Attuning to the native dialect: When more means less

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This study examines infants' attention to dialect differences in American and Australian English. Using a visual fixation preference task, Australian and American infants aged 6 months heard sentence sets spoken in Australian- and American-English. Results showed that at 6 months, American infants listened longer to Australian than American sentences, but Australian infants did not differentially respond to the two dialects. It is probable that Australian infants have more exposure to the American dialect (e.g. television programs) than American infants to the Australian dialect. Thus, it was predicted, with less experience, Australian 3-month-olds would show a dialect preference comparable to American 6-month-olds. Data from 3-month-old infants support this hypothesis; they listen longer to Australian than American sentences. Together the results imply that in the first year, the ability to discriminate two dialects decreases as infants filter out irrelevant phonetic information and cluster American and Australian dialects into the same language group.

1. Introduction

Infants begin attuning to their native language well before birth, since responsiveness to auditory stimulation emerges around the fifth to sixth month of foetal life (Bredberg, 1985). Thus the foetus can hear aspects of the extra-uterine world through the walls of the mother's womb including ambient speech, which although segmentally impoverished, is rich in prosodic information. In this way, infants are exposed to sufficient low frequency speech information in the womb to enable them at birth, to distinguish their own mothers' voice from a female stranger's voice (DeCasper & Fifer, 1980), and to recognize their native language (Mehler et al., 1988). It is also the case that during their first few months, infants can discriminate both native and non-native consonant and vowel contrasts (1971; Trehub, 1976); an ability which is also found in infrahuman monkey species (Kuhl & Padden, 1983; Morse & Snowden, 1975).

In the early months, infant speech abilities appear to depend on general auditory processing at the psychoacoustic level with little influence from ambient phonetic or phonological information (Aslin & Pisoni, 1980). However, by the end of the first year, infant consonant discrimination shows experience-related effects, such that there is a substantial decline in discriminating most non-native contrasts by 9-11 months (Best, McRoberts, Lafleur, & Silverstadt, 1995; Werker & Lalonde, 1988; Werker & Tees, 1984). Language specific attunement occurs earlier for vowels, and perhaps in a different manner to consonants (Kuhl, Williams, Lacerda, Stevens, & Lindblom, 1992; Polka & Werker, 1994). While newborns and 4-month-olds can discriminate native and non-native vowels alike (Polka & Werker, 1994; Trehub, 1976), by 6 months experience-related effects emerge showing that phonetic categories are becoming organized around native language vowel prototypes such that poor exemplars are assimilated into the vowel prototype (Kuhl et al., 1992; Polka & Werker, 1994).

There is thus extensive evidence showing that experience with the patterns of ambient speech has systematic effects on infants' perception of segmental information well before the first birthday. Furthermore it is the case that suprasegmental attunement also occurs, and increasingly becomes more language-specific. While newborns can discriminate between their own and another language, they cannot discriminate between two non-native languages (Mehler et al., 1988) unless they are from different rhythmic classes (Nazzi, Bertoncini, & Mehler, 1998). In low-pass filtered conditions, newborns continue to prefer their native language showing that early in development this preference is based on suprasegmental, not segmental information (Mehler et al., 1988). By 5 months, infants can discriminate their native language from other languages within the same rhythm class (Nazzi, Jusczyk, & Johnson, 2000) and by 9 months recognize their native language using phonetic and phonotactic information (Jusczyk et al., 1993a). While the mechanism for discrimination by young infants is usually ascribed to intonation and/or rhythm, it has recently been shown that 5-month-olds are also able to make fine discriminations between dialects of their language *within* the same language and rhythm class (Nazzi et al., 2000).

The focus in research investigating the development of speech perception abilities has been on how infants tune into the properties of their native language, either in terms of native language consonant and vowel segments, or the fine details of native language prosody, such as its rhythm, intonation and stress patterns. The recent series of experiments conducted by Nazzi and colleagues was aimed at demonstrating infants' growing knowledge of the details of their native language rhythm as opposed to the general rhythm of the class to which their native language belongs (Nazzi et al., 2000). Accordingly, they found that American English infants do not discriminate two non-native stress-based languages (German and Dutch) but can discriminate English and Dutch, and surprisingly, make the fine within-language discrimination between American and British dialects of

English. These two English dialects have very similar segmental and suprasegmental properties. However, rhotic "r" is found in American-English, and there are differences in the distribution of vowels in F1/F2 space even though the number and type of vowels is similar in both dialects (Labov, Ash, & Boberg, 2006; Wells, 1982). Furthermore, although prosodic variation is also minimal, an analysis of the experimental stimuli in the Nazzi et al. study showed British-English had higher F_0 in the utterance initial position, more terminal rises, and that there was a tendency for the vowels to be longer in stressed syllables, and shorter in unstressed syllables than American-English (Nazzi et al., 2000). Thus, there is the possibility that 5-month-olds can detect some or all of these subtle nuances in segmental and suprasegmental information.

A prosodic explanation of the Nazzi et al. results is the most probable with what we know of infants' attunement to linguistic rhythm, and the strongest source of evidence for this comes from a study conducted by Bosch and Sebastian-Galles (1997) who investigated 4-month-old preferences for two phonologically and prosodically close languages - Spanish and Catalan. Spanish and Catalan are both syllable-timed languages that have some differences at both the segmental (Spanish has five vowels while Catalan has eight), and suprasegmental level (there is vowel reduction in Catalan but not in Spanish). Their results showed that both Catalan and Spanish 4-month-old infants prefer their own language, and that the preference persisted even when infants were tested using low-pass filtered versions of the language samples. Thus, Bosch and Sebastian-Galles attribute a primary role to linguistic rhythm in the acquisition and organisation of native language speech perception in infancy.

The results from Nazzi and colleagues, and Bosch and Sebastian-Galles appear to show that both 4- and 5-month-old infants can make very fine distinctions between two similar languages/dialects based on subtle prosodic differences. However, other sources of evidence suggest this conclusion is problematic. Firstly, English 6-month-old infants do not show a preference when presented with two lists of English words, one list with strong-weak (e.g. pliant) and the other with weak-strong (e.g. comply) stress pattern, whereas by 9 months, infants prefer the more common strong-weak pattern found in English (Jusczyk, Cutler, & Redanz, 1993a). Secondly, both English and Dutch 6-month-olds show no preference for their own language if tested with English and Dutch word lists (Jusczyk, Friederici, Wessels, Svenkerud, & Jusczyk, 1993b). While it is true these latter two studies used word lists and not sentences, and the second was designed to examine the transition from a reliance on prosodic information to phonetic/phonotactic detail to process speech, it is also the case that 6-month-olds cannot discriminate the more substantial suprasegmental differences between Dutch and English (Jusczyk et al., 1993b), whereas it is claimed they can discriminate smaller suprasegmental differences between American- and British- English (Nazzi et al., 2000).

These apparently conflicting results call for a more in-depth investigation of infant *dialect* perception. Indeed, recent findings in this area indicate that the account of how infants attune to native language dialects is more complex than previously presumed (Diehl, Panneton, Kitamura, & Burnham, 2006; Phan & Houston, 2006). Diehl et al. (2006) tested 6- and 8-month-old American infants using utterances derived from corpora of naturalistically collected speech from American and Australian mothers. Their results show at 6 months of age American infants can discriminate the two dialects, as they pay more attention to Australian- than American-English. However, 8-month-olds, show no preference, and when 6-month-olds are presented with low-pass filtered dialect stimuli, the preference disappears. Extensive work by Phan and Houston (2006) also reports a similar decline in the ability to discriminate dialect information. They tested infants at 7, 11, 14, and 24 months using repetitions of the word "pine" recorded in *north midland* and *southern* American English, and only the youngest group of 7-month-olds could discriminate the two pronunciations of "pine". Rather than indicate an improvement in infants ability to detect their ambient dialect, these results reveal a decline in discrimination of dialect information. This study will extend these finding by testing 6-month-old American and Australian infants' preferences for their native dialect, but instead of naturalistic utterances, utterances containing identical words, and matched for mean F0, pitch range, duration and positive affect will be used. It is expected that Australian infants will follow the trend of American infants and differentiate Australian from American English.

2. Method and Results

The experiments reported below test Australian and American infants' ability to detect differences between two English dialects, Australian and American.

2.1. Experiment 1

In Experiment 1, 6-month-old Australian and American infants were tested with Australian- and American-accented English using a visual fixation preference procedure.

2.1.1. Participants

In the American sample, 20 infants (9 males, 11 females) aged 6 months (mean age= 26.2 weeks, SD=1.2) from monolingual American-English speaking families were successfully tested. An additional 3 infants were not included due to fussiness (1), equipment failure (1), a sibling watching the Australian group the *Wiggles* on television (1). The Australian sample consisted of 24 infants (13 males, 11 females) aged 6 months (mean age=26.1weeks, SD=1.1) from monolingual Australian-English speaking families. An additional 3 Australian infants were not included due to fussiness.

2.1.2. Dialect Stimuli

For the dialect stimuli, 4 American and 4 Australian female speakers produced multiple tokens of 5 sentences using an infant-directed speech register. The Australian speakers were from the Sydney region of Australian, and spoke with a *general* Australian dialect. The American speakers were from the University town of Blacksburg, Virginia (but were not born there), and tended to speak with a *midland* accent (Labov et al., 2006). The 5 sentences were 'We came in our car, didn't we?', 'Where's your toy?', 'Let's look for a game,' 'Look at the orange bears', and 'Today is going to be so nice.' All utterances were acoustically analysed for mean F_0, pitch range and duration. Because vocal affect has been shown to influence infants' preferences for speech (Kitamura & Burnham, 1998; Panneton, Kitamura, Mattock, & Burnham 2006; Singh, Morgan, & Best, 2002) each utterance was also rated for its level of positive vocal affect by 12 post-graduate

students. Based on matching acoustic and affective measures, 3 American and 3 Australian strings were constructed. Each string contained an exemplar of the 5 sentences and in most cases included tokens from all four speakers. The sentences and strings were appended and looped with a 500ms gap between them. The strings were counterbalanced between infant participants so that one third of the infants heard the string order 1, 2, 3; one third heard string order 2, 3, 1 and one third heard string order 3, 1, 2. The dialect stimuli were presented paired with an image of a coloured bulls-eye on a video screen at an intensity level of 60-65dB SPL (A).

2.1.3. Apparatus and Procedure

A serial visual fixation preference method was used, the sequencing of which was controlled by SerialPref developed by MARCS Auditory Laboratories programmers. Infants sat on their parent's lap facing a video monitor placed slightly to the right of infants' midline. At the beginning of testing, the infant's attention was drawn to the screen with a set of silent flashing multi-coloured circles. Once the infant fixated the screen for 2 seconds, testing began. On each trial, presentation of the dialect stimuli was controlled by the infants' fixation on a coloured bulls-eye, and continued until the child looked away for more than 2 consecutive seconds or 40 seconds had elapsed; then the screen flashed multi-coloured circles until the infant looked back, at which time the next trial began. There were 6 trials of each dialect, with dialect presentation alternating across trials for a total of 12 trials. The order of dialect presentation in trials was counterbalanced across participants, so that half the infants heard American-English first, and the other half heard Australian-English first. The experimenter was blind to the order of trials.

2.1.4. Results and Discussion

Figure 1 shows the mean fixation times of the American and Australian infants to the two dialects. The data were analysed in two (2) x 2 ANOVAs with dialect (Australian/American) as the within-participant variables and order of presentation (Australian first/American first) as the between- participants' factor. The results for the American infants show a significant main effect for dialect $F(1,18)=5.58$, $p<.03$, $\eta^2=.237$, a significant order x dialect interaction, $F(1,18)=5.77$, $p<.027$, $\eta^2=.243$, but no main effect for order. The significant main effect for dialect reveals that American 6-month-olds listen longer to Australian- (mean=17.1, SD=5.7) than American-English (mean=14.8, SD=4.95). However, the significant order x dialect interaction ameliorates this finding as it indicates there were equivalent fixation times to the two dialects when American infants heard Australian first, but when they heard American first, they looked longer to Australian- (mean=19.9) than American-English (mean=14.8). It seems that if American infants hear Australian first, they treat Australian as a member of their native language, so that when they hear American next, they categorise the two dialects as one. However, if they hear American first, their own dialect acts as a baseline, so when they hear the Australian accent next it is perceived as different.

The data for the Australian infants were analysed using the same approach. The results revealed no significant main effects for dialect or order, but there was a trend towards a significant dialect x order interaction (p=.093). Six-month-olds showed statistically equivalent fixation times to Australian- (mean=16.98, SD=5.46) and American-English (mean=15.93, SD=6.41) with a trend to Australian infants preferring their native dialect but only when they hear it first.

The results show that American infants can discriminate American- from Australian-English, but Australian infants show no differential responsiveness to the two dialects. The results for the Australian infants was unexpected given American 5-month-old infants discriminate British- and American-English sentences, (Nazzi et al. (1998); American 6-month-olds discriminate naturalistic Australian- and American-English (Diehl et al., 2006), and 7-month-olds discriminate the same word pronounced in two North American dialects (Phan & Houston, 2006). However, more to the point here, is the fact that when American and Australian infants of the same age are tested with the same procedure and same dialect stimuli, only the American infants show a preference. Usually, if an infant shows a preference for one stimulus over another, it implies that they discriminate the two stimuli. Nevertheless it is possible that Australian infants find the two dialects equally salient, and in the event that this is the case, discrimination was tested directly.

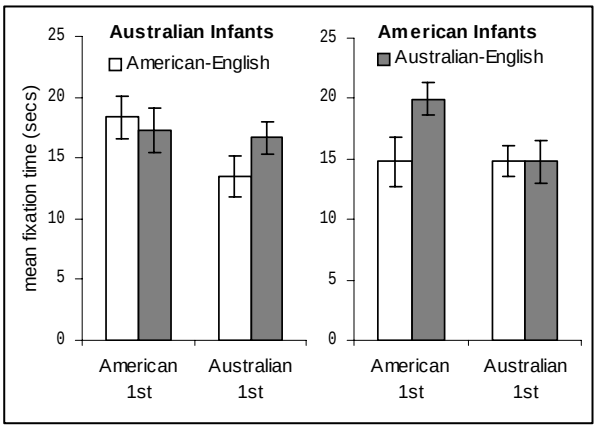

Figure 1: Mean fixation times to American- and Australian-English dialects for the two groups of 6-month-old infants who heard American-English first, and Australian-English first. The results for the Australian infants are shown in Panel (A) and for the American infants in Panel (B).

2.2. Experiment 2

Experiment 2 tests 6-month-old Australian infants' ability to discriminate Australian- and American-English dialects.

2.2.1. Participants

Eighteen infants (11 females, 7 males) aged 6 months (mean=25.8 weeks; range=24.3-27.6 weeks) from monolingual Australian English backgrounds were successfully tested. An additional 2 infants were not included due to technical faults.

2.2.2. Dialect Stimuli

The same dialect stimuli described in Experiment 1 were used.

2.2.3. Apparatus and Procedure

An infant-controlled habituation procedure was used to test dialect discrimination. As in the preference task used in Experiment 1, presentation of stimuli was controlled by the infants' fixation on a coloured bulls-eye on the monitor in

front of them. The audio stimuli were played for as long as the child fixated on the monitor, and trials ended when the child looked away for 2 seconds. The same set of silent multi-coloured flashing circles was used to draw the infants' attention to the screen at the beginning of testing and between trials. In the habituation procedure, however, the same habituation stimulus (one dialect) was presented on repeated trials until there was an average 50% decrement in looking times over two trials (compared to the average of the first two trials). Once this criterion was met, there were two no-change control trials of the habituation dialect, followed by two test trials of the novel stimulus (the other dialect). The habituation stimulus was counterbalanced so that half the infants heard the American dialect first, and the other half heard the Australian dialect first. Infants were said to discriminate the two sets of stimuli if they showed a recovery response (longer fixation times) in the novel trials as compared to the control trials.

2.2.4. Results and Discussion

Figure 2 shows mean fixation times and standard errors in the control trials and in the novel trials. A (2) (trial type) x 2 (presentation order) ANOVA was used, with trial type (control/novel) as the within-participants variable, and order of presentation of the habituation stimulus (American first/Australian first) as the between-participants factor. The results revealed no significant effects for trial type (p = >.2), order or dialect x order interaction. There was no difference in average looking times in the two control trials (mean=10.1) compared to the two novel trials (mean=8.6). It is clear from the results from Experiment 1 and 2 that 6-month-old Australian infants cannot discriminate between their native Australian dialect and American English.

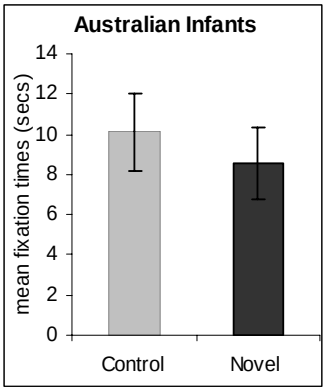

Figure 2: Mean fixation times in habituation control trials and novel test trials by Australian 6-month-olds

If the diminishing ability to discriminate two native dialects is a function of increasing experience with the native language, not dialect per se (Diehl et al., 2006; Phan & Houston, 2006), then it might be the case that younger Australian infants will be able to discriminate American- and Australian-English dialects. The developmental acceleration in Australian infants may be due to them hearing American accents through American media broadcast on the home television. American infants, on the other hand, would have little or no exposure to Australian English. An alternate but less preferred explanation is that Sydney, Australia has a more multi-cultural population than Blacksburg, Virginia and that this mix of languages and dialects influences early infant speech perception. Whatever the source, it was predicted that with less experience of American-English than 6-month-olds, Australian 3-month-olds would show a dialect preference comparable to that shown by American 6-month-olds.

2.3. Experiment 3

Experiment 3 tests 3-month-old Australian infants' dialect preferences using a visual fixation task.

2.3.1. Participants

Twenty-one infants (12 females, 9 males) aged 3 months (mean=15.1 weeks, SD=1.48) from monolingual Australian-English speaking families were successfully tested. An additional 3 infants were not included due to fussiness and/or crying.

2.3.2. Dialect Stimulus

The same dialect stimuli described in Experiment 1 were used (section 2.1.2).

2.3.3. Apparatus and Procedure

A serial visual fixation preference method was used as described in Experiment 1 (section 2.1.3)

2.3.4. Results and Discussion

Figure 3 shows the mean fixation times to American- and Australian-English by 3-month-old Australian infants. Infants fixated on Australian-English for an average 19.9 seconds (SD=6.9) and on American-English for an average 17.4 seconds (SD=6.4). A (2) (dialects) x 2 (order of presentation) ANOVA revealed a significant main effect for dialect, F (1,19)=6.043, p<.02, η^2 =.241, no main effect for order, nor a dialect x order interaction. Thus, regardless of whether infants heard American or Australian English first, they listened significantly longer to Australian- than American-English.

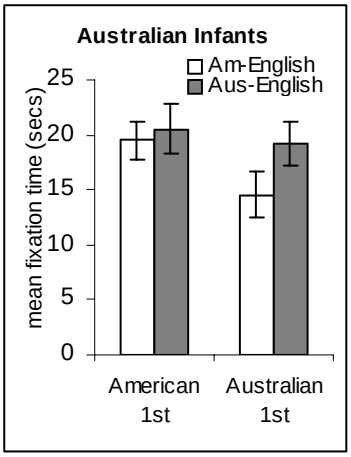

Figure 3: Mean fixations times to Australian- and American-English by Australian infants aged 3 months.

The present findings support the hypothesis, and provide confirmation that the more exposure an infant has to a non-native dialect the less likely they are to discriminate it from the native dialect. In the case of Australian infants, it seems likely that their exposure to background American television programs during day-to-day activities has accelerated this process.

3. General discussion

This study examined American and Australian infants' attunement to their native dialect. It was shown that while 6-month-old American infants can discriminate native and non-native English dialects, Australian 6-month-olds cannot. It was assumed that the reason for the diminished ability to discriminate dialects by Australian 6-month-old infants was because they are exposed to American accents through their experience with American media. Therefore, we tested the hypothesis that a younger group of Australian infants with less exposure to American English would be able to discriminate

American and Australian dialects. This hypothesis was supported; 3-month-old Australian infants listened longer to Australian- than American-accented English indicating that they could indeed discriminate the two dialects.

The results indicate that exposure to a non-native dialect accelerates attunement such that by 6 months, Australian infants have categorized Australian and American accents as the same language irrespective of dialect, whereas American infants with little or no exposure to Australian English take longer to do this. Furthermore American infants only respond differentially to the two dialects if they hear their own dialect first in testing, suggesting that it acts to contrast the subsequent presentation of the non-native dialect. However, when they hear Australian first, they appear to recognize it as their own language, and do not respond to differences between Australian- and American-English, indicating that American 6-month-olds are on the threshold of classifying the two dialects as one.

It might be asked what attunement to the native dialect means, when dialect attunement appears to take a different, but most likely parallel course, to that taken as infants attune to the properties of their native language. While we know native *language* experience improves infants' ability to distinguish native and non-native languages (Hayashi, Tamekawa, & Kiritani, 2001), evidence suggests this experience also impairs the ability to discern *dialect* differences (Diehl et al., 2006; Phan & Houston, 2006). Moreover, as found here, even detached encounters with another native dialect exacerbated this effect.

This study seems to raise more questions than it answers. We might ask why infants group dialects into the same language category, when we know that adults easily recognize dialectal accent, and that dialect functions as an important social marker enabling the listener to identify the speakers' geographical and ethnic origin, and social status (Wells, 1982). The phenomenon must serve some purpose in early life, but at what point in development does the child regain the ability to recognize a dialect as different to their own (Phan & Houston, 2006)? Probing this issue would enhance insight into the development and organization of early speech perception abilities, with the recovery of native dialect recognition signaling more sophisticated speech perception abilities.

Another critical question raised is, by what mechanism do infants categorise dialects? One could argue that infants very efficiently filter out irrelevant phonetic information in order to classify two dialectal accents as the same, in a similar manner to the way infants categorise native language phonemes. There is overwhelming evidence to show that older infants ignore linguistically irrelevant non-native phonemes, so that it becomes increasingly difficult for them to distinguish non-native vowels by about 6 months (Kuhl et al., 1992; Polka & Werker, 1994) and non-native consonants by the end of the first year (Best et al., 1995; Werker & Tees, 1984). However, unlike dialect discrimination, in the case of native language phoneme discrimination, infants' performance approximates that of adults.

Phonetic variation in vowels is a likely source of variability as the majority of English dialectal differences are carried in the properties of the vowels, including the differences between American and Australian dialectal accents used here. In this study, there are indications that infants assimilate variations of vowels into a single category in a manner akin to the perceptual magnet effect proposed by Kuhl (Kuhl, 1991; Kuhl et al., 1992). Kuhl proposes that phonetic categories are organised around native language prototypes, which act as perceptual magnets to attract neighbouring representations of the vowel, and this occurs around 6 months of age. Thus, a pair of non-prototypical, poor vowel exemplars is better discriminated than a pair of good vowel exemplars the same distance apart in formant space, but closer to the prototype, by 6-month-old infants and adults alike (Kuhl, 1991). However, there is considerable disparity between the sentence stimuli used in this study and the exemplars of single vowels from a single dialect used in Kuhl's studies. Thus it would seem that while vowels may be implicated, this argument is speculative, and the issue best addressed in a systematic manner in future experiments.

Another possible explanation of how infants group dialects is the way in which humans generally group sounds together which vary along phonetically irrelevant dimensions, such as voice pitch, speaking rate, sex of speaker, and other differences between speakers. Infants acquire the ability to deal with speech variability very early in life, such that between 1 and 4 months infants can categorise vowels into the categories /a/ and /i/, despite within- and between-vowel variations in pitch (Kuhl & Miller, 1982); at 2 months infants classify two syllables as different despite their presentation by multiple speakers (Jusczyk, Pisoni, & Mullenix, 1992); and at 6 months successfully generalise the distinction between two vowels presented by male, female or children's voices, either when they are spectrally distant (Kuhl, 1979) or spectrally similar (Kuhl, 1983). This indicates that, despite a reliance on psychoacoustic processing, there is some rudimentary phonetic processing occurring in young infants. However, how sophisticated this ability is, is still to be examined.

4. Conclusions

The results show that the *more* exposure an infant has to a non-native dialect the *less* likely they are to discriminate that dialect from their own. What explanation is there for this phenomenon? It is possible the mechanism responsible for organizing early speech perception is "over active" and infants perceive differences between accents as speaker variability, and thus classify close dialects as the same. Mechanisms responsible for the perceptual magnet effect (Kuhl, 1991; Kuhl et al., 1992) may also be involved. This explanation is in accord with an account where infants are persistently acquiring knowledge of their native language (not dialect), and early in development it may be more functionally adaptive to acquire general native language knowledge, rather than to differentiate dialects. Thus, examining the age at which the ability to discriminate between dialects returns would provide valuable information about the development and organization of early infant speech perception.

At this point, we can only speculate on why and how infants group dialects together. Furthermore, it seems infants may not require experience with the non-native dialect to classify two dialects as the same (Diehl et al., 2006; Phan & Houston, 2006). However, this study indicates that familiarity with a dialectal accent accelerates the categorization of dialects as belonging to the same native language. Experiments are currently being conducted with an unfamiliar English dialect to confirm this proposition. These experiments will also substantiate the assumptions in this

study that background speech such as that heard from a non-interactive source such as the television impinges on infant speech perception (Kuhl, Tsao, & Liu, 2003). Clearly, there is much to learn about infant speech processing from the study of infant responses to dialect information.

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