THE PENNSYLVANIA STATE UNIVERSITY
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TOLERANCE FOR SYNTACTIC SLIPS: THE EFFECT OF CHILD AND FOREIGN ACCENTED SPEECH ON SENTENCE COMPREHENSION IN NATIVE ENGLISH SPEAKERS IN MULTILINGUAL AND MONOLINGUAL SOCIETIES

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ABSTRACT

Research suggests that listeners modify their expectations about speech based on pragmatic cues and social stereotypes (Van Berkum, van den Brink, Tesink, Kos, & Hagoort, 2008). ERP data indicates that listeners infer stereotypes about speakers based on voice in the earliest stages of meaning construction (Van Berkum, van den Brink, Tesink, Kos, & Hagoort, 2008). However, what if the content of the speech is not only pragmatically anomalous, but semantically incorrect? To address this question, Hanulikova, Van Alphen, van Goch, and Weber (2012) conducted an ERP study examining reactions to grammatical errors spoken by accented second language Dutch speakers and native Dutch speakers. The researchers found that Dutch listeners are less likely to react to gender pronoun errors spoken by Turkish-accented Dutch speakers than errors spoken by Dutch native speakers.

Importantly, this study examined multilingual speakers who have extensive experience in learning and speaking foreign languages. They know firsthand how hard speaking a foreign language without grammatical errors or without an accent can be. To determine if tolerance for semantic errors from nonnative speakers extends to those without foreign language exposure, the participant pool should widen to include participants from a largely monolingual society. However, nonnative speakers are not the only speaking group who commonly make semantic errors. Children across all cultures develop their language processes over a period of years. Semantic errors are inevitable as they slowly learn the syntax, grammar, and vocabulary of their native language.

The present study furthers Hanulikova, Van Alphen, van Goch, and Weber's (2012) research by comparing English native speakers living the Netherlands (a multilingual society) and English native speakers living in State College, Pennsylvania (a monolingual society). Both participant groups heard grammatically correct and grammatically incorrect sentences spoken by adult native English speakers, adult Chinese-accented English speakers, and child native English speakers. The grammatically incorrect sentences contained a gender pronoun that failed to align with the gender of the subject of the sentence. A

self-paced listening task was employed to measure participants' reaction times at four different words in each sentence.

While the results of this experiment suggest that participants living in a monolingual community and participants living in a multilingual community were both intolerant of speech errors regardless of speaker condition, the findings demonstrate that participants living in a multilingual environment recover faster after hearing speech errors from the child and adult speaker groups.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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Chapter 1

Introduction

In an increasingly globalized world, second language education continues to gain emphasis in curricula. English—the premier language of research, business, and technology—has become a crucial international language. As second language speakers of English proliferate, cross-cultural communication becomes standard in daily life for a growing number of individuals. However, effective cross-cultural communication may pose a challenge for those who lack experience with nonnative speakers. Accent and grammatical errors that tend to punctuate the speech of second language speakers may impede comprehension for native listeners. How does exposure to second language speakers and personal experience with learning a second language influence how native language speakers process nonnative speech? Do primarily monolingual societies remain less adept at processing foreign-accented speech than multilingual societies?

A well-rounded understanding of the common grammatical mistakes made by nonnative speakers may make native language listeners more attentive to speech content rather than speech errors. If listeners expect grammatical mistakes in the speech of a second language speaker, then the errors become less jarring and attention-grabbing when heard. Listeners can then more easily focus on the message being conveyed rather than how the message is being conveyed.

Such expectations of the speech patterns of second language speakers are also theoretically and empirically relevant for pragmatics, the field of linguistics focusing on language use in a given context. Speaker identity, an integral part of speech contextualization, transforms how individuals process language. For instance, a child discussing abstract philosophical concepts would strike listeners as abnormal, because speaker identity and speech content seem incompatible. Similarly, individuals should form certain expectations for the language use of accented speakers.

Listeners should anticipate fewer grammatical errors from native speakers than nonnative speakers. Second language speakers often struggle with semantics—the branch of linguistics concerned with meaning—as they attempt to navigate the sentence structure (syntax) and vocabulary of a new language. Examples of common errors in, for example, Chinese speakers of English as a second language, include misused pronouns (Steven completed *her* homework) and incorrect prepositions (She is married *with* him). Pragmatics and semantics then become highly intertwined in bilingualism research as speaker identity informs semantic predictions. How the two fields of linguistics interact during language processing remains a topic of debate. Currently, two models exist to explain the relationship between pragmatics and semantics in regards to language interpretation: the two-step model and the one-step model.

Theoretical Models of Language Interpretation

The Two-Step Model

In theorizing how sentences encode meaning, psycholinguistic researchers differentiate between the combination of lexical-semantic features of the words in a sentence devoid of context (the semantics) and the input offered by the larger context (the pragmatics). This distinction has led to the formulation of the standard two-step model of language interpretation (Nieuwland and Van Berkum, 2006). According to this model, listeners first compute a context-free understanding of a sentence or phrase before connecting that meaning to the wider communicative situation (Hagoort & Van Berkum, 2007; Nieuwland and Van Berkum, 2006). Supporters of the one-step model believe that the sentence is the core unit of language interpretation; overall sentence meaning is computed by first interpreting meaning at the level of individual words and combining fixed word meanings in ways specified by the syntax (Hagoort & Van Berkum, 2007). In the two-step model, language interpretation utilizes a bottom-up approach in which the

smallest units of sentences must be interpreted first before listeners take into account the discourse context. Meaning then becomes partitioned as listeners integrate the semantic information with a pragmatic understanding of the language environment (Hagoort & Van Berkum, 2007). In this model, information about the speaker, information from previous discourse, and world knowledge all become factored into meaning construction in the second step of language interpretation. If a semantic understanding is processed before a pragmatic understanding as the two-step model postulates, then speech content would be processed before speaker identity. In the example of the child discussing abstract philosophical concepts, the two-step model of language interpretation would argue that listeners interpret a sentence describing a philosophical concept first before noting that a child should not be able to discuss such an intellectual topic.

The One-Step Model

The one-step model of language interpretation, on the other hand, asserts that speech content and speaker identity are processed together. An increasing body of research upholds this more interactive model of language comprehension (Hagoort & Van Berkum, 2007; Hanulikova, Van Alphen, Van Goch, & Weber, 2012; Nieuwland & Van Berkum, 2006; Van Berkum, Van den Brink, Tesink, Kis, & Hagoort, 2008). This model posits that world knowledge, information from prior discourse, speaker identity, and information from the visual world (including gestures and the setting of the conversation) become integrated into meaning construction simultaneously with the message of speech (Hagoort & Van Berkum, 2007). Semantic cues, therefore, take no temporal or functional precedence over pragmatic cues.

While all cues are processed together, not all cues are given equal consideration. Semantic and pragmatic cues can overrule each other depending on their strength and relevance (Nieuwland & Van Berkum, 2006). For instance, the sentence "The girl comforted the clock" may seem anomalous if heard without any sort of context, because inanimate objects cannot be comforted (Nieuwland & Van Berkum,

2006). However, if that sentence is heard within the context of a fairy tale in which inanimate objects come to life, then cues from the immediate circumstances of the story override real world knowledge regarding the impossibility of such an action (Nieuwland & Van Berkum, 2006). The strength and relevance of semantic and pragmatic cues, however, becomes particularly complex when considering nonnative speakers.

Conceptual Pacts and Lexical Entrainment

Nonnative speakers must navigate the vocabulary, syntax, and pronunciation of another language. Semantic errors inevitably occur as these individuals slowly master the rules of a second language and gain proficiency. However, semantic errors from second language (L2) speakers do not necessarily prevent understanding for native (L1) listeners (Purmohammad, 2015). L1 listeners modify their language expectations based on the perceived proficiency of their L2 interlocutors. Native language speakers may utilize simplified language or avoid slang and idioms in order to meet the proficiency level of their nonnative listeners. L1 speakers, therefore, coordinate their linguistic behavior with their L2 conversational partners in an effort to promote comprehension.

Such linguistic coordination between L1 and L2 speakers may lead to the formation of a conceptual pact. Conceptual pacts form when a speaker refers to an object with a specific lexical choice; the lexical choice becomes a conceptualization, and the conversation partner agrees to share the conceptualization (Brennan & Clark, 1996). When in a conceptual pact, both conversation partners utilize the lexical choice even when simpler references exist (Brennan & Clark, 1996). For instance, an L1 speaker may refer to a couch as a settee even though the term couch remains much more familiar, because their L2 interlocutor applied that label earlier in the conversation (Purmohammad, 2015). Over time, speakers simplify conceptual pacts and, when necessary, abandon them for new conceptualizations

(Brennan & Clark, 1996). As proficiency increases, L1 and L2 interlocutors adjust conceptual pacts in order to find the most efficient way of reaching a mutual understanding.

Lexical entrainment exists as one consequence of a conceptual pact. Lexical entrainment concerns the repeated use of the same or closely related terms in referring to an object (Brennan & Clark, 1996). For instance, if a conversation partner consistently refers to a pen as a frindle, then his/her interlocutor will become lexically entrained to expect the conversation partner to use that new label consistently. Representations in memory from which entrainment emerges encode a partner-specific cue, which leads conversation partners to expect that a speaker should continue to utilize an entrained-upon expression whenever relevant (Metzing & Brennan, 2003). Therefore, conceptual packs and lexical entrainment develop with an increased understanding of one's conversation partner, and linguistic expectations then develop with the relationship.

The Effect of Accent

Lexical entrainment becomes particularly intriguing when considering the role of accents. In L1-L2 conversations, lexical entrainment may occur as native speakers grow accustomed to and expect an accented version of a common lexical choice from their L2 interlocutors (Purmohammad, 2015). Moreover, if nonnative speakers engage in a particular semantic violation often enough, that violation may become entrained in native listeners as a loose conceptual pact takes formation. As an L1 conversation partner becomes familiarized with the accent of an L2 interlocutor, he/she may begin to apply the lexical entrainments and conceptual pacts learned from one L2 speaker to similarly accented individuals. The conceptual pact then would exist not between pairs of individuals, but between a native speaker and a particular nonnative speaking group. In fact, Hanulikova, Van Alphen, Van Goch, & Weber (2012) examined the extent to which exposure to accented speech could habituate native listeners to common grammar violations in a nonnative speaking group.

Hanulikova, Van Alphen, Van Goch, & Weber (2012) investigated how native listeners process grammatical errors that appear frequently in nonnative speech in an effort to learn whether speaker identity modulates syntactic processing. Thirty-four native Dutch speakers listened to 240 sentences spoken by a female Dutch native speaker and by a female Turkish speaker of Dutch; half of the sentences spoken by each speaker contained a syntactic violation in the form of a gender pronoun error (i.e., "Megan missed *his* appointment."). The experimenters also created a set of 104 control sentences that included semantic world knowledge violations (i.e., "I put a thick *evening* on my bed."). While neither L1 nor L2 speakers of Dutch are likely to make such world knowledge violations, the same cannot be said for gender pronoun errors. Turkish speakers make up one of the largest immigrant communities in the Netherlands, and thus many Dutch listeners have become very familiar with Turkish-accented Dutch (Statistics Netherlands, 2010). Turkish lacks grammatical gender, so Turkish learners of Dutch have been found to utilize incorrect gender agreement or omit gender pronouns altogether up to 67% of the time (Blom, Polišenská, & Weerman, 2006; Orgassa, 2009; Weerman, Bisschop, & Punt, 2006). L1 listeners automatically expect L1 interlocutors to utilize correct gender agreement, but those default expectations might relax when interacting with L2 speakers (Hanulikova, Van Alphen, Van Goch, & Weber, 2012). L1 listeners may focus less on grammatical errors and accents in an effort to concentrate on the meaning of the speech.

In order to study the effect of accent on the processing of grammatical errors, Hanulikova, Van Alphen, Van Goch, and Weber (2012) conducted an EEG (electroencephalography) study to compare Dutch listeners' ERP (event-related potential) responses to Dutch nouns that either agreed or disagreed in gender with previous context in the sentences. ERPs reflect regularities in electrical brain activity that are time-locked to the onset of an external event, such as hearing or reading a word (Van Berkum, Van den Brink, Tesink, Kis, & Hagoort, 2008). ERPs provide a millisecond-by millisecond record of the brain's electrical activity during mental processing as it unfolds over time, and this method has been widely used in research studying sentence processing. For instance, a P600 effect is a particular spike in the ERP

waveform that indicates the detection of a syntactic violation while an N400 effect is a spike in the data that indicates the detection of a pragmatic or semantic violation (Hanulikova, Van Alphen, Van Goch, & Weber, 2012; Van Berkum, Van den Brink, Tesink, Kis, & Hagoort, 2008). Thus, ERP data can shed light on the role pragmatics plays in modulating responses to syntactic and semantic violations.

In Hanulikova, Van Alphen, Van Goch, and Weber's (2012) study, gender agreement errors spoken by L1 and L2 Dutch speakers yielded vastly different ERP results. Gender violations in native speech resulted in a P600 effect, but the same violation in accented speech produced little to no reaction seen in the ERP data. These results suggest that Dutch listeners do, in fact, modify their speech expectations based on accent. Control sentences containing semantic violations elicited similar N400 effects for both L1 and L2 speakers, which suggests that Dutch listeners anticipate specific types of errors from Turkish speakers of Dutch.

Importantly, participants in the Hanulikova, Van Alphen, Van Goch, and Weber's (2012) study were multilingual speakers in the Netherlands who have extensive experience in learning and speaking foreign languages. They know from personal experience the difficulties that lie in speaking a foreign language without grammatical errors or without an accent. Nonnative language processing may look different in native language speakers who lack exposure to L2 speakers of their native language and have limited experience themselves with learning a foreign language. My experiment examines how responses to syntactic errors made by nonnative speakers differ between cultural contexts. Specifically, do reaction times when listening to gender pronoun errors made by Chinese-accented speakers vary between listeners living in a multilingual community (the Netherlands) and listeners living in a largely monolingual community (State College, Pennsylvania)? Chinese, like Turkish, lacks gender pronouns.

Since many English native speakers living in the US have not experienced the challenges of learning a second language and have had limited exposure to accented English speech, they may not have learned to expect grammatical errors from nonnative speakers and will therefore process nonnative speech errors similarly to native speech errors. I hypothesize that participants living in a monolingual community

will have similar reaction times when processing the syntactic errors of adult Chinese-accented English speakers and adult native English speakers. I expect that native English native speakers who live in a multilingual society (as the Netherlands) will demonstrate a different response pattern. Since English native listeners who live in a multilingual society understand the difficulties associated with learning a second language and experience accented speech nearly daily, they may process nonnative speech errors more easily than native speech errors. I hypothesize that the difference between listening to foreign-accented speech and native-accented speech will be smaller in the native-English listeners living in a multilingual society relative to those living in a monolingual society. Given the difference in language exposure, English native speakers in the US will be less tolerant of syntactic violations of accented speakers than the English native speakers in the Netherlands.

Syntactic errors are common in L2 speakers of a language, but they also exist as common errors in children who are learning their native language. In a second manipulation, my experiment examines how listeners' responses to children making gender pronoun errors vary between English native speakers in the US and in the Netherlands. While not all English native speakers have exposure to L2 speakers of English, all adults understand that children must develop their language skills over years. When listening to syntactic errors, do reaction times vary depending on if the speaker is an adult native English speaker or a child native English speaker? Since adult native speakers of any language are the least likely speaker group to make grammatical errors, I hypothesize that participants living in both monolingual and multilingual contexts will have slower reaction times when processing the gender pronoun violations made by adult native English speakers than when processing the violations made by child native English speakers. Since child syntactic errors are common in every language and culture, participants in both monolingual and multilingual societies will be more tolerant of syntactic violations of child speakers than adult speakers.

Chapter 2

Methods

Modeled after the study by Hanulíková, Van Alphen, Van Goch, and Weber (2012), this experiment utilizes a self-paced listening task to determine if the processing time of semantically and syntactically anomalous sentences, produced by a Chinese-accented speaker, an English-accented speaker, and a child speaker varies between English-native speaking listeners living in a multilingual society (the Netherlands) and a monolingual society (State College, Pennsylvania).

Participants

Table 1. Multilingual Society Language History Questionnaire Results

	Multilingual Society	
	Language Ability (Proficiency 1-7 Scale)	**Age of Acquisition**
Participant 1	English-7, German-5, French-3	English-3, German-6, French-6
Participant 2	English-7, German-6, Dutch-2	English-3, German-6, Dutch-9
Participant 3	English-7, French-4	English-3, French-8
Participant 4	English-7, Dutch-5, German-4	English-4, Dutch-7, German-7
Participant 5	English-7, Spanish-5, French-5	English-3, Spanish-6, French-6
Participant 6	English-7, Dutch-6, German-4	English-3, Dutch-8, German-9
Participant 7	English-7, Spanish-4, Dutch-3, German-3	English-4, Spanish-6, Dutch-8, German-8
Participant 8	English-7, Dutch-5, German-3	English-4, Dutch-6, German-9
Participant 9	English-7, Spanish-4	English-3, Spanish-6
Participant 10	English-7, French-5	English-3, French-7

Ten native English speakers (6 women, 4 men) living in the Netherlands were recruited for participation in this study. The average age of the participants was 25, but the ages ranged from 22 to 28. All participants grew up in native English speaking households in Europe and received foreign instruction

throughout their education (see Table 1). Flyers, word of mouth, and an online subject pool study sign-up were all utilized to recruit participants, and therefore participants came from a variety of academic fields.

Table 2. Monolingual Society Language History Questionnaire Results

Monolingual Society		
	Language Ability (Proficiency 1-7 Scale)	**Age of Acquisition**
Participant 1	English-7, Spanish-2	English-3, Spanish-14
Participant 2	English-7	English-4
Participant 3	English-7, Spanish-1	English-3, Spanish-16
Participant 4	English-7	English-3
Participant 5	English-7	English-3
Participant 6	English-7	English-4
Participant 7	English-7, Spanish-2	English-3, Spanish-14
Participant 8	English-7, French-2	English-3, French-15
Participant 9	English-7	English-2
Participant 10	English-7	English-3
Participant 11	English-7	English-4
Participant 12	English-7	English-3
Participant 13	English-7, French-1	English-3, French-16
Participant 14	English-7	English-3
Participant 15	English-7	English-3
Participant 16	English-7	English-3
Participant 17	English-7	English-4
Participant 18	English-7, Latin-1	English-3, Latin-14
Participant 19	English-7	English-2
Participant 20	English-7	English-3

Twenty native English speakers (12 women, 8 men) were recruited from the Pennsylvania State University to participate in this study. The average age of the participants was 21, but the ages ranged from 20 to 23. All participants had limited exposure to foreign languages (no instruction past the introductory level and no time spent abroad in a non-English speaking country) (see Table 2). All participants were recruited through word of mouth.

Materials

Self-Paced Listening Task

The stimuli consisted of 240 English sentences: 80 of the sentences were spoken by a Chinese-accented adult English speaker, 80 by an adult native English speaker, and 80 by a child native English speaker. Two speakers were recruited for each of the three speaking groups. All participants heard 15 sentences that contained a correct gender pronoun and 15 sentences that contained an incorrect gender pronoun from each of the six speakers. Similarly, all participants heard 5 sentences that contained a semantically correct noun and 5 sentences that contained a semantically anomalous noun from each of the six speakers.

Of the 240 sentences, 180 of them contained a gender pronoun manipulation and 60 of them contained a semantic manipulation. Each sentence contained at least 8 words. At least three words (amounting to at least 5 syllables) preceded and followed every target word. The target words were either a syntactically correct/incorrect gender pronoun or a semantically correct/incorrect noun. See Table 1. For examples.

The 80 sentences heard by participants that were spoken by a Chinese-accented English speaker were divided evenly between two female Chinese Penn State students who were fluent in English. Both females possessed clear Chinese accents.

The 80 sentences that were spoken by an adult native English speaker were divided evenly between two female American Penn State students who possessed no regional accents.

The 80 sentences heard by participants that were spoken by a child native English speaker were divided evenly between two female children, ages 6 and 5. All of the child sentences incorporated age-relevant content (sleepovers, finger painting, chores, etc.) so that the speaker and message were always congruent.

Of the 180 sentences containing a gender pronoun manipulation, 90 of them contained a gender pronoun that failed to align with the gender of the subject, and 90 sentences utilized the correct gender pronoun. Of those 90 sentences that included an incorrect gender pronoun, 45 of the sentences contained an incorrect use of a female pronoun and 45 contained an incorrect use of a male pronoun. Similarly, 45 of the correct sentences utilized a correct female pronoun and 45 utilized a correct male pronoun. All pronouns were possessive rather than reflexive (i.e., his not him), and every sentence containing a gender pronoun manipulation was a compound sentence using either "but" or "since" as the conjunction. See Table 3 for examples.

Table 3. Example Sentences with Gender Agreement Manipulation

	Masculine Correct	Masculine Incorrect	Feminine Correct	Feminine Incorrect
Adult Speakers	Richard borrowed the book since his copy was missing.	Richard borrowed the book since her copy was missing.	Megan studied all night since her test was tomorrow.	Megan studied all night since his test was tomorrow.
Child Speakers	Adam loved drawing because his markers were very bright.	Adam loved drawing because her markers were very bright.	Kristin fell asleep since her graduation ran long.	Kristin fell asleep since his graduation ran long.

In addition, participants heard 60 total filler sentences that did not include a gender pronoun manipulation. Instead, 30 of the sentences contained a semantically anomalous noun and 30 sentences were semantically correct. See Table 4 for examples.

Table 4. Example Sentences with Semantic Manipulation

	Semantically Correct	Semantically Incorrect
All Speakers	Richard ate a bagel with jelly and butter for lunch.	Richard ate a bagel with chair and butter for lunch.

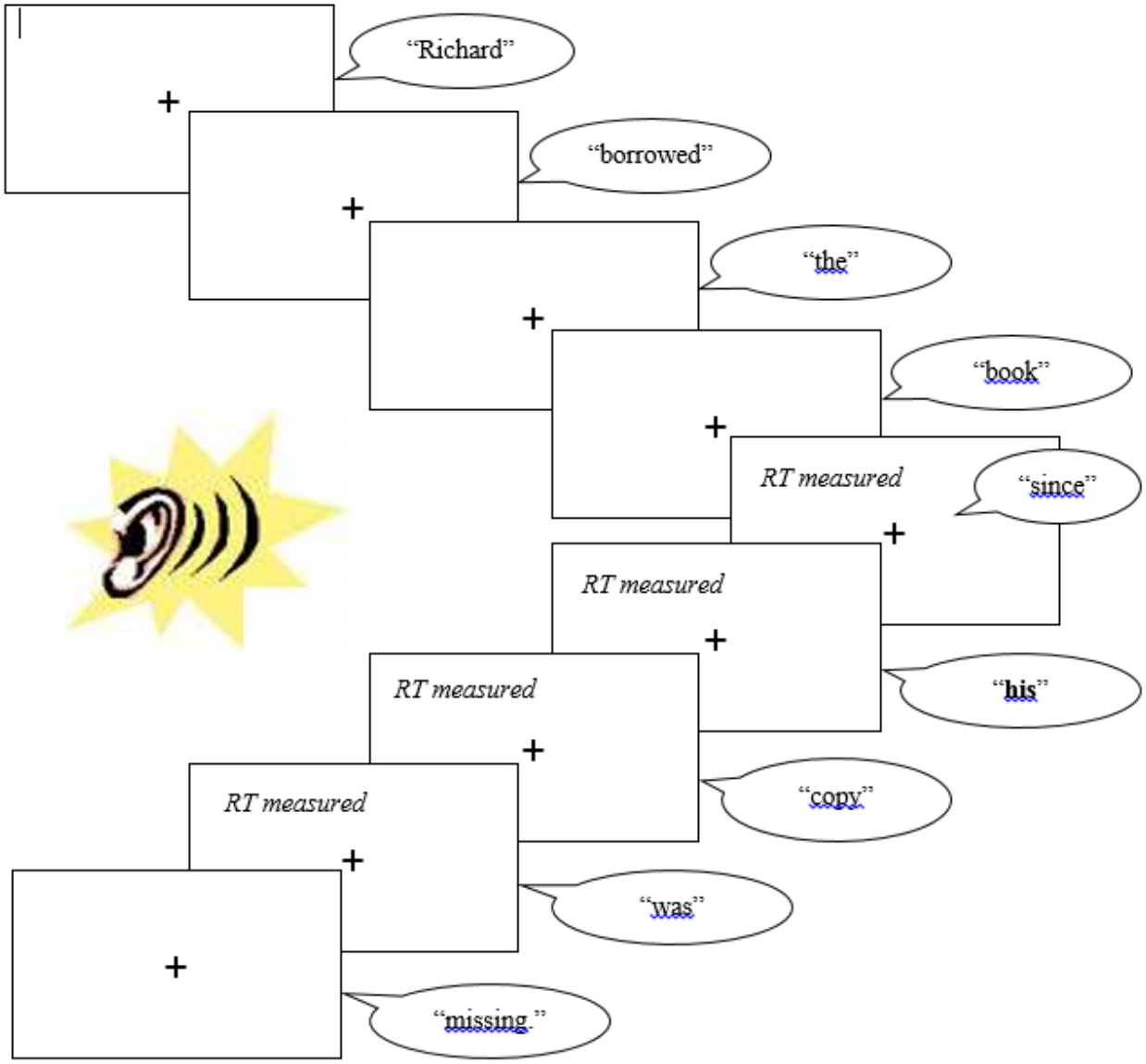
Procedures

Participants were first presented with a consent form, which was then followed by the self-paced listening task. At the end of the experiment, participants completed the Boston Naming Task to test their language proficiency and filled out a Language History Questionnaire. Throughout the test session, participants were seated at a laptop within a soundproofed room. Participants' eyes were approximately 24 inches from the computer screen.

Self-Paced Listening Task

A fixation cross was displayed on the screen as participants listened to the sentences through headphones. Each sentence was presented word by word, and participants used a button box to click through the words of the sentence at their own pace. Before every word, 50 ms of silence was added to ensure no word was cut short. Reaction time was measured from the onset of the word until the participant pressed the button to initiate presentation of the next word. Reaction time measures were collected for the word preceding the target word, the target word, and the two words following the target (see Figure 1). In order to ensure that the participants remained focused throughout the duration of the experiment, 60 of the sentences were followed by a comprehension question regarding the content of the last sentence the participants heard. The comprehension questions followed 23 correct and 23 incorrect experimental sentences as well as 7 correct and 7 incorrect filler sentences.

Figure 1. Self-Paced Listening Task



The sentences in the self-paced listening task were presented in pseudo-randomized order, and all participants heard 240 sentences presented across five blocks. Every block contained 48 sentences, and each block contained 16 sentences spoken by each of the three speaking groups. In each block, 36 sentences contained a gender pronoun manipulation: 18 sentences contained a male subject, and 18 sentences contained a female subject. Of the 18 sentences pertaining to either gender, 9 of them contained a possessive pronoun that failed to align with the gender of the subject, and the other 9 pronouns were

correctly aligned. Each block also included 12 filler sentences; 6 of the filler sentences contained a semantically anomalous noun, and the other 6 sentences were semantically correct. In an effort to stave off fatigue, participants could take breaks between blocks.

Boston Naming Task

A picture-naming task, the Boston Naming Task (BNT, Kaplan, Goodglass, & Weintraub, 1983) was administered to measure English language proficiency. In the BNT, participants are asked to name 68 images (60 testing trials and 8 practice trials) as quickly and accurately as possible. How well they perform is seen as a measure of their fluency in the tested language. During the task, a fixation cross appears on the screen for 750 ms, and then a picture is presented for 5,000 ms or until the voice key is triggered by a response from the participant. An inter-stimulus interval of 1,500 ms follows the presentation of each picture. Performance of the participants immersed in a monolingual society (tested at Penn State) and a multilingual society (tested at Radboud University, Nijmegen) is presented in Table 5. A *t*-test showed that their BNT scores were not significantly different, $t\ (28) = 37.895$, $p < .001$.

Table 5. Performance on BNT

	Mean	Standard Deviation (SD)
Monolingual Society	0.8061	0.0531
Multilingual Society	0.8429	0.0494

Language History Questionnaire

The Language History Questionnaire (LHQ) consisted of an array of questions that provided language background information for all participants. Participants supplied information about their age, sex, education level, countries of residence/origin, and language ability. Participants were asked to write short answers about their age of acquisition and method of learning each language. Participants also provided self-ratings about their perceived proficiency in reading, writing, speaking, and listening within

each of their languages. The LHQ was intended to gain insight into participants' fluency and literacy in their native language and any other languages they knew, as well as provide information regarding all language immersion experiences they encountered by living or studying abroad. See Tables 1 and 2 for results.

Analysis

The self-paced listening task reaction time data was analyzed by conducting a series of ANOVAs to measure the effects of accent and age on the reaction times between and within participant groups. The effect of accent within participant groups was analyzed by conducting a 2 accent (Chinese-accented vs. adult English-accented) x 2 sentence (correct vs. incorrect) ANOVA. The effect of age within participant groups was analyzed by conducting a 2 age (adult English-accented vs. child English-accented) x 2 sentence (correct vs. incorrect) ANOVA. The effect of accent between participant groups was analyzed by conducting a 2 listener type (monolingual society vs. multilingual society) x 2 accent (Chinese-accented vs. adult English-accented) x sentence (correct vs. incorrect). The effect of age between participants was analyzed by conducting a 2 listener type (monolingual society vs. multilingual society) x 2 age (child English-accented vs. adult English-accented) x sentence (correct vs. incorrect).

Chapter 3

Results

Comparisons Within Participant Groups

The self-paced listening task reaction time data was analyzed by conducting two different ANOVAs to examine the effect of accent and age on RTs for correct and incorrect sentences. The effect of accent on participants living in monolingual and multilingual societies were analyzed by conducting a 2 accent (Chinese-accented vs. adult English-accented) x 2 sentence (correct vs. incorrect) ANOVA.

Monolingual Society

Figure 2. Comparison of Monolingual Society RTs in Correct and Incorrect Sentences for Chinese-Accented and Adult-Accented Speaker Conditions

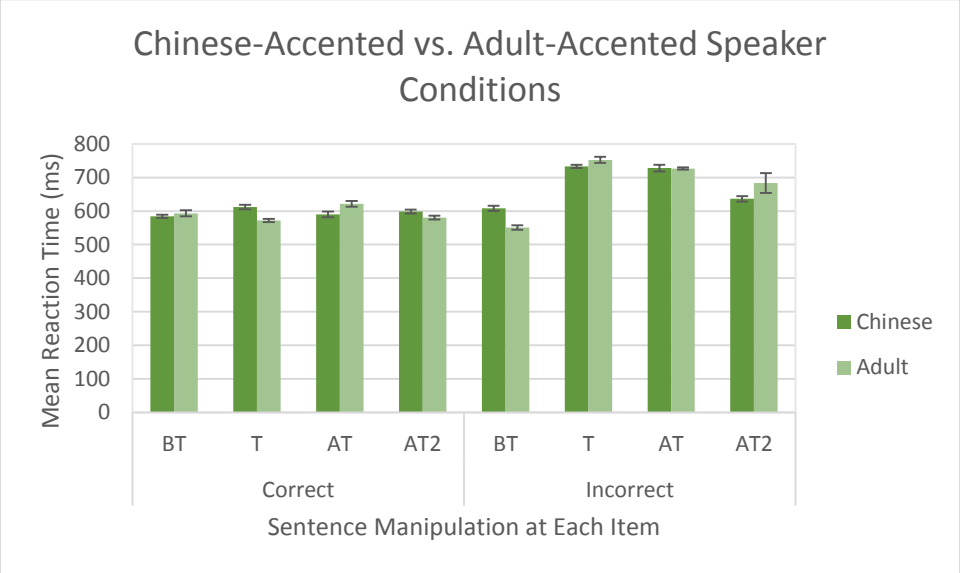


Table 6. Main Effects of Accent, participants in Monolingual Society

Simple Main Effects of Accent				
	BT		**T**	
	Correct	**Incorrect**	**Correct**	**Incorrect**
***F*-ratio**	$F(1, 76) = .406$	$F(1, 76) = 15.819$	$F(1, 76) = 9.768$	$F(1, 76) = 2.252$
***p*-value**	$p = .526$	$p < .001$*	$p = .003$*	$p = .138$
	AT		**AT2**	
	Correct	**Incorrect**	**Correct**	**Incorrect**
***F*-ratio**	$F(1, 76) = 3.927$	$F(1, 76) = .005$	$F(1, 76) = .316$	$F(1, 76) = .316$
***p*-value**	$p = .051$	$p = .943$	$p = .576$	$p = .140$

The main effects of accent in the correct sentences at item Target are statistically significant; the average RT was slower in the Chinese-accented speaker condition than in the English-accented speaker condition (see Table 6). The main effect of accent for item BT in the incorrect sentences is statistically significant. Participants reacted slower when listening to the Chinese-accented speaker condition than adult-accented speaker condition. The remaining effects were not significant.

Table 7. Main Effects of Sentence, participants in Monolingual Society

Simple Main Effects of Sentence				
	BT		**T**	
	Adult	**Chinese**	**Adult**	**Chinese**
***F*-ratio**	$F(1, 76) = 8.571$	$F(1, 76) = 2.847$	$F(1, 76) = 194.869$	$F(1, 76) = 87.113$
***p*-value**	$p = .005$*	$p = .096$	$p < .001$*	$p < .001$*
	AT		**AT2**	
	Adult	**Chinese**	**Adult**	**Chinese**
***F*-ratio**	$F(1, 76) = 43.357$	$F(1, 76) = 74.621$	$F(1, 76) = 10.599$	$F(1, 76) = 1.447$
***p*-value**	$p < .001$*	$p < .001$*	$p = .002$*	$p = .233$

The main effects of the adult native-accented speaker condition for BT, T, AT, and AT2 are statistically significant (see Table 7). The participants' average RT was statistically significantly slower for incorrect sentences than correct sentences at items T, AT, and AT2 when listening to native-accented speakers. The RTs were statistically significantly slower for the correct sentences than incorrect sentences at item BT for the native-accented speaker condition. Participants reacted significantly slower when

listening to Chinese-accented speakers for T and AT in the incorrect sentences compared to the correct sentences. The remaining effects were not significant.

Table 8. Interactions Between Accent and Sentence, participants in Monolingual Society

Interactions				
	BT	**T**	**AT**	**AT2**
***F*-ratio**	$F(1, 76) = 10.648$	$F(1, 76) = 10.700$	$F(1, 76) = 2.109$	$F(1, 76) = 2.107$
***p*-value**	$p = .002$*	$p = .002$*	$p = .151$	$p = .151$

Two significant interactions emerged from the ANOVA. There was a significant interaction between accent and sentence for BT and T (Table 8). For the correct sentences at item BT, speaker condition had no effect, but for incorrect sentences at item BT, the Chinese-accented speaker condition led to slower RTs than the English-accented speaker condition. For the correct sentences at item T, the Chinese-accented speaker condition led to slower RTs than the adult English-accented speaker condition, but for incorrect sentences at item T, speaker condition had no effect. The remaining interactions were not significant.

Figure 3. Comparison of Multilingual Society RTs in Correct and Incorrect Sentences for Chinese-Accented and Adult-Accented Speaker Conditions

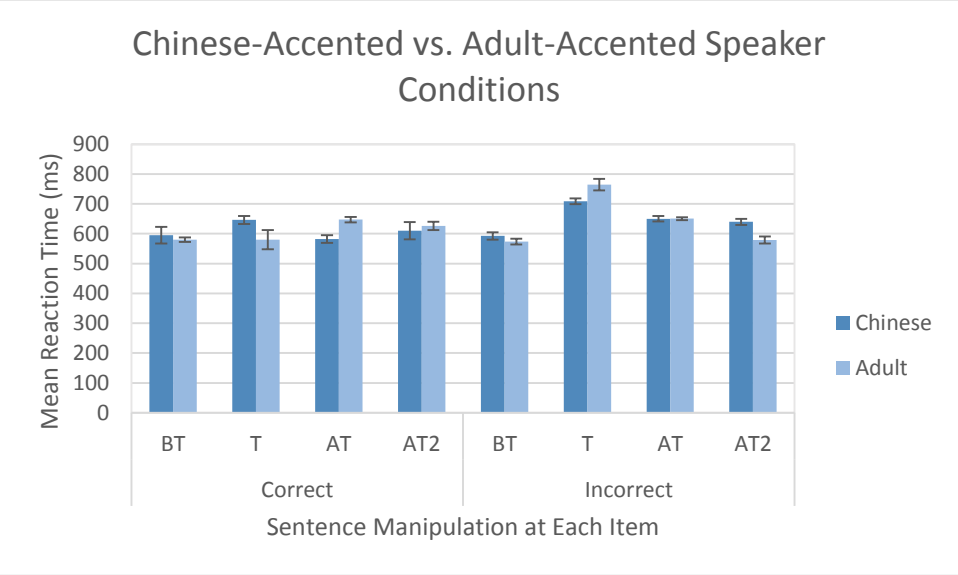


Table 9. Main Effects of Accent, participants in Multilingual Society

Simple Main Effects of Accent				
	BT		**T**	
	Correct	**Incorrect**	**Correct**	**Incorrect**
***F*-ratio**	$F(1, 36) = .225$	$F(1, 36) = .315$	$F(1, 36) = 4.001$	$F(1, 36) = 2.408$
***p*-value**	$p = .638$	$p = .578$	$p = .053$	$p = .129$
	AT		**AT2**	
	Correct	**Incorrect**	**Correct**	**Incorrect**
***F*-ratio**	$F(1, 36) = 4.581$	$F(1, 36) = .323$	$F(1, 36) = .313$	$F(1, 36) = 2.901$
***p*-value**	$p = .039$*	$p = .573$	$p = .579$	$p = .097$

Participants reacted significantly slower at item AT in the correct sentences when listening to the English-accented speaker condition than Chinese-accented speaker condition (see Table 9). The remaining effects were not significant.

Table 10. Main Effects of Sentence, participants in Multilingual Society

Simple Main Effects of Sentence				
	BT		**T**	
	Adult	**Chinese**	**Adult**	**Chinese**
***F*-ratio**	$F(1, 36) = .032$	$F(1, 36) = .008$	$F(1, 36) = 26.659$	$F(1, 36) = 2.596$
***p*-value**	$p = .860$	$p = .928$	$p < .001$*	$p = .116$
	AT		**AT2**	
	Adult	**Chinese**	**Adult**	**Chinese**
***F*-ratio**	$F(1, 36) = .993$	$F(1, 36) = 6.597$	$F(1, 36) = 2.039$	$F(1, 36) = .697$
***p*-value**	$p = .326$	$p = .015$*	$p = .162$	$p = .409$

Participants reacted statistically significantly slower when listening to incorrect sentences than to correct sentences by native-accented speakers for T (see Table 10). Participants reacted statistically significantly slower when listening to incorrect sentences than to correct sentences by Chinese-accented speakers for AT. The remaining effects were not significant.

Table 11. Interactions Between Accent and Sentence, participants in Multilingual Society

Interactions				
	BT	**T**	**AT**	**AT2**
***F*-ratio**	$F(1, 36) = .004$	$F(1, 36) = 6.306$	$F(1, 36) = 1.1236$	$F(1, 36) = 2.560$
***p*-value**	$p = .118$	$p = .274$	$p = .017$*	$p = .951$

There was one significant interaction between accent and sentence at item AT (see Table 11). For the correct sentences, the Chinese-accented speaker condition led to a faster reaction time than the adult English-accented speaker condition. For the incorrect sentences, speaker condition had no effect. The remaining interactions were not significant.

The effect of age was analyzed by conducting a 2 age (adult-accented vs. child-accented) x 2 sentence (correct vs. incorrect) ANOVA.

Figure 4. Comparison of Monolingual Society RTs in Correct and Incorrect Sentences for Adult-Accented and Child-Accented Speaker Conditions

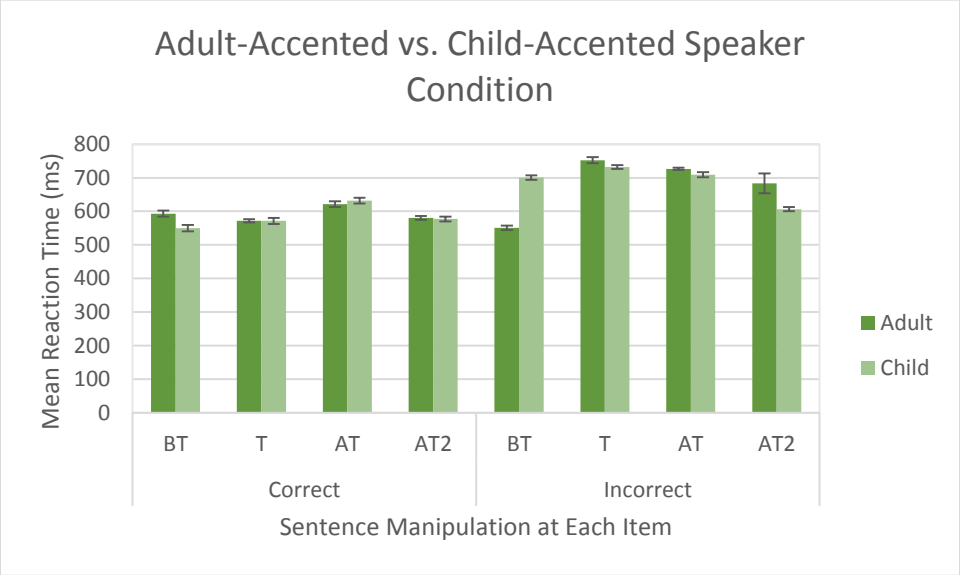


Table 12. Main Effects of Age, participants in Monolingual Society

Simple Main Effects of Age				
	BT		**T**	
	Correct	**Incorrect**	**Correct**	**Incorrect**
***F*-ratio**	$F(1, 76) = 7.603$	$F(1, 76) = 91.724$	$F(1, 76) = .000$	$F(1, 76) = 1.895$
***p*-value**	$p = .007$*	$p < .001$*	$p = .984$	$p = .173$
	AT		**AT2**	
	Correct	**Incorrect**	**Correct**	**Incorrect**
***F*-ratio**	$F(1, 76) = .514$	$F(1, 76) = 1.436$	$F(1, 76) = .011$	$F(1, 76) = 5.999$
***p*-value**	$p = .476$	$p = .234$	$p = .915$	$p = .017$*

Participants reacted significantly slower when listening to the adult -accented speaker condition than the child-accented speaker condition for correct sentences at BT (see Table 12). For incorrect sentences at item BT, participants reacted statistically significantly slower when listening to the child-accented speaker condition than the adult-accented speaker condition. For incorrect sentences at item

AT2, participants reacted statistically significantly slower when listening to the adult-accented speaker condition than the child-accented speaker condition. The remaining effects were not significant.

Table 13. Main Effects of Sentence, participants in Multilingual Society

Simple Main Effects of Sentence				
	BT		**T**	
	Adult	**Child**	**Adult**	**Child**
***F*-ratio**	$F(1, 76) = 7.272$	$F(1, 76) = 92.889$	$F(1, 76) = 148.978$	$F(1, 76) = 117.711$
***p*-value**	$p = .009$*	$p < .001$*	$p < .001$*	$p < .001$*
	AT		**AT2**	
	Adult	**Child**	**Adult**	**Child**
***F*-ratio**	$F(1, 76) = 51.417$	$F(1, 76) = 27.615$	$F(1, 76) = 10.688$	$F(1, 76) = .859$
***p*-value**	$p < .001$*	$p < .001$*	$p = .002$*	$p = .357$

In the adult-accented speaker condition, participants reacted significantly slower for the correct sentences than the incorrect sentences at items BT and T (see Table 13). Participants reacted slower for the incorrect sentences than correct sentences at items AT and AT2 in the adult-accented speaker condition. In the child-accented speaker condition, participants reacted significantly slower for the incorrect sentences than the correct sentences at items BT, T, and AT. The remaining effects were not significant.

Table 14. Interactions Between Age and Sentence, participants in Multilingual Society

Interactions				
	BT	**T**	**AT**	**AT2**
***F*-ratio**	$F(1, 36) = 76.071$	$F(1, 36) = .920$	$F(1, 36) = 1.835$	$F(1, 36) = 2.744$
***p*-value**	$p < .001$*	$p = .341$	$p = .180$	$p = .102$

There was one significant interaction between age and sentence at BT (see Table 14). For the correct sentences, the adult-accented speaker condition led to a slower reaction time than the child-accented speaker condition. For the incorrect sentences, the adult-accented speaker condition led to a faster reaction time than the child-accented speaker condition. The remaining interactions were not significant.

Figure 5. Comparison of Multilingual Society RTs in Correct and Incorrect Sentences for Adult-Accented and Child-Accented Speaker Conditions

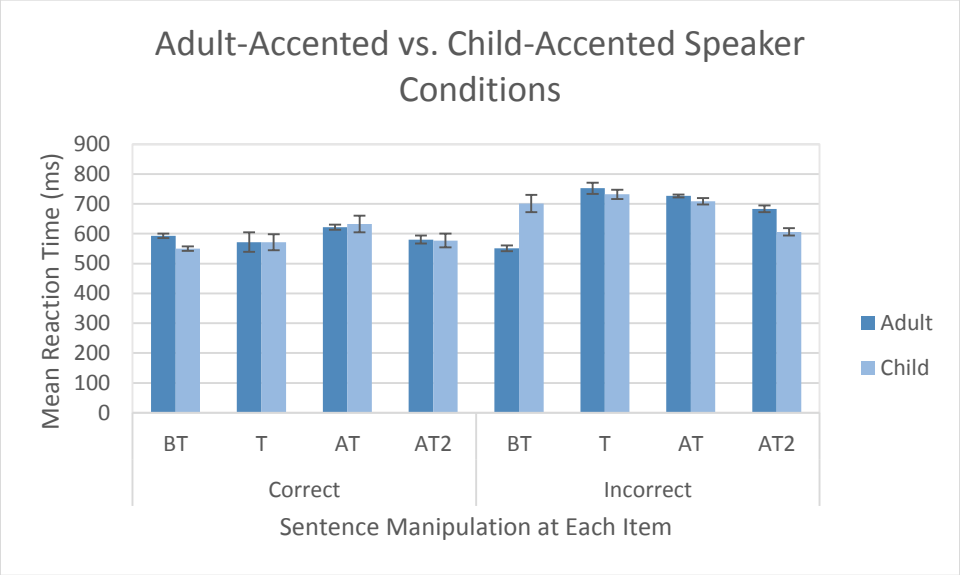


Table 15. Main Effects of Age, participants in Multilingual Society

Simple Main Effects of Age				
	BT		**T**	
	Correct	**Incorrect**	**Correct**	**Incorrect**
***F*-ratio**	$F(1, 36) = 3.998$	$F(1, 36) = .900$	$F(1, 36) = .396$	$F(1, 36) = .364$
***p*-value**	$p = .053$	$p = .349$	$p = .533$	$p = .550$
	AT		**AT2**	
	Correct	**Incorrect**	**Correct**	**Incorrect**
***F*-ratio**	$F(1, 36) = 4.128$	$F(1, 36) = .187$	$F(1, 36) = .042$	$F(1, 36) = 3.769$
***p*-value**	$p = .050$*	$p = .668$	$p = .839$	$p = .060$

Participants reacted slower for the child-accented speaker condition than adult-accented speaker condition for AT2 in the incorrect sentences (see Table 15). The remaining effects were not significant.

Table 16. Main Effects of Sentence, participants in Multilingual Society

Simple Main Effects of Sentence				
	BT		T	
	Adult	Child	Adult	Child
***F*-ratio**	$F(1, 36) = .033$	$F(1, 36) = 9.798$	$F(1, 36) = 18.489$	$F(1, 36) = 9.411$
***p*-value**	$p = .857$	$p = .003$*	$p < .001$*	$p = .004$*
	AT		AT2	
	Adult	Child	Adult	Child
***F*-ratio**	$F(1, 36) = .519$	$F(1, 36) = 5.380$	$F(1, 36) = 2.631$	$F(1, 36) = .274$
***p*-value**	$p = .476$	$p = .026$*	$p = .114$	$p = .604$

Participants reacted slower to adult accented speakers for incorrect sentences than correct sentences for item T (see Table 16). In the child-accented speaker condition, participants reacted statistically significantly slower for item BT in the correct sentences than the incorrect sentences. Participants reacted significant slower to child-accented speaker for the incorrect sentences than the correct sentences at items T and AT. The remaining effects were not significant.

Table 17. Interactions Between Age and Sentence, participants in Multilingual Society

Interactions				
	BT	T	AT	AT2
***F*-ratio**	$F(1, 36) = 4.346$	$F(1, 36) = .759$	$F(1, 36) = 1.279$	$F(1, 36) = 2.302$
***p*-value**	$p = .044$*	$p = .389$	$p = .266$	$p = .138$

There was one significant interaction between age and sentence at BT (see Table 17). For the correct sentences, the adult-accented speaker condition led to a faster RT than the child-accented speaker condition. For the incorrect sentences, the speaker condition had no effect. The remaining interactions were not significant.

Comparisons Across Participant Groups

The self-paced listening task reaction time data was analyzed by conducting two different ANOVAs to examine the effect of accent and age on RTs for correct and incorrect sentences. The effect

of accent on participants living in both monolingual and multilingual societies were analyzed by conducting a 2 listener type (monolingual society vs. multilingual society) x 2 accent (Chinese-accented vs. adult English-accented) x 2 sentence (correct vs. incorrect) ANOVA.

Figure 6. Comparison of RTs to Accented Speech in Correct and Incorrect Sentences for Monolingual and Multilingual Societies

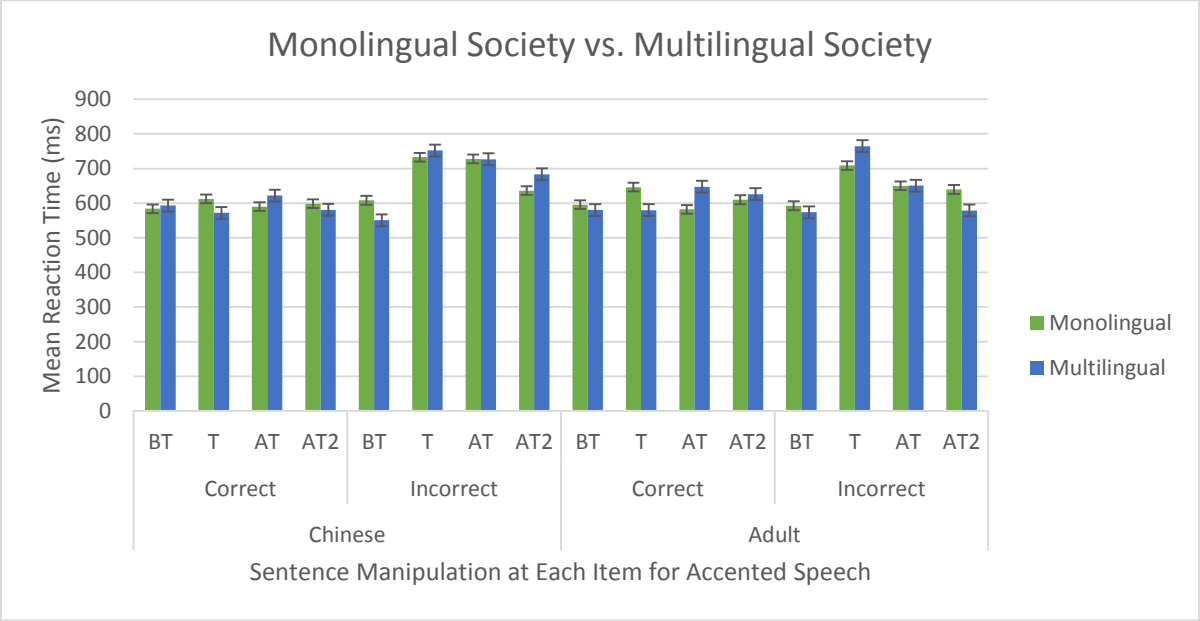


Table 18. Main Effects of Listener Type

Simple Main Effects of Listener Type				
	BT			
	Correct		**Incorrect**	
	Adult	**Chinese**	**Adult**	**Chinese**
***F*-ratio**	$F(1, 112) = .371$	$F(1, 112) = .282$	$F(1, 112) = 1.225$	$F(1, 112) = .521$
***p*-value**	$p = .544$	$p = .596$	$p = .293$	$p = .472$
	T			
	Correct		**Incorrect**	
	Adult	**Chinese**	**Adult**	**Chinese**
***F*-ratio**	$F(1, 112) = .018$	$F(1, 112) = 2.182$	$F(1, 112) = .527$	$F(1, 112) = 1.085$
***p*-value**	$p = .893$	$p = .142$	$p = .470$	$p = .300$
	AT			
	Correct		**Incorrect**	
	Adult	**Chinese**	**Adult**	**Chinese**
***F*-ratio**	$F(1, 112) = .673$	$F(1, 112) = .148$	$F(1, 112) = 8.934$	$F(1, 112) = 14.218$
***p*-value**	$p = .414$	$p = .701$	$p = .003$*	$p < .001$*
	AT2			
	Correct		**Incorrect**	
	Adult	**Chinese**	**Adult**	**Chinese**
***F*-ratio**	$F(1, 112) = 1.847$	$F(1, 112) = .105$	$F(1, 112) = 8.227$	$F(1, 112) = .009$
***p*-value**	$p = .177$	$p = .747$	$p = .005$*	$p = .925$

Participants in a multilingual society reacted slower than participants in a monolingual society at item AT in the incorrect sentences heard in the Chinese-accented and English-accented speaker conditions (see Table 18). Participants in a monolingual society reacted slower than participants in a multilingual society for incorrect sentences at AT2 in the English-accented speaker condition. The remaining main effects were not significant.

Table 19. Main Effects of Accent

Simple Main Effects of Accent				
	BT			
	Monolingual		**Multilingual**	
	Correct	**Incorrect**	**Correct**	**Incorrect**
***F*-ratio**	$F(1, 112) = .266$	$F(1, 112) = 10.373$	$F(1, 112) = .388$	$F(1, 112) = .545$
***p*-value**	$p = .607$	$p = .002$*	$p = .535$	$p = .462$
	T			
	Monolingual		**Multilingual**	
	Correct	**Incorrect**	**Correct**	**Incorrect**
***F*-ratio**	$F(1, 112) = 4.594$	$F(1, 112) = 1.059$	$F(1, 112) = 8.475$	$F(1, 112) = 5.101$
***p*-value**	$p = .034$*	$p = .306$	$p = .004$*	$p = .026$*
	AT			
	Monolingual		**Multilingual**	
	Correct	**Incorrect**	**Correct**	**Incorrect**
***F*-ratio**	$F(1, 112) = 3.509$	$F(1, 112) = .005$	$F(1, 112) = 5.609$	$F(1, 112) = .395$
***p*-value**	$p = .064$	$p = .946$	$p = .020$*	$p = .531$
	AT2			
	Monolingual		**Multilingual**	
	Correct	**Incorrect**	**Correct**	**Incorrect**
***F*-ratio**	$F(1, 112) = .358$	$F(1, 112) = 2.519$	$F(1, 112) = .225$	$F(1, 112) = 2.085$
***p*-value**	$p = .551$	$p = .115$	$p = .636$	$p = .152$

Participants living in a monolingual society reacted statistically significantly slower when listening to incorrect sentences by the Chinese-accented speakers than the English-accented speakers at BT (see Table 19). Monolingual and multilingual society participants reacted statistically slower when listening to the English-accented speakers for correct sentences at item T. Participants in a multilingual society reacted statistically significantly slower when listening to the English-accented speaker condition than the Chinese-accented speaker condition for item AT. Participants in a monolingual society reacted slower when listening to the Chinese-accented speaker for incorrect sentences at item BT. The remaining effects were not significant.

Table 20. Main Effects of Sentence

Simple Main Effects of Sentence				
	BT			
	Monolingual		**Multilingual**	
	Adult	**Chinese**	**Adult**	**Chinese**
***F*-ratio**	$F(1, 112) = 5.620$	$F(1, 112) = 1.897$	$F(1, 112) = .055$	$F(1, 112) = .014$
***p*-value**	$p = .019$*	$p = .175$	$p = .815$	$p = .905$
	T			
	Monolingual		**Multilingual**	
	Adult	**Chinese**	**Adult**	**Chinese**
***F*-ratio**	$F(1, 112) = 91.660$	$F(1, 112) = 40.975$	$F(1, 112) = 56.467$	$F(1, 112) = 5.498$
***p*-value**	$p < .001$*	$p < .001$*	$p < .001$*	$p = .021$*
	AT			
	Monolingual		**Multilingual**	
	Adult	**Chinese**	**Adult**	**Chinese**
***F*-ratio**	$F(1, 112) = 38.746$	$F(1, 112) = 66.686$	$F(1, 112) = 1.215$	$F(1, 112) = 8.078$
***p*-value**	$p < .001$*	$p < .001$*	$p = .273$	$p = .005$*
	AT2			
	Monolingual		**Multilingual**	
	Adult	**Chinese**	**Adult**	**Chinese**
***F*-ratio**	$F(1, 112) = 12.012$	$F(1, 112) = 1.640$	$F(1, 112) = 1.465$	$F(1, 112) = .501$
***p*-value**	$p = .001$*	$p = .203$	$p = .229$	$p = .481$

Participants in monolingual and multilingual societies reacted slower when listening to incorrect than correct sentences at item T in the English-accented and Chinese-accented speaker conditions (see Table 20). Participants in a monolingual society reacted slower when listening to incorrect than correct sentences at item AT in the Chinese-accented and English-accented speaker conditions. When heard in the Chinese-accented speaker condition, participants in a multilingual society reacted slower for AT in the incorrect than correct sentences. Participants in a monolingual society reacted slower when listening to incorrect than correct sentences in the English-accented speaker condition for items BT and AT2. The remaining effects were not significant.

Table 21. Interactions Between Listener Type, Accent, and Sentence

Interactions: Listener*Accent*Sentence				
	BT	**T**	**AT**	**AT2**
***F*-ratio**	$F(1, 112) = 2.129$	$F(1, 112) = 2.854$	$F(1, 112) = .045$	$F(1, 112) = 3.998$
***p*-value**	$p = .147$	$p = .094$	$p = .833$	$p = .058$
Interactions: Participant*Speaker				
	BT	**T**	**AT**	**AT2**
***F*-ratio**	$F(1, 112) = .101$	$F(1, 112) = .006$	$F(1, 112) = .987$	$F(1, 112) = .929$
***p*-value**	$p = .751$	$p = .938$	$p = .323$	$p = .337$
Interactions: Speaker*Sentence				
	BT	**T**	**AT**	**AT2**
***F*-ratio**	$F(1, 112) = 2.129$	$F(1, 112) = 2.854$	$F(1, 112) = .045$	$F(1, 112) = .046$
***p*-value**	$p = .147$	$p = .094$	$p = .833$	$p = .830$
Interactions: Participant*Sentence				
	BT	**T**	**AT**	**AT2**
***F*-ratio**	$F(1, 112) = .043$	$F(1, 112) = .688$	$F(1, 112) = 12.94$	$F(1, 112) = 4.964$
***p*-value**	$p = .837$	$p = .409$	$p = .051$	$p = .054$

There were no significant interactions between listener type, accent, and sentence (see Table 21). There were no significant 2-way interactions between listener type and accent, accent and sentence, and listener type and sentence.

The effect of age was analyzed by conducting a 2 listener type (monolingual vs. multilingual) x 2 age (adult-accented vs. child-accented) x 2 sentence (correct vs. incorrect) ANOVA.

Figure 7. Comparison of RTs to Age in Correct and Incorrect Sentences for Monolingual and Multilingual Societies

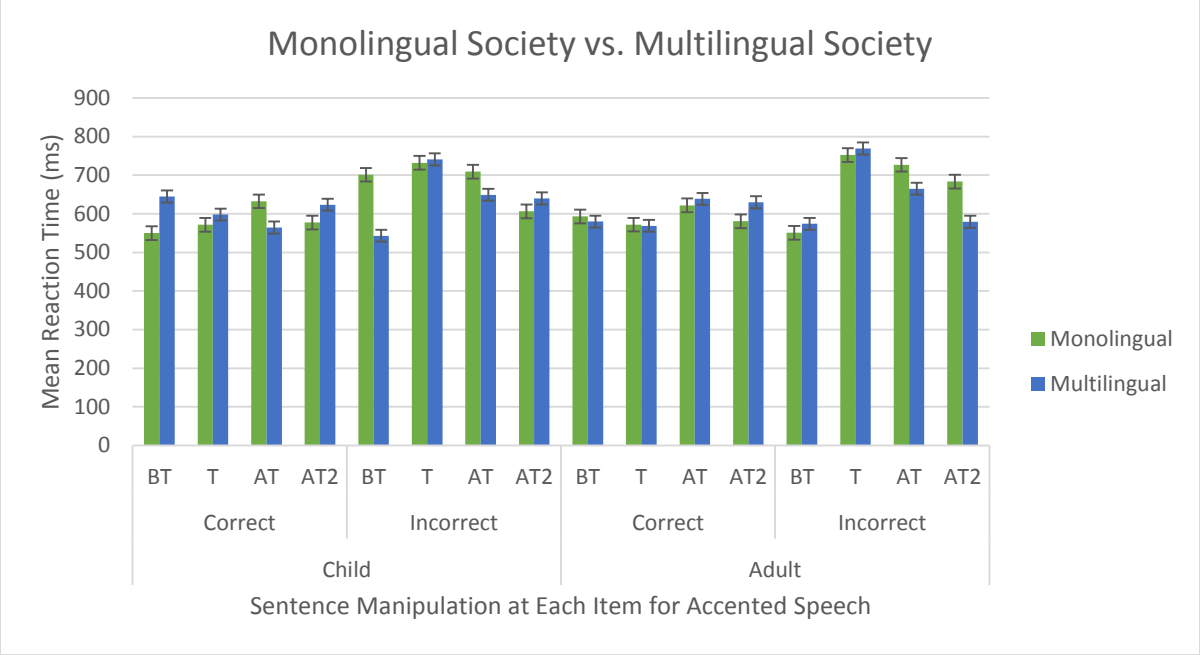


Table 22. Main Effects of Listener Type

Simple Main Effects of Listener Type				
	BT			
	Correct		**Incorrect**	
	Adult	**Child**	**Adult**	**Child**
***F*-ratio**	$F(1, 112) = .351$	$F(1, 112) = 17.837$	$F(1, 112) = 1.055$	$F(1, 112) = 49.423$
***p*-value**	$p = .555$	$p < .001$*	$p = .307$	$p < .001$*
	T			
	Correct		**Incorrect**	
	Adult	**Child**	**Adult**	**Child**
***F*-ratio**	$F(1, 112) = .013$	$F(1, 112) = .942$	$F(1, 112) = .376$	$F(1, 112) = .109$
***p*-value**	$p = .910$	$p = .334$	$p = .541$	$p = .742$
	AT			
	Correct		**Incorrect**	
	Adult	**Child**	**Adult**	**Child**
***F*-ratio**	$F(1, 112) = .532$	$F(1, 112) = 8.504$	$F(1, 112) = 7.065$	$F(1, 112) = 6.670$
***p*-value**	$p = .467$	$p = .004$*	$p = .009$*	$p = .011$*
	AT2			
	Correct		**Incorrect**	
	Adult	**Child**	**Adult**	**Child**
***F*-ratio**	$F(1, 112) = 1.962$	$F(1, 112) = 1.727$	$F(1, 112) = 8.738$	$F(1, 112) = .908$
***p*-value**	$p = .164$	$p = .191$	$p = .004$*	$p = .343$

Participants in the multilingual society reacted slower than participants in a monolingual society when listening to item BT in the correct sentences. At BT in the incorrect sentences, participants in a monolingual society reacted slower than participants in a multilingual society (see Table 22). Participants in the multilingual society reacted slower than those in a monolingual society when listening to item AT in the correct sentences for the child-accented speaker condition. For the adult-accented condition, participants in a multilingual society reacted slower than participants in a monolingual society at item AT in the incorrect sentences. In the child-accented speaker condition, participants in a monolingual society reacted slower than participants in a multilingual society at item AT in the incorrect sentences. Participants in a monolingual society reacted slower than participants in a multilingual society at item AT2 in the incorrect sentences for the adult-accented speaker condition. The remaining main effects were not significant.

Table 23. Main Effects of Age

Simple Main Effects of Age				
	BT			
	Monolingual		**Multilingual**	
	Correct	**Incorrect**	**Correct**	**Incorrect**
***F*-ratio**	$F(1, 112) = 5.556$	$F(1, 112) = 67.031$	$F(1, 112) = 6.270$	$F(1, 112) = 1.412$
***p*-value**	$p = .020$	$p < .001$*	$p = .014$	$p = .237$
	T			
	Monolingual		**Multilingual**	
	Correct	**Incorrect**	**Correct**	**Incorrect**
***F*-ratio**	$F(1, 112) < .001$	$F(1, 112) = .833$	$F(1, 112) = .864$	$F(1, 112) = .794$
***p*-value**	$p = .989$	$p = .363$	$p = .355$	$p = .375$
	AT			
	Monolingual		**Multilingual**	
	Correct	**Incorrect**	**Correct**	**Incorrect**
***F*-ratio**	$F(1, 112) = .306$	$F(1, 112) = .856$	$F(1, 112) = 7.650$	$F(1, 112) = .347$
***p*-value**	$p = .581$	$p = .357$	$p = .007$*	$p = .557$
	AT2			
	Monolingual		**Multilingual**	
	Correct	**Incorrect**	**Correct**	**Incorrect**
***F*-ratio**	$F(1, 112) = .014$	$F(1, 112) = 7.160$	$F(1, 112) = .025$	$F(1, 112) = 2.229$
***p*-value**	$p = .908$	$p = .009$	$p = .875$	$p = .138$

Participants living in a monolingual society reacted slower when listening to the child-accented incorrect sentences than the adult-accented incorrect sentences for BT (see Table 23). Participants in a multilingual society reacted significantly slower in the child-accented speaker condition than the adult-accented speaker condition for correct sentences at item AT. No other significant main effects were found.

Table 24. Main Effects of Sentence

Simple Main Effects of Sentence				
	BT			
	Monolingual		**Multilingual**	
	Adult	**Child**	**Adult**	**Child**
***F*-ratio**	$F(1, 112) = 5.314$	$F(1, 112) = 67.883$	$F(1, 112) = .052$	$F(1, 112) = 15.366$
***p*-value**	$p = .023$*	$p < .001$*	$p = .820$	$p < .001$*
	T			
	Monolingual		**Multilingual**	
	Adult	**Child**	**Adult**	**Child**
***F*-ratio**	$F(1, 112) = 65.511$	$F(1, 112) = 51.762$	$F(1, 112) = 40.358$	$F(1, 112) = 20.542$
***p*-value**	$p < .001$*	$p < .001$*	$p < .001$*	$p < .001$*
	AT			
	Monolingual		**Multilingual**	
	Adult	**Child**	**Adult**	**Child**
***F*-ratio**	$F(1, 112) = 30.640$	$F(1, 112) = 16.456$	$F(1, 112) = .961$	$F(1, 112) = 9.969$
***p*-value**	$p < .001$*	$p < .001$*	$p = .329$	$p = .002$*
	AT2			
	Monolingual		**Multilingual**	
	Adult	**Child**	**Adult**	**Child**
***F*-ratio**	$F(1, 112) = 12.757$	$F(1, 112) = 1.025$	$F(1, 112) = 1.556$	$F(1, 112) = .162$
***p*-value**	$p = .001$*	$p = .314$	$p = .215$	$p = .688$

Participants in monolingual and multilingual societies reacted slower when listening to incorrect than correct sentences at item T in adult-accented and child-accented speaker conditions (see Table 24). At item BT, participants in a monolingual society reacted slower when listening to incorrect than correct sentences spoken in the child-accented condition. Participants in a monolingual society reacted faster when listening to incorrect sentences than correct sentences spoken in the adult-accented condition. At item BT for participants living in a multilingual society, participants reacted faster when listening to

incorrect sentences than correct sentences spoken by the child-accented speaker condition. Participants in monolingual and multilingual societies reacted slower for the incorrect than correct sentences at item AT in the child-accented speaker condition. Participants in a monolingual society reacted slower for incorrect than correct sentences at item AT in the adult-accented speaker condition. Participants living in a monolingual community reacted slower for the incorrect than correct sentences at item AT2 in the adult-accented speaker condition. No other significant main effects were found.

Table 25. Interactions Between Listener, Age, and Sentence

Interactions: Listener*Age*Sentence				
	BT	**T**	**AT**	**AT2**
***F*-ratio**	$F(1, 112) = 41.428$	$F(1, 112) = .468$	$F(1, 112) = 3.462$	$F(1, 112) = 3.990$
***p*-value**	$p = .425$	$p = .495$	$p = .065$	$p = .058$
Interactions: Listener*Age				
	BT	**T**	**AT**	**AT2**
***F*-ratio**	$F(1, 112) = 2.626$	$F(1, 112) = .160$	$F(1, 112) = 3.187$	$F(1, 112) = 3.652$
***p*-value**	$p = .108$	$p = .690$	$p = .077$	$p = .059$
Interactions: Speaker*Sentence				
	BT	**T**	**AT**	**AT2**
***F*-ratio**	$F(1, 112) = 4.722$	$F(1, 112) = 2.011$	$F(1, 112) = .427$	$F(1, 112) = .008$
***p*-value**	$p = .052$	$p = .159$	$p = .515$	$p = .927$
Interactions: Listener*Sentence				
	BT	**T**	**AT**	**AT2**
***F*-ratio**	$F(1, 112) = 23.204$	$F(1, 112) = .002$	$F(1, 112) = 2.332$	$F(1, 112) = 5.565$
***p*-value**	$p = .071$	$p = .966$	$p = .130$	$p = .060$

There were no significant interactions between listener type, age, and sentence. There were no significant 2-way interactions between listener type and age, age and sentence, and listener type and sentence.

Chapter 4

Discussion

Counter to the hypothesis, exposure to accented speech and experience learning a second language did not make participants living a multilingual community differentially sensitive to Chinese-accented speech errors relative to participants living in a monolingual community. The difference between listening to Chinese-accented speech and English-accented speech was not smaller for native English listeners living in a multilingual society relative to those living in a monolingual society. Despite their differences in exposure to accented speech, both participant groups reacted similarly when listening to Chinese-accented and English-accented speech in correct and incorrect sentences.

The effect of age on participants living in multilingual and monolingual societies was also largely unexpected. While the hypothesis posited that participants in both monolingual and multilingual societies will be differentially sensitive to adult-accented speech errors relative to child-accented speech errors, the results suggest that neither participant group was sensitive to the difference in age when processing speech errors. However, the findings for the effect of age on participants did align with one hypothesis: Participants living in a multilingual community were not differentially sensitive to adult-accented or child-accented speech errors relative to participants in a monolingual society. Both participant groups exhibited similar reaction times when listening to child-accented and adult-accented speech.

The results of this experiment failed to align with past research regarding the effect of accent on sentence interpretation. The findings of Hanulikova, Van Alphen, Van Goch, and Weber (2012) suggest that individuals with exposure to foreign accented speech are differentially sensitive to native-accented speech errors relative to foreign-accented speech errors. Gender agreement errors led to a change in the electrophysiological response to the subsequent noun when the participants heard the mistakes made by a

native speaker, but not when the same mistakes were made by an accented speaker. Listeners' previous experiences with the correlation between accented speech and error likelihood appeared to have modified the participants' expectations about the grammatically well-formedness of foreign-accented speech. That difference in sensitivity was found to emerge at the earliest stages of meaning construction, as the one-step model of language interpretation suggests. In the present study, no difference in sensitivity between native and nonnative speech errors existed for either participant group. Listeners in both monolingual and multilingual contexts failed to modify their expectations of accented speech regardless if they had personal experiences with the correlation between accented speech and speech errors. Unlike in Hanulikova, Van Alphen, Van Goch, and Weber (2012), no support for the one-step model of language interpretation was found in this study, since a pragmatic knowledge of the speaker failed to influence their processing of the speech message.

Instead, the results seem to uphold the two-step model of language interpretation. Participants in both multilingual and monolingual societies may not have processed speaker identity, because they were focused on interpreting the meaning of each individual word. The two-step model of language interpretation asserts that language is processed for semantic meaning first before a pragmatic understanding can be taken into account; meaning construction occurs for the individual words, and syntactic rules are applied to give the words meaning within the context of a sentence. In a word-by-word presentation style, participants may be so focused on the meaning of the words in the unfolding sentence that they do not process speaker identity alongside the semantics. The two-step model of language interpretation could explain the lack of impact pragmatics had on the results of the present study.

If the results of this study are not due to the participants' adherence to the two-step model of language interpretation, then these largely unexpected findings may be due to the methodology. The self-paced listening task may not have been sensitive enough to pick up the differences across participant groups in regards to accent and age. An ERP task may be a more sensitive methodology, since the task

provides a millisecond-by-millisecond record of the brain's electrical activity during mental processing as it unfolds over time.

A similar experiment should then be done with a different methodology. Rather than using a self-paced listening task, experimenters could utilize an ERP methodology. Not only can the P600 and N400 effects seen in ERP experiments shed more light onto the specific role pragmatics plays in modulating responses to speech errors, but such an experiment more closely aligns with the methodology utilized by Hanulikova, Van Alphen, Van Goch, and Weber (2012), which is the study that served as the basis of this experiment. Since Hanulikova, Van Alphen, Van Goch, and Weber (2012) studied a form of accented speech that is very common in the Netherlands, a future experiment may utilize a nonnative speaker condition with an accent that is uncommon to the country to see if listeners in a multilingual community are more tolerant of accented speech regardless of how familiar they are with the accent itself. Another future direction may add a fourth speaker group: child Chinese-accented English speakers. Such a study would compare how responses to accent vary depending on the age of the speaker group. This experiment could also be expanded into a vastly different area of research: gender studies. A future experiment may not look at how tolerance for gender pronoun errors varies between language groups, but between sexual orientation groups. Such a study would compare how gender pronoun errors are processed by homosexual and transgendered individuals compared to heterosexual individuals. Perhaps individuals who identify as homosexual or transgender are more tolerant of mixing masculine pronouns with feminine subject names and vice versa, since members of such non-traditional sexual orientation groups tend to be more accepting of the idea of a fluid gender. While the results of this experiment required too much conjecture to be conclusive, the idea of the study itself can have exciting implications for a world that is rapidly globalizing and growing increasing progressive in its treatment of sexual minority group.

BIBLIOGRAPHY

Blom, E., Polišenská, D., & Weerman, F. (2006). Effects of age on the acquisition of agreement inflection. Morphology, 16, 313–336.

Brennan, S. E., & Clark, H. H. (1996). Conceptual pacts and lexical choice in conversation. Journal of Experimental Psychology: Learning, Memory, and Cognition, 22(6), 1482.

Hagoort, P. (2003). How the brain solves the binding problem for language: a neurocomputational model of syntactic processing. Neuroimage, 20, S18-S29.

Hagoort, P. (2005). On Broca, brain, and binding: a new framework. Trends in cognitive sciences, 9(9), 416-423.

Hagoort, P., Hald, L., Bastiaansen, M., & Peterson, K. M. (2004). Integration of word meaning and world knowledge in language comprehension. Science, 304(5669), 438-441.

Hagoort, P., & van Berkum, J. (2007). Beyond the sentence given. Philosophical Transactions of the Royal Society of London B: Biological Sciences, 362(1481), 801-811.

Hanulíková, A., Van Alphen, P. M., Van Goch, M. M., & Weber, A. (2012). When one person's mistake is another's standard usage: The effect of foreign accent on syntactic processing. Journal of Cognitive Neuroscience, 24(4), 878-887.

Kaplan, E., Goodglass, H., & Weintraub, S. (1983). Boston naming task. Malvern, PA: Lea & Febiger.

Metzing, C., & Brennan, S. E. (2003). When conceptual pacts are broken: Partner-specific effects on the comprehension of referring expressions. Journal of Memory and Language, 49(2), 201-213.

Nieuwland, M. S., & Van Berkum, J. J. (2006). When peanuts fall in love: N400 evidence for the power of discourse. Journal of cognitive neuroscience, 18(7), 1098-1111.

Orgassa, A. (2009). Specific language impairment in a bilingual context: The acquisition of Dutch inflection by Turkish-Dutch learners. Utrecht: LOT.

Purmohammad, M. (2015). Linguistic alignment in L1–L2 dialogue. Language and Dialogue, 5(2), 312-333.

Statistics Netherlands. (2010). http://statline.cbs.nl/StatWeb/publication/?DM=SLEN&PA=37325eng&D1=0&D2=0&D2=0&D3=0&D4=0&D5=0-1,84,102,139,145,210,225&D6=a&LA=EN&HDR=G2,G3,G4,T&STB=G1,G5&VW=T.

Weerman, F., Bisschop, J., & Punt, L. (2006). L1 and L2 acquisition of Dutch adjectival inflection. ACLC Working Papers, 1, 5–36.

Van Berkum, J. J., Van den Brink, D., Tesink, C. M., Kos, M., & Hagoort, P. (2008). The neural integration of speaker and message. Journal of cognitive neuroscience, 20(4), 580-591.

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EDUCATION

The Pennsylvania State University (University Park, PA)

Schreyer Honors College, The College of Liberal Arts — Class of May 2016
Bachelor of Arts: *English, Psychology, and Letters, Arts, and Sciences (LAS)* — Honors: *Psychology and LAS*
Minors: *Linguistics and Global Studies* — Dean's List: *Past Five Semesters*
Certificate: *Honors Globalization*

WORK EXPERIENCE

The Pennsylvania State University (University Park, PA)

Student Researcher in the Center for Language Science — August 2013—Present

- Created stimuli, ran participants, and analyzed data for a semantic/pragmatic study
- Conducted EEG studies

The Pennsylvania State University (University Park, PA)

Innovation Consultant in the Krause Innovation Studio — August 2014—Present

- Wrote blog posts focused on advancing understanding of learning sciences
- Aided students and professors with any technological issues

The Public Defender's Service (Washington, DC)

Investigative Intern — May 2015—August 2015

- Worked directly with staff attorneys to complete investigative tasks

LEADERSHIP/ACTIVITIES

The Liberal Arts Undergraduate Council (University Park, PA)

- Act as a representative student body in the College of Liberal Arts to the University

Student Faculty Senator — May 2015—May 2016

- Acted as the student voice in legislative educational decisions in the Faculty Senate

Programming Chair — September 2014—May 2015

- Organized functions that promote opportunities and resources available within the College, as well as social events, volunteer work, and educational trips

The Pennsylvania Literacy Corp (State College, PA)

ESL Tutor — January 2015—May 2016

- Aided reading, writing, and speaking skills of an adult learner and a third grader

Penn State IFC/Panhellenic Dance MaratTHON (University Park, PA)

- Provide emotional and financial support to the Four Diamonds Fund

HOSpitality Cadet — October 2015—February 2016

- Worked closely with the captains to procure and serve all food at THON events

OPPerations Committee Member — October 2014—February 2015

- Built and dismantled the infrastructure within the Bryce Jordan Center

Morale Committee Member — October 2012—February 2013

- Ensured the safety and well-being of the Dancers

South Halls Residence Association (University Park, PA)

- Act as a representative body of students living in South Halls to the University

Treasurer — August 2013—May 2014

- Ensured timely payments to all parties for all events hosted by the organization

Association of Residence Halls Student Representative — August 2012—May 2013

- Voiced South Hall's issues to the weekly meeting of all area governments

HONORS AND AWARDS

National Residence Hall Honorary Lifetime Member — January 2014—May 2016

- Honorary that recognizes the top 1% of leaders in the residence halls

Schreyer Honors College Academic Excellence Scholarship — August 2012—May 2016

Partnerships for International Research and Education (PIRE) Grant — October 2013—July 2014

- Fully-funded trip to the Netherlands to conduct a research experiment on bilingualism