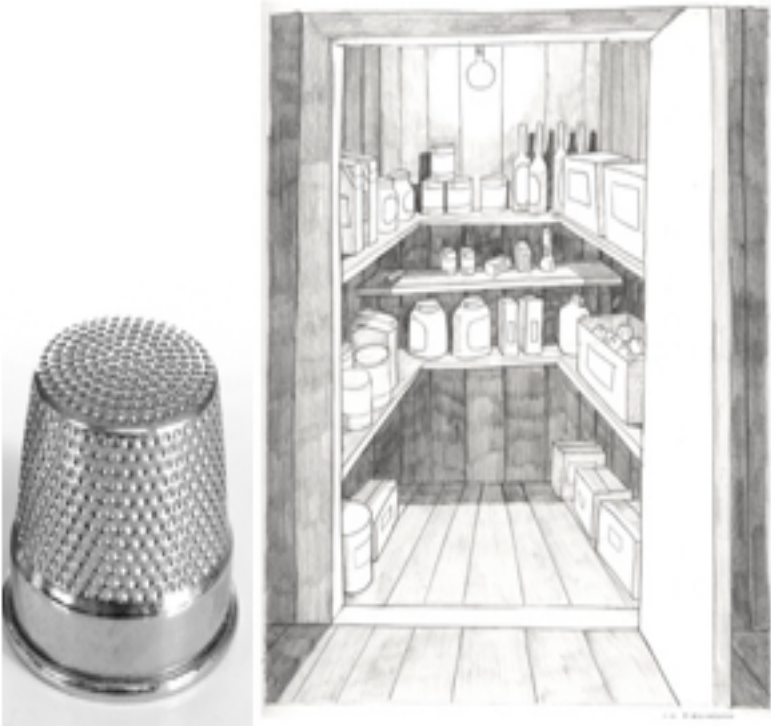


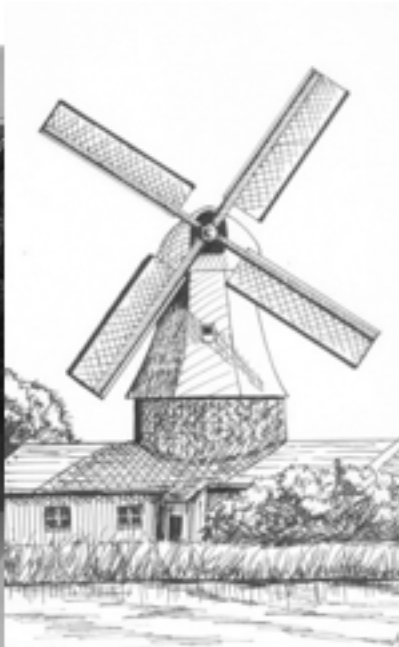




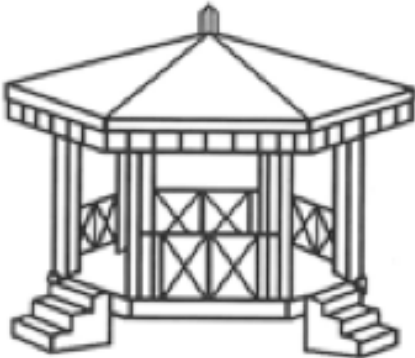












Appendix B

Tip-of-the-tongue Elicitation Task

Experimenter explains what a tip-of-the-tongue (ToT) experience is and gives task instructions.

Experimenter: This experiment is on the Tip-of-the-tongue experience. I will refer to this as a T O T. A TOT is a frustrating experience that a person has when the person is sure that he or she knows a particular word but cannot recall it at that particular moment. People usually experience TOT in their everyday lives. Have you ever had a TOT experience? Can you describe it for me?

I will now show you pictures, and as you are naming them in English, I will try and see if you are having a TOT. If you are confident that you know the word and can't say it right away, that is a TOT. It is very important that you let me know when you are having a TOT even if it only lasts a second or two. Whenever this happens, please give me as much information as you can. An example of this is, if you are thinking of the last time you used the word, tell me that. Or you might remember that the word starts with a particular sound or letter, tell me that too. Often when people are experiencing a TOT state, other words come into mind. For example, in trying to come up with the word "blender," you instead keep thinking "mixer," even though you know that is not the word you are looking for. I want you to tell me the "other words" that come to mind.

For each of the pictures, I am looking for a specific word even though there may be more than one word to name the picture. I will ask you to continue with the same picture until we arrive at the right word. Let me know if the picture is unclear or if you do not know what the picture is of.

Remember, as soon as you are in a TOT state, tell me! Again, a TOT is when you are sure you know the name, but can't remember it right away.

Do you have any questions?

Experimenter: Okay. You can start naming the pictures one by one and let me know if you have a TOT.

Appendix C**BILINGUAL LANGUAGE QUESTIONNAIRE****Contact Information**

Name_____	Male_____	Female_____
Date of birth_____	Age_____	
Where did you grow up? City_____	State_____	
Permanent address _____		
City_____	State_____	Zip_____
Phone (_____)_____	Voice_____	VP_____
Pager/Text _____		
Email addresses 1. _____		
2. _____		

Ethnicity (Optional - For government records)

Hispanic or Latino/a _____ Not Hispanic or Latino/a _____ Unknown _____

Race (Optional - For government records)

African American or Black _____
 American Indian or Alaskan Native _____
 Asian _____
 Native Hawaiian or other Pacific Islander _____
 White _____
 More than one _____
 Unknown _____

For Lab Use:

Experimenter Name: _____
 Today's Date _____
 Studies completed:

Language Background continued...

Please approximate the percentage of time during an average day that you use:

Spanish _____
 English _____
 Other _____
 Total 100%

Please approximate the percentage of time during an average day that you used Spanish, English, and other languages **growing up?**

Spanish _____
 English _____
 Other _____
 Total 100%

Educational Background

Are you currently in college? Yes____ No____

If yes, how many years have you been in college? _____

What is/was your major? _____ Minor? _____

What is your highest earned degree?

HS/GED____ Associate's ____ Bachelor's____ Master's____ Doctorate____

Have you taken any Spanish literature or language classes? Yes____ No____

If yes, where did you take the classes? _____

What is the highest level of education of your **primary** caretaker (Please circle one)?

Less than 7th Grade 7th-9th Grade 10th or 11th Grade High School
 Partial College (at least one year) College education Graduate Degree

What is the highest level of education of your **secondary** caretaker (Please circle one)?

Less than 7th Grade 7th-9th Grade 10th or 11th Grade High School
 Partial College (at least one year) College education
 Graduate Degree

General Background

Are you right or left-handed? Right-handed_____ Left-handed_____

Is anyone in your immediate family left-handed? Yes_____ No_____

Do you have a hearing loss? Yes_____ No_____

If yes, what is your dB (decibel) loss in your: Left ear?_____ Right ear?_____

Do you wear glasses? Yes_____ No_____

Do you have any vision problems (e.g., Usher Syndrome)? Yes_____ No_____

If yes, please explain_____

Have you ever had a serious neurological problem (e.g., head injury, epilepsy, coma?)

Yes_____ No_____ If yes, please explain_____

Professional and Work History

What is your occupation? _____

What is your **primary** caretaker's most recent occupation?

- | | |
|---|---|
| <input type="checkbox"/> Farm or day laborer | <input type="checkbox"/> Unskilled or service worker |
| <input type="checkbox"/> Skilled manual worker, emergency services or enlisted military | <input type="checkbox"/> Clerical/sales, small farm owner |
| <input type="checkbox"/> Technician, supervisor, office manager | <input type="checkbox"/> Small business owner, farm owner, teacher or low-level manager |
| <input type="checkbox"/> Mid-level manager/professional, mid-sized business owner, military officer | <input type="checkbox"/> Senior manager/professional, owner or CEO of large business |

If you are unsure, list the most recent occupation in the space provided:

What is your **secondary** caretaker's most recent occupation?

- | | |
|---|---|
| <input type="checkbox"/> Farm or day laborer | <input type="checkbox"/> Unskilled or service worker |
| <input type="checkbox"/> Skilled manual worker, emergency services or enlisted military | <input type="checkbox"/> Clerical/sales, small farm owner |
| <input type="checkbox"/> Technician, supervisor, office manager | <input type="checkbox"/> Small business owner, farm owner, teacher or low-level manager |
| <input type="checkbox"/> Mid-level manager/professional, mid-sized business owner, military officer | <input type="checkbox"/> Senior manager/professional, owner or CEO of large business |

If you are unsure, list the most recent occupation in the space provided:

Language Proficiency

What is your strongest spoken language? _____

Please list the languages that you know, the age you were first exposed to it, the number of years you studied it, and how you were exposed to it.

Language	Age at first exposure	Years of formal study	Total years of language use	Method of exposure (Check all that apply)			
				<i>School</i>	<i>Study abroad</i>	<i>Immersion in the community</i>	<i>Exposure at home</i>
Spanish							
English							

Please circle the number that best represents your proficiency for Spanish, English, and any language(s) you listed in the table above.

Language	Skill	Almost None	Very Poor	Fair	Functional	Good	Very Good	Like Native
Spanish	Speaking	1	2	3	4	5	6	7
	Reading	1	2	3	4	5	6	7
	Writing	1	2	3	4	5	6	7
	Understanding	1	2	3	4	5	6	7
English	Speaking	1	2	3	4	5	6	7
	Reading	1	2	3	4	5	6	7
	Writing	1	2	3	4	5	6	7
	Understanding	1	2	3	4	5	6	7
	Speaking	1	2	3	4	5	6	7
	Reading	1	2	3	4	5	6	7
	Writing	1	2	3	4	5	6	7
	Understanding	1	2	3	4	5	6	7
	Speaking	1	2	3	4	5	6	7
	Reading	1	2	3	4	5	6	7
	Writing	1	2	3	4	5	6	7
	Understanding	1	2	3	4	5	6	7

MONOLIGUAL LANGUAGE QUESTIONNAIRE**Contact Information**

Name _____	Male ___	Female ___	Other ___
Date of birth _____	Age _____		
Where did you grow up? City _____	State _____		
Permanent address _____			
City _____	State _____	Zip _____	
Phone (_____) _____	Voice ___	VP ___	
Pager/Text _____			
Email addresses 1. _____			
2. _____			

Ethnicity (Optional - For government records)

Hispanic or Latino/a _____ Not Hispanic or Latino/a _____ Unknown _____

Race (Optional - For government records)

African American or Black _____
American Indian or Alaskan Native _____
Asian _____
Native Hawaiian or other Pacific Islander _____
White _____
More than one _____
Unknown _____

For Lab Use:

Experimenter Name: _____
Today's Date _____
Studies completed:

Language Background

What do you consider to be your native language? _____

Were you exposed to **English** from birth? Yes _____ No _____

If **not** exposed to English at birth, at what age did you begin to learn English? _____

From whom did you learn **English**? (Check all that apply)

Parents _____ Brothers/Sisters _____ Friends _____ Teachers _____

Other(s) please list: _____

At which age did you actively start using English on a daily basis? _____

Do you have an older brother or sister? Yes _____ No _____

Does he/she know **English**? Yes _____ No _____

What was your **primary** caretaker's primary language? _____

What was your **secondary** caretaker's primary language? _____

How "culturally ethnic" (i.e. in the language spoken in your home) do you consider yourself?

1	2	3	4	5	6	7
Weak			Moderate			Strong

Language Background continued...

Please approximate the percentage of time during an average day that you use English and other languages:

English _____
 Other _____
 Total 100%

Please approximate the percentage of time during an average day that you used English and other languages growing up:

English _____
 Other _____
 Total 100%

Educational Background

Are you currently in college? Yes _____ No _____

If yes, how many years have you been in college? _____

What is/was your major? _____ Minor? _____

What is your highest earned degree?

HS/GED _____ Associate's _____ Bachelor's _____ Master's _____ Doctorate _____

What is the highest level of education of your **primary** caretaker (Please circle one)?

Less than 7th Grade 7th-9th Grade 10th or 11th Grade High School
 Partial College (at least one year) College education Graduate
 Degree

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If yes, please explain_____

Have you ever had a serious neurological problem (e.g., head injury, epilepsy, coma?)

Yes_____ No_____ If yes, please explain_____

Professional and Work History

What is your occupation?_____

What is your **primary** caretaker's most recent occupation?

- | | |
|---|---|
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| <input type="checkbox"/> Mid-level manager/professional, mid-sized business owner, military officer | <input type="checkbox"/> Senior manager/professional, owner or CEO of large business |

If you are unsure, list the most recent occupation in the space provided:

What is your **secondary** caretaker's most recent occupation?

- | | |
|---|---|
| <input type="checkbox"/> Farm or day laborer | <input type="checkbox"/> Unskilled or service worker |
| <input type="checkbox"/> Skilled manual worker, emergency services or enlisted military | <input type="checkbox"/> Clerical/sales, small farm owner |
| <input type="checkbox"/> Technician, supervisor, office manager | <input type="checkbox"/> Small business owner, farm owner, teacher or low-level manager |
| <input type="checkbox"/> Mid-level manager/professional, mid-sized business owner, military officer | <input type="checkbox"/> Senior manager/professional, owner or CEO of large business |

If you are unsure, list the most recent occupation in the space provided:

General Background continued*Education*

What is your highest earned degree?

HS/GED___ Associate's ___ Bachelor's___ Master's___ Doctorate___

What is the highest level of education of your **primary** caretaker (Please circle one)?

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Partial College (at least one year) College education Graduate Degree

What is the highest level of education of your **secondary** caretaker (Please circle one)?

Less than 7th Grade 7th-9th Grade 10th or 11th Grade High School

Partial College (at least one year) College education

Graduate Degree

Language Proficiency

What is your strongest spoken language? _____

Please list the languages that you know, the age you were first exposed to it, the number of years you studied it, and how you were exposed to it.

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				School	Study abroad	Immersion in the community	Exposure at home
English							

Please circle the number that best represents your proficiency for English and any language(s) you listed in the table above.

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	Understanding	1	2	3	4	5	6	7
	Speaking	1	2	3	4	5	6	7
	Reading	1	2	3	4	5	6	7
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	Reading	1	2	3	4	5	6	7
	Writing	1	2	3	4	5	6	7
	Understanding	1	2	3	4	5	6	7

