What's in a Name?: How Infants Respond to Some Familiar Sound Patterns

Denise Mandel-Emer
Department of Psychology
St. Bonaventure University
St. Bonaventure, NY 14778

Peter W. Jusczyk
Departments of Psychology & Cognitive Science
Ames Hall
Johns Hopkins University
Baltimore, MD 21218

The research discussed here was conducted while DM-E was supported by a training grant from NIDCD (DC #00036). In addition, funding for this investigation was made possible by a research grant from NICHHD (# 15795) to PWJ. The authors which to thank Ann Marie Jusczyk, Amy Gambon-Dennis, Nancy Redanz, Debbie Dombrowski, and Eileen Worden for their help in testing and recruiting participants. We also thank Deborah Kemler Nelson and David Pisoni for helpful comments on portions of the experimental designs, and Thierry Nazzi and Ann Marie Jusczyk for their comments on the paper. Some of the studies (Experiments 5 & 6) were conducted as part of the first author's dissertation research. She would like to thank all of her committee members (Peter Jusczyk, James Sawusch, Paul Luce, Nancy Collins, & Elaine Hull) for their helpful comments and guidance throughout the evolution of her dissertation proposals and investigations. Correspondence may be addressed to either author.

Abstract

Mandel, Jusczyk, and Pisoni (1995) demonstrated that 4.5-month-olds recognize the sound patterns of their own names. Using the headturn preference procedure, we explored the changing nature of infants' name representations and their potential use in attaining other language-processing milestones. Experiments 1 - 3 explored the specificity of name representations and infants' responsiveness to other socially-salient items. Experiments 4 - 6 moved beyond recognition of socially-salient patterns, and tested the effects of name recognition in on-line processing, such as name detection in fluent speech contexts and its potential role in to segmenting other words. Results suggest that names may be special lexical items which are recognized earlier and in more detail than other words during early stages of language learning.

From about the age of two years on, it has been estimated children learn at least ten new words a day and that by the age of seven, they have acquired close to 14,000 words (Clark, 1993). Much of the literature on word learning has focused on comprehension. Consequently, most studies have tended to examine when children come to understand the referential function of words. Other studies have concentrated on children's ability to learn distinctions between common and proper nouns, specifically, that common nouns refer to classes of objects, while proper nouns refer to specific individuals (Katz, Baker & Macnamara, 1974; La Palme Reyes, Macnamara, Reyes & Zolfaghari, 1993).

In order for successful language acquisition to occur, infants must learn word meanings and the referential function of labels. However, building a lexicon also requires infants to identify possible words (sound patterns) in their language, and recognize these patterns on subsequent occasions. For example, not only do infants have to discover that "baby" is a possible word in English, but also they must be able to recognize it when spoken by different talkers and in different sentential contexts. However, talker differences, changes in speaking rates, and surrounding sentential contexts are all known to affect the acoustic characteristics of a given word (Cole & Jakimik, 1978; Klatt, 1986; Liberman & Studdert-Kennedy, 1978; Mills, 1980). This acoustic variability in the production of words is so important that it has been a considerable obstacle in accurate machine recognition of words (Bernstein & Franco, 1996; Marcus, 1984; Reddy, 1976).

Storing information about the specific words of a language would be easier if naïve learners always heard potential forms in isolation (e.g., "baby"…. "baby"…. "baby"). However, even when mothers are explicitly instructed to teach their children new words, they typically present items as single-word

utterances only about 20% of the time (Woodward & Aslin, 1990). This suggests that early lexical development involves at least some rudimentary ability to segment words from fluent speech.

Nevertheless, it is possible that infants hear some types of words frequently in isolation during their first year. For example, when trying to attract an infant's attention, parents often repeat the child's name in isolation (Leopold, 1939; Leopold, 1947; Morikawa, Shand & Kowsawa, 1988; Newport, 1977; Phillips, 1973; Ringler, 1981; Snow, 1972). Even when the name is used within the context of a sentence, it is often separated by a prosodic pause (e.g., "Johnny, look at mommy"; "Johnny, don't touch that!"). This deliberate pausing increases the likelihood that the child will orient to the name before further information is provided (Durkin, Rutter & Tucker, 1982; Smiley & Huttenlocher, 1995). Furthermore, research has demonstrated that when mothers do utter infants' names within the context of a sentence, they tend to place them in salient utterance positions (Durkin et al., 1982; Newport, Gleitman & Gleitman, 1977; Slobin, 1973; Smiley & Huttenlocher, 1995) and will often sacrifice grammaticality in order to maximize the attention-getting function of name usage (Durkin et al., 1982). In sum, one characteristic that proper name usage seems to have is that names are uttered to infants early on in a manner that makes them most salient to the child – they are isolable, they are frequently used, and they appear in prominent utterance positions. Such usage would seem to attract the child's attention to their names early on, causing them to be learned perhaps earlier than other, less salient words.

Mandel, Jusczyk, & Pisoni (1995) investigated whether repetitions of infants' own names were more likely to capture their attention than repetitions of other

infants' names. In particular, they explored whether 4.5-month-olds would listen significantly longer to isolated repetitions of their own names. A modified version of the Headturn Preference Procedure (Kemler Nelson et al., 1995) was used to test the infants. The stimulus materials consisted of four names: the infant's own name, and three foils. One foil matched the stress pattern of the infant's own name; the other two had the opposite stress pattern. For example, an infant named "Aaron" might be presented with three foils such as "Corey" (same stress), "Christine" (opposite stress), and "Michele" (opposite stress). The rationale for creating the "stress-matched" and "stress-mismatched" foils had to do with the possibility that young infants might only have partial representations of their names early on. For instance, if 4.5-month-olds have only learned the global prosodic features of their own names, then although they might distinguish their own names from ones with different stress patterns, they might not distinguish them from other names with the same stress pattern. In fact, the infants listened significantly longer to their own names than to any of the other names - even ones with the same stress patterns as their own names. Thus, it appears that very young infants have begun to store a representation of their names that allows for sound-based recognition (even though they might not yet realize that the name has meaning or serves a specific, referential function). This sound-based representation is evidently fairly detailed -- 4.5-month-olds did not "false alarm" to sound patterns that were prosodically similar to their own names.

Young infants have learned to differentially respond to a particular sound pattern which will ultimately have special personal and conceptual significance for them (Howarth & Ellis, 1961; Moray, 1959; Van Lancker, 1991; Wood &

Cowan, 1995). This suggests that an infant's name might be among the very earliest lexical entries, along with possibly other words which are frequently used in the infant's social-communicative environment. Infants' names, along with other potentially salient items, might then serve some linguistically useful function during the first year of life as infants begin to learn about the structure of their language, and how to efficiently process the complexities inherent in fluent infant-directed speech addressed.

The following series of experiments were designed to further explore how infants respond to the sound patterns of their own names throughout the first year of life. The general aim was to investigate whether early sound-based storage of the name in lexical memory might serve some important and interesting function with regard to further language development and more efficient language processing. Mandel et al.'s (1995) finding that 4.5-month-olds listen longer to their own names raises some interesting questions. For example, how detailed are infants' representations of their names, and how do these representations change over time? Is the infant's name a special sound pattern, or do very young infants also show evidence of recognizing other socially-salient words likely to occur in their early language environments (e.g., "baby", or "mommy")? Does the early storage of the sound pattern of one's own name in the lexicon facilitate the attainment of other important milestones in language processing and acquisition? For instance, can infants detect their own names within sentential contexts sooner than they detect other words in fluent speech? If so, how might familiarity with these sound patterns facilitate the segmentation of other items from fluent speech? The present study explored these questions to trace out the implications of early name recognition on language development.

Experiment 1

Mandel et al. (1995) found that, by 4.5 months of age, infants recognize the sound pattern that corresponds to their names. The fact that infants listened longer to the sound patterns of their own names over prosodically-matched foils suggests that even this early representation of the name is fairly specific. However, what is not clear from this initial study is just how specific the early name representation is. Although Mandel et. al presented infants with foil names, which either matched or mismatched the stress patterns of their own names, the phonetic content of the foils in relation to the infants' own names was not directly manipulated. Thus, it is conceivable that young infants store only an incomplete phonetic representation of their names early in development. Might infants false alarm to names that are close phonetic neighbors to their own names? A number of investigators have suggested that at the early stages of language development, infants may only encode a level of phonetic detail that is sufficient to distinguish items from one another in their receptive lexicons (Charles-Luce & Luce, 1990; 1995; Jusczyk, 1986; 1993; Walley, 1988; 1993). Such representations would be more global and less precise than that of adults. If so, it is possible that infants' incomplete representations could lead to misses and false alarms in word recognition under certain conditions (but see Gerken et al., 1995). This global storage strategy may suffice during the early stages of vocabulary acquisition, because infants' early lexicons may be less densely populated than those of adults – i.e., a given item in the infant's lexicon may have very few highly similar "neighbors" to compete with (Charles-Luce & Luce, 1990; 1995;

Logan, 1992). In a longitudinal survey of the vocabulary development of five children, Logan (1992) found that a less-than-complete phonetic encoding of a word's sound pattern (e.g., one that considers more global features such as stress pattern and manner of articulation) would be sufficient to distinguish most words for children below the age of five years.

Thus, it is possible that at the earliest stages of language learning, infants' representations of their own names may include only the more salient details of these patterns, such as prominent vowels and manner of articulation (e.g., the presence of stops, fricatives, or nasals). Less salient characteristics, such as precise details about place of articulation, might not be fully specificied in the information stored about their names[1]. If so, then one might expect to find that although young infants respond to their own names, they might also respond to close approximations of these names, such as ones that differ by a single place of articulation feature (e.g., "Bob" vs. "Dob").

Previous research on infant speech perception provides some clues about how infants might respond to items that are phonetically similar to their own names. For example, Jusczyk and Aslin (1995) found that 7.5-month-old English-learners who were familiarized with items like "tup" and "gike" did not subsequently generalize from these to a highly similar words such as "cup" and "bike" when the latter appeared in sentential contexts. Similarly, Tincoff and Jusczyk (1996) found that 7.5-month-olds familiarized with items that differed in their final segments from words that later appeared in sentential contexts, did not generalize to these (i.e., familiarization with "cut" did not lead infants to

[1] Results of a recent investigation with 9-month-olds (Jusczyk, Goodman & Bauman, submitted) indicate that infants at this age are attentive to the manner of articulation properties of the onsets of syllables, but not to place of articulation properties.

respond to "cup"). However, Hallé and Boysson-Bardies (1996) reported that 11-month-old French-learning infants were as apt to listen to lists of items which differed from known words in their initial phonetic segments as they were to lists of the known words. This finding suggests that their representations of the known words were phonetically underspecified. Although the paradigms used in these two investigations differed in several ways, a critical factor in explaining the differences in the experimental outcomes seems to be whether the infants were matching the input to a previously stored lexical item attached to some referent or just to a stored sound pattern. Results of a recent investigation by Stager and Werker (1997) provide some additional support for this position. They found that 8-month-olds successfully discriminate the kind of phonetic detail that 14-month-olds have difficulty with in learning novel words. The 14-month-olds can still discriminate the phonetic details, but they do not seem to use these details in the word learning task. Stager and Werker attribute this to a change in the ability to use phonetic detail as infants move from listening to sound patterns to learning words. Given these observations, we might suppose that at the earliest stages of recognizing the sound patterns of their own names, infants will attend more closely to the phonetic details of these patterns. To examine this issue more closely, Experiment 1 explored the specificity of infants' name representations by presenting them with foils that differed in place of articulation from the first phoneme in their own names.

Method

Participants. Twenty-four infants from monolingual, English-speaking homes (11 males, 13 females) with a mean age of 19 weeks, 6 days (range = 18

weeks, 3 days to 21 weeks, 5 days) were recruited from the Buffalo Metropolitan area to participate in the present study. An additional 19 infants were tested but not included in the study for the following reasons: crying (14), failed to look to the flashing lights (3) and experimenter error (2). Each infant was paid $5.00 for a single visit to the laboratory. Any infants with known hearing disorders were excluded from the study.

Stimuli. Following Mandel et al. (1995) infants were presented with isolated repetitions of 4 names. One name differed from the infant's own name by a single phoneme. Another name followed the same stress pattern of the infant's own name (but was not phonetically similar). The remaining two names had different stress patterns from the infant's own name. The infant's own name was never presented. Thus, in the present study, if the infant's name was "Bob", he might hear repetitions of "Dob", "Jim", "Michelle", and "Darlene".

The foil, which represented a single phonetic variation on the infant's own name, was created by making a place of articulation change in the strong syllable of the infant's name. This seemed like a reasonable change to make to test the specificity of infants' name representations, since place of articulation changes are rather subtle, and arguably among the more difficult distinctions to detect. For example, under noisy conditions, adults are more apt to misidentify place of articulation features than they are to misidentify manner of articulation features (Miller & Nicely, 1955; Wang & Bilger, 1973). To control for the possibility that some names might be inherently more interesting to listen to, all infants did not hear the same set of foils. A monolingual, English-speaking talker recorded repetitions of all name items for the current study. She was instructed to record the names as if calling to an infant, with attention-getting prosody. Each name

was repeated 15 times in a row with some variation of prosody. The sound files were digitized at a 20 kHz sampling rate via A/D converter and stored on a VAXStation Model 3176 computer. Digitized versions of the samples were transferred to a Macintosh computer for playback during the experiment.

Apparatus. A Macintosh Quadra 650 computer controlled the presentation of the stimuli and recorded the observers' coding of the infants' headturn responses. The audio output for the experiment was generated from the digitized waveforms of the speech samples. A 16 bit D/A converter (at a 20 kHz sampling rate, and low-pass filtered at 9.5 kHz) was used to recreate the audio signal. The output was fed through anti-aliasing filters and a Kenwood audio amplifier (KA 5700) to one of two 7-inch Advent loudspeakers mounted on the side walls of the testing booth.

Design and procedure. As in Mandel et al. (1995) all infants were tested on a modified version of the Headturn Preference Procedure (for an extensive discussion concerning the reliability of this procedure, see Jusczyk, in press; Kemler Nelson et al., 1995; Polka, Jusczyk & Rvachew, 1995). Each infant sat on a caregiver's lap in the middle of a three-sided enclosure constructed out of pegboard panels (4ft by 6ft) on three sides and open at the back. On the center panel of the enclosure, directly facing the infant, there was a green light, mounted at eye level, that could be flashed to direct the infant's attention to midline. Directly below the green light, a 5 cm hole accommodated the lens of a video camera that was used to record each test session. Except for a small area just above the green light, the pegboard was backed with white cardboard to prevent the infant from responding to movements behind the panel. A white curtain suspended around the top of the booth shielded the infant's view of the

rest of the room. A red light was mounted on each side panel, and a loudspeaker was mounted at the infant's ear level behind each of these panels. A computer terminal and response box were located behind the center panel, out of view of the infant. The response box, which was connected to a Macintosh Quadra 650, was equipped with a series of buttons that started and stopped the flashing center and sidelights, recorded the direction and duration of headturns, and terminated a trial when the infant looked away for more than 2 seconds. Information about the direction and duration of headturns and the total trial duration were stored in a data file on the computer. Computer software was responsible for the selection and randomization of the stimuli and for the termination of test trials. The average listening times to each of the names were calculated by the computer following the completion of each session.

The experimenter began and terminated trials, recording the infant's looking times by operating the response box. Since the sample played on a given trial was selected by the computer program, the experimenter had no knowledge of which name was played on a given trial. The loudness levels for the samples were set by a second assistant, who was not involved in the observations, at 72 $\pm$ 2 dB (C) SPL. A test trial began with the flashing of the green light on the center panel. When the infant faced center, the green light was extinguished, and a red light on one of the side panels began to flash (this was randomly determined via computer). When the infant made a headturn of at least 30 degrees in the direction of the flashing light, a speech sample was played from the loudspeaker on the same side as the light. If the infant turned away from the loudspeaker for less than 2 consecutive seconds, and then reoriented in the appropriate direction, the trial continued but the time spent looking away from the loudspeaker was

not included in the total orientation time on that particular trial. However, if the infant looked away for more than 2 consecutive seconds, the trial was terminated. The next trial was started by flashing the green light on the center panel. To ensure that bias was not introduced into the study inadvertently by either the caregiver holding the infant, or the experimenter operating the button box behind the pegboard, both the parent and the experimenter wore earplugs and were given sound-insulated headphones to wear throughout the duration of the experiment, over which loud masking music was played. This music effectively prevents either individual from hearing the test stimuli being presented to the infant during the study (see Kemler Nelson et al., 1995).

Each infant began a testing session with a preparatory phase in which musical stimuli were presented. This initial phase was designed to orient infants to the testing apparatus, and ensure that they could make the required behavioral response. Stimuli presented during this initial phase were not related to stimuli presented in the later test phase of the experiment. Infants listened to musical stimuli until they accumulated at least 20 seconds of listening time to each musical passage. After this criterion was met, infants entered the testing phase. Each infant completed three test blocks, composed of four trials each (12 test trials in all). Repetitions of each name (the phonetically-changed item, and all other foils) appeared once in a given block in random order. Preferences for names were determined by averaging the duration of infant headturns for each name in a given block, across all three blocks. Reliability checks between the live observer and observers of videotaped sessions are high, with correlations from .92 to .96 (Kemler Nelson, 1995).

Results and Discussion

Mean listening times to each name were calculated for each infant across the three blocks of trials. These means were then averaged across subjects for the phonetically altered item, and for each of the other foil names (see Figure 1). To examine potential differences in listening times to the different items, we conducted a Repeated Measures ANOVA. This analysis revealed that mean listening times to each of the items were not significantly different from one another (F (3, 69) < 1.00). To further examine possible infant preferences for particular foil types, we conducted an additional analysis in which we compared the two most extreme means (the foil with a place of articulation change from the infant's own name, and different stress foil). This comparison did not reach significance (t (23) = .911, p = .3711). No other comparisons yielded significant results.

Insert Figure 1 about here

These results suggest that 4.5-month-olds do not false alarm to an item which differs from their own names by only a single phonetic feature (a place of articulation distinction). Infants did not respond to an item that differed minimally in its phonetic properties from their own name any differently than they did to other, unfamiliar names. This finding parallels that of Jusczyk and Aslin (1995) who found that infants did not respond to an item which differed from a familiar target by only a single phoneme. This also accords well with Stager and Werker's (1997) results showing that 8-month-olds respond only to items which precisely match target words. Taken together with Mandel et al.'s

(1995) demonstration that infants listen significantly longer to their own names than to other infants' names, the current results (with the same test procedure) suggest that the infants' have a rather detailed representation of the sound patterns of their own names. Not only do infants prefer to listen to their own names over prosodically-matched foils (Mandel et. al), but they also do not false alarm to an item that is a close phonemic neighbor to their own names. Thus, even at the age of 4.5 months, infants appear to have encoded and stored the sound patterns of their names. A stable, specific representation of one's own name - one that distinguishes it from other similar words in the speech environment - is certainly important for social interactions, but could also potentially play some role in language development.

To what extent is infants' sensitivity to the sound patterns of their own names special? As noted earlier, studies of mother-infant interactions suggest that names are uttered frequently in the presence of infants during social-communicative interchanges and explicit teaching situations. Often, mothers will call an infant's name while making direct eye-contact with the child in order to make the name more salient and increase the likelihood that infants will respond to the task at hand. However, the infant's own name is not the only item that an infant is likely to hear uttered frequently. Is it possible that 4.5-month-olds also are storing information about the sound patterns of some of these items? The next study was designed to investigate this possibility.

Experiment 2

Although names might be among the earliest sound-patterns stored by infants, the sound patterns of other frequently occurring words may also attract their attention. For instance, when mothers and infants are engaged in play activities or feeding and bathing, a mother might make eye contact with the infant and utter the word "baby". Infants are also likely to hear the words "mommy" and "daddy" uttered frequently in their presence. Is it possible that infants are beginning to encode the sound patterns of such words at about the same time that they encode information about their own names? One way to determine if infants recognize other salient sound patterns, such as "baby" and "mommy" is to see whether they respond differently to these words than to unfamiliar ones (e.g., "hamlet" and "kingdom"). For example, are repetitions of potentially familiar items more likely to capture infants' attention than repetitions of less salient items? Following the logic of the previous experiment, we explored whether 4.5-month-olds would show any tendency to listen significantly longer to items such as "baby" and "mommy" than to ones such as "hamlet" and "kingdom".

Method

Participants. Thirty-six infants from monolingual, English-speaking homes (19 males, 17 females) with a mean age of 20 weeks, 6 days (range = 18weeks, 0 days to 22 weeks, 2 days) were recruited from the Buffalo Metropolitan area to participate in the present study. An additional 15 infants were tested but not included in the study for the following reasons: Crying (6); failed to look at the flashing lights (4); parental interference (2); looking times less than 3 s. (2), and equipment failure (1) . Each infant was paid $5.00 for a single visit to the

laboratory. Any infants with known hearing disorders were excluded from the study.

Stimuli. Stimulus materials consisted of four words: two words were assumed to be potentially familiar sound patterns ("mommy" & "baby"), and two words were assumed to be unfamiliar patterns ("kingdom" & "hamlet"). All four words followed the same (trochaic) stress pattern to control for the possibility that infants would respond differently to the items based on preferred stress. The same female talker as in the previous experiment, recorded the test items in a lively voice, as if calling to an infant. Once again, each item was repeated 15 times, with some variation in prosody. The stimuli were digitized and stored as described for the previous experiment.

Apparatus, design, and procedure. These were identical to that of Experiment 1.

Results and Discussion

The data were analyzed as in Experiment 1. Mean listening times to each word were calculated for each infant across three blocks of trials. These means were then averaged for each of the words (see Figure 2). A Repeated Measures ANOVA revealed that mean listening times to each of the words were not significantly different from one another ($F(3, 105) = .610$, $p = .61$). In order to test for significant differences among particular words, a series of planned comparisons was conducted. The first comparison examined whether there were any significant differences between the two assumed "familiar" words, "mommy" and "baby". Additional comparisons, using contrast tests based on the ANOVA, explored possible differences between each of these words and the

two "unfamiliar" items. No significant differences emerged across any of these comparisons (For "mommy" vs. "baby", F (1, 105) = .002, p > .95; For "baby" vs. "hamlet" & "kingdom", F (1, 105) = .965, p > .30; For "mommy" vs. "hamlet" & "kingdom", F (1, 105) = 1.08, p > .30).

Insert Figure 2 about here

These results indicate that although 4.5-month-olds respond to their names, they do not yet show show recognition of other words that are presumably frequently spoken in their presence. Infants treated the potentially familiar sound patterns ("mommy" and "baby") in the same way as the infrequent patterns ("kingdom" & "hamlet"). Thus, it does not seem to be the case that 4.5-month-olds respond to any frequently occurring words in their environment. In this sense, names might be somewhat special during this developmental period. This raises the question of when infants show recognition of other frequently occurring sound patterns, such as "baby" and "mommy".

Experiment 3

If infants' names are encoded prior to other salient sound patterns, then we should be able to find evidence that other socially-relevant sound patterns are becoming recognizable to infants at a slightly later developmental period. Consequently, we decided to examine whether 6-month-olds might show some receognition of items such as "mommy" and "baby".

Method

Participants. Thirty-six infants from monolingual, English-speaking homes (19 males, 17 females) with a mean age of 26 weeks, 2 days (range = 24 weeks, 2 days to 29 weeks, 5 days) were recruited from the Buffalo Metropolitan area to participate in the present study. An additional 8 infants were tested but not included in the study for the following reasons: Crying (6) and parental interference (2). Each infant was paid $5.00 for a single visit to the laboratory. Any infants with known hearing disorders were excluded from the study.

Stimuli, apparatus, design and procedure. These were all identical to those used in Experiment 2.

Results and Discussion

Once again, mean listening times (and standard errors) to each of the words were calculated (see Figure 3). Inspection of the data suggested that 6 month old infants responded differently to "baby" than they did to the other items. A Repeated Measures ANOVA revealed a marginally significant effect for the differences among the mean listening times to the four words (F (3, 105) = 2.276, p = .08). A series of planned comparisons, using contrast tests based on the ANOVA, were conducted to explore possible differences among the various words. There was a marginally significant difference (F (1, 105) = 3.75, p = .055) in the listening times to "mommy" and "baby" (with longer listening times to the latter). Further comparisons revealed that the mean listening times for "mommy" did not differ significantly from the infrequent words ("kingdom" and "hamlet", F (1, 105) = .037, p > .80), but that the listening times to "baby"

were significantly longer than to "kingdom" and "hamlet" (F (1, 105) = 5.90, p < .02).

Insert Figure 3 about here

Hence, 6-month-olds show signs of recognizing the sound patterns of an item (i.e., "baby") used often in social-communicative interactions with caregivers. Thus, 6-month-olds do respond to other, socially relevant sound patterns beyond their own names. In the present case, infants listened longer to "baby" than to infrequent items such as "hamlet" and "kingdom. However, they did not show the same kind of listening preference for "mommy". Indeed, there is suggestive evidence that 6-month-olds listen longer to "baby" than to "mommy".

It is certainly possible that infants are also beginning to recognize other salient patterns that were not tested in the present study. However, it is noteworthy that the cases in which infants have shown listening preferences to date involve items that are used to refer to the infants themselves -- their own names and "baby". The lack of a listening preference for "mommy" was somewhat surprising. However, it is plausible that infants might first come to recognize the sound patterns of words which refer specifically to themselves, because these items are often uttered while caregivers are making eye contact, or directly interacting with them. The use of these items in more direct communicative contexts might increase their salience for infants.

Thus, sound patterns that refer to infants appear to be encoded and recognized early in development. Might infants' sensitivity to such patterns also

be manifest in other ways? For instance, is it easier for infants to pick their own names out of fluent speech contexts than to detect other words?

Experiment 4

Research on infants' abilities to detect words in fluent speech suggests that the ability to segment certain types of sound patterns begins to surface at approximately 7.5 months of age (Echols, Crowhurst & Childers, 1997; Jusczyk & Aslin, 1995; Newsome & Jusczyk, 1995; Saffran, Aslin & Newport, 1996). For example, Jusczyk and Aslin (1995) familiarized 7.5-month-olds for 30 seconds with a pair of words, such as "dog" and "cup" which were spoken in citation form. Then, during a test phase, the infants heard four 6-sentence passages, two of which contained the familiar items, whereas the other two contained two different items (such as "bike" & "feet"). The infants listened significantly longer to the passages containing the items that they had been familiarized with. In contrast, 6 month old infants did not show any ability to segment the familiarized items from the test passages. Hence, 7.5-month-olds, but not 6-month-olds, displayed some capacity to segment words from fluent speech.

The question addressed in the present study was whether 6-month-olds might demonstrate an ability to segment fluent speech, if the items to be detected corresponded to their own names. Thus, after a familiarization period in which an infant heard his or her own name and the name of another infant, 6-month-olds were presented with four short passages containing certain names. Two of these contained the names heard during familiarization; the other two

contained unfamiliar names. We hypothesized that infants would be most apt to show a listening preference for the passage containing their own names.

Method

Participants. 32 infants from monolingual, English-speaking homes (23 boys, 9 girls) with a mean age of 27 weeks, 0 days (range 24 weeks, 1 day to 28 weeks, 4 days) were recruited from the Buffalo Metropolitan Area to participate in the present study. An additional 17 infants were tested but not included in the study for the following reasons: Crying (12), experimenter error (2), and failure to orient to the testing apparatus (3). Each infant was paid $6.00 for a single visit to the laboratory. Any infants with known hearing disorders were excluded from the study.

Stimuli. A monolingual, English-speaking female recorded fifteen different tokens of each infant's name in a infant-directed speech register, as if calling the infant. She also recorded a series of 6-sentence test passages in an infant-directed speech register. The name of the infant to be tested appeared in one of these passages. The other three passages included the names of three other infants, one of which was a name that was also used during the familiarization phase of the experiment. (See Figure 4 for examples of the passages used in the present study). The order of the sentences within a given passage was fixed, and each trial always began with the first of the six sentences in the passage. Position of the names varied across sentences (i.e., the name appeared in twice in the initial, twice in the medial, and twice in the final position of a sentence). Care was taken to ensure that all four passages were of approximately equal duration and amplitude to control for artifacts relating to differences in the acoustic properties

of the stimuli. The stimulus materials, were digitized and stored as described for Experiment 1.

Apparatus. This was the same as in the previous experiments.

Insert Figure 4 about here

Design and procedure. A version of the Headturn Preference Procedure was used. However, in contrast to the previous experiments, the present experiment was modeled on the version of the procedure used by Jusczyk and Aslin (1995). Hence, infants were first familiarized with a pair of items, then tested on a series of four test passages. During the familiarization phase, the 6-month-olds heard repetitions of two names on alternating trials until they accumulated at least 30 s. of listening time to each. One of the names was the infant's own; the other was a name with the same stress pattern (i.e., the name of another infant in the study). If the infant reached familiarization criterion for one name but not for the other, the trials continued to alternate until the criterion was reached for both. After the infant completed this initial phase, the test phase began. During the test phase, infants were presented with a series of four 6-sentence passages. One of the passages included the name of the infant in each sentence. Another passage included in its sentences the other name that the infant had heard during the familiarization period. Likewise each of the remaining two passages contained a name (not heard during the familiarization period) that appeared in each sentence of the passage. Test trials were grouped into blocks of four, such that the passage containing each name occurred once per block. Within a block, the ordering of the passages was random, and the ordering of passages differed

across different blocks of trials. Each infant was tested on all four blocks, completing sixteen test trials in all.

To ensure that any effects would not be attributable to the content of the passages themselves (e.g., that some passages might be inherently more interesting to listen to) we counterbalanced, across infants, which passage contained the infant's own name and which contained the other name from the familiarization. So, some infants heard their names in the zoo passage, others heard theirs in the parade passage, etc.

Results and Discussion

Mean listening times to each passage type were calculated for each infant across the four blocks of test trials. These means were averaged across subjects for the passage containing the infant's own name, and for each of the other three passages (see Figure 5). A Repeated Measures ANOVA revealed that mean listening times to the various passages differed significantly from each other ($F(3, 93) = 3.69$, $p < .02$). Planned comparisons, using contrast tests based on the ANOVA, were carried out to examine possible differences among the means. The first comparison indicated that the infants listened significantly longer to the passages containing the familiar names (their own and the other name from the familiarization period) than to the ones containing the unfamiliar names ($F(3, 93) = 5.28$, $p < .05$). A comparison of the listening times to the passages containing the infant's and the other name from the familiarization period indicated no significant difference between these ($F(3, 93) = 1.98$, $p < .20$). However, the listening times to the passage containing the infants' names was significantly longer than to the ones containing unfamiliar names ($F(3, 93) = 7.24$, $p < .01$), whereas there was no evidence that listening times to the passage with the other familiarized name differed significantly from those with the unfamiliar names $F(3, 93) = 1.13$, $p < .30$). Hence, the listening preference for the passages with the familiar names seems to have been carried largely by how infants responded to the passage containing their own names.

Insert Figure 5 about here

The present results indicate that 6-month-olds detect the occurrence of their names in fluent speech passages. Infants listened significantly longer to passages containing their own names than to passages containing unfamiliar names. This finding contrasts with an earlier one by Jusczyk and Aslin (1995) indicating that 6-month-olds did not detect the occurrence of familiarized words in fluent speech contexts. Their greater prior familiarity with the sound patterns of their own names may have been a factor here. In any case, this is the first evidence that 6-month-olds have some ability to segment fluent speech. The fact that infants at this age show evidence of detecting their own names in fluent speech contexts earlier than other kinds of words is also another indication of the salience that the sound patterns of their own names have for them.

Given the propensity that 6-month-olds display to responding to their own names even when these names are embedded in fluent speech, one might ask how sensitivity to these sound patterns might be useful for acquiring language. For example, it has been suggested that distributional properties could be helpful to learners in segmenting words in fluent speech. Thus, as one of her principles for segmenting units of speech, Peters (1983) proposed that learners segment units that are repeated within the same utterances (just as the name was repeated in the present experiment). Information about changes in the context surrounding such known items could potentially be helpful in identifying the boundaries of other words in fluent speech (see also (Cole & Jakimik, 1978; 1980; Pinker, 1984; Suomi, 1993). Along these lines, Brent & Cartwright (1997)

developed a simulation model of how one learns to segment words from fluent speech. In the INCDROP model, information about previously learned words is used to isolate potential new words in fluent utterances (e.g., if "cat" is already known, the model would assume that "Siamese" is a potential word when it gets the phrase "Siamese cat"). Is it possible that the ability to detect one's own name in fluent speech might be useful in just this way, so that the occurrence of one's own name might serve to highlight the boundaries of immediately surrounding words? The next two experiments were undertaken to explore whether the presence of their own names in fluent provides infants with useful cues to word boundaries.

Experiment 5

Parents often use infants' names in the context of other words, particularly in situations which involve teaching the child something new, such as the name of a new item or object. When the infant's name is used in such contexts, it often occurs in the possessive form (e.g., "Carol's feet"). Given the results of Experiment 1, it was not obvious that infants will respond to the possessive form of their own names. Hence, before examining whether infants could use the possessive forms of their own names to pick out new lexical candidates, it was first necessary to determine whether young infants even respond to these variants of their own names. Hence, in the present experiment, we investigated whether 6-month-olds listened longer to the possessive form of their own names than to the possessive form of other infants' names?

Method

Participants. Twenty-four infants from monolingual, English-speaking homes in the Buffalo Metropolitan area (11 boys, 13 girls), approximately 6 months of age were tested. The infants had an average age of 26 weeks, 2 days (range: 23 weeks, 6 days, to 27 weeks, 3 days). Four additional infants were tested but not included in this study for failing to complete the experiment due to crying or extensive fussing. Each infant was paid $6.00 for a single visit to the laboratory. Any infants with known hearing disorders were excluded from the study.

Stimuli. Following Mandel et al. (1995), we presented infants with 4 name items, each in the possessive form. For example, if the infant's name was "Michael", he might hear repetitions of his own name in the possessive form ("Michael's"), along with three foil items ("Carol's", "Taylor's", and "Peter's"). Note that unlike Mandel et al.'s original task with 4.5 month olds, this study involved foil items which were all matched in stress-pattern to the infant's own name. This was done because the present study sought to test the specificity of the infant's name representation with regard to segmental properties, rather than prosodic features. The same monolingual English speaking talker who recorded the stimuli across Experiments 1-4, recorded repetitions of all the names with attention-getting prosody. The stimulus materials, were digitized and stored as described for Experiment 1.

Apparatus, Design, and Procedure. These were basically the same as in Experiment 1, with the exception of the fact that each infant heard the possessive forms of his or her own name and the names of three other infants.

Results and Discussion

Mean listening times to each name were calculated for each infant across the three blocks of trials. These means were averaged for the possessive form of the infant's own name, and for each of the three "foil" name forms (see Figure 6). A Repeated Measures ANOVA revealed that mean listening times to each of the names were significantly different from one another (F (3, 69) = 3.34, $p < .025$). Planned comparisons, using contrast tests based on the ANOVA, indicated that listening times to the possessive forms of the infants own names were significantly longer than to those of any of the other names (F (1, 69) = 7.06, $p <$ .01 for foil name 1; F (1, 69) =5.60, $p < .025$ for foil name 2; and F (1, 69) = 7.22, $p <$ .01 for foil name 3). Hence, 6-month-olds' show the same kind of preference for the possessive form of their own names as 4.5-month-olds do for the vocative forms (Mandel et al., 1995). [2]

Insert Figure 6 about here

Experiment 6

Having established that 6-month-olds do respond to the possessive form of their own names (Experiment 5), and that they can locate their own names in fluent speech (Experiment 4), we can now ask whether the occurrence of their names

[2] The fact that infants responded to a phonetic variant of their own names in the present experiment, but not in Experiment 1 may have to do with where the variation occurred, at the end of the name, rather than at the beginning. Evidence from another investigation (Jusczyk et al., submitted) suggests that infants at this age are more sensitive to information at the onsets of words than at the ends of words. Another possible factor is that, in contast to the stimuli used in Experiment 1, the vocative form of the name is included in the possessive form

helps to mark the boundary of a following word in the same utterance. Information about the occurrence of a known item might be particularly helpful in cases in which detecting the onsets of words is difficult. One such situation for English-learning infants involves the detection of words with weak/strong (i.e., iambic) stress patterns. Recent studies (Houston, Jusczyk & Newsome, 1995; Newsome & Jusczyk, 1995) suggest that it is not until the age of approximately 10.5 months that English learners show evidence of detecting weak-strong words in sentential contexts. Younger infants, 7.5-month-olds, familiarized with weak/strong words (e.g., "beret", "device") did not listen significantly longer to passages containing these items than to ones containing unfamiliar weak/strong target words. In particular, 7.5-month-olds appeared to miss the initial weak syllables of these words in fluent speech contexts. By comparison, 7.5-month-olds are able to detect the onsets of words with strong/weak stress patterns under the same circumstances. In line with distributional accounts of word segmentation (e.g., Brent & Cartwright, 1996; Suomi, 1993), is it possible that the occurrence of one's own name in fluent speech just prior to a weak/strong word aids 7.5-month-olds in detecting the onsets of these words? Experiment 6 was designed to test this possibility. Specifically, we examined whether 7.5-month-olds would listen longer to weak/strong target words that had followed their names in passages than they would either to weak/strong targets that had followed another repeated name in a passage, or to unfamiliar weak/strong words.

Method

Participants. Twenty-four infants from monolingual, English-speaking homes in the Buffalo Metropolitan area (19 boys, 5 girls), approximately 7.5 months of age were tested. The infants had an average age of 34 weeks, 1 day (range: 31 weeks, 2 days, to 35 weeks, 0 days). Four additional infants were tested but not included in this study for failing to complete the experiment due to crying or extensive fussing. Each infant was paid $6.00 for a single visit to the laboratory. Any infants with known hearing disorders were excluded from the study.

Stimuli. Short passages, modeled on those used by Newsome and Jusczyk (1995), were constructed. The possessive forms of a particular infant's name appeared right before the target word in each of the five sentences in one of the passages. The other three passages were similarly structured, but each included the possessive form of a different infant's name before the target words in each sentence of a passage (see Figure 7 for examples of the passages). The target words were the same ones used by Newsome and Jusczyk (1995): "guitar", "device", "beret", and "surprise". In addition to the passages, fifteen repetitions of each of the target words were recorded by the same female talker. These isolated repetitions of the target words were used during the test phase of the present experiment. The passages and words were produced by the same female talker who recorded the materials for the previous experiments. The stimulus materials, were digitized and stored as described for Experiment 1.

Insert Figure 7 about here

Apparatus. This was the same as in the previous experiments

Design and procedure. A modified version of the headturn preference procedure (similar to that in Experiment 4) was used to test the infants. However, in the present case, the infants were familiarized with passages, and then tested on repetitions of isolated versions of the target words. During the familiarization phase, half of the infants heard the "guitar" and "device" passages; the other half, heard the "beret" and "surprise" passages. In one of the two familiarization passages, the possessive form of the infant's name preceded each occurrence of the target word; in the other passage, a different infant's name preceded each occurrence of the target word. Which word was paired with a given infant's name was determined by random assignment. After an infant had accumulated 45 sec. of listening time to each of the two familiarization passages, the test phase began. During the test phase, infants heard the isolated repetitions of one of the four weak/strong words on a given trial. Two of these words had occurred in the familiarization passages; the other two had not. On a given test trial, an infant heard the repetitions of a single weak/strong word. The presentation order of the four weak/strong words in a block of trials was randomly determined. Each infant was tested on four blocks of trials (each with a different random ordering of the words).

Results and Discussion

Mean listening times to each word were calculated for each infant across four blocks of test trials. These means were then averaged for the targets presented with the infants' own names, targets presented with other infants' names, and for each of the unfamiliar targets (see Figure 8). A Repeated Measures ANOVA

revealed that mean listening times to each of the names were not significantly different from one another (F (3, 69) = 1.49, p =.222). Planned comparisons, using contrast tests based on the ANOVA, were used to explore potential differences among the individual means. The first of these indicated that listening times in the test phase to the target words from the passages heard during familiarization were not significantly longer than to the unfamiliar words (F (1, 69) = 1.02, p > .30). Moreover, there was no indication that listening times during the test phase for the item that had been preceded by the infant's own name differed significantly from the unfamiliar targets (F (1, 69) < 1.00) or from the target word in the other passage heard during familiarization (F (1, 69) < 1.00).

Insert Figure 8 about here

Contrary to our hypothesis, the presence of 7.5-month-olds' names prior to weak/strong words did not lead to any improved ability to segment these words from fluent speech. Thus, even the presence of a salient item like the infant's own name did not help in the detection of the onsets of weak/strong words. One possible explanation of why infants failed to respond to target words from the familiarization passage is that the task may have encouraged them to form highly specific memories in which name-word pairs were treated as whole units. For example, an infant named "Michael" always heard "beret" in the context of "Michael's beret". In the passages, "Michael's beret" remained while the other words changed from sentence to sentence. There is some support for this suggestion in the results of other investigations that indicate infants at this age will tend to link items that continually co-occur with each other (Houston et al.,

1995; Jusczyk, Hohne & Bauman, submitted; Morgan & Saffran, 1995; Saffran et al., 1996). Alternatively, it is possible that the presence of the infants' own names in the passages so thoroughly captured their attention that they ignored the immediately surrounding words. In any case, the consistent insertion of the infant's own name prior to the occurrence of a weak/strong target word did not seem to lead to better segmentation of the target from fluent speech.

General Discussion

The present series of studies provide further support for the view that infants' own names are salient sound patterns for them. In particular, infants' attention appears to be drawn to their own names sooner than to other names or to other words that occur frequently in their environment. Hence, although 4.5-month-olds orient longer to repetitions of their own names than to other infants' names (Mandel et al., 1995), they do not orient longer to frequently occurring words such as "baby" and "mommy" than they do to relatively unfamiliar words such as "kingdom" and "hamlet". By 6 months of age, infants did show significant orientation to "baby", but not yet to "mommy". Whether infants at this age might orient significantly to other frequently occurring words or names (e.g., "daddy", the names of siblings or pets, etc.) has yet to be determined. However, it is interesting that thus far the sound patterns that appear to be recognized early are ones that are used to refer to infants.

Young infants appear to have a fairly detailed representation of the sound patterns of their own names. They orient more to their own names than they do to other names with the same stress patterns (Mandel et al., 1995) and, as the

present study suggests, they do not respond to near phonetic neighbors of their own names. Hence, 4.5-month-olds did not orient longer to sound patterns that differed by a single phonetic feature from their own names than they did to other names that shared the same stress patterns as theirs. This behavior stands in contrast to what Hallé and Boysson-Bardies (1996) reported with respect to how 11-month-olds respond to phonetic neighbors of other kinds of familiar words. Specifically, Hallé and Boysson-Bardies found that their infants were as likely to respond to phonetically transformed versions of these words as they were to respond to phonetically correct versions. They concluded that infants do not store precisely detailed phonetic representations of early lexical items.

There are several possible explanations of the apparent discrepancy between Hallé and Boysson-Bardies' results and ours. The first possibility is that, as Stager and Werker (1997) have suggested, the 4.5-month-olds are matching the input simply to a stored sound pattern, rather than to a lexical item with an attached referent (as Hallé and Boysson-Bardies' 11-month-olds may have been doing). Another possibility is that in terms of its familiarity and emotional and social significance, the infant's own name is a rather special sound pattern -- one that is encoded in a very detailed way from an early age[3]. Hence, infants may develop a better representation of the sound patterns of their own names than they do for other kinds of lexical patterns whose sounds and meanings they are trying to learn.

The salience of the sound patterns of infants' own names is also revealed in another way. Namely, 6-month-olds display some ability to detect their own

[3] Interestingly, the existence of precisely detailed representations in the child's productive vocabulary has been noted in the literature on phonological development. Such items may incorporate details that are well beyond, the

names in fluent speech contexts. A previous investigation (Jusczyk & Aslin, 1995) found no indication that 6-month-olds detected the occurrence of other kinds of familiarized words in fluent speech contexts. Of course, one crucial difference between the two studies was the degree of familiarity that infants had with the target items. Given that infants do begin to respond to the sound patterns of their own names from an early age, and receive considerable social reinforcement for doing so, their ability to detect such patterns in fluent speech may again be in advance of their ability to detect other, less familiar, patterns in such contexts.

Still, the occurrence of infants' own names in fluent speech did not seem to improve their detection of other kinds of lexical items. Thus, 7.5-month-olds in the present study did no better in detecting the occurrence of weak/strong words in fluent speech than did the infants in Newsome and Jusczyk's (1995) study. The infants apparently did not use the name's presence in the passages as a distributional cue to mark the onset of a following weak/strong word. Given the results of previous studies (Houston et al., 1995; Jusczyk et al., submitted; Morgan & Saffran, 1995; Saffran et al., 1996), it seems unlikely that this is attributable to an inability of infants at this age to use distributional cues. Nor, given the results of Experiment 5, is it plausible that infants simply did not recognize the possessive form of their own names. Rather, this may be a case in which the salience of the name may have drawn their attention away from the occurrence of the following weak/strong target word. Perhaps at a later point in development, infants' own names may become a little less attention-grabbing and, therefore, more useful in segmenting other words.

---

same child's typical productions of words at the same time. Perhaps, the best known such case is the one that

It is possible that infants' names may play a different kind of supportive role in word segmentation. Cutler and her colleagues (e.g., Cutler & Carter, 1987; Cutler & Norris, 1988) have noted that a very high proportion of English content words begin with a stressed syllable. Hence, these investigators proposed that English-listeners may identify the onsets of words in fluent speech with the occurrence of stressed syllables (the Metrical Segmentation Strategy). It also has been suggested that English-learners may use such information about the predominant stress pattern of words in segmenting speech (Jusczyk, Cutler, & Redanz, 1993). Indeed, as noted earlier, 7.5-month-old English-learners detect words with strong/weak stress patterns in fluent speech, but not ones with weak/strong patterns. Yet, use of a Metrical Segmentation Strategy seems to require that infants have learned what the predominant stress patterns are. How can they attain such knowledge before they begin segmenting words? One possibility is that infants learn about the predominant stress patterns from words that are likely to be produced frequently in isolation. The infant's own name is one such item (as are words such as "mommy" and "daddy" and many other diminutive terms). In this regard, we note that of the 24 infants tested in Experiment 6, 23 had names that followed a strong/weak pattern. Moreover, even when infants from English-speaking homes have weak/strong names such as Michele or Danielle, they often receive nicknames with strong/weak patterns, such as Shelly or Danny. Hence, the salience of the infant's own name may play a role in developing the expectation that English words begin with a strong syllable.

Leopold (1937; 1947) reported for his daughter's production of the word "pretty".

In conclusion, the sound patterns of infants' own names appear to be learned and attended to from an early age. Not only do infants have detailed representations of these sound patterns, but they also appear to detect their own names sooner in fluent speech than they can detect other words.

References

Bernstein, J., & Franco, H. (1996). Speech recognition by computer. In N. J. Lass (Ed.), Principles of experimental phonetics, (pp. 408-434). St. Louis, MO: Mosby.

Brent, M. R. (1997). Toward a unified model of lexical acquisition and lexical access. Journal of Psycholinguistic Research, 26, 363-375.

Brent, M. R. & Cartwright, T. A. (1996). Distributional regularity and phonotactic constraints are useful for segmentation. Cognition, 61, 93-125.

Charles-Luce, J., & Luce, P. (1995). An examination of similarity neighborhoods in young children's receptive vocabularies. Journal of Child Language, 22.

Charles-Luce, J., & Luce, P. A. (1990). Similarity neighborhoods of words in young children's lexicons. Journal of Child Language, 17, 205-215.

Clark, E. V. (1993). The lexicon in acquisition. Cambridge: Cambridge University Press.

Cole, R. A. (Ed.). (1980). Perception and production of fluent speech. Hillsdale, N.J.: Erlbaum.

Cole, R. A., & Jakimik, J. (1978). Understanding speech: How words are heard. In G. Underwood (Ed.), Strategies of information processing, . New York: Academic.

Durkin, K., Rutter, D. R., & Tucker, H. (1982). Social interaction and language acquisition: Motherese help you. First Language, 3, 107-120.

Echols, C. H., Crowhurst, M. J., & Childers, J. B. (1997). Perception of rhythmic units in speech by infants and adults. Journal of Memory and Language, 36, 202-225.

Hallé, P., & Boysson-Bardies, B. d. (1996). The format of representation of recognized words in infants' early receptive lexicon. Infant Behavior & Development, 19, 463-481.

Houston, D., Jusczyk, P. W., & Newsome, M. (1995). Infants' strategies of speech segmentation: Clues from weak/strong words. Paper presented at the 20th Annual Boston University Conference on Language Acquisition, Boston, MA.

Howarth, C. I., & Ellis, K. (1961). The relative intelligibility threshold for one's own name compared with other names. Quarterly Journal of Experimental Psychology, 13, 236-240.

Jusczyk, P. W. (1986). Towards a model for the development of speech perception. In J. Perkell & D. H. Klatt (Eds.), Invariance and variability in speech processes, (pp. 1-19). Hillsdale, N. J.: Erlbaum.

Jusczyk, P. W. (1993). From general to language specific capacities: The WRAPSA Model of how speech perception develops. Journal of Phonetics, 21, 3-28.

Jusczyk, P. W. (in press). Using the headturn preference procedure to study language acquisition. In E. Bavin & D. Burnham (Eds.), Advances in Infancy Research, (Vol. 13,).

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

Jusczyk, P. W., Cutler, A., & Redanz, N. (1993). Preference for the predominant stress patterns of English words. Child Development, 64, 675-687.

Jusczyk, P. W., Goodman, M., & Bauman, A. (submitted). 9-month-olds' attention to sound similarities in syllables. Journal of Memory and Language.

Jusczyk, P. W., Hohne, E. A., & Bauman, A. (submitted). Infants' sensitivity to allophonic cues for word segmentation. Perception & Psychophysics.

Katz, N., Baker, E., & Macnamara, J. (1974). What's in a name? A study of how children learn common and proper nouns. Child Development, 45, 469-473.

Kemler Nelson, D. G., Jusczyk, P. W., Mandel, D. R., Myers, J., Turk, A., & Gerken, L. A. (1995). The Headturn Preference Procedure for testing auditory perception. Infant Behavior & Development, 18, 111-116.

Klatt, D. H. (1986). The problem of variability in speech recognition and in models of speech perception. In J. S. Perkell & D. H. Klatt (Eds.), Invariance and variability in speech processes, (pp. 300-319). Hillsdale, NJ: Erlbaum.

La Palme Reyes, M., Macnamara, J., Reyes, G. E., & Zolfaghari, H. (1993). Proper names and how they are learned. In G. Cohen & D. M. Burke (Eds.), Memory for proper names, (pp. 433-455). Hillsdale, NJ: Erlbaum.

Leopold, W. F. (1939). Speech development of a bilingual child, 1: Vocabulary growth in the first two years. Evanston & Chicago: Northwestern University.

Leopold, W. F. (1947). Speech development of a bilingual child, 2: Sound learning in the first two years. Evanston: Northwestern University.

Liberman, A. M., & Studdert-Kennedy, M. G. (1978). Phonetic perception. In R. Held, H. Leibowitz, & H. L. Teuber (Eds.), Handbook of sensory physiology: Perception, (Vol. 8, pp. 143-178). Berlin: Springer-Verlag.

Logan, J. S. (1992). A computational analysis of young children's lexicons (Research on Spoken Language Processing: Technical Report 8): Indiana University.

Mandel, D. R., Jusczyk, P. W., & Pisoni, D. B. (1995). Infants' recognition of the sound patterns of their own names. Psychological Science, 6, 315-318.

Marcus, S. M. (1984). Recognizing speech: On the mapping from sound to word. In H. Bouma & D. G. Bouwhuis (Eds.), Attention and Performance: Control of language processes, (Vol. X, pp. 151-163). Hillsdale, NJ: Erlbaum.

Miller, G. A., & Nicely, P. E. (1955). An analysis of perceptual confusions among some English consonants. Journal of the Acoustical Society of America, 27, 338-352.

Mills, C. B. (1980). Effects of the match between listener expectancies and coarticulatory cues on the perception of speech. Journal of Experimental Psychology: Human Perception and Performance, 6, 528-535.

Moray, N. (1959). Attention in dichotic listening: Affective cues and the influence of instructions. Quarterly Journal of Experimental Psychology, 11, 56-60.

Morgan, J. L., & Saffran, J. R. (1995). Emerging integration of sequential and suprasegmental information in preverbal speech segmentation. Child Development, 66, 911-936.

Morikawa, H., Shand, N., & Kowsawa, Y. (1988). Maternal speech to prelingual infants in Japan and the United States: Relationships among functions, forms, and referents. Journal of Child Language, 15, 237-256.

Newport, E., Gleitman, H., & Gleitman, L. (1977). Mother, I'd rather do it myself:Some effects and non-effects of maternal speech style. In C. E. Snow & C.

A. Ferguson (Eds.), Talking to children: Language input and acquisition, (pp. 109-149). Cambridge: Cambridge University Press.

Newport, E. L. (1977). Motherese: Speech of mothers to young children. In N. J. Castellan, D. B. Pisoni, & G. R. Potts (Eds.), Cognitive theory, (Vol. 2,). Hillsdale, N. J.: Erlbaum.

Newsome, M., & Jusczyk, P. W. (1995). Do infants use stress as a cue for segmenting fluent speech? In D. MacLaughlin & S. McEwen (Eds.), Proceedings of the19th Annual Boston University Conference on Language Development, (Vol. 2, pp. 415-426). Somerville, MA: Cascadilla Press.

Peters, A. (1983). The units of language acquisition. Cambridge, England: Cambridge University Press.

Phillips, J. R. (1973). Syntax and vocabulary of mothers' speech to children: age and sex comparisons. Child Development, 44, 182-185.

Pinker, S. (1984). Language learnability and language development. Cambridge, MA: Harvard University Press.

Polka, L., Jusczyk, P. W., & Rvachew, S. (1995). Methods for studying speech perception in infants and children. In W. Strange (Ed.), Speech perception and linguistic experience: Theoretical and methodological issues in cross-language speech research, (pp. 49-89). Timonium, MD: York Press.

Reddy, R. (1976). Speech recognition by machine: A review. Proceedings of the IEEE, 64, 501-531.

Ringler, N. M. (1981). The development of language and how adults talk to children. Infant Mental Health Journal, 2, 71-83.

Saffran, J. R., Aslin, R. N., & Newport, E. L. (1996). Statistical learning by 8-month-old infants. Science, 274, 1926-1928.

Slobin, D. I. (1973). Cognitive prerequisites for the development of grammar. In C. A. Ferguson & D. I. Slobin (Eds.), Studies of child language development, (pp. 175-208). New York: Holt, Rinehart and Winston.

Smiley, P., & Huttenlocher, J. (1995). Conceptual development and the child's early words for events, objects, and persons. In M. Tomasello & W. Merriman (Eds.), Beyond names for things, (pp. 21-62). Hillsdale, NJ: Erlbaum.

Snow, C. E. (1972). Mothers' speech to children learning language. Child Development, 43, 549-565.

Stager, C. L., & Werker, J. F. (1997). Infants listen for more phonetic detail in speech perception than in word-learning tasks. Nature, 388, 381-382.

Suomi, K. (1993). An outline of a developmental model of adult phonological organization and behavior. Journal of Phonetics, 21, 29-60.

Tincoff, R., & Jusczyk, P. W. (1996,). Are word-final sounds perceptually salient for infants? Paper presented at the LabPhon V, Northwestern University, Evanston, IL.

Van Lancker, D. (1991). Personal relevance and the human right hemisphere. Brain and Cognition, 17, 64-92.

Walley, A. C. (1988). Spoken word recognition by young children and adults. Cognitive Development, 3, 137-165.

Walley, A. C. (1993). The role of vocabulary development in children's spoken word recognition and segmentation ability. Developmental Review, 13, 286-350.

Wang, M. D., & Bilger, R. C. (1973). Consonant confusions in noise: A study of perceptual features. Journal of the Acoustical Society of America, 54, 1248-1266.

Wood, N., & Cowan, N. (1995). The cocktail party phenomenon revisited: How frequent are attention shifts to one's own name in an irrelevant auditory channel? Journal of Experimental Psychology: Learning, Memory, and Cognition, 21, 255-260.