ABSTRACT

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ACROSS ACCENT

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The purpose of this study was to explore the phonetic flexibility of toddlers' early lexical representations. In this study (based on Schmale, et al., 2011), toddlers' ability to generalize newly learned words across speaker accent was measured using a split-screen preferential looking paradigm. Twenty-four toddlers (mean age = 29 months) were taught two new words by a Spanish-accented speaker and later tested by a native English speaker. One word had a phonological (vocalic) change across speaker accent (e.g., [*fim*]/[*feem*]), while the other word did not (e.g., [*mef*]/[*mef*]). Toddlers looked to the correct object significantly longer than chance only when the target label did not phonemically differ across accent. However, toddlers did not look longer to the non-phonemic target variant than the phonemic variant. High variability between subjects was noted and the potential need for additional exposure prior to testing infants on such a contrast is discussed.

INFANTS' ABILITY TO LEARN NEW WORDS ACROSS ACCENT

By

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INTRODUCTION

An important skill in learning language is dealing with variability. Differences in speech within and across talkers occur as a result of a variety of factors, including gender, shape of the vocal tract, conversational timing, and emotion, among many possible factors. In fact, two different talkers may produce the same sound in different ways, such that phoneme categories may overlap across speakers. Similarly, the same word can be produced by the same person in acoustically different ways depending on, for example, the sentence in which it is used (effects of surrounding phonemes), the emotional state of the person (anger, sadness, joy, etc.), or the rate of speech. In order to know what a speaker intended, listeners must learn to adjust for this variability. Children learn their first language based on linguistic input, and must therefore learn to adapt to speaker differences. As noted, variability across talkers comes from a variety of sources, but a primary form of variability is that of accent. Accents are variations in the pronunciation of language in aspects such as vowel and consonant production, stress patterns, and/or prosody, which generally result from the influence of one's native dialect or language (Flege, 1981; Shriberg & Kent, 2003; Whitley, 2002). In order to comprehend speech in every day contexts, listeners must be able to recognize and resolve these differences across accents.

Talker difference and accent variation are important topics relevant for parents faced with the decision of having other caregivers provide care to their children. This includes daycare facilities, pre-schools, and private individuals. A question often posed by parents is whether deviations in the pronunciation of their native language (i.e. dialects or foreign accents) by other caregivers will impact their child's language

development. In fact, parents may be more open to having their child learn a new language in a child-care setting, while feeling rather apprehensive about immersing the child in an environment with a predominantly non-standard, or nonnative, production of the parent's native language. Research on the impact of speech variability on early language skills could inform parents, who are confronted with questions surrounding the best care for their child's development.

A number of studies have addressed how it is that children detect, interpret, and generalize across talker variations. The ability to deal with this variability requires that infants know what aspects of the speech signal are more critical to meaning and which aspects can be ignored. This means that children must develop skills beyond acoustic signal detection and recognition that will allow them to understand a word regardless of its initial presentation or speaker. To facilitate the rapid recognition and comprehension of unfamiliar words or unfamiliar variants of words (a different pronunciation, for example), adults must be able to process ambiguous acoustic properties (phoneme characteristics), and interpret the message using their language experience (context) and knowledge of language (vocabulary and grammar). New language learners, at 7.5 months, appear to be overly sensitive to irrelevant acoustic characteristics, such as tone of voice or speaker gender (Houston & Jusczyk, 2000; Singh, Morgan, & White, 2004), causing them to interpret the speech signal differently than older toddlers and adults. In fact, overreliance on acoustic properties can become an obstacle for generalization across different speakers. For example, 9-month-olds can recognize words across two distinct voices but not across two accents, while 13-month-olds can recognize familiarized words

across either distinct voices or accents but not both (Schmale & Siedl, 2009; Schmale,

Cristia, Seidl, & Johnson, 2010). In their second year, infants continue to have trouble

with accommodating variations of the acoustic signal in learning new words.

Acoustic variability appears to impede older infants' (24-month-olds) abilities to

learn and generalize new words across speakers of different genders, but in a similar

task at 30 months, toddlers ignore this difference and successfully generalize across

the two speakers (Hollich, 2006; Morini & Newman, 2010). Thus, as infants develop

they become better able to recognize and learn words despite differences in their

acoustic properties across speakers (Houston & Jusczyk, 2000; Hollich, 2006) and

accent (Schmale, et al., 2010; Schmale, et al., 2011). The current study aimed to

investigate infants' word learning under accent variability to provide additional

information on the specificity of young word-learners' newly stored words and

whether infants are able to generalize their word learning across accents. This study

examined whether children were able to ignore differences in accent and generalize

learned novel words despite speaker accent.

Adults and the Effect of Speaker Variability

To understand how infants and toddlers become competent users of language

despite accent variation, it is necessary to see where they must arrive as mature

listeners. It appears that adult listeners require some adjustment, or normalization, to

resolve speaker differences, such as the qualities of a talker's voice, speech rate, or an

accent. For example, Mullenix, Pisoni, and Martin (1989) found that adults'

identification performance in noise differed according to the number of talkers used.

Trials were spoken by either a single talker or by fifteen different talkers. Results

showed that adults performed better in the single talker trials, and this suggests that adults experience some costs when dealing with multiple talkers. That is, adults appear to require some on-line adjustments when tuning to different speakers. Similarly, Sommers, Nygaard, and Pisoni (1994) found that adults demonstrate a similar decline in an identification task when the rate of speech varies, even when the same talker is used throughout the word list presentation. Error rates were higher and response times were longer in high-variability contexts (varying speech rate) than in low-variability contexts (constant speaking rate). Adult speakers demonstrate a period of adjustment, or additional effort, to identify words when the suprasegmental cues (speaking rate) fluctuate. It is logical to assume that adults will likewise require additional processing for tasks involving a switch between a native dialect and a foreign accent that have both subphonemic and suprasegmental differences.

In some cases, adults' performance on dialect perception and sound changes appears to be affected by the listener's own dialect. Accents of the same language may differ in the extent to which sounds are distinguished. One example of such a change in English is the [*pin*]-[*pen*] merger of Southern American English, in which the vowels [ɪ] and [ɛ] are produced as [ɪ] before nasal consonants. In this dialect, the words *pin* and *pen* are pronounced the same. This phonetic shift has spread to different regions of the United States, while not merged in dialects spoken in other regions (for example, in most northern dialects). Thus, some dialects of the language will maintain the distinction between these two sounds, when other dialects no longer do so. Studies investigating perception of such phonetic mergers have found that adult speakers of a dialect that merges vowels were unable to discriminate between

those two vowels in speakers using a different (unmerged) dialect (Janson & Schulman, 1983). Speakers who treated the two vowels as separate in their own dialect were not consistently able to discriminate between merged vowels (Janson & Schulman, 1983). These differences imply that changes in accents can alter the extent to which different words can be distinguished. A northern speaker listening to a southern speaker might be prone to specific types of misunderstandings as a result of these differences given sufficiently ambiguous context. Yet speakers from different dialectal regions interact frequently, and thus the ability to adjust one's perception to account for such pronunciation differences is important for ease of communication.

Not all accent differences involve mergers. There are a number of other changes in sounds across accents, aside from phonetic mergers, that could likewise cause confusion. For example, in British English, northern-accented speakers do not use the vowel [ʌ], as in "c**u**d", as southern British speakers do, but instead use [ʊ], as in "b**oo**k". Therefore, a southern speaker would have to adjust to a northern speaker's pronunciation of "luck" versus "look" for example. On the other hand, although both accents contain the vowels [a] and [ɑː], southern British speakers may produce the vowel [ɑ:] within the same words that northern speakers will produce an [a] (Evans & Iverson, 2004). Thus, speakers of each dialect must tune their perception to the other speakers' vocalic shift in order to accurately identify, and comprehend, the correct lexical item, or word. In order for speakers of each group to avoid confusion, they must adjust their own perception of these vowels, taking the accent of the nonnative speaker into account.

Evans and Iverson (2004) investigated the extent to which southern and northern British speakers living in a multidialectal environment and northern British speakers exposed predominantly to their native accent adjusted their vowel perception to different accents. Participants were tested in both native and nonnative vowel perception in two separate sessions. Each session consisted of a short (two minute) passage in the selected accent, followed by computer-adaptive test trials that manipulated target vowel-synthesized, CVC words (or words consisting of a consonant-vowel-consonant frame, e.g., "bud").   During each test trial, participants rated the target word presented in a carrier phrase as either a close or distant exemplar of the word displayed on the screen. Over 30 trials, participants' judgment of the "closeness" of target vowel pronunciation was narrowed along four dimensions, first formant frequency (F1), second formant frequency (F2), third formant frequency (F3) and vowel duration. That is, as participants made decisions about the pronunciation of a specific target word in each trial, their judgment of the appropriate vowel was being refined in terms of vowel space and duration. Using this method, Evans and Iverson (2004) expected to determine whether adults adjust for nonnative vocalic variants, the degree to which they adjust, and whether previous experience dealing with accents has an effect on performance.

Evans and Iverson (2004) found that adult listeners from multidialectal environments adjusted their perception of vowels according to the perceived accent of the carrier phrase, as opposed to rating the words closer to their own regional dialects. For example, regardless of the production difference in the vowel [ʊ] within accents, both southern and northern British speakers rated the vowels presented in their

respective dialects as those appropriate to that dialect. However, when each group was presented a carrier phrase in respective nonnative dialects, both groups chose a centralized version of the vowel, demonstrating a shift in what they perceived as appropriate. The researchers also found that the pattern in which adults shifted vowels (increasing or decreasing frequency along F1 and F2 formants) depended on each group's respective dialect and experience with dialects. Northern British adults predominantly exposed to their native accent judged vowels in both northern and southern-accented sentences as those appropriate for northern speakers (accent). That is, adults having less experience with the southern accent did not normalize vowels. In contrast, listeners having more experience (as the result of living in a multidialectal environment) normalized vowels. Therefore, adults who have more experience with linguistic variation across dialects are able to perceive and identify phonetic differences well enough to predict the non-native variation of a word.

Adults appear to be able to detect phonetic distinctions across accents and dialects; however, mature listeners must go beyond the pattern recognition of sounds in order to link the information to an identifiable real word. Maye, Aslin, and Tanenhaus (2008) found that adults exposed to accented speech in stories were able to adjust their recognition of real words to accommodate that accent. They presented adults with a familiar passage from *The Wizard of Oz.* In two separate sessions, adults heard this passage first in normal (native) speech, then in synthetically-accented speech. The accent was created by lowering front vowels in the F1-F2 vowel space. Following each condition adults participated in a lexical decision task which contained both native and accented words. Adults who initially judged

nonnative items as non-words (such as "wetch") under the normal speech condition
identified the same items as real words after exposure to the accented speech. This
suggests that adults are able to adjust their phonetic representations to account for a
speaker difference across lexical items, even after a relatively short exposure period.
It also implies that there can be multiple mappings between stored phonetic
representations and lexical items.

The use of synthetically created accents, or acoustically altered speech as
accents within the Maye, et al. (2008) study brings up two points of interest. First,
participants' responses were not biased by prior experience with the artificial accent.
By eliminating previous experience with an accent as a variable, the study directly
examined how mature listeners deal with new variation. Secondly, since the accent
used the "normal" speaker's back vowels and imposed synthetically lowered front
vowels, the study looked at perceptual shifts in the adults' phonetic system
(individual sound contrasts, allophones, voicing/devoicing, etc.) rather than the
phonological system (phonemic distinctions, non-allophonic sound contrasts, etc.) in
word recognition. The results supported similar findings from previous work. Adults
require very little information to detect variations from their native language (Flege,
1984); and previous experience with a particular subphonemic deviation, such as
feature changes or allophones, may not be required for recognition of (accented)
words (Maye, et al., 2008; Flege, 1984), although exposure to a dialectal variation
certainly has been shown to improve processing (e.g., Janson & Schulman, 1983).

Adults have demonstrated an initial delay when processing words presented
with an accent (Clarke & Garret, 2004; Munro & Derwing, 1995). However, after a

relatively short period of adaptation (as short as one minute), adults' reaction times improve with familiarized accented words, as well as unfamiliarized accented words, and to different talkers with similar accents (Clarke & Garret, 2004; Munro & Derwing, 1995). Sidaras, Alexander, and Nygaard (2009) looked at whether previous training with an accent aided adults' performance in a sentence transcription task. Participants were grouped in different training conditions: those that received training spoken by multiple Spanish-accented English speakers, those that were trained by one Spanish-accented speaker, those trained by a native speaker, and those who did not receive any training at all before testing. Training consisted of rating accentedness of sentences or words and transcribing sentences or words in isolation prior to receiving auditory and visual feedback of intended target utterances. Testing involved transcribing novel sentences or words (without feedback) spoken by multiple Spanish-accented speakers and native speakers. Results showed that transcription performance improved across test blocks for the group trained by the single Spanish-accented speaker and the group exposed to multiple Spanish-accented speakers. However, those trained in the multiple Spanish-accented training condition did perform better. This study showed that adults were able to adapt to speaker accent and generalize the perceived shift to novel words and sentences, and to novel voices. A subsequent analysis of phonemic error rates during testing showed that regardless of training group, adult listeners tended to confuse the high front vowels [I] and [i], and the low vowels [æ], [^], and [a] more often. Interestingly, when training was accounted for, identification of the vowels [i], [æ], and [a] were significantly more accurate by those trained with a Spanish-accent versus those who were not trained.

This suggests that adult listeners adapt relatively quickly to variations in accented speech, such as prosodic differences and acoustic-phonetic variants.

The above research has shown how adults treat words with multiple pronunciations in spoken word recognition tasks, but it has not looked into the mechanism by which adults adapt to these variants. Adults may store words with multiple sound variations, including those variants that do not pertain to one's dialect or experience. If adults have this representational quality in their word mappings, then word recognition reaction times may not be affected by whether a word is pronounced with an accent or not. On the other hand, it may be that adults have learned to improve their phonetic (sound) mapping so that they are able to link a new sound onto an existing one as a variant of that sound. In order to examine this in adults, studies have employed tasks that make use of the effect of priming. In the priming effect, words are recognized faster when they are preceded by a related word than an unrelated word. The use of priming within a lexical decision task testing recognition of accented words can measure not only the response time to recognize targeted words, but also accuracy of recognition based on the prime (either accented or native variations). Thus, priming tasks also make assumptions about the organization and storage of existing items in memory. That is, a lexical decision task using accented and native primes could lead to suggestions about the manner in which adults have organized stored phonetic representations of words.

If adults have stored phonetic variations and word meanings together, then it would follow that an accented word could activate retrieval of a related word, and do so as quickly as the native pronunciation of that same word. Sumner and Samuel

(2009) used both perceptual and conceptual priming to look at how effective dialectal variants are at activating lexical items and how these variants are encoded and represented in the phonological systems. They used three groups of adult speakers who differed in their production and experience with the New York City (NYC) dialect, in which the final consonant [r] is dropped (for example, [sɪstɚ] versus [sɪstə]). The three groups were those who were exposed to and produced General American (GA) dialect, those who were both exposed to and produced words without the final –r, and those who were raised with the NYC dialect, but did not themselves omit word final –r when speaking. In a form (phonological) priming task, all groups were found to have improved accuracy when the target word was preceded by a General American accented prime word. For example, people responded faster to [beɪkə] when preceded by [beɪkɚ] or [fɪltɚ] as opposed to [beɪkə] or [filtə]. That is, regardless of their own production, General American accented primes made it easier for all groups to recognize a phonetically-related target variant. However, the reaction times to the targets varied by group and condition. General American speakers only showed priming effects when the target was spoken in General American accent. The two groups with prior exposure to the NYC dialect showed priming effects across all conditions (General American prime and targets, NYC prime and targets, General American prime and NYC target, and NYC target and General American prime). General American speakers also responded significantly less accurately to NYC targets than the other two speaker groups. However, overall all listener groups' error rates decreased in response to General American primes. Similar results were found in a semantic priming task. General American speakers showed significantly reduced

semantic priming with the non-dialectal variant, whereas those with experience with the NYC accent, regardless of their own production, were equally primed by the General American and NYC dialect primes.

Although adults are significantly slower and less accurate at recognizing variable word exemplars, this study showed that all groups were better at recognizing the "popular" dialect (General American) probably due to natural exposure, such as the media. Interestingly, these results bring forward the notion that speakers of a minority dialect, or speech community, master a wider variety of accents than speakers of the prominent dialect. That is, speakers of minority dialects must often face variation from (at a minimum) the majority dialect, and it is expected that they have more experience and familiarity with dialect variation. Thus, word recognition appears to be strongly impacted by familiarity with dialects. That is, background experience (Sumner & Samuel, 2009; Evans & Iverson, 2004) and/or previous exposure (Maye, et al., 2008; Sidaras, et.al., 2009) facilitate on-line retrieval of stored words.

Older Children. School-aged children are also able to accommodate variable features of accents. Nathan, Wells, and Donlan (1998) analyzed responses given by 4- and 7-year-old children in a word repetition and definition task containing London accented (native) or Glaswegian accented (non-native) single words. Responses were analyzed as either a phonological or a phonetic response. Phonologically-based responses were those in which the child repeated the word in their own accent (regardless of the accent presented) and provided an accurate definition. Responses in which children repeated the Glaswegian regional accent

with an incorrect definition or inability to define the word were rated as phonetically-based responses. The latter would suggest that the children did not map the unfamiliar pronunciation onto the known word. Four-year olds gave more phonetic responses, while 7-year olds gave more phonological responses. This suggests that older children have better word recognition skills across variation in accents.

In summary, school-age children have not fully developed the skill to overcome variability as do mature listeners. They continue to develop this skill across linguistic tasks over time. Adults can perceive, identify and adjust for phonetic variations in spoken words, but word recognition does improve with experience with dialectal variation and contextual exposure to the variant. Adults do not need to have already stored the various patterns in memory in order to recognize them.

Infant Speech Perception and Discrimination

Infants obviously have less experience than adults and older children with language. The mechanisms responsible for language acquisition are going through a process of development contemporaneously with the child's experience with language. Therefore, infants display shifts over time in what aspects of spoken language they consider more interesting or relevant. Regardless of the mechanisms necessary to acquire language, infants must be able to not only learn new words, but generalize word tokens past the primary instance of that word in order to build vocabulary and comprehend language.

One of the first steps required in understanding speech in a different dialect is the ability to recognize that dialects actually differ. Several studies have investigated

infants' ability to discriminate between their native language and other languages and dialects (Mehler, Jusczyk, Lambertz, Halsted, Bertoncini, & Amlel-Tison,1988; Nazzi, Bertoncini, & Mehler, 1998; Bosch & Sebastian-Galles, 1997). In general, these studies suggest that infants can distinguish even between very similar dialects (e.g., Catalan and Spanish dialects, Bosch & Sebastian-Galles, 1997; Dutch and English, Nazzi, Jusczyk, & Johnson, 2000) by 4 to 5 months of age.   Infants appear to discriminate their native dialect from another one early in their development primarily on the basis of prosodic cues, such as syllable stress, duration, and rhythmic class (Bosch & Sebastian-Galle, 1997; Nazzi, et al., 2000; Nazzi, et al., 1998). Interestingly, they can not discriminate between similar variants within an unknown language family (Italian and Spanish or Dutch and German, Nazzi, et al., 1998).

There are very few studies showing infant preference for native or accented language. The studies that do exist have not clearly pointed to one finding across languages. For example, Kitamura, Panneton, Deihl, and Notley (2006) recorded listening times of 3- and 6-month-old Australian infants and 6- and 8-month-old American infants exposed to passages in the two English dialects. At 3-months, Australian infants listened longer to Australian sentences than American sentences. However, at 6 months of age Australian infants did not show a preference for either accented passage, while American infants (same aged) listened longer to Australian than American sentences. By 8 months, American infants showed the same lack of preference for either dialect that Australian infants demonstrated at 6 months of age. The authors suggested that one possible explanation for the earlier development of Australian infants to generalize across accents is that these infants have more

experience with the American dialect through popular media, whereas American infants are less likely to have the same experience with the Australian accent. However, it is not clear how much experience, or exposure Australian infants have with sources of mass media, particularly at such young ages. Therefore, it is impossible to conclude that Australian infants' performance was the result of any previous exposure. Nonetheless, the study did indicate that as infants develop, they become less sensitive to (regional) dialectal differences, and are able to parse out the irrelevant differences.

As they get older, infants begin to focus more on phonetic markers as a means of discriminating between languages rather than just prosodic cues (Jusczyk, Cutler, Redanz, 1993; Jusczyk & Luce, 1994; Friederici & Wessel, 1993). Infants need to acquire skills that go beyond the suprasegmental level in order to increase their knowledge of words and must develop the ability to deal with variation in the phonetic presentations within words in order to recognize words across dialects. One dimension in which accents differ from one another is in the production of vowels and consonants. The ability of infants to discriminate non-native sound contrasts begins to decline between 8 months and 12 months (Werker & Tees, 1984), when a shift in speech perception towards learning the contrasts and phonetic details of one's native language occurs. That is, infants begin to discriminate the sounds in their own language differently as they get older.

Infants demonstrate an interesting developmental pattern in terms mastery of vowel and consonant features throughout their development that may shed some light on their ability to manage accents. Accents manifest as pronunciation differences of

both vowels and consonants. Native language vowel attunement begins to occur prior to and differently than consonants in infants (Polka & Werker, 1994; Nespor, Peña, Mehler, 2003). Language-specific phonemic sensitivity appears around 6 months of age for vowel perception (Polka and Werker, 1994) and around 10 months of age for consonant perception (Werker and Tees, 1984). Nespor, Peña, and Mehler (2003) have argued that vowels give information regarding syntax, while consonants give information regarding the lexicon. In the case of adults, Bonatti, Peña, Nespor, and Mehler (2005) found that when presented with an artificial language, listeners were better able to pick up the statistical regularities of consonants but not vowels in a word identification task. Infants show a developing pattern similar to adults in their reliance on consonants and vowels in lexical distinction and acquisition tasks (Werker, Fennel, Corcoran, & Stager, 2002; Nazzi, 2005; Nazzi & New, 2007; Nazzi & Bertoncini, 2009). Because there is evidence suggesting that infants focus more on certain acoustic properties of language at different points throughout their development, processing vowels differently and with more difficulty may be indicative of the type of linguistic cues that they might be relying on when processing an unfamiliar accent.

Word Recognition & Generalization

Beyond discriminating the sounds and sound system of their native language, infants must acquire the ability to recognize words across different talkers. Word recognition is a necessary step prior to word learning. The processes involved in word recognition must be developed such that words across a variety of contexts will be retrieved. Infants initially store too much detail about words, which impedes their

ability to generalize across multiple exemplars of those words (Houston & Jusczyk, 2000; Singh, Morgan, & White, 2004; Newman, 2008). This overspecificity appears to resolve as infants get older, but it does mirror the pattern infants show in their early skills of native language sound acquisition. It appears that the process of generalization occurs very gradually.

By 7.5 months infants are able to segment familiar words in connected speech (Jusczyk & Aslin, 1995) and are able to identify the words when produced in isolation and when produced in fluent speech (when the acoustic signal of their phonemes is influenced by the surrounding words). Seven and a half month olds can generalize across two talkers of the same gender, but not across talkers of both genders (Houston & Jusczyk, 2000). Houston and Jusczyk (2000) familiarized 7.5-month-olds and 10.5-month olds with isolated words by one talker then tested their recognition of those words within passages presented by another talker. It appears that 7.5-month olds are not able to categorize words spoken with different acoustic attributes, such as gender, as the same word. Younger infants (7.5 months) also fail to recognize a word when familiarized in one affective tone (for example, a happy voice) and later presented in a different tone (for example, a neutral tone) (Singh, Morgan, & White, 2004).

In a series of experiments, Schmale and Seidl (2009) sought to test infants' abilities to recognize familiar words across voice and/or accent. Nine-month-old infants were able to recognize familiarized words when the familiarization items and test passages were spoken by the same speaker with a Spanish-accent. However, 9-month-olds failed to recognize words when familiarization and test passages were

presented by two distinct Spanish-accented speakers or by one native speaker and one Spanish-accented speaker. It is unclear what aspect of the speech signal was hindering recognition in younger infants. Spanish-accented English differs from native English at multiple levels (for example, speech rate, vowel duration, VOT, etc.). Schmale and Siedl (2009) suggested that younger infants lack abstract representations that can accommodate more subphonemic and suprasegmental variation. Nine-month-olds also failed to recognize familiarized words under the same task across two native English accents: Canadian-accented English and American English (Schmale, Cristia, Seidl, & Johnson, 2010). These two accents are said to be similar across consonant production and suprasegmental features, but to differ in vocalic features. This suggests that younger infants show difficulty with the acoustic variations of vowels within accents. Infants can not generalize familiar words across accent even when talker voices are perceptually similar. Young infants appear able to match the surface forms of words and continue to rely on speaker-specific patterns to aid in word recognition. Infants continue to be sensitive to irrelevant speech characteristics, failing to link relevant phonemic patterns to stored lexical items.

The ability to ignore talker variation in word recognition is not evident until about 10.5 months. At this age, infants can generalize across talkers of different genders, but not across accents (Houston & Jusczyk, 2000; Schmale & Seidl, 2009; Schmale, et al. 2010). Twelve-month-olds recognized words across two relatively similar accents (Canadian vs. American-English) (Schmale, et al. 2010), but only 13-month-olds were able to recognize words across more dissimilar accents (Spanish-accented

English vs. American English; Schmale & Seidl, 2009). In fact, 13-month-old infants are able to recognize words across similar voices and different accents (native and Spanish-accented English), as well as across distinct voices and similar accents (both familiarization and test presented by Spanish-accented English speakers) (Schmale & Seidl, 2009). The older infants were able to accommodate subphonemic and suprasegmental variations across two perceptually-similar speakers that differed acoustically based on large differences in VOT (voice onset time).
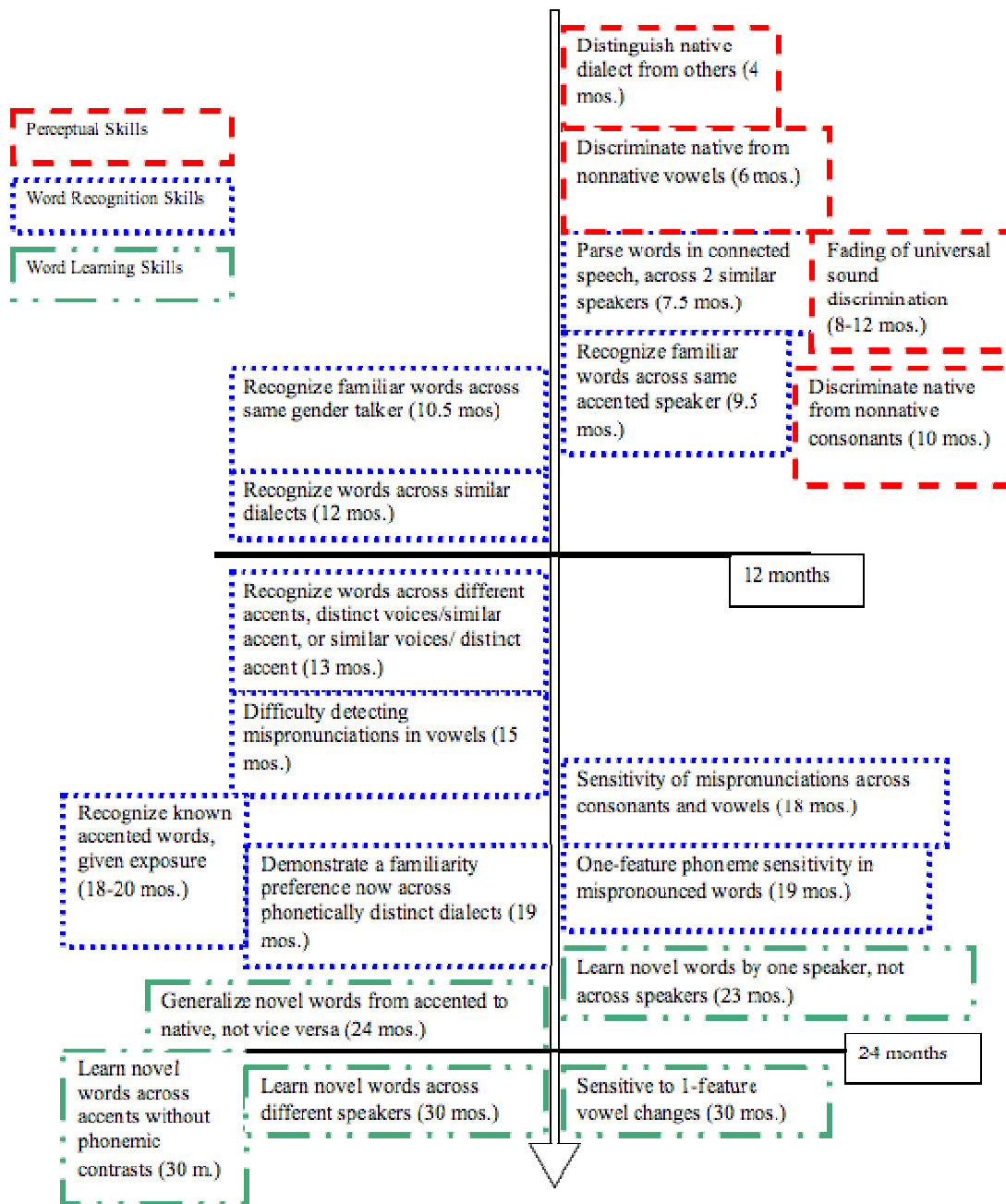
What comes across from these studies is a pattern of gradual abstraction in terms of infant representations, allowing the representations to accommodate greater degrees of variability between 9 and 14 months (see Figure 1). During their first year, infants show a process of parsing out what is important and unimportant in their own language in order to build basic and fundamental skills. Yet other studies suggest that this ability may continue to develop during the second year of life. In particular, infants in their second year begin learning many more words, and their phonetic discrimination abilities are particularly relevant to this task. At 17 months, infants can accurately differentiate minimally different labels in a word-object association task (Werker, et al., 2002). By 18 months, children can detect mispronunciations of consonants and vowels in familiar word representations, while 15-month-olds show more difficulty across vowels (Mani & Plunkett, 2007). Additionally, 19-month-olds are able to detect mispronunciations in known words in as small as a one-feature change (White & Morgan, 2008). Thus, children are sensitive to mispronunciations of known words and there is some accommodation that is given (by infants) to degrees of mispronunciation. If infants notice minor mispronunciations in known words, we

might expect that they would be similarly affected by pronunciation differences that are the result of foreign accents.

The evidence provided by experiments on speech perception show a step-wise progression of infants' speech perception abilities that supports word recognition and facilitates word-learning (see Figure 1). Infants must move beyond the fine tuning of speech sounds in order to accommodate variability of (similar) spoken words. There is a large body of research dedicated to the nature of the development of phonological constancy, a term described by Best, Tyler, Gooding, Orlando, and Quann, (2009) as "a principle that states two spoken words are the same regardless of phonetic variation as long as the phonological structure is maintained". One way to look at this is to see whether infants are capable of shifting their phonetic categories without necessarily learning new words. Best et al. (2009) conducted an experiment to investigate the theoretical accounts for the development of phonological constancy using a familiar-word preference paradigm. They presented two groups of infants, 15-month-olds and 19-month-olds, with both familiar and unfamiliar words pronounced in Connecticut American English and Jamaican Mesolect English. Differences between these dialect varieties include consonant and vowel production and stress patterns. Infants were tested in a familiar-word-preference task, in which each child heard equal trials of each dialect, with half of the trials using familiar words and the other half using unfamiliar words (per dialect). Prior research had shown that infants listen longer to familiar words than unfamiliar words (e.g., Halle & de Boysson-Bardies, 1994), when the items are in the native dialect; this study examined whether infants would show that same pattern when the words were in an

unfamiliar accent (implying recognition of the words as familiar). Fifteen-month-old infants did not listen longer to familiar words in the unfamiliar dialect, while 19-month-olds showed a preference for familiar words across dialects (Best, et al., 2009). The authors suggest that the recognition of a word's underlying form across surface variations is facilitated by the adjustment of phonetic representations and concurrently developing language skills throughout their second year.

At 18 to 20 months of age children show a pattern much like adults in their word recognition abilities (e.g., Clark & Garrett, 2004), such that initial exposure to accented speech facilitates subsequent recognition of familiar words. White and Aslin (2011) tested toddlers' ability to adapt to a novel accent in a word recognition task. The novel accent involved shifting words that contained the vowel [a], as in "d**o**g", to the vowel [æ], as in "b**a**g". During training, children saw pictures and heard them labeled. Half the children heard the standard pronunciation of the familiar words (control group), and half heard the shifted vowel, novel pronunciation (accented group). All infants were later tested on the recognition of words in both the standard pronunciation and the novel "accent". The children in the control group only correctly recognized words produced without the shift. Children previously exposed to the shifted (accented) pronunciation were able to recognize familiarized words (both standard and shifted), as well as generalize across other novel productions presented at test. Exposure to the shifted pronunciation, or vowel change, affected later performance.

Perceptual Skills

Word Recognition Skills

Word Learning Skills

Distinguish native dialect from others (4 mos.)

Discriminate native from nonnative vowels (6 mos.)

Parse words in connected speech, across 2 similar speakers (7.5 mos.)

Fading of universal sound discrimination (8-12 mos.)

Recognize familiar words across same gender talker (10.5 mos)

Recognize familiar words across same accented speaker (9.5 mos.)

Discriminate native from nonnative consonants (10 mos.)

Recognize words across similar dialects (12 mos.)

12 months

Recognize words across different accents, distinct voices/similar accent, or similar voices/ distinct accent (13 mos.)

Difficulty detecting mispronunciations in vowels (15 mos.)

Sensitivity of mispronunciations across consonants and vowels (18 mos.)

Recognize known accented words, given exposure (18-20 mos.)

Demonstrate a familiarity preference now across phonetically distinct dialects (19 mos.)

One-feature phoneme sensitivity in mispronounced words (19 mos.)

Learn novel words by one speaker, not across speakers (23 mos.)

Generalize novel words from accented to native, not vice versa (24 mos.)

24 months

Learn novel words across accents without phonemic contrasts (30 m.)

Learn novel words across different speakers (30 mos.)

Sensitive to 1-feature vowel changes (30 mos.)

Linguistic experience and previous exposure to accents may help children become more flexible when dealing with variability; however, children's ability to correctly process the variant may be affected by the language skill that is being challenged.

Mulak, Best, Irwin, and Tyler (2008) tested 19 to 20-month-old toddlers in a word comprehension task comparing performance in two American dialects (American English and Jamaican Mesolect English). Using an intermodal preferential-looking procedure, American children were presented two familiar pictures. The target item was then named by either a native speaker or by a Jamaican Mesolect speaker. Children were only able to identify the referents, or match word to the correct picture, when the referent was produced by the native speaker. Although at this same age, toddlers show a familiarity preference across the same dialects (Best, et al., 2009), it appears that in a different task (recognition and comprehension) toddlers are unable to accommodate the variability in the input. This suggests that children deal with linguistic variability presented by accent differently throughout the lifespan, and that their ability to be more flexible may depend on the linguistic task in question.

Word Learning & the Variability Problem

Variability seems to still pose problems for older children, particularly when they are attempting to learn new words. By 23 months, infants are able to pair a novel word to a novel object when the speaker remains the same through familiarization and testing, but have difficulty doing so when talkers change between training and test (Hollich, 2006). This finding suggests that the act of learning new words may continue to be affected by variability across talkers (and presumably accents) even when such effects are no longer apparent in simple recognition tasks. In a split-screen preferential looking paradigm, 30-month-old infants were taught two novel word-object associations, each trained by a different talker, using novel words that differed phonologically ("doop" and "neff") (Morini & Newman, 2010). In a

subsequent test phase, both objects were (visually) presented on screen and one of the two talkers presented an object label. Infants looked longer at the named object regardless of talker and did not demonstrate any relative weakness when the talker producing the word differed from the talker used at training, unlike the decrements experienced by 23-month-olds in Hollich's (2006) experiment.

But dialect differences are likely larger than talker differences within a dialect, and such effects may be larger when learning words. Interestingly, Nazzi, Floccia, Moquet, and Butler (2009) found that 30-month-old French infants who were taught pseudowords that contrasted by one consonantal or vocalic feature in a name-based categorization task were more inclined to associate labels differing in vowels than consonants. Toddlers were taught two new object label associations across three unfamiliar objects. Two objects were given the same name (e.g., [pize] and the third object a phonologically contrasted pseudoword (e.g., [pyze]).   When asked to "find the one that goes with this one", toddlers chose the correct pairing significantly more than chance. Toddlers demonstrated a phonetic sensitivity to vowel distinctions across words. In a separate experiment, the names given to the three objects contrasted such that the name of the target object (e.g., [pide]) differed from the other names by either a consonant (e.g., [tide]) or a vowel (e.g., [pyde]). The participants were asked to "give the one that goes with this one". Toddlers chose the word with the vocalic contrast (e.g., [pyde]) over the consonantal contrast (e.g., [tide]) significantly more than chance. The results of this study suggest that children were more likely to overlook vocalic feature changes in order to preserve the consonantal features of the learned, target word. However, this age group did demonstrate

phonological sensitivities to vowels within the word-learning task when labels were contrasted by small, (one-feature) vocalic changes (Nazzi, et al., 2009). Thus, toddlers' ability to generalize across accents could be negatively impacted by the change in vowel cues between speakers (native vowel versus accented vowel).

Schmale, Hollich, and Seidl (2011) conducted a study to look at whether 24-month-old and 30-month-old toddlers were able to generalize novel word tokens across accents. The design implemented a preferential looking procedure to teach toddlers two new words taught by either a native or Spanish-accented speaker. Over two repeated blocks, infants were taught one novel word-object pairing per block and immediately tested within the same block. Novel words were embedded in carrier phrases over 3 presentations, "Do you see a _____? Look, it's a _____? A _____?", by either a Spanish-accented or native speaker with one object presented on the screen. They were then tested over two trials with two objects presented on the screen. Toddlers were asked to look at either the trained word-object pairing ("feem" or "neech") or an untrained word-object pairing ("choon" or "moof") by the alternate speaker (either native or Spanish-accented speaker). According to the results of Schmale, et al.'s (2011) study, younger infants, 24-month-old toddlers, recognized word-object pairings only in the case when a Spanish-accented speaker taught the novel word-object pairing and they were tested by a native speaker, but not vice versa. Older infants, 30-month-old toddlers, were able to learn and generalize two novel words and object pairings across accents regardless of the speaker used in training. The findings imply that older toddlers can ignore some differences in accent and generalize learned novel words despite those differences.

The target words selected in the Schmale et al. (2011) experiment consisted of vowels and consonants represented in both English and Spanish phonological inventories. For example, the three phonemes within the target word "feem", [f], [i], and [m], overlap in the sound systems of both languages. The pronunciation differences between the native speaker and the Spanish-accented speaker are perceptually and acoustically-phonetically minimal in comparison to other across-language sound changes. A foreign accent is influenced by both the speaker's native phonology and the sound system of the target language. One of the more striking features of an accent is the manipulation, or change, to the other language's sounds, or phonemes. An accent is particularly difficult to comprehend when phonemic differences across languages are not preserved. Phonemic differences within a language are those sound changes used to distinguish words. An accented speaker may preserve the phonemes distinctive to their native language; however, those distinctions may not apply or be sufficient for the second language. For example, the vowels [i] and [I] are phonemically different in English, as seen in "bit" and "beat". However, Spanish does not contain the [I] vowel. One language may hold two sounds as nonphonemic contrasts (or allophones), while in the sound system of the other language, the same sounds are phonemically contrasted (distinguished). Since Spanish does not contain the [I] vowel, a speaker with a strong Spanish accent will likely produce the English [I] sound more like [i], which could cause confusion to an English listener. The results of Schmale et al.'s (2011) study demonstrated that toddlers have the ability to generalize novel words across accents when the tokens did not cause any phonemic confusion.

One goal of the present study is to extend the findings of Schmale et al. (2011) to examine whether toddlers can accommodate pronunciation differences from a foreign accent that creates a phonemic contrast with the toddler's native language. If toddlers are able to learn a novel word and generalize that word token across accent despite a phonemic distinction in the vowel, this may demonstrate that toddlers have learned something about the accent to promote flexibility of lexical storage and retrieval, and that toddlers are able to normalize vowel space across speakers on-line. However, if they are not able to generalize the novel word across accents, this may demonstrate that toddlers' stored phonetic representations are restricted by the phonological rules of their native language and they are unable to learn the important difference of a given accent. That is, they may be unable to accommodate phonological deviations that cross phonemic boundaries of their own language. The Schmale et al. (2011) paper may overestimate toddlers' ability to deal with foreign accent, in that they only tested infants on the simplest case: where the accent has no potential to cause phonetic confusion. On the other hand, it is possible that toddlers can quickly adjust their perception to foreign accents even across phonetic changes. Doing so would likely require some exposure to the types of changes made in that language. It is predicted that given sentential cues (a carrier phrase) along with the target words, infants at this age will be able to recalibrate their vowel space to accommodate a shift in word pronunciation.

The following study aimed to investigate whether early word-learners are able to accommodate phonemic sound changes caused by an accent during a word-learning task. To address this, two questions were posed: First, can 30-month-old

toddlers learn and generalize phonemically-contrasted (accented) novel words across the native production? Second, do toddlers perform differently generalizing non-phonemically, contrastive novel words versus phonemically contrastive, novel words?

METHODS

Participants

A total of 24 children (11 f, 13 m) ranging in age from 27 months 25 days to 31 months 27 days, with a mean age of 29 months 13 days (sd: 1 month 11 days) participated in this study. All participants came to the University of Maryland, College Park Department of Hearing and Speech Sciences for testing. Children were recruited for the study if they were primarily monolingual (equal to or greater than 90% English spoken in the home) with less than 20% daily exposure to any foreign (non-English) accent. In addition, toddlers exposed to a Spanish-accented speaker daily or weekly were not included in the final data. Data from an additional eight children were not included in the final analysis for the following reasons: fussiness/crying (2), equipment error (2), and home exposure to a Spanish-accented speaker (4). Of the twenty-four participants whose data were used in the final analysis, twenty-two children were reported to hear (and speak) 100% English on a daily basis. The remaining two participants heard on average one percent of Arabic and Portuguese, respectively. None of the infants included in the final data were reported to have a history of visual, hearing, or neurological impairment/disorder. In addition, only one participant was reported to have a history of ear infections, with the most recent infection occurring more than 6 months prior to the time of the study.

Twenty-two parents identified their children as the following ethnicities: Caucasian (18) and African American or Black (4).Of the parents who reported educational background, 32% reported at least one parent completed a 4 year college degree, 59% reported at least one parent completed a Master's level degree, and 9% reported that at least one parent earned a Doctoral degree. Two parents did not provide information regarding ethnicity or educational background.

Materials

Infants' caregivers were asked to provide information in the form of three questionnaires: a) An infant language history and development questionnaire pertaining to factors related to language history (e.g., history of speech and/or hearing difficulties) and language exposure (e.g., exposure and percentage of exposure to foreign accent) (see Appendix A); b) a biographical information questionnaire pertaining to the participants' and caregivers' background information (for example, ethnicity, race, education) (see Appendix B); and, c) the MacArthur-Bates Communicative Development Inventory (*CDI*) (Fenson, Dale, Reznick, Bates, Thai, & Pethick, 1994) used to measure vocabulary comprehension and production. Participants were offered a small prize, either a toy or book, for their time at the completion of the visit, regardless of outcome.

Design

The experiment was designed to replicate Schmale, et al.'s (2011) experiment. It consisted of a total of 4 blocks. The first two blocks each involved teaching the child a new word (and subsequently testing learning of that word). The third and fourth blocks are exact repetitions of blocks 1 and 2, added in order to increase the

likelihood that children would learn the new words. Each block consisted of a training phase followed by a test phase (see Table 1). The training phase began with a salience trial, followed by three training trials. The salience trial consisted of the presentation of both objects on screen in silence for the same duration as subsequent trials (training and test). This gave toddlers the first opportunity to see both objects and served as an introduction to the position of the objects on the screen when presented during test trials. Schmale et al. (2011) describe the salience trial as a means to prevent toddlers from forming a novelty preference for an untrained object. Following the salience trial, each of the three training trials presented one novel object centered on the screen while the recorded female, Spanish-accented English speaker presented the label four times within a carrier phrase. Children were taught two new words on two different blocks. One of the trained words ("fim" or "nutch") had a phonological change in the vowel ([fIm] pronounced as "feem", or [n^tʃ] pronounced as "notch"); the other ("shoon" or "mef") did not, and was thus a replication of Schmale et al. (2011), as well as being a test that the procedure was sufficient to train the words. Following the training trials, participants were presented with two test trials; these tested not only the trained word, but also the novel word. Based on mutual exclusivity, if children have learned the trained objects, they should treat the novel words as indicating the novel object. That is, if children have learned that "fim" refers to object 1, then they should not only look at object 1 when told to look at the "fim", but should look at object 2 when told to find the "shoon" (see Table 1). In this way, both test trials are testing for children's learning of the same trained word.

Table 1. Sample Condition. An example of the presentation of stimuli blocks			
Block	Trial	Visual	Prediction
1	Salience		Participants are expected to look at each object equally, approximately 50% of the time each
	Training (Spanish-accented English): "Look! It's a fim. Wow, it's a fim. Do you see it? A fim." (Pronounced as, "Luke! Eets ah feem. Wow, eets ah fim. Do you see eet? Ah feem.") (x3)		This is the phonemically contrasted training trial. Thus, it is expected to be harder to generalize across productions.
	Trained Test (American-English): "Look! It's the fim. Do you see the fim? Where is that fim? Fim".		If children are able to generalize the token across accent, they will look longer to the correct object (left) than the incorrect (novel) object
	Novel Test (American-English): "Look! It's the shoon. Do you see the shoon? Where is that shoon? Shoon"		If children correctly learned and generalized the trained word, then they will look longer at the named, untrained novel object (right)
2	Salience		
	Training (Spanish-accented English): "Look! It's a mef. Wow, it is a mef. Do you see it? A mef. (Pronounced as, "Luke! Eets ah mef. Wow, eets ah mef. Do you see eet? Ah mef." (x3)		This is the non-phonemically contrasted training trial. Thus, it is expected to be easier to generalize across productions.
	Trained Test (American-English): "Look! It's the mef. Do you see the mef? Where is that mef? Mef."		Children are expected to look at the trained object-label (left) longer than the untrained label demonstrating they have learned and can generalize the learned word across accents

	Novel Test (American-English): "Look! It's the Nutch. Do you see the nutch? Where is that nutch? Nutch".	Children are expected to look longer to the named, untrained target object if they have learned the non-phonemic, "easier" paired object based on the theory of mutual exclusivity.

*Blocks 1 and 2 repeat, with visual object orientation switched

Whether toddlers were taught one phonemic contrast versus another (either "fim" or "nutch"), whether the trained or novel object-label was presented first at test, and whether the harder contrast was presented during the first and third blocks or the second and fourth blocks were all counterbalanced across participants. Left and right orientation of objects was counterbalanced across blocks and participants. This created a total of 8 orders.

All trials were matched for length, lasting 6.6 seconds. An eight-second black and white image of a baby and auditory baby laughter was included in between all trials to keep the child's attention. Presentation of the visual stimuli appeared 0.5 seconds prior to the auditory stimulus. Audio recordings were combined with images of the novel objects using Final Cut Pro audio and video editing software, which allows for the manipulations of timing (onset of speech to visual presentation).

Auditory Stimuli

Two female speakers were selected to record stimulus items. One female was born and raised in Maryland, and was judged to have the regional Mid-Atlantic American speech dialect (or Midland speech). She was a 29-year-old graduate student attending the university at the time of the study. Three native Spanish speakers volunteered to record sentences in English. Selection of the Spanish-

accented English voice was based on intelligibility of sentences, vocalic feature distinctions and consonant integrity within the speech sample, and appropriate Infant-directed speech. The 36-year-old female selected was born and raised in El Salvador and reported living in the Washington, DC metro area for the past 12 years. She reported the ability to read and write in Spanish, with beginning fluency in spoken and written English. All recorded speakers were informed about the purpose of the study and signed written consents for use of their recorded voices. Speakers were instructed to read sentences aloud into a microphone as if they were speaking to a young child.

Selection of target words and phrases. The target words and carrier phrases were selected to take into account the phonetic distinctions across languages. Sentence frames were developed to elicit accented speech without causing any phonological confusion across the language. Target words were created in order to cause a phonological change in the vowels produced in two words, but no change in the vowels of another two novel words. In this way, the selection of the target words and phrases were used to compare the learning and generalization of words with and without phonological change in the vowels. It was necessary to take into account the phonetic and phonological sound transference from a Central American dialect of Spanish to American English due to the origin of the female Spanish-accented English speaker. It is possible to predict foreign-accented speech by comparing the native language phonetic inventory and phonotactic rules, segmental features, and suprasegmental features to those of the second language acquired (Flege, 1981). A

second language learner is influenced by their native language sound system when perceiving and producing the sound inventory of a different target language.

Spanish differs from English in a variety of ways. The Spanish language is a syllable-timed language, unlike English, which is a stress-timed language; as a result, Spanish-accented speech differs in speech rate and vowel duration (e.g., Shah, 2004; Schmale & Seidl, 2009; Magen, 1998). In addition, while English and Spanish share many phonemes, not all of the phonemes in English exist in Spanish. In particular, the phonemes that do overlap in English and Spanish do not share allophonic variations across the languages. The voiced interdental English phoneme "th" is not shared in Spanish; however it may occur as an allophonic variant of the stop consonant [d] in Spanish when produced between vowels (intervocalic). As another example, a Spanish speaker may pronounce the [v] found in English as a bilabial fricative or stop. The Spanish bilabial fricative does not exist in the English sound system, and although the stop consonant [b] does occur in English as an individual phoneme, it is not an allophonic variant for the English [v]. Therefore, the likely substitution of the English [v] for a stop consonant [b] by a Spanish speaker would cause confusion about the intended word in English, such as "saber" and "saver".

The carrier phrase selected for the Spanish-accented speaker (to be presented at training) was, "Look! It's a _____. Wow, it's a_____. Do you see it? A _____" and the four novel words, "fim", "choon", "nutch", and "mef" were chosen in order to provide phonemically distinct vocalic contrasts and to preserve consonantal pronunciation.

Spanish/American English Consonants. In comparing the two sound systems, the phonemes [f], [m], [n], [l], and [s] overlap (Whitley, 1986). The consonant sound [tʃ] has been reported to overlap in Spanish and English production (Whitley, 1986); however, acoustic analyses have shown that Spanish-accented speakers say [ʃ] in place of [tʃ] (Magen, 1998). Therefore, the target consonant [ʃ] was also selected. Other consonants within the carrier phrase include the stop consonants [k] and [t] in the syllable-final position, [d] in the syllable-initial position, and [w] and [j] in syllable-initial position. Spanish and English stop consonants differ in voice-onset time (VOT), the timing between plosive release and the onset of voicing, or vocal fold vibration, mainly affected by aspiration prominent in English and not Spanish. Both languages have voiced and voiceless stop consonants; however, depending on the native language of a given listener, the boundary between these two sounds differ across languages (Benki, 2005). In syllable-initial position, Spanish voiced stops are prevoiced (resulting in a range of -20ms to 20ms VOT), while English stops are not (approximately 0 ms VOT); prevoicing is an acceptable allophonic difference in English, and Spanish voiced stops are typically still heard as the same sound by English listeners. Therefore, the phoneme [d] is an appropriate phoneme to use in syllable-initial position, as in "do". However, Spanish voiceless stop consonants are acoustically very similar to English voiced stop consonants, and thus could not be used syllable-initially in the present experiment. In syllable-final stop consonants, the situation differs somewhat. Bent and Bradlow (2003) discuss that native American-English speakers inconsistently release, or aspirate, final stop consonants. That is, they can release final stop consonants, but they do not always do

so. The lack of aspiration of stop consonants in the final position of words does not

impede a native listener's perception. Thus, while the voiceless final stop consonants

in Spanish and English differ in their putative aspiration, the fact that these stop

consonants are not always released in English means that the unaspirated Spanish

version is not expected to result in misidentification. The effect of a Spanish accent

on the consonants selected within the carrier phrase ("**L**oo**k**! **It**'s a ___. **W**ow, i**t**'**s**

a___. **D**o **y**ou **s**ee i**t**? A ___.") and target words ("**nutch**", "**mef**", "**fim**", and

"**sh**oo**n**") was judged to have minimal pronunciation differences with native

American English pronunciation. Therefore, it was expected that the "accented"

production of these consonants would not cause a shift in perceptual phonetic

category (i.e. words will not be confused for other words in English based on the

consonant production by Spanish-accented speakers).

  Spanish/American English Vowels. Spanish is comprised of 5 vowels

similar to the English tense vowels. However, the Spanish vowel inventory lacks the

lax vowels (as in b<u>i</u>t, b<u>a</u>t, b<u>u</u>t, b<u>oo</u>k, b<u>ough</u>t). Spanish speakers of English generally

have trouble producing words distinguished by a tense/lax vowel contrast, for

example "bit" vs. "beat", differently. In addition, English speakers often reduce

unstressed vowels to a schwa (a lax, mid-central vowel), such as the pronunciation of

[biliv] versus [bəliv]. The schwa and its stressed counterpart, [^], do not exist in the

Spanish vowel space (Whitley, 1986).

  The 5 vowels of Spanish are not exactly like the English tense vowels, in that

the latter are more diphthongal than the former. MacDonald (1989) notes that

English has two vowels for each of the front, back, mid and high vowels in Spanish.

For example, in the vowel space of the Spanish high front vowel [i], English has [iy] and [I]. The novel words chosen in this study were selected based on these phonemically contrastive features between the two languages. The novel words "shoon" and "mef" were chosen because each has a vowel that occurs in both languages, the tense vowels [u] and [ɛ]. The other novel words, "fim" and "nutch" create phonological changes when produced by a Spanish-accented speaker. The Spanish-accented speaker produced the English [I] and [^] closer to the native phonetic variant [i] and [a], respectively, which creates a phonemic contrast for native English speakers. In addition, these accented vowels, [I] and [^], are often confused by adult listeners, while the accented production of [ɛ] is not (Sidaras, Alexander, & Nygaard, 2009). The carrier phrase contained 3 instances of the [I] variation, ("**I**t's a … **i**t's a… Do you see **i**t? A…") and 3 instances of the [^] variation ("It's **a** … it's **a**… Do you see it? **A**…"), as well as one instance of another phonemic change in vowel ("L**oo**k" was pronounced [luk]). Thus, the carrier phrase would provide multiple opportunities for the toddler to hear how this accent differs from English, particularly in pronunciation of vowels (and especially the vowels [I] and [^], which occur 3 times each.

Native, American-English. Following the procedures outlined in the Schmale, et al. (2011) study, one speaker introduces, or teaches, the object-label association, while a different speaker tests the generalization of the target words. For the purposes of this study, all training trials were presented by the selected Spanish-accented speaker, while all test trials were presented by the American-English speaker. The wording for the carrier sentence was changed to highlight the difference
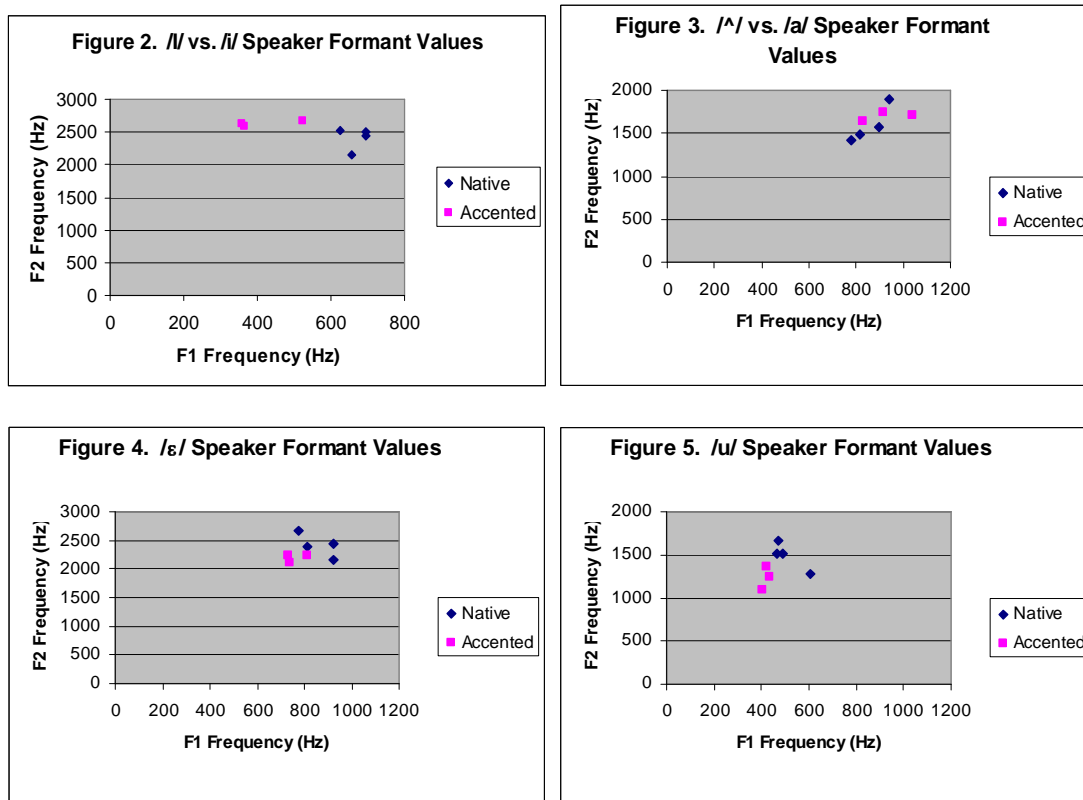
in trials. The carrier phrase to be presented by the native English speaker is "Look!

It's the ___. Do you see the ____? Where is that ___? _____".

Vowel Analysis

Actual vowel variations between the talkers selected were compared using

PRAAT acoustic-analysis software (Boersma, & Weenink, 2011) on the basis of F1

and F2 vowel formants and durational qualities in order to demonstrate the contrast

(native versus non-native) in production between the two speakers.

It was assumed that the Spanish-accented speaker would pronounce the target

word containing [I] more like [i] (e.g., fim→ feem), and the target word containing

[^] more like [a] (e.g., nutch→ notch), while preserving the acoustic integrity of both

[u] (in shoon) and [ɛ] (in mef). That is, although the Spanish-accented speaker's

production of [u] and [ɛ], respectively, may differ slightly from the American

speaker's productions, the alternate productions would not acoustically differ such

that they cross phonemic boundaries, as in the shift from [I] to [i] or [^] to [a]. The

recorded phrases used in this study were taken to evaluate the acoustic values of each

of the vocalic contrasts presented between speakers. Each production of the target

vowels within the words, "mef", "nutch", "shoon", and "fim", for each speaker

(Spanish-accented and American) was analyzed using Praat acoustical analysis

software. Vowel formant analysis was taken from the mid-point of the steady state of

the vowel. The first and second formant values (F1 and F2, respectively, in hertz)

and duration were measured. The formant structures, patterns at particular

frequencies (F1 and F2 frequencies), were compared to identifiable patterns reported

by Peterson and Barney (1952), as well as between speakers. Figures 5-8 (below) represent the first and second formant measurements taken during the analysis.

Figure 2. /I/ vs. /i/ Speaker Formant Values

Figure 3. /^/ vs. /a/ Speaker Formant Values

Figure 4. /ɛ/ Speaker Formant Values

Figure 5. /u/ Speaker Formant Values

Phonemic targets [I] vs. [i]. The vowel [I] is typically produced with higher first formant frequency (hertz, or Hz) and lower second formant values than the vowel [i]. The results of the analysis showed that the pattern of difference between the accented speaker and native speaker matched the expected pattern of phonemic change (see Figure 2). The Spanish-accented speaker produced the intended target vowel [I] with the average (over three productions) formant frequencies of 415 hertz (F1) and 2629 hertz (F2). The native speaker produced the target vowel with the average frequencies of 668 hertz (F1) and 2392 hertz (F2). Thus, the Spanish-accented speaker's [I] was closer to [i] than the native speaker's [I]. Only one token of the vowel, in the second production of the target word, "fim", by the Spanish-

accented speaker had a higher F1 frequency than expected for [i] (see Table 2). In

general, the accented speaker produced the intended vowel with a lower F1 and a

higher F2 than the native speaker. Peterson and Barney (1952) (see Table 2) showed

that the average formant frequencies for an English female speaker producing the [i]

vowel had a lower F1 (310 hertz versus 430 hertz) and higher F2 value (2790 hertz

versus 2480 hertz) than for the production of the vowel [I]. The different

pronunciation between the two speakers showed an acoustic shift in both first and

second formants similar to those needed to produce a [i] versus and [I].

Table 2. Vowel Formant Values and Duration: Native & Accented [I]

Accented	Native	Accented		Native		*Average Native [I]		*Average Native [i]	
Duration (seconds)		F1	F2	F1	F2	F1	F2	F1	F2
0.123	0.145	357	2635	657	2160	430	2480	310	2790
0.105	0.13	521	2672	695	2440				
0.143	0.105	367	2579	626	2514				
	0.177			694	2454				

*Average female F1 and F2 formant frequency values.
Taken from Peterson & Barney (1952)

Phonemic targets [^] vs. [a]. The Spanish-accented speaker was expected to

produce [^] more like [a]. The average first and second value formants for the

accented speaker's intended production of [^] (as in "nutch"), 928 hertz and 1703

hertz respectively, suggest that the speaker's production was lower (similar to [a],

with an F1 average value of 850), and more front than the native speaker (see Figure

3). The average formant frequencies for the native speaker were 858 hertz (F1) and

1594 hertz (F2). According to Peterson and Barney (1952), F1 values should increase

and F2 values decrease in comparing [^] to [a]. However, the accented speaker had

higher F1 and F2 values in comparison to the native speaker (see Table 3). All three

accented vowels had a higher F1 values similar to [a], but F2 values represented a

more frontal (tongue position) production than either [^] or [a]. Fox, Flege, and

Munro (1995) found that the native production of [a] by Spanish speakers had

average higher F2 values than both [a] and [^] produced by an American-English

speaker, and higher F1 values than the American-English production of [a], but not

[^]. The native speaker also produced three tokens of the vowel, [^] with typical first

formant frequency values, but one token with slightly higher F1. Similarly, in the

second formant dimension, the native speaker produced three instances of the vowel

at typical frequencies, but one token appeared to be produced slightly more front than

expected from Peterson and Barney's (1952) averages. The results showed that the

formant value shifts were not those expected in the F2 dimension; however, acoustic

analysis revealed that the production of the vowel [^] was different in both F1 and F2

dimensions, suggesting a within-language difference in vowel production.

Table 3. Vowel Formant Values and Duration: Native & Accented [^]

Accented	Native	Accented		Native		*Average Native [^]		*Average Native [a]		*Average Native [ae]	
Duration (seconds)		F1	F2	F1	F2	F1	F2	F1	F2	F1	F2
0.127	0.126	913	1751	817	1487	760	1400	850	1220	860	2050
0.165	0.136	830	1647	897	1565						
0.118	0.138	1041	1711	942	1897						
	0.208			777	1426						

*Average female F1 and F2 formant frequency values.
Taken from Peterson & Barney (1952)

Non-phonemic target [ɛ]. The average formant values of [ɛ] within the

target word "mef" by the accented speaker were 746 hertz (F1) and 2166 hertz (F2).

For the native speaker, the F2 formant values analyzed by Praat resulted in

inexplicably low values. It was likely that the program captured some other element

in analyzing this second formant of the vowel. The values resulting for F3 resembled

natural second formant values and were therefore substituted for the erroneous second formant values. The native speaker's average formant frequencies for the intended vowel [ɛ] were 859 hertz (F1) and 2417 hertz (F2). Peterson and Barney (1952) showed that female speakers produce [ɛ] with an average first formant frequency of 610 hertz and second formant frequency of 2330 hertz. Neither speaker produced the vowels with similar formant values to those posed by Peterson and Barney (1952). Both speakers produced the vowels with higher F1 formant values, while the native produced the vowel slightly lower. The native speaker produced the vowel slightly more front than expected, while the accented speaker produced the vowel slightly more back than predicted (see Figure 4). However, the analysis of each individual phoneme (see Table 4) showed that speakers produced the vowels with relative similarity, with two tokens approximating values similar to the vowel [æ].

Table 4. Vowel Formant Values and Duration: Native & Accented [ɛ]

Accented	Native	Accented		Native		*Average Native [ɛ]	
Duration (seconds)		F1	F2	F1	F2	F1	F2
0.115	0.077	810	2236	812	2396	610	2330
0.079	0.098	737	2117	924	2429		
0.061	0.128	691	2146	925	2173		
	0.162			777	2669		

*Average female F1 and F2 formant frequency values.
Taken from Peterson & Barney (1952)

Non-phonemic target [u]. The production of the vowel in "choon" was expected to be similar across native and Spanish-accented speakers. Peterson and Barney (1952) reported the average formant values for a female native speaker to be 370 hertz (F1) and 950 (F2) hertz. Both speakers produced the vowel with similar F1

values (see Figure 5); however, both speakers had slightly higher F1 values than

expected. The average formant frequency values for the Spanish-accented speaker

were 421 hertz (F1) and 1232 hertz (F2), with the first (presented) token having the

closest acoustic approximation to Peterson and Barney's averaged formant values.

The native speaker's average formant frequencies were 508 hertz (F1) and 1490 hertz

(F2). It is important to note that the native speaker produced the diphthong [Iu], as in

"c**u**te", rather than the monophthong [u] expected. Therefore, acoustic analysis was

measured at the start of the vowel [u], following [I], for the purpose of this study. The

production of the diphthong, in this case, would not likely cause a shift in phoneme

boundaries for native English speakers, particularly because the accented speaker's

[u] resembled English [u]. Bradlow (1995) found that native Spanish speakers

produce [u] with decreased F2 values than native English speakers, and that both

speakers produce the same vowel with similar F1 values. Overall, the productions of

[u] by both speakers were very similar.

Table 5. Vowel Formant Values and Duration: Native & Accented [u]

Accented	Native	Accented		Native		*Average Native [u]	
Duration (seconds)		F1	F2	F1	F2	F1	F2
0.106	0.1	403	1096	609	1274	370	950
0.109	0.11	437	1237	473	1660		
0.095	0.1	424	1362	463	1513		
	0.11			487	1514		

*Average female F1 and F2 formant frequency values.
Taken from Peterson & Barney (1952)

Recording Method. Each speaker was asked to produce three tokens of

each stimulus sentence in infant-directed speech. All audio files were recorded using

a Shure SM58 microphone at a 44,100 Hz sampling rate and 16-bit precision within a

sound-attenuated booth. Cool Edit Pro audio software was used for selection and

modification (amplitude and length normalization) of target phrases and tokens to be used within the experiment.

The recordings provided by the Spanish-accented English speaker offered inconsistent production of the phonemic contrasts of interest within this experiment. That is, at times the speaker pronounced targeted sounds (expected to be contrastive) near native pronunciation. Selection of the final target words and phrases took into account preserving a consistent, contrastive pronunciation of vowels. In order to provide the best obtained examples of the contrast, at times the same token of a target word was used across training trials. Due to the effect of the Spanish-accent on both syllabification (language timing) and phonetic changes, it was not possible to separate the target words from the preceding determiner; instead the target words combined with the token "a" ("a fim", "a nutch", "a shoon", "a mef") were used for testing. One example of each token was selected to be combined with the isolated carrier phrases to create the final sentences presented at training.

The American English speaker's recorded productions of the token sounds were judged to be consistent. Tokens were selected in phrases, such that one sample of each phrase ("look", "It's the", "Do you see the", and "Where is that") was coupled with one sample of each of the target words to create natural-sounding sentences to be presented at test.

All sentences were separated by short, silent pauses with the length chosen to match overall stimulus duration across trials. Additional short silent pauses were inserted such the first instance of the target word (fim, shoon, mef, and nutch) was presented at 1.5 seconds across all trials. Final sentences were matched for amplitude

and duration such that each sentence spoken by either speaker shared the same length

(6.6 seconds) and sentences were normalized for amplitude.

Visual Stimuli

Four visual stimuli (see below) were selected as novel objects. The four novel

labels, "fim", "choon", "nutch", and "mef" were used to refer to the novel objects

during the experiment. Objects were paired such that objects A and B always

appeared together, and Objects C and D always appeared together. Object pairs were

counterbalanced across labels ("fim"/"shoon" and "nutch"/"mef"); however, Object

pair A and B represented labels in the non-phonemic block, whereas Objects C and D

represented labels in the phonemic block.

Object A   Object B   Object C   Object D

Apparatus

A large 58" LCD monitor was used to present the recorded final video

presentation. A digital video camera rested above the monitor and will be used to

record the experimental sessions. A DVD player was positioned behind the monitor.

Procedures

The experiment was designed as a split-screen preferential looking paradigm

(Hollich, 2006). This method had children seated on their caregivers' laps at a given,

standard distance from an LCD video monitor. Testing took place within a dimly lit

sound attenuated room. The experimenter was not visible to the participant or

caregiver during the experiment. The caregiver wore headphones delivering masking

music during the experiment in order to prevent them from biasing the child.

Recorded session files were uploaded and coded off-line using the Supercoder

software (Hollich, 2005). This software allows for frame-by-frame coding (30 frames

equals one second).

Coding

Data from each session were collected via off-line coding. Using the

Supercoder computer software (Hollich, 2005), two coders, judged to be reliable

coders (based on meeting a pre-established reliability criterion in prior coding), coded

all looks as either, center, left, right, or away, during both training and test trials per

participant. Coders were blind to the location of the objects on screen. Coding data

began at the onset of the target word (1.5 seconds, or forty-five frames, after the

presentation of the visual stimulus) and ended after the last presentation of the target

word. The data from Supercoder was then used to calculate the looking time

attributed to each object within trials. Discrepancies between coder judgments of

looking times (left, right, and center total looking time and longest looking times)

were calculated as a measure of reliability. Trials coded with a discrepancy in looking

time greater than 15 frames were later recoded by a third person (also judged to be

reliable). Discrepant looks were replaced by the third coder judgments in any instance

where two out of the three looks matched. The use of a third coder's judgment was

necessary in 60 out of 576 (10%) trials. Of these, 78% of recoded trials were the

training or salience trials, and 22% of recoded trials were of test trials (i.e., 12% of all

training and salience trials required recoding, and 7% of all test trials required recoding).

RESULTS

Participants' mean looking time to target and non-target objects was calculated from target word onset (1.5 seconds or 45 frames) following the start of the trial until the end of each trial (6.6 seconds or 198 frames). Following Schmale, et al. (2011), difference scores were used as a measure of overall learning. The raw total looking time in frames to the unnamed, non-target object was subtracted from the total looking time in frames to the named, target object to determine the difference score for each trained and untrained (novel) test trial. For example, if a child looked to the named object for 5 seconds (150 frames) and to the unnamed (incorrect) object for 1.6 seconds (48 frames), the child would receive a difference score of 102 frames. The mean raw looking time to trained and untrained objects across trials was calculated.

Consideration was given to the possibility that children would look longer to a particular object during test trials regardless of the object named. For example, in each test block, children were trained over three trials on only one of the two object-label associations that were later presented at test. The object trained in this design is then more familiar to the participant than the untrained object. The salience trials presented at the beginning of each block functioned as a means to minimize the potential of an object preference forming, but these trials cannot completely eliminate the possibility.

The results of this experiment showed that mean looking time to each object pair during salience trials ranged from 2.8 to 3.8 seconds. Specifically, children looked to object pairs A and B 46% and 54% of the time, and to the object pairs C and D 42% and 58% of the time. The latter object pairs revealed a significant difference in looking time, $t(23)= 2.28$, p=.03, suggesting an object preference to object D during the salience trials. There was not a significant object preference in the other object set. A follow-up t-test to examine whether the object preference was continuous throughout the entire experiment revealed that participants looked significantly longer at Object D during the first salience trial, $t(23)$: 2.21, p=.04, but not during the second salience trial. That is, it appears that overall, the children showed a preference for object D during the first salience trial, but this decreased after training was presented.

Despite the use of the salience trials at the start of each block as a means to rule out a novelty preference at testing, there was a strong bias evident. Across all test trials, regardless of the object named, participants looked to the familiar object for 55.3 frames, or 1.8 seconds (SD: 10.2 frames, or 0.3 seconds), and the unfamiliar object for 77.8 frames, or 2.6 seconds (SD: 15 frames, or 0.5 seconds). In other words, participants looked at the novel object 58% of the time and the familiar object 42% of the time. As a result, participants' looking time data suggested that children were "learning" the untrained items (mean: 36.06 frames or 1.2 seconds; SD: 23.08 frames or 0.77 seconds), but not the trained items (mean: -9.02 frames or -0.3 seconds; SD: 33.68 frames or 1.12 seconds). The effect of this novelty preference, or bias to look at the untrained object, would impact the interpretation of the results if analyzed at the level of the individual trial (trained versus untrained). To exclude this

bias as a measure of learning, difference scores were averaged across both trained and untrained trial types to get an overall measure of learning per block[1]. That is, the looking time in frames to the named, trained object and to the named, novel object were combined and averaged per block types, yielding an overall learning score of the named item for the "harder", phonemic block and the "easier" non-phonemic block types.

To compare performance across block types, three separate *t*-tests were conducted. A paired *t*-test was calculated to compare the mean difference score to the named objects in the phonemic block to the mean difference score to named objects in the non-phonemic blocks. This analysis revealed that participants did not perform statistically significantly differently on the phonemic (harder) trials versus non-phonemic (easier) trials, $t(23)=-0.87$, p=0.391. The overall mean difference score in looking time for each block type is presented in Figure 6.

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[1] Because children demonstrated a novel object preference, mean looking time in frames for both trained and untrained trials were averaged per block. Suppose a child preferred looking at object A over object B. During a test trial, when asked to look at Object A, the child looks at the Object A for the entire length of the trial, or 198 frames (6.6 seconds). In the subsequent test trial, the child is asked to look at Object B, and does so for 60 frames (2 seconds), but then looks to the preferred object, Object A, for the remainder of the trial (138 frames), resulting in a difference score of -78 frames. If we were to interpret results based on the trial data, it would lead to the conclusion that the child correctly associated the label to object A (since they looked for more than 50% of the time), but did not correctly associate the label to object B. Instead, to account for this, we averaged the difference scores of looking time to both objects A and B: 198+(-78)/2= 60 frames. In this way, we could interpret the results as the child looked to the named object for 2 seconds longer (difference score of +60 frames) in that particular block as a measure of their overall learning..

Figure 6. Mean Difference Score Per Block Type
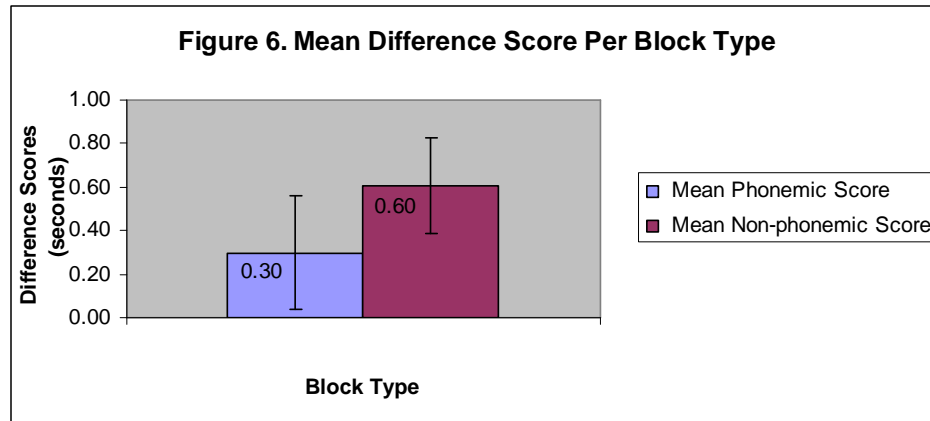
Two subsequent one sample *t*-tests were performed for the participants' mean

difference scores in phonemic block trials and non-phonemic block trials, separately,

compared to chance looking time (in this case, a difference score of 0 would be

chance). These analyses revealed that participants looked statistically significantly

more than chance to non-phonemic block trials, $t(23)=2.80$, $p<.05$ (17 of 24 infants

showed this pattern), but did not look significantly more than chance to phonemic

block trials, $t(23)=1.13$, $p>.05$ (9 of 24 participants showing this pattern). Children

successfully looked at the correct object during the non-phonemic contrasted test

blocks, replicating the findings of Schmale, et al. (2011). Children were not

successful in learning the correct object when the trained word changed phonemically

between the two speakers. The children were able to generalize across minimally

different vocalic changes; however, larger contrasts appeared to diminish their ability

to do the same[2]. The individual data per participant revealed a large amount of

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[2] Previous word-learning studies have used proportion of looking time to target object as a measure of learning (e.g., Morini & Newman, 2010). The amount of time (in frames) spent looking at the named, target object is divided by the sum of the time spent looking at the target and non-target object for each test trial. Comparisons of the mean proportion of looking time to correct objects in the phonemic versus non-phonemic test trials yielded similar results to those reported using difference score measures. That is, participants looked significantly more than chance to correct objects in the non-phonemic trials, $t(23)=2.28$, $p<.05$, but did not look significantly more than chance to correct objects in

variability in children's looking time per block. Of the 24 partcipants, 14 toddlers

showed a larger difference score for words learned in the non-phonemic (easier)

contrasted block than the phonemic (harder) contrasted block. Both Figure 6 (above)

and Figure 7 (below) demonstrate the variance in the mean and individual participant

data.

Figure 7. Individual Participant Mean Difference Scores
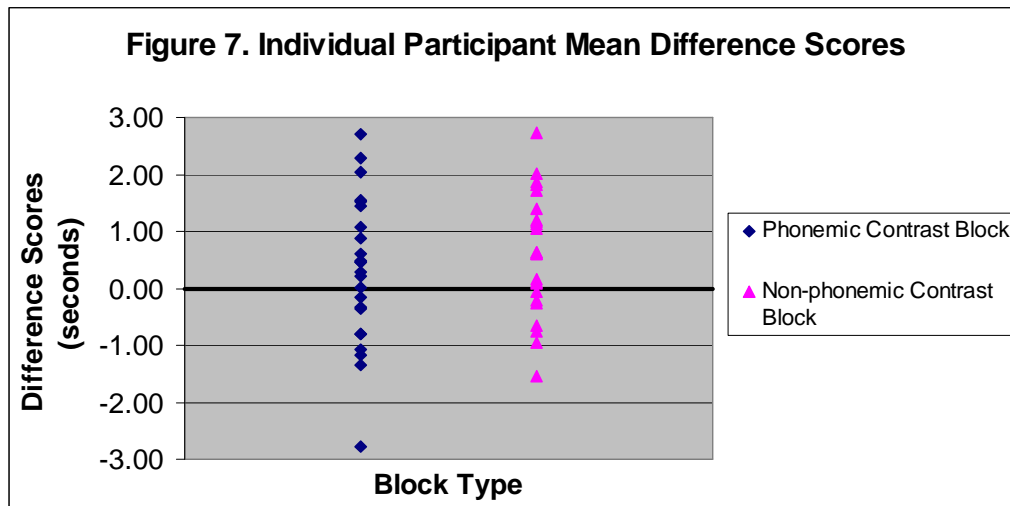
To examine whether children's scores differed depending on the phonemic

contrasts, "feem-fim" or "notch-nutch", they received at training, three additional *t*-

tests were calculated. A paired *t*-test was used to compare the mean difference score

of looking to named objects in the "feem-fim" phonemic blocks (mean: 11.76 frames,

or 0.39 seconds, SD: 35.96 frames, or 1.2 seconds) to the mean difference score of

looking to named objects in the "notch-nutch" phonemic blocks (mean: 6.1 frames, or

0.2 seconds, SD: 42.42 frames, 1.41 seconds). Results of this test did not reveal a

significant difference, $t(22)=0.36$, p=0.73. Children's mean scores across the

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the phonemic trials, $t(23)=1.51$, p>.05. There was no statistically significant difference in mean
looking time to correct objects in the phonemic versus non-phonemic test trials, $t(23)=-0.37$, P=0.717.

phonemic trials are displayed in Figure 8. To determine whether children performed better than chance on one phonemic trial type or the other, two one-sample *t*-tests we conducted. Children did not look longer than chance to named items in either the "feem-fim" phonemic blocks, $t(11)= 1.13$, p>0.10, or the "notch-nutch" phonemic blocks, $t(11)= 0.50$, p>0.10. Therefore, children performed relatively similarly across all phonemic contrasted blocks regardless of the contrast taught, and overall learning was not impacted by the particular phonemic contrast ([i]-[I] vs. [a]-[^]).

Figure 8. Mean Difference Scores: Phonemic Targets
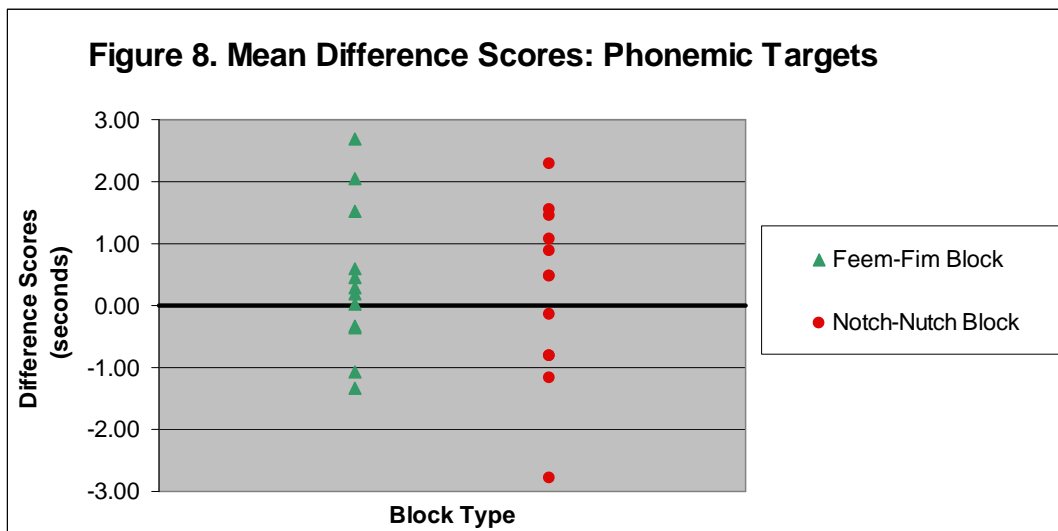
The age range of the children who participated in this study was considered as a potential factor in their ability to generalize phonemic contrasts across accent. The median age of participants was 29 months and 2 days. Participants younger than median age had a mean age of 28 months and 11 days (SD: 11 days), and those older than median age had an average age of 30 months and 17 days (SD: 1 month, 20 days). It appeared as though older children looked at the correct object in phonemic test blocks (mean: 23.14 frames, or 0.77 seconds; SD: 34.26 frames, or 1.14 seconds) longer, on average, than younger children (mean: -5.27 frames, or -0.18 seconds; SD: 38.67 frames, or 1.29 seconds) However, an analysis comparing the children's scores

revealed that older children did not look significantly longer to the correct object in hard blocks than younger children $t(22)=1.9$, p>0.05.

Figure 9. Younger vs. Older Group Mean Phonemic Block Scores
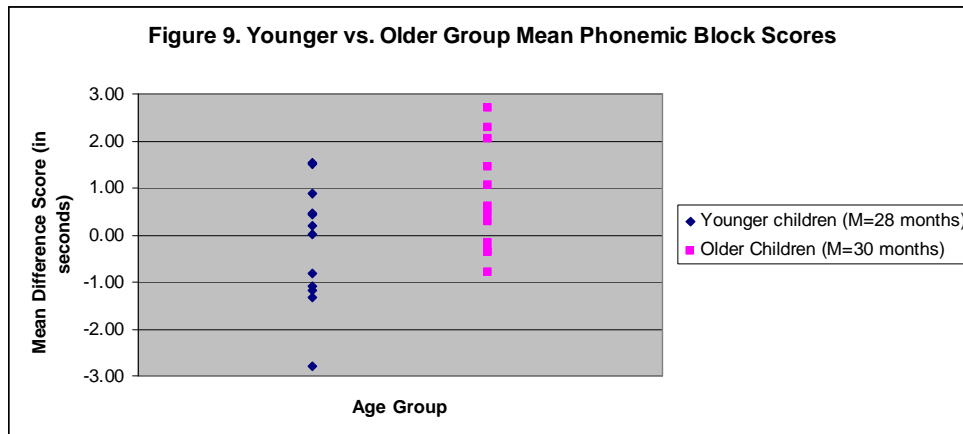
Correlational analyses were conducted to ascertain a relationship, if any, between participants' overall vocabulary scores and their difference scores within the experiment. Vocabulary scores were calculated using the MacArthur-Bates Communicative Development Inventory (*CDI*) (Fenson, Dale, Reznick, Bates, Thai, & Pethick, 1994). Seventeen inventories, out of a total of 24, were turned in within one week of the child's participation. The number of words parents selected on the questionnaire, out of a total of 680 words, was summed to find the child's vocabulary score. Children scored an average of 518.35 words (SD: 143.68 words; range: 184-680). This vocabulary score was then compared to the child's average looking time difference score for phonemic contrast blocks and non-phonemic contrast blocks. Table 2 below demonstrates the results of the analyses. There was no correlational significance between children's vocabulary score and their performance on the phonemically contrasted test blocks (r=-0.06, n.s.) nor a significant correlation with their performance on the non-phonemically contrasted test blocks (r=0.049, n.s.).

Table 2. Correlations of Vocabulary and Block Performance

	MCDI	*Hard Block*
Hard Block	-0.06	
Easy Block	0.05	-0.09

DISCUSSION

This experiment explored whether children are able to learn and generalize new word tokens across two speakers with different accents. One portion of the experiment was meant to replicate Schmale, et al.'s (2011) finding that toddlers as young as 24 months can generalize newly learned words across accent when the person teaching the word has an accent and the person testing does not. In fact, we found (like Schmale et al., 2011) that 30-month-old toddlers were successful in learning novel words across accent in the case where the novel words being spoken did not cross any phonological boundaries in the children's native language. The results of the current study support Schmale et al.'s (2011) findings, in which toddlers were successful in generalizing newly learned words that had minimally contrastive phonemic pronunciation across speakers (the non-phonemic test blocks).

The second purpose of the study was to evaluate whether toddlers could generalize novel word tokens that would cause a phonemic shift when spoken by a non-native speaker. Children were taught a novel word by the Spanish-accented speaker and tested on their ability to generalize by a native speaker. Under this condition, prior work has shown that with minimally phonetically contrastive words (e.g., *feem-choon*, and *moof-neech*), younger toddlers (24-months-old) were

successful in generalizing across accent (Schmale, et al. 2011). This pattern was replicated in the current study. But, given additional sentential cues of the given phonemic changes ([I] to [i] and [^] to [a]), 29-month-old toddlers were not able to generalize across speaker accent. The toddlers looked statistically longer than chance to the named object only when the words did not cross phonemic boundaries (*mef* and *shoon*), but not in the case when the words could phonologically represent different objects (*feem/fim* or *notch/nutch*) in their native language.

Children's early lexical representations are flexible enough to accommodate some within language phoneme variation, but do not routinely accommodate phonemic contrasts that cross boundaries, even when given brief, immediate exposure to the vowel shifts. However, this interpretation must be taken with caution, because although children looked longer than chance to one pair and not the other, the children did not look statistically longer to the "easier", non-phonemic word pairs than the "harder", phonemic word-pairs. That is, they did not perform significantly better under one type versus the other. Between subjects there was a large amount of variability in performance, making it difficult to find one trend in either direction. It is plausible that by increasing the number of participants a more notable trend could appear.

It remains unclear what characteristics or skills might allow some children to accommodate variability to a greater extent than do others. Half of the participants in this study did look longer than chance to the correct object across both trial types; however, this was not at a level of statistical significance. In addition, older participants (30-month-olds) looked longer to the correct object in "harder",

phonemic trials on average, than younger participants (28-month-olds). However, approximately half of the children in each age group, looked longer to the correct object within this test block. Therefore, older participants were not significantly "better" at generalizing the phonemic contrast than younger children. These results do suggest that some children are able to learn words despite the variation across accents, including the phonological variation presented. Therefore, it is possible that some children confronted with accents within daycare settings will not experience difficulty processing the variation. Children who are not yet accommodating accent variability may be in the process of developing richer acoustic-phonetic lexical mappings, but have not acquired sufficient skills to resolve this variability. However, the analysis and results provided here can not specify what mechanisms or traits make some children more resilient to the phonetic variations presented and others more sensitive.

The children's vocabulary scores were highly variable. Eight scores, constituting one-third of the participants, were not available for analysis. It is possible that the missing vocabulary scores could have led to more insight about the actual variability between subjects; however, for the remaining two-thirds of the participants there was no correlation between the children's vocabulary and their ability to generalize words. Schmale, et al. (2011), likewise, did not find a significant relationship between children's vocabulary score and performance on the task.

The vowels were selected to provide two phonemically contrasted words and two words that would maintain the phonological representation across speakers. With the exception of the [I] to [i] phonemically contrastive pair, the other vowels

produced by each speaker, whether influenced by accent or not, were not as strictly

similar or contrastive as predicted. However, vowels tend to be less restrictive in

production than consonants, and the dimensions in which they are measured (first and

second formants) are dependent on one another (Shriberg & Kent, 2003). That is, if

there is a change in tongue height (the first formant dimension) there is often a

subsequent change in tongue directionality (frontness or backness- the second

formant dimension). Although vowels are identified by average formant structures,

or spectral energy patterns, their acoustic characteristics are more variable in natural

speech. It was observed in the process of selecting the best Spanish-accented

exemplar that vowel productions varied. Only word tokens judged to contain the

appropriate vowels were implemented in the study. However, the acoustic pattern

differences of "nutch" versus its accented counterpart ("notch") did not result in as

strong an acoustic-phonetic difference as did the "fim"-like accented contrast. In

addition, the native speaker also had unexpected differences in her pronunciation of

native vowels. For example, by pronouncing the target word "shoon" with a

diphthong, the vowel came across as an acoustically different vowel, although not

phonemically contrastive. One study found that 24-month-old children are more

sensitive to 2- and 3-feature vowel changes related to acoustic differences, than to 1-

feature vowel shifts in a word-recognition task (Mani and Plunkett 2011). Children's

performance was significantly correlated to within-language acoustic deviations

rather than feature changes. This suggests that children would have more difficulty

with the acoustic patterns revealed in the phonemic contrasted vowels, than the shifts

in the non-phonemic vowels. In the current experiment, the intended acoustic

differences and similarities still proved to be distinct enough to cause a different pattern of recognition across children. This has also been shown in a study of adults' perception of Spanish-accented vowels across various tokens. Sidaras, et al. (2009) found of all the presentations by a number of Spanish-accented speakers and native English speakers, native English-speaking adults were likely to confuse the vowel contrasts (through accent) [i] and [I], and [a], [æ] and [^], but not as likely with productions of [ɛ]. Therefore, although speakers, accented and native, may produce vowels acoustically differently across productions, the relative distinctions between those vowels are maintained..

LIMITATIONS

Further analysis to determine whether infants considered the native pronunciation of the phonemically contrasted test label (either fim or nutch) a novel object, thus a different word, or whether they were generally confused or undecided about the label-object associations was unable to be conducted. Despite the presentation of salience trials prior to training and testing in each block, children failed to equally familiarize themselves with the visual objects, resulting in a novelty preference (a preference for the untrained object) during test trials across participants. This effect eliminated the option to directly compare children's looking time to trained, phonemic contrast versus trained non-phonemic, contrast test trials, as well as the novel (untrained) object-label associations. Generalization was, instead, extended to measure overall learning to both trained and untrained items within each type of test block (phonemic and non-phonemic) in order to discount the bias. An overall calculation of learning is a valid way to measure children's learning behavior in this

case because it diminishes the preference bias and accounts for mutual exclusivity. Further, this measure still revealed a relative difference in ability to generalize across word tokens. However, if a novelty preference had not existed, it is possible that a more sensitive comparison of word-learning, such as a comparison of trained phonemic versus trained non-phonemic contrast test trials, would find a significant difference in learning between the two contrasts. A future experiment may want to alter the word-learning task such that children are taught all word-object associations by one speaker and later tested by another. For example, Morini and Newman's (2010) study presented a series of training trials with one speaker teaching a word and another speaker teaching the second word. During test, both speakers presented the same word or the other token to test learning and generalization. This would remove the need for a salience trial and eliminate the risk of forming a novelty preference. It would also lend itself well to the presentation of different conditions, such as different talkers teaching and testing, while testing both learning and generalization.

An additional object preference was noted within the first salience trials in one set of object pairs. This preference did subside once the children learned about the objects (i.e. were given a label for the object) and was not significant in the second salience trial. Therefore, it is assumed that the object preference disappeared within the first training trials of that particular block; however, the failure to counterbalance object pairs across contrast types (phonemic versus non-phonemic) should be avoided in the future to avoid the potential for confounding results.

As mentioned, this study was designed to replicate and extend Schmale et al.'s (2011) findings. However, a large body of evidence supports that more exposure to an

accent prior to testing facilitates word recognition for both children (e.g., Clark and Garrett, 2004) and adults (e.g., Maye, et al., 2008; Janson and Schulman, 1983). That is, for more difficult cross-linguistic phonetic deviations, such as foreign accents, children may require immediate, but longer exposure time, or increased experience with a specific accent in order to adjust for such large deviations.

Recent research seems to support the thought that providing increased variability in the input may actually aid flexibility of the retrieval of stored lexical representations (Rost & McMurray, 2009). According to Rost and MacMurray (2009), younger toddlers (14-month-olds) failed to learn phonologically similar words in a switch-task design when habituation consisted of one exemplar of each word taught by one speaker through several presentations. However, 14-month-olds succeeded within the same task when habituation consisted of the presentation of three exemplars of each word across 18 different speakers (primarily differing in voice). These findings suggested that infants succeed when given a large amount of variability across the trained tokens. In Schmale et al. (2011) and the current study, the words taught by the Spanish-accented speaker reflected three separate exemplars of the same word. That is, children were taught the novel word across three different tokens, giving them more experience with the intra-speaker variability. Despite the additional variability in the production of vowels (revealed in the acoustic analysis of the Spanish-accented speaker's vowels in this study), the children were unable to accommodate (as a group) the non-phonemic contrasts. It may be that increasing children's exposure to accented speech using additional speakers, additional exemplars, or tokens, or by increasing the length of exposure (i.e. length of training

trial) during a word-learning task will facilitate the flexibility of children's lexical representations.

FUTURE RESEARCH & CONCLUSIONS

The current investigation showed that in general, children are able to learn and recognize accented words with non-phonemic changes, and that some children can learn and recognize accented words across phonemic changes. This finding is relevant to children exposed to unfamiliar, nonnative accents or dialects within daycare settings. Some children appear to accommodate for variations in accent relatively quickly, and thus do not experience difficulty learning words under this variability. However, little is known about how much experience with an accent children need to be able to accommodate the differences in productions. Some children require relatively little experience, while others may require more. Future research should explore the possibility that given more exposure to an accent, children could learn to accommodate variability in speaker productions, even when that variability results in a phonemic change.

Based on the literature of earlier developing skills, in order to generalize tokens (sounds, words, etc), infants require more experience with language and language contexts (Newman, 2008). For example, infants have demonstrated the ability to recognize familiarized words in a passage spoken by two speakers of the same gender at 7.5 months, across genders at 10.5 months (Houston & Jusczyk, 2000), and across both voice and accent at 13 months (Schmale & Seidl, 2009). Infants at 30-months old can learn words across two speakers differentiated by gender (Morini & Newman, 2010), and they can generalize minimally contrasted words across accent

(Schmale, et al., 2011). However, the findings here suggest that early lexical representations are limited to within-language sound deviations. When a speaker's production of a word-embedded vowel changes the acoustic realization to such degree as to resemble a different vowel, a child may interpret it as new word, rather than a different production of the same word by a different speaker. This suggests that some children confronted with an accented speaker who produces the aforementioned changes may not be able to quickly adjust to those changes.

It is unclear what lexical processing skills are aiding some children and not others. It is possible that with more exposure to foreign-accented speech, children may gain insight into the vowel shifts and appropriately adjust their perception. More research is needed to investigate whether exposure and experience have a role in children's ability to be more flexible in lexical processing. Additional investigations could extend this research to the role of experience with language variation in bilingual infants, who may deal with this variability daily, in similar word-learning paradigms.

APPENDIX A

Questionnaire, Dialects & Accents: Participant # _____ Date
_____

(Infants)

      This experiment is designed to look at young children's ability to learn new words. Please consider the following factors that may influence children's ability to learn and comprehend new words, such as experience with different languages, different accents, hearing ability, and attention ability. We would like for you to answer a few questions regarding your child's family and language history. This questionnaire is optional.

1. Was your child born on-time?   Y   N   If not, about how early or late was he or she born? _____

2. Are there any languages besides English that are spoken in your house?   Y   N

      If so, which ones?

_____

      About how often are they used? (Please provide a percentage of time)

      _____

3. Does anyone in your family or anyone who regularly cares for your child speak English with a foreign accent? If so, which ones?

_____

How often (please provide a percentage of time)?

      _____

4. When your child hears English, what dialect does he or she typically hear? For example, does your child hear southern English, Bostonian English, Midwestern English, British English . . . ?

___

5. In order to get a sense of which dialects and/or accents your child might regularly hear please let us know where you and your child's other caregivers were born and raised (if different)?

_____

6. Does your child regularly hear other people (besides the primary caregiver) speak with an accent (either a foreign accent, or a non-Maryland accent?) Please describe which accent, and how often (in terms of percentage) this occurs:

_____

7. Has your child had a history of frequent ear infections, or does he or she currently have an ear infection?

_____

      If your child has had ear infections in the recent past, when was the last ear infection? _____

8. Does your child have any siblings in the house?   Y   N   If not, please disregard questions 9-11.

9. Have any of them had hearing difficulties (either in the past, or presently)? If so, please describe.

_____

10. Have any of them been diagnosed with attention or language difficulties? If so, please describe.

_____

_____

_____

11. Has anyone else in your immediate family had difficulties in hearing, attention, or language? If so, please describe.

_____

_____

_____

APPENDIX B

Biographical information

The government likes to ensure that the children we study in our research come from a wide variety of backgrounds. Likewise, many research journals like to know how well the children we study represent the US population. Because of this, we have been asked to collect the following information. Your answers will be kept completely confidential; we will only report summary data.

I would identify my child's sex as: _____ Male _____ Female

I would identify my child's ethnicity as: _____ Hispanic/Latino _____ Non-Hispanic

and my child's race as (choose all that apply):

_____ American Indian/Alaska Native _____ Asian

_____ Black or African American _____ White

_____ Other: _____

_____ I prefer not to answer these questions

Please provide the following information for the parent(s) of the child:

Parent 1	Parent 2
____ Male ____ Female	____ Male ____ Female
____ Hispanic/Latino ____ Non-Hispanic	____ Hispanic/Latino ____ Non-Hispanic
Race: ___ American Indian/Alaska Native ___ Asian ___ Black or African American ___ White ___ Other: _____	Race: ___ American Indian/Alaska Native ___ Asian ___ Black or African American ___ White ___ Other: _____
Highest Degree Earned: _____ Eighth grade completion _____ High school diploma _____ 2 year college degree _____ some college _____ 4 year degree _____ Master's degree _____ Doctoral degree (Ph.D., M.D., etc.)	Highest Degree Earned: _____ Eighth grade completion _____ High school diploma _____ 2 year college degree _____ some college _____ 4 year degree _____ Master's degree _____ Doctoral degree (Ph.D., M.D., etc)

Occupation? _____	Occupation? _____

REFERENCES

Bent, T. & Bradlow, A. (2003). The interlanguage speech intelligibility benefit. *Journal of the Acoustical Society of America*, *114,* 1600–1610.

Best, C. T., Tyler, M. D., Gooding, T. N., Orlando, C. B., & Quann, C. A. (2009). Development of phonological constancy: Toddlers' perception of native- and Jamaican-accented words. *Psychological Science, 20*(5), 541-544.

Boersma, P. & Weenink, D. (2011). Praat: doing phonetics by computer [Computer program]. Version 5.2.09, retrieved 9 January 2011 from http://www.praat.org/

Bonatti, L., Peña, M., Nespor, M., & Mehler, J. (2005).Linguistic constraints on statistical computations: The role of consonants and vowels in continuous speech processing. *Psychological Science, 16*(6), 451-459.

Bosch, L., & Sebastian-Galles, N. (1997). Native language recognition abilities in 4 month old infants from monolingual and bilingual environments. *Cognition, 65*, 33-69.

Bradlow, A. (1995). A comparative acoustic study of English and Spanish vowels. *Journal of the Acoustical Society of America, 97* (3), 1916–1924.

Clarke, C.M., & Garrett, M. (2004). Rapid adaptation to foreign accented speech. *Journal of the Acoustical Society of America, 116*, 3647–3658.

Cruttenden, A. (2001). *Gimson's pronunciation of English.* London: Hodder Headline Group.

Dockterman, D. (n.d.). Data and Resources: Country of Origin. In Pew Hispanic Center.Retrieved April 20, 2011, from http://pewhispanic.org/data/origins/.

Evans, B., & Iverson, P. (2004). Vowel normalization for accent: An investigation of best exemplar locations in northern and southern British English sentences. *Journal of the Acoustical   Society of America, 115*(1), 352-361.

Fenson, L., Dale, P S., Reznick, J. S., Bates, E., Thai, D. J., & Pethick, S. (1994). Variability in early communicative development. *Monographs of the Society for Research in Child Development, 59 (5, Serial No. 242).*

Flege, J. E. (1981). The phonological basis of foreign accent. *TESOL Quarterly, 15,* 443-455.

Flege, J. E. (1984). The detection of French accent by American listeners. *Journal of the Acoustic Society of America, 76*(3), 692-707.

Fox, R. A., Flege, J. E., Munro, M. J. (1995). The perception of English and Spanish native vowels by native English and Spanish listeners: A multidimensional scaling analysis. *Journal of the Acoustic Society of America, 97*(4), 2540-2551.

Friederici, A. & Wessels, J. (1993). Phonotactic knowledge of word boundaries and its use in infant speech perception. *Perception and Psychophysics, 54*(3), 287-295.

Halle, P. & de Boysson-Bardies, B. (1994). Emergence of an early lexicon : Infant's recognition of words. *Infant Behavior and Development, 17*, 119-129.

Hollich, G. (2005). Supercoder: A program for coding preferential looking (Version 1.5). [Computer Software]. West Lafayette: Purdue University.

Hollich, G. (2006). Combining techniques to reveal emergent effects in infant segmentation, word learning, and grammar. *Language & Speech, 49 (1),* 3 -19.

Houston, D. M. & Jusczyk, P. W. (2000). The role of talker-specific information in word segmentation in infants. *Journal of Experimental Psychology: Human Perception and Performance, 20*(5), 1570-1582.

Janson, T., & Schulman, R. (1983). Non-distinctive features and their use. *Journal of Linguistics, 19*, 321–336.

Jusczyk, P., & Aslin, R. (1995). Infants' detection of the sound patterns of words in fluent speech. *Cognitive Psychology, 29*, 1-23.

Jusczyk, P., Cutler, A., & Redanz, N. (1993). Infants' preference for predominant stress patterns of English words. *Child Development, 64*, 675-687.

Jusczyk, P., & Luce, P. (1994). Infants' sensitivity to phonotactic patterns in the native language. *Journal of memory and language, 33*(5), 630-645.

Kitamura, C., Panneton, R., Notley, A., & Best, C. (2006). Aussie, aussie, aussie, oi-oi-oi: Infants love an Australian accent. *The Journal of the Acoustical Society of America*, *120*(5), 3135.

MacDonald, M.G. (1989). The influence of Spanish phonology on the English spoken by United States Hispanics. In Hammond, R., & Bjarkman, P. (Eds.), *American Spanish Pronunciation: Theoretical and Applied Perspectives (pp.215-237).* Washington D.C.: Georgetown University Press.

Magen, H. S. (1998). The perception of foreign-accented speech. *Journal of Phonetics, 26*, 381–400.

Mani, N. & Plunkett, K. (2007). Phonological specificity of vowels and consonants in early lexical representations. *Journal of Memory and Language, 57,* 252 -272.

Mani, N. & Plunkett, K. (2008). Fourteen-month-olds pay attention to vowels in novel words.   *Developmental Science, 11*(1), 53-59.

Mani, N. & Plunkett, K. (2011). Does size matter? Segmental cues to vowel mispronunciation detection. *Journal of Child Language, 38*, 606-627.

Maye, J., Aslin, R., & Tanenhaus, M. (2008). The weckud wetch of the wast: Lexical adaptation to a novel accent. *Cognitive Science, 32,* 543-562.

Maye, J., Werker, J. F., & Gerken, L. (2002). Infant sensitivity to distributional information can affect phonetic discrimination. *Cognition, 82*, B101–B111.

Mehler, J., Jusczyk, P. W., Lambertz, G., Halsted, N., Bertoncini, J., & Amlel-Tison, C. (1988). A precursor of language acquisition in young infants. *Cognition, 29*, 144-178.

Morini, G. & Newman, R. (2010, November). Children's ability to generalize across speakers during early word learning. Poster presented at the American Speech Language and Hearing Association convention, Philadelphia, PA.

Mulak, K.E., Best, C.T., Irwin, J.R., & Tyler, M.D. (2008). The effect of dialect on toddler identification of depicted words. International Conference on Infant Studies, Vancouver, BC, Canada.

Mullenix, J.W., Pisoni, D.B., & Martin, C.S. (1989). Some effects of talker variability on spoken word recognition. *Journal of the Acoustical Society of America, 85*, 365-378.

Munro, M.J., & Derwing, T. M. (1995). Processing time, accent, and comprehensibility in the perception of native and foreign-accented speech. *Language and Speech*, *38*, 289 –306.

Nathan, L., Wells, B., & Donlan, C. (1998). Children's comprehension of unfamiliar regional accents: A preliminary investigation. *Journal of Child Language, 25*, 343-365.

Nazzi, T. (2005). Use of phonetic specificity during the acquisition of new words: Differences between consonants and vowels. *Cognition, 98*, 13-10.

Nazzi, T., & Bertoncini, J. (2009). Phonetic specificity in early lexical acquisition: New evidence from consonants in coda position. *Language and Speech, 52*, 463-480.

Nazzi, T, Bertoncini, J., & Mehler, J. (1998). Language discrimination by newborns: Toward an understanding of the role of rhythm. *Journal of Experimental Psychology, 24*(3), 756-766.

Nazzi, T., Floccia, C., Moquet, B., & Butler, J. (2009). Bias for consonantal over vocalic information in 30-month-olds: Crosslinguistic evidence from French and English. *Journal of Experimental Child Psychology, 102*(4*), 522-537.

Nazzi, T., Jusczyk, P. W., & Johnson, E. K. (2000). Language discrimination by English-learning 5-month-olds: Effects of rhythm and familiarity. *Journal of Memory and Language 43,* 1–19.

Nazzi, T., & New, B. (2007). Beyond stop consonants: Consonantal specificity in early lexical acquisition. *Cognitive Development, 22*, 271–279.

Nespor, M., Peña, M., Mehler, J. (2003). On the different roles of vowels and consonants in speech processing and language acquisition. *Lingue and Linguaggio, 2*, 221   247.

Newman, R. S. (2008). The Level of Detail in Infants' Word Learning. *Current Directions in Psychological Science (Wiley-Blackwell)*, 17(3), 229-232

Peterson, G. & Barney, H. (1952).Control methods for a study of the vowels. *Journal of the Acoustical Society of America, 24,*175-184.

Polka, L. & Werker, J. F. (1994). Developmental changes in the perception of non native vowel contrasts. *Journal of Experimental Psychology: Human Perception and Performance, 20(2), 421-435.*

Rost, G.C. & McMurray, B. (2009). Speaker variability augments phonological processing in early word learning. *Developmental Science, 12*(2), 339-349.

Schmale, R., Cristia, A., Seidl, A., & Johnson, E K. (2010). Developmental changes in infants' ability to cope with dialect variation in word recognition. *Infancy, 15*(6), 650- 662.

Schmale, R., Hollich, G., & Seidl, A. (2011). Contending with foreign accent in early word-learning. *Journal of Child Language, 11,* 1-13.

Schmale, R., & Seidl, A. (2009). Accommodating variability in voice and foreign accent: Flexibility of early word representations. *Developmental Science, 12*(4), 583–601.

Schafer, G., & Plunkett, K. (1998). Rapid word learning by fifteen--month-olds under tightly controlled conditions. *Child Development, 69(2)*, 309-320.

Shah, A. P. (2004). Production and Perceptual Correlates of Spanish-Accented English. *Proceedings of the MIT Conference: From Sound to Sense: 50+ Years of Discoveries in Speech Communication*, Massachusetts Institute of Technology (MIT), Cambridge, MA .

Shriberg, L. & Kent, L. (2003). *Clinical Phonetics* (3rd ed.). Boston, MA: Pearson Education.

Sidaras, S. K., Alexander, J. E. D., & Nygaard, L. C. (2009). Perceptual learning of systematic variation in Spanish-accented speech. *Journal of the Acoustic Society of America, 125*, 3306–3316.

Singh, L., Morgan, J.L., & White, K.S. (2004). Preference and processing: The role of speech affect in early spoken word recognition. *Journal of Memory and Language*, *51*, 173–189.

Sommers, M. S., Nygaard, L. C., & Pisoni, D. B. (1994). Stimulus variability and spoken word recognition. I. Effects of variability in speaking rate and overall amplitude. *Journal of the Acoustical Society of America*, 96, 1314-1324.

Sumner, M. & Samuel, A. (2009). The effect of experience on the perception and representation of dialect variants. *Journal of Memory and Language, 60*, 487 501.

Werker, J. F., Fennell, C. T., Corcoran, K. M., & Stager, C. L. (2002). Infants' ability to learn phonetically similar words: Effects of age and vocabulary. *Infancy, 3*, 1–30.

Werker, J. F., & Tees, R. C. (1984). Cross-language speech perception: Evidence for perceptual reorganization during the first year of life. Infant Behavior and *Development, 7*, 49–63.

White, K., & Aslin, R. (2011). Adaptation to novel accents by toddlers. *Developmental Science, 14*(2), 372-384.

White, K., & Morgan, J. (2008). Sub-segmental detail in early lexical representations. *Journal of Memory and Language, 59*, 114–132.

Whitley, M. S. (2002). *Spanish-English contrasts: A course in Spanish linguistics*. Washington, DC: Georgetown University Press.