

### Discrimination of Linguistic and Prosodic Information in Infant-Directed Speech by Six-Month-Olds

When speaking to infants, adults typically expand and exaggerate several aspects of their speech than when speaking to other adults. This altered speech pattern, known as infant-directed (ID) speech, differs from adult-directed (AD) speech in many of its linguistic as well as paralinguistic features. Linguistically, ID speech can be characterized as consisting of shorter utterances, more repetition of sentences, and syntactically simplified sentence constructions (Aslin, Jusczyk, & Pisoni, 1996; Snow 1972). Paralinguistically, ID speech is typically higher in pitch, contains more pitch variability, wider pitch excursions, and longer pauses (Fernald & Simon, 1984; Papousek, Papousek, & Haekel, 1987). Several proposals in the literature (Aslin et al., 1996; Fernald, 1992) contend that ID speech is an important multifaceted event in the lives of infants especially regarding infants' language learning. Such proposals imply that infants are (at some point) capable of paying attention to both the linguistic (e.g., word content) and paralinguistic (e.g., pitch contours) features of ID speech. However, we have little information on the relative saliency of linguistic and paralinguistic features of ID speech for infant attention. It is important to look at both linguistic and paralinguistic components of ID speech in order to assess its developmental function. The purpose of the current experiment was to investigate six-month-olds' abilities to discriminate changes in either the linguistic or paralinguistic features (by means of differential responding) of the common ID utterances of their caretakers.

In trying to get at this question, it is helpful to utilize a model recently proposed by Anne Fernald (1992). According to her model, the function of the linguistic and paralinguistic aspects of speech to infants changes qualitatively throughout the first year. That is, the function that ID speech serves at the first level is quite different from the function that it serves at later levels. In the "dance" that characterizes the relationship between mother and infant, the function of ID speech can be seen as related to the evolving physical and cognitive development of the infant. As infants develop larger attention spans and more control over their bodies, infants learn to selectively respond to their caregivers, letting them know what they do and do not like. For example, if infants like the way mom speaks to them, they gaze at her and she holds the infant's attention. If they do not like the way mom speaks to them, then they gaze avert and perhaps even get upset. Because her baby gazes at her at length while she is using typical ID speech, she continues to alter her speech to gain the infant's attention. Throughout development, while the caregiver is trying to successfully master the ability to capture and maintain the infant's attention with her speech, she is teaching the infant about the world. It appears that not until later development does the infant "hook" into the lessons about objects and events that the mother is teaching and begin to extract words from the melody that captures so much of the infant's attention. A schematic depiction of Fernald's model is presented in Figure 1. This representation captures the evolving functions that ID speech serves throughout the first postnatal year, as well as makes clear the progressive overlap between the functional levels.

-----  
Insert Figure 1 Here  
-----

Thus, according to Fernald's (1992) model, ID speech serves different functions prior to infants' expression of language. First, a brief discussion of the four stages of the model will be provided, followed by a more detailed presentation of the empirical work which both supports and challenges the first three levels of the model.

In the first stage, ID speech is regarded as an unconditioned stimulus signals the infant to either calm down, get excited, or pay attention. In essence, this means that ID speech does not need to be paired with anything (such as feeding or touching) in order for the infant to respond to paralinguistic aspects of ID speech. Because ID speech is unconditioned, the infant should, according to Fernald, automatically respond to the contour of the speech. To this end, mothers use smooth, wide-range pitch contours which rise in intonation when trying to gain the infant's attention. However, when trying to soothe the infant, mothers rock the infant and speak in a low, falling pitch (Fernald, 1985). The communicative force of mothers' vocalizations comes from their immediate melodic power to arouse and alert or to calm and to delight. Although the exaggerated pitch patterns of maternal vocalizations may eventually help the child in the second year to identify linguistic units in speech, the human voice becomes meaningful to the infant through maternal intonation much earlier in development. Through this distinctive form of communication, the infant begins to experience communication before their production of words is possible.

In the second stage, the power of the paralinguistic aspects of ID speech to elicit attention moves from an unconditioned stimulus to a conditioned one that is paired with nurturance and caretaking. In a quantitative and not qualitative shift, ID speech at this level of the model is more effective in modulating arousal, attention, and emotion.

At the third stage of the model, vocal and facial expressions allow the infant to interpret the emotional states of others. Therefore, ID speech not only captivates attention, but also engages the infant emotionally at this stage of the model. It appears that the contours of ID speech start to "inform" the infant (e.g. social referencing). Social referencing is when the infant looks to the caregiver for information on how to behave or react to a given situation. Infants learn through ID speech to respond with the appropriate affect to both positive and negative ID vocal expressions. For example, adults at this point are instructing the infant when it is and is not appropriate to smile. Therefore, melodies of ID speech become compelling auditory stimuli which are particularly effective in eliciting emotion in preverbal infants.

At the last stage of the model, the paralinguistic aspects of ID speech are evolving to serve linguistic functions. At this point in the development of speech perception, words gradually emerge from the melody. Infants are now paying more attention to the information contained in the linguistic aspects of ID speech rather than the paralinguistic aspects. For instance, the paralinguistic features of ID speech help to mark focused words for the infant, identifying linguistic units within the stream of speech (e.g., "Look at the *ball!* See the *ball?*"). It is no longer just the melody that the infant recognizes as

containing the relevant information but also that the words have come to have meaning as well.

From this model there appears to be a gradual progression in the way in which ID speech changes in its effect on the infant. Through ID speech the infant moves from responding only to the paralinguistic aspects of speech to responding to both paralinguistic and linguistic aspects in conjunction with one another and finally to where the linguistic aspects of speech account for the attention of the young child.

With Fernald's model in mind it is important to consider both the linguistic and paralinguistic features of ID speech in order to gain an understanding of the role that each plays in the development of speech perception. Both aspects work together over time to create an organism that can comprehend and produce speech. But, how much of each aspect can account for the attention that infants pay to ID speech?

#### The Paralinguistic Aspects of ID Speech

Generally speaking, it appears from the literature that the paralinguistic features of speech engage and maintain attention in infants. When given the opportunity to listen to ID and AD speech, infants throughout the first postnatal year show a preference for ID speech (Cooper & Aslin, 1990; Fernald, 1985; Pegg, Werker, & McLeod, 1992; Werker & McLeod, 1989). However, in all of the studies just cited, the infants were able to listen to actual speech samples which contained both the linguistic and paralinguistic features of ID and AD speech. As mentioned earlier, it is not known whether and/or when infants are perceptually selective in their processing of linguistic and paralinguistic features. However, we do know something about infants' responsivity to the paralinguistic features of ID speech.

Sullivan and Horowitz (1983) investigated the differential attention of infants to synthetically generated and naturally produced rising and falling intonation contours. The results of an infant-controlled procedure were that 2-month-old infants attended more to the naturally-produced rising intonation contour. This study successfully demonstrated that a rising intonation contour produced by a female voice was effective in eliciting and maintaining infant attention. From this finding it was concluded that the paralinguistic aspects of the speech addressed to the young infant appear to be salient components of the infant's auditory environment. Therefore, as early as 2 months of age, at least one feature of ID speech (rising intonation contour) is so salient to the infant that it may serve to enhance mother-infant interaction by gaining and holding the infant's attention to the mother.

In a study by Papousek, Bornstein, Nuzzo, Papousek, and Symmes (1990), visual behavior in 4-month-olds was analyzed as to whether specific types of rising-falling contours used by adults in "approving" and "disapproving" contexts differentially affected attention. Each auditory stimulus consisted of a rising-falling contour with the absence of linguistic information: one slow, as used in approving ID speech, and one fast, as used in disapproving ID speech. Based on mothers' pragmatic use of these contours in naturalistic contexts, it was predicted that infants would look longer at a picture of an adult face associated with an approving contour and shorter at an identical picture associated with a disapproving contour. The results showed that approving contours

elevated infant looking time as compared to disapproving contours. Thus, prototypical approving and disapproving rising-falling contours from ID speech differentially affected visual behavior in 4-month-olds, independent of linguistic information and other contextual or acoustic features.

Fernald (1989) investigated whether the information about emotion and communicative intent is conveyed with special clarity through the exaggerated intonation patterns of ID speech. Adults listening to content-filtered ID and AD speech samples were asked to identify the communicative intent of the speaker, using only prosodic information. Fernald found that listeners were able to use intonation to identify the speaker's intent with significantly higher accuracy in ID speech. This finding suggests that the prosodic patterns of ID speech are more distinctive and more reliable cues to the affective state and intentions of the speaker. Knowing that adults can gain access to the communicative intent of speakers with the help of prosodic contours does not necessarily mean that infants perceive comparable information. Whether (and when) infants begin to perceive communicative intent in ID speech is still an active research question.

In research conducted by Trehub on music perception in 3- to 6-month-old infants, it can be seen that for the most part, infants focus on relational aspects of melodies. That is, when perceiving musical tones infants begin by synthesizing global representation from local details. This means that infants process holistic aspects of sound patterns first (e.g., contours) and more detailed aspects later (e.g. individual notes). Infants appear to encode the contour of a melody across variations in exact pitches and intervals. For example, Trehub, Bull, and Thorpe (1984, Experiment 2) presented infants from 8 to 11 months of age with repetitions of a 6-tone sequence or melody with retention intervals of 2.6 and 15 sec.. Infants failed to detect transpositions and contour-preserving transformation, but did detect contour-violating transformations. These findings imply that, under different conditions, infants encode and retain information about contour as opposed to specific pitches or intervals. Thus infants' perception of melodies is holistic in the sense that the global property of contour is perceived across specific changes in pitch and interval size. This holistic mode of auditory processing, in which the relational features of a tonal sequence are retained, could enable infants to encode the prominent melodic patterns of ID speech and recognize these characteristic melodies across variations in speaker, content, and pitch range.

Although infants can identify contour changes in melodies, is there something specific to language that makes the intonation contour recognizable to the infant? The basis for classifying utterances from one's own native language may be provided by prosodic cues. A critical task for the infant who is acquiring language is to distinguish speech from the manifold array of noises that are present in the acoustic environment. Four-day-old French and 2-month-old American infants discriminated utterances in their native languages from those of another language (Mehler, Jusczyk, Lambertz, Halsted, Bertocini, & Amiel-Tison, 1988). In contrast, neither group discriminated utterances from two foreign languages. The ability to distinguish utterances from two different languages appears to depend upon some familiarity with at least one of the two languages. When the previous experiment was done with low-pass filtered versions of the same

stimuli (i.e., all linguistic information was eliminated from the sample, leaving only paralinguistic information), infants discriminated their native language from a non-native one. This means that there is a lot of information carried in the paralinguistic aspect of ID speech that informs the infant. According to Mehler et al. (1988), the ability to segregate utterances from different languages is critical from the point of view of language acquisition.

In a related study, Moon, Cooper, and Fifer (1993) assessed the development of preference for native language over nonnative language in 2-day-old infants. Newborn infants whose mothers were monolingual speakers of Spanish or English were tested with recordings of female strangers speaking either Spanish or English. By using a contingency-based sucking procedure, these authors found that newborns activated recordings of their native language for longer periods than the foreign language. From these results, it appears that newborns respond preferentially to more speaker-general properties (e.g., intonation patterns characteristic of their native language).

What aspect of ID speech makes this type of speech so enticing and interesting? Is it the duration, the intensity, or the frequency? Three experiments were conducted by Fernald and Kuhl (1987) investigating the possible acoustic determinants of 4-month-old infants' preferences for ID speech. Each of the experiments focused on a particular paralinguistic variable in the absence of linguistic content:  $F_0$ -contour, amplitude, and duration. Infants showed a significant preference for the  $F_0$ -contours of ID speech but not for duration or amplitude. This pattern of results suggests that the fundamental frequency characteristics of infant-directed speech may be a critical acoustic determinant of infants' preferences for ID speech. However, because the infant never encounters  $F_0$ -contours in isolation, it is difficult to generalize from this finding to more natural circumstances. Moreover, some studies have failed to find such differential responding to the isolated  $F_0$  characteristics of ID speech in younger infants (Cooper & Aslin, 1994) as well as in same-aged infants using different behavioral paradigms (Colombo & Horowitz, 1985; Kaplan et al., 1995).

Although several studies have found that infants prefer rising (approving) contours, the exaggerated modulation of fundamental frequency inevitably covaries with distinctive patterns of intensity, rhythm, and content in natural speech to infants. It is unclear how these other factors co-act with  $F_0$  in affecting infant perception. Cooper and Aslin (1994) investigated this point by pitting unfiltered versions of ID speech samples against low-pass filtered versions of these same samples. They found that 1-month-olds exhibited a significant preference for the unfiltered samples. On the basis of these findings, these authors argued that there are other acoustic properties in addition to expanded pitch contours (such as spectral structure) that contribute to the preference for ID speech in infants.

Cooper and Aslin (1994) have demonstrated that there may be more than one paralinguistic feature that attracts and maintains infant attention (e.g., harmonic structure). This is interesting because there have not been any further studies to assess the contribution of words to ID speech preferences. Because research on speech perception has demonstrated that young infants are remarkably sensitive to fine

distinctions between phonetic segments (even those that exist in languages other than their native one), it seems reasonable that the linguistic aspects of ID speech need to be assessed in the contribution to gaining, maintaining, and disengaging infant attention. This is important because natural ID speech is not low-pass or content filtered. Words are being spoken to the infant throughout the stages in which the paralinguistic features of ID speech are of primary salience. It is difficult to undertake an analysis of ID speech without looking into the contribution that linguistic aspects have in affecting the infant.

#### The Linguistic Aspects of ID Speech

According to Fernald's (1992) model, the prosodic patterns of ID speech increasingly serve a linguistic function during the later months of the first year of postnatal development. Although early in development the infant perceives prosodic contours holistically, words gradually begin to emerge from the melody toward the end of the first year. It is no longer just the melody that the infant recognizes as containing the relevant information. The words have come to have meaning as well. The prosody of ID speech helps to draw the infant's attention to particular linguistic units within the continuous stream of speech. For example, Fernald and Mazzie (1991) found that when highlighting focused words, mothers used a distinctive prosodic strategy in speech to their infants. Focused words occurred most often on exaggerated pitch peaks in the final position in phrases in ID speech, whereas in AD speech the acoustic correlates of lexical stress were much more variable. Fernald and McRoberts (1991) found that infants in the early stages of language acquisition were better able to recognize familiar words in ID speech than in AD speech (at 15 months). However, at 18 months of age, babies recognize familiar words in both ID and AD speech contexts.

Karzon (1985) investigated the effects of paralinguistic parameters (fundamental frequency, amplitude, and duration) on discrimination of consonant-vowel sequences by 1 and 4-month-old infants. Results indicated that even the younger infants discriminated the three-syllable sequences [marana] and [malana] when paralinguistic characteristics typical of ID speech were used to emphasize the middle syllable. Under these conditions, infants showed clear evidence of discrimination of three-syllable sequences differing by only one speech sound. However, infants failed to demonstrate discrimination when AD paralinguistic characteristics were used. This pattern of results suggests that the exaggerated paralinguistic features of ID speech may function as perceptual "pointers", facilitating phoneme discrimination by focusing the infant's attention on a distinctive syllable within polysyllabic sequences.

Moreover, some recent evidence suggests that younger infants recognize the sound patterns of their own names. Mandel, Jusczyk, and Pisoni (1995) had 4.5 month old infants choose between their own names and foils that either matched or mismatched the stress pattern of their name. Infants demonstrated a preference for their own names over the names that shared the same stress pattern as well as those that did not (e.g., "Johnny" VS. "Abby" VS. "Elaine" or "Lamont"). This indicates that infants begin to recognize sound patterns of items that are frequently uttered in their environments. In a further investigation of name recognition, Mandel and Jusczyk (1996) embedded 6-month-old infants' names in sentences. In contrast to their earlier study, 6-month-olds did not

prefer sentences with their names over sentences with another name even when the name was placed in sentence-initial or sentence-final positions (two salient sentence locations). However, a replication of the previous procedure with 7.5-month-olds showed that these infants could detect their own names embedded in sentences, even when their names were randomly placed throughout the sentence. Thus, there appears to be a developmental shift from 6 month to 7.5 months in the ability to detect highly salient information (such as the infants name) embedded in a sentence.

In sum, there appears to be a shift from the melody carrying the message to the melody enhancing the content in the message in the development of speech perception. Thus, it appears that sensitivity to the native language starts by or shortly after birth and is evident earlier for paralinguistic (e.g., prosody, speaker identity) aspects of the native language than it is for detailed linguistic information. Later in development, the linguistic information becomes as informational as the paralinguistic aspects of the speech.

### Purpose of the Study

The present experiment contributes to the literature by teasing apart the paralinguistic (such as rising and rising-falling intonation contours) from the linguistic aspects (such as individual words) of infants' perception of ID speech. Of interest here is whether 6-month-old infants could detect a contour change or a linguistic change when listening to common ID utterances. Specifically, infants were presented with either a change in contour when the words remained the same or a change in the word content when the contour remained the same. Using a discrimination procedure, infants were habituated to a common ID utterance (e.g., "What are you doing?" in a rising contour). Once habituated to this utterance, either the utterance or the contour was changed. That is, the words changed within the same contour (e.g. "Can you say something?" with a rising contour), or the contour changed with the words remaining the same (e.g. "What are you doing?" with a falling contour). It was hypothesized that 6-month-olds would either be unable to discriminate a word change when contour remained the same, or that their ability to do so would not be as robust as their discrimination of a contour change when the words remained the same.

### Method

#### Participants

Thirty-five 24- to 28-week-old infants ( $M = 25.2$  weeks, range = 24 to 27 weeks,  $SD = .97$ ; 15 male and 17 female) were recruited for participation in this experiment. Two infants were excluded from the data sample because they became fussy and could not finish the procedure. An additional infant was also excluded from the data sample due to a previous history of hearing problems.

Two different methods of recruiting subjects were used in the attempt to obtain a diversified sample. The first method of recruitment was pursued through the birth announcements in The Roanoke Times and World News. Upon receipt of the birth announcements, the parents were sent a letter describing the study and inviting their participation. A few days after the letter was mailed, the parents were contacted by phone to determine if the parents were interested in participating. The second method of recruiting subjects was to place a flyer at Super Wal-Mart in Christiansburg. This site

was chosen because it is probably the most frequented store in the Montgomery County area. Once subjects had been successfully recruited, they were brought to the lab for testing. Demographic information from the thirty-two infants was obtained via a questionnaire given on the day of the testing (see Appendix A). This questionnaire requests parent ages, race, education levels, net yearly income, occupations, as well as information regarding the infant's gestational age, method of delivery, and method of feeding. See table 1 for a summary of the demographics.

-----  
Insert Table 1 here  
-----

### Speech Recordings

One goal of the present study was to test infants with utterances that had a high probability of occurrence in the infants' everyday experiences. In order to accomplish this, a content analysis was conducted on 20 transcripts from previous recordings of mothers speaking to their 4-month-old infants (Cooper, Abraham, Berman, & Staska, in press). Although the target age of the infants in this study was 6 months of age, we felt that these transcripts of mothers talking to 4-month-olds was still appropriate given the similarity of maternal speech across this age range (i.e., 4 to 6-months of age; Stern et al., 1983). A frequency count on linguistic content of the maternal recordings was conducted by noting sentences that occurred more than once within each mother. Then, a tally was taken as to the occurrence of these utterances across recordings. From this process, the utterance "What are you doing?" was found to be spoken by all 20 women. The second most common utterance was not as unequivocal. All the women made some sort of request for the infant to talk but not specifically the same sentence (e.g. "Can you say something?" "Can you talk to mommy?" "Are you going to say something?") "Can you say something?" was chosen because it contained the same number of syllables as the first utterance chosen.

In conjunction with the content analysis, these same recordings of mothers speaking to their infants were listened to and the pitch contours of the ID utterances were coded as either rising, falling, or rising-falling. A frequency count was made of the most commonly occurring contours. All the women used rising contours and rising-falling contours, with less than half using a falling contour. Thus, the end result of this content analysis was the following: "Can you say something?"- rising contour; "Can you say something?"- rising/falling contour; "What are you doing?"- rising contour; and "What are you doing?"- rising/falling contour.

To make the test recordings, five women (all mothers) were asked to speak these four different utterances as they were being tape recorded. Then, 13 naive students (both undergraduate and graduate) rated all the speech samples by all five mothers. First, each sentence was rated as to whether the contour was rising or rising/falling. Second, each sentence was rated for quality on a Lickert scale 1-5 (e.g., was this speech sample a very good or very poor example of rising or rising/falling speech?). Once each sentence had been rated individually, students were asked to rank order all five women in overall speech quality. Subject number 5 was rated by 62% of the students as having the best



speech recordings and was used to generate the test recordings. These speech samples were also visually inspected on a speech analysis program (Micro Speech Lab) to verify if the intended contours of the speech were obtained. As can be seen in Figures 2-5, the  $F_0$  generally increased in both "rising" utterances (Figures 2 and 4) whereas the  $F_0$  generally increased and subsequently decreased in the "rising-falling" utterances (Figures 3 and 5).

-----  
 Insert Figures 2-5 here  
 -----

Several prosodic features were calculated for the four test sentences (see Table 2). An analysis conducted on the prosodic features of these utterances revealed that the two rising sentences differed significantly in  $F_0$  ( $t = 2.56$ ,  $p < .05$ ). However, the two rising-falling sentences did not differ ( $t = 1.877$ ,  $p > .05$ ). The difference in  $F_0$  between the rising utterances is discussed in the results section.

-----  
 Insert Table 2 here  
 -----

#### Apparatus

Upon arrival to the laboratory, the parent was seated facing a black wooden 3-sided enclosure (80-cm (length) X 80-cm (width) X 60-cm (height)). The surroundings of the parent was to the rear, a white wall, and to his/her right and left was a black covering (pieces of cardboard). These black pieces of cardboard were in place to restrict the infant's peripheral view and prevent them from being distracted. Each parent held each of the infants on their lap facing the front wooden panel. Between the parent/infant pair and the front panel, was a 40-cm X 80-cm wooden shelf painted black and covered with a white foam pad. This shelf extended from the front panel and provided the infant with support and a safe place to touch. A custom-built interface, an Emerson VCR-875 videocassette player/recorder, a 13 in Mitsubishi color television screen (model #cs 1347R), a Realistic (model 40 2054 8 ohms) loudspeaker, and a Panasonic VHS camcorder (model AG 170; see Figure 6) were located behind the front panel.

-----  
 Insert Figure 6 here  
 -----

Infants were able to view the screen of the television monitor through a cut-out in the wall of the front panel. The screen was approximately 35 cm from the infant's face. A video tape of static concentric colored circles was played on the color television monitor to the infant via a VCR. The loudspeaker was located behind a cut-out in the front panel directly above the television monitor, over which the auditory recordings was presented. The infant's responses were watched by an observer on a JVC 9" color monitor (model #TM22U) connected to the Panasonic camcorder.

Watching this color monitor, an observer recorded the infant's visual activity during testing. A small red light was in front of the observer (attached to the bottom of the monitor) to indicate when the infant's screen was on. The observer held a small box

which contained a button that was depressed to begin and end the speech presentations. All of the electrical-mechanical equipment was controlled through a customized program on a Power Macintosh computer, which regulated the presentation of both the visual and audio stimuli, time between stimulus presentations, and stored the length of infant visual fixations for each trial.

#### Procedure

Each of the infants were seated on either their mother's or father's lap in front of the three-sided enclosure. The parent wore headphones over which continuous vocal music was played to mask the speech stimuli being presented. Once the infant was judged to be happy and alert by the experimenter, the procedure was started. During testing, the room lights were turned off, allowing the observer to judge looks based on the reflection of light from the color monitor off the infant's eyes. The observer recorded the duration of each look to the visual display by depressing the button on the box connected to the computer. This observer wore headphones and listened to uninterrupted music at a level that masked all extraneous sounds. A second experimenter stood next to the apparatus and was responsible for maintaining infant temperament and overall comfort of parent and child, and monitored the testing equipment.

When the observer judged that the infant was looking toward the visual display, he or she depressed a key that activated channel 1 (or 2) of the tape recorder. The recording associated with that channel played continuously through the loudspeaker (@ 65 dB, as recorded at the infant's head) until the observer judged that the infant had looked away from the circles. As soon as the key was depressed signaling the end of a look, the recording and the visual display were turned off. The observer in this experiment was a well-trained graduate student from the same laboratory.

In the discrimination procedure, infants heard the same speech recording on successive trials until the habituation criterion had been met. The criterion for habituation was as follows: The mean looking time to the visual display on the first three trials was computed and stored by the computer for later reference. After the initial three trials, when the average looking time across any three consecutive trials fell to 50% or less of the mean looking time from the first three trials, the habituation criterion had been met. Thus, the minimum number of habituation trials was six.

For half of the infants ( $n=16$ ), their looks to the visual display on the next four trials after habituation activated the other channel of the tape recorder. The session ended after these four postcriterion trials were completed. For the other half of the infants ( $n=16$ ), two additional trials (hereafter called "lag" trials) were administered after the habituation criterion had been met but before the change in speech stimulus was presented. This partial-lag design controlled for the possibility of spontaneous recovery in looking times during habituation (Bertenthal, Haith, & Campos, 1983). Additionally, to control for any bias due to the order of speech presentation, 16 of the 32 infants heard "What are you doing?" first, with 8 of these 16 infants hearing the rising contour and the other 8 hearing the rising-falling contour. The other 16 infants heard "Can you say something?" first, with 8 of these 16 infants hearing the rising contour and the other 8 hearing the rising-falling contour.

### Results

To test for discrimination, infants' mean looking times on the last two precriterion trials (which were lag trials for 16 of the infants) were compared to their mean looking times across the first two postcriterion trials using a mixed analysis of variance (ANOVA) with change (contour, word), control (lag, no lag), and order (order 1 first, order 2 first) as the between-subject factors and trials (precriterion, postcriterion) as the within-subject factor. The results of this analysis showed a significant main effect for test trials [ $F(1,24) = 6.71, p < .05$ ], with the mean looking time across the two postcriterion trials ( $M = 7.74$  sec,  $SD = 6.83$ ) being significantly longer than the mean looking time on the last two precriterion trials ( $M = 4.75$  sec,  $SD = 3.01$ ). There were no other significant main or interaction effects (see table 3). The mean looking times across infants on the first three trials of the session (baseline), the last two precriterion trials (collapsed across the lag variable: pre 1 and 2), and the first two postcriterion trials (post 1-2) are presented in Figure 7.

-----  
 Insert Table 3 and Figure 7 here  
 -----

Although the infants appeared to discriminate the word change independent of the contour in which the words were embedded, it is possible that discrimination was better in the rising condition (given the difference in  $F_0$ ; see Table 2) compared to the rising-falling condition. In other words, the infants in the rising condition could have discriminated the two rising sentences based on  $F_0$  and not necessarily on the change in word content. An ANOVA was conducted to see if the type of contour (rising or rising/falling) used in the word change conditions made a difference in the magnitude of discrimination. This analysis included contour type (rising, rising/falling) as the between subject factor and trials (prechange/postchange) as the within subject factor. The results of this analysis showed that infants in the rising condition did not discriminate utterances significantly better in the rising-falling condition,  $F(1, 14) = .151, p > .05$ .

As previously mentioned, some studies have found that infants prefer to listen to rising contours more than other contour types (e.g., Sullivan & Horowitz, 1983). To assess this, we compared the infants' looking times on the first trials of the procedure as well as the number of trials to habituation as a function of which contour the infants heard first. Additionally, a similar analysis was also conducted as a function of which word content the infants heard first.

The infants who received a contour change did not differ significantly in looking time on the first trial, if they heard the rising contour first ( $M = 13.41$  sec,  $SD = 9.24$ ) or the rising-falling contour first ( $M = 13.76$  sec,  $SD = 8.39$ ),  $t(1,30) = -.113, p > .05$ . Also, the infants who received a word change did not differ significantly if they heard the "what" sentence on the first trial ( $M = 12.08$  sec,  $SD = 8.28$ ) or the "can" sentence on the first trial ( $M = 15.09$ ,  $SD = 9.09$ ),  $t(1,30) = -.979, p > .05$ .

In addition, the mean number of trials to habituation as a function of contour or word change was examined. The mean number of trials to habituation as a function of a contour change was 11.5 ( $SD = 5.42$ ; range = 6 - 17). Whereas, the mean number of trials

to habituation in the word change condition was 9.75 ( $SD = 2.98$ ; range = 6 - 24). A  $t$ -test was conducted to assess whether there was a difference in the number of trials for the infants to reach the habituation criterion as function of what order. When looking at the group that received a contour change, the number of trials to habituation when receiving a rising contour first did not differ significantly from the number trials to habituation when receiving a rising-falling contour first ( $t(1,30) = .515, p > .05$ ). In addition, the group that received the word change did not differ significantly depending on whether they received the "what" or the "can" sentence first ( $t(1,30) = .356, p > .05$ ).

Lastly, 23 infants (out of 32) had greater average looking times on the two postcriterion trials compared to their averages on the two precriterion trials ( $p < .01$ ; two-tailed binomial).

### Discussion

The results of this study indicate that 6-month-olds discriminated both a change in contour (when the words were held constant) and a change in words (when the contour was held constant) in utterances that are common in their caretaking environment. It was predicted that 6-month-olds would easily discriminate the change in contour, but that they would not be able to discriminate the change in words when the contour of the utterance remained the same (or at least that they would not make this discrimination as readily as the contour discrimination). This prediction was made based on a previous finding that 6-month-olds did not differentially attend to a sentence in which their names were embedded (Mandel & Jusczyk, 1996). There is little other available data on the emergence of infants' ability to discriminate word changes within sentences. Thus, the first hypothesis was supported but the second was not. I will address possible reasons for these two outcomes respectively.

#### Infants' discrimination of speech

##### Paralinguistic information

That the 6-month-olds discriminated the change in contour supports past research indicating that infants can discriminate the paralinguistic aspects of ID speech (Cooper & Aslin, 1994; Fernald & Kuhl, 1987; Mehler et al., 1988; Papousek et al., 1990; Sullivan & Horowitz, 1983). This ability to discriminate one pitch contour from another has been found in infants as young as 4 days old (Mehler et al., 1988) and within a variety of contexts. That is, infants discriminated pitch contours when the contours were low-pass filtered, simulated sine waves, octave-bands, and embedded within melodies. The present results for the contour change group adds to the robustness of this general finding.

##### Linguistic information

In contrast, that the 6-month-olds in the word change group could discriminate between the two sentences despite the constancy of contour is a novel finding. One explanation for this result is that the redundancy of the repeated contour (regardless of whether it was rising or rising-falling) during habituation allowed the infants to focus on specific word information. If the contour shape had been more variable during habituation (e.g., both rising *and* rising-falling), it may have been more difficult for infants to discriminate a change in words. Generally speaking, this is consistent with the literature on auditory discrimination in infants in that habituation is easiest when the number of

featural dimensions that are changing during familiarization is kept to a minimum. For example, it is easier for an infant to discriminate /ba/ from /pa/ when spoken by the same speaker rather than different speakers.

However, it may be that redundancy itself is necessary but not sufficient to account for the findings in my word change group. A second factor that may have enhanced discrimination could be the ID context. That is, infants may pay more attention to ID utterances than AD utterances and this enhanced general attention increases the probability that they will process word information. We do know that infants as young as 2 days of age attended more to ID than AD speech (Cooper & Aslin, 1990). Interestingly, general increases in attention also may not be sufficient to explain infants' discrimination of words. In her study with 1-month-olds, Karzon (1985) found that they could discriminate /ra/ from /la/ in the words "marana" and "malana" only if the target syllables were accompanied by ID-like features (e.g., expanded pitch contours). When the initial syllables were ID-like (/ma/), 1-month-olds failed to discriminate the two words.

In the current study, it may have been that the exaggerated pitch contours of ID speech directed the infants' attention to specific words within the utterances. For example, the final words (i.e., "doing" and "something") were concomitant with the highest pitch levels in the utterances with rising contours (see Figures 2 and 4). If the infants' attention was drawn to this area of the utterances, they could discriminate between the utterances on the basis of these single words. However, this explanation is not consonant with the findings from the Mandel and Jusczyk (1996) study. These authors also used ID speech when creating their speech recordings. However, the 6-month-olds in their study failed to prefer the utterance in which their names were embedded, regardless of whether the names occurred in initial, middle, or final sentence position. Unfortunately, Mandel and Jusczyk (1996) did not subsequently test the 6-month-olds for their ability to discriminate one sentence from another. Assuming that the contour was held constant between sentences as in the present experiment, 6-month-olds should have been able to discriminate the sentences at least when the names occurred in final sentence position. These various accounts of 6-month-olds' abilities to discriminate words within contours can be teased apart experimentally. Suggestions for future studies will be presented at the end of the discussion.

#### A model for the global-to-local processing of speech information

That infants at 6-months of age discriminated both a contour and a content change is congruent with the model proposed by Fernald (1992; see Figure 1). As discussed earlier, this model attempts to explain the function of linguistic and paralinguistic aspects of speech to infants throughout the first postnatal year. Fernald proposed that the paralinguistic information in utterances is of primary importance in the speech to young infants, but that the linguistic aspects of utterances increase in importance as infants grow older (this coincides with the period of time between her third and fourth levels of the model, during which the words begin to emerge from the melody). By 6 months of age, infants are equally able to process both the paralinguistic and linguistic aspects of ID speech.

A criticism of Fernald's (1992) model, however, is that it is vague regarding the approximate age at which this prosodic-to-linguistic transition occurs. If this transition is primarily due to maturational factors, then we need to be able to specify the time in development that corresponds to infants' discrimination of words within utterances, and why (e.g., possible activation of frontal areas of cortex that increase infants' abilities to inhibit responding to irrelevant information). If the transition from prosody to words is primarily due to experiential factors, we need to explore the types and timing of events that allow infants to process at these various levels.

One such experiential model has been discussed by Eleanor Gibson (1969). Gibson's general argument is that infants are initially more sensitive to global information (e.g., the outer contour of their mothers' faces) and become more sensitive to local information with experience (e.g., the internal features of their mothers' faces; see Sullivan & Horowitz, 1983, for a review).

For instance, Trehub and her colleagues have demonstrated in research on music perception that infants process melodies in a similar global-to-local fashion. When listening to melodies infants process the holistic aspects of the sound pattern first (i.e., the general melodic contour) and the more detailed aspects of sound patterns later (e.g., individual notes; Trehub, Bull, & Thorpe, 1984). It is possible that infants use the same processing strategy when listening to speech.

A recent study by Moore, Spence, and Katz (1997) found that 6-month-olds discriminated a change in contour category (e.g., comforting vs. approval) even though the infants heard a different utterance on each familiarization trial. That is, the only basis for discrimination after habituation was a change in category type. Because the utterances these authors used were low-pass filtered, the infants must have relied on contour shape alone to make the discrimination.

According to Gibson's (1969) perceptual learning theory, the move from global-to-local levels of information is not constrained by age; it is more a function of experience. The finding that 4.5-month-old infants preferred their own name over other names (Mandel et al., 1995) suggests that they were able to process the local features (individual letters, despite identical stress patterns). The argument here is that 4.5-month-olds could discriminate (and prefer) their own names only because they heard this acoustic pattern more often. When presented with two sentences with the same contour patterns, but one containing their name and the other containing another name, 6-month-olds did not show a preference whereas 7.5-month olds did (Mandel & Jusczyk, 1996). It is important to note that Mandel and Jusczyk (1996) did not subsequently follow up this study with a discrimination study. Therefore, we do not know if these 6-month-old infants could discriminate two utterances, one containing their name.

In the present experiment, 6-month-olds discriminated changes in both contours and words. This seems inconsistent with the pattern of results from the Mandel studies mentioned above. One reason for this difference may have come from the local information that these infants had to evaluate. In the present experiment, the utterances in the word change group were more different from each other than those used in the Mandel and Jusczyk (1995) study. For example, the utterances in the present study

shared only one word (i.e., “you”) whereas the utterances in the Mandel and Jusczyk study were identical except for the infant’s name.

#### Suggestions for future studies

In sum, it has been suggested here that several factors may influence the development of infants’ discrimination of word information in utterances: redundancy of contours, ID speech context, maturation, and/or specific experience. Several potential studies will be discussed as ways to tease apart the contributions of these various factors.

Redundancy of contours. One interesting way to test the power of redundancy in contours for word discrimination would be to present 6-month-olds with the same word content on every trial during habituation, but allow the contour to vary randomly from trial to trial. For example, the infant will hear “Can you say something?” repeatedly, but with rising, rising-falling, falling, and flat contours depending on the trial. After habituation, the infant would then hear “What are you doing?” embedded in one of these contour types. I predict that under these conditions, the infants would not discriminate the word change. This prediction is based on the variability of speech samples that the infant would have heard in the habituation procedure. If the redundancy of the contour is what helps the infant to process at a local level (e.g., words) then changing the words amid an array of variability in contour would not make a difference to the infant. Therefore, the change in words would go undetected.

ID speech context. If ID speech acts to enhance the general attention of infants to speech, it is predicted that 6-month old infants would fail to discriminate a change in word content if the utterances were adult-directed (AD). That is, the inability of AD utterances to increase attention would mask the infants’ word discrimination.

However, if ID speech serves a more specific function in that it draws attention to local differences in utterances (e.g., different nouns which correspond to pitch peaks), then ID speech alone is not sufficient. This possibility could be tested by systematically varying the placement of similar and dissimilar words within ID utterances during habituation. For example, two groups of 6-month-olds could be habituated to “Can you say something?” with the pitch peak occurring in final sentence position; one group would then be tested with “Can you say mommy?”, but the other group would be tested with “Should I do something?” , both with the same contours as the familiarization sentence. If ID speech draws attention to local features, the infants should recover responding to the test utterance with mommy but not to something.

Experience. If repeated experience with specific acoustic patterns enhances infants’ processing of local information, it should be possible induce preference their own name embedded in a sentence at 6-months of age. The proposed experiment would consist of asking mothers of infants at 4.5-months of age to make an overt effort to use the infant’s name as much as possible when talking to him/her. These infants could then be tested at 6 months of age in the same procedure used by Mandel and Jusczyk (1996). A preference for the sentences which contain their names would indicate that experience alone is sufficient for word processing.

The search for individual differences. Interestingly, Colombo and his colleagues (e.g., Freesman, Colombo, & Coldren, 1993) have found individual differences in 3- to 4-

month-old infants' abilities to process global and local visual information. Two groups typically emerge: short-lookers and long lookers. Short-lookers tend to process global features quickly and then move on to local details of a visual display. In contrast, long-lookers have a difficult time transitioning from the global information to the specific, at least within the same time frame. Of interest here is whether 6-month-olds who were initially categorized as either short- or long-lookers would respond differentially in the present experiment. Specifically, I would predict that both short- and long-lookers would discriminate the contour change, but that the long-lookers would not discriminate the word change.



Table 1

Summary of demographic information as reported by mothers

<u>Variable</u>	<u>Median</u>	<u>Range</u>	<u>%</u>	<u>n</u>
Mother's Age	30	18 -39	--	32
Mother's Occupation				
homemaker	--	--	47	15
other	--	--	53	17
Mother's Education Level	16	7 - 20	--	32
Father's Education Level	16	4 - 20	--	32
Estimated Family Income	\$32,000	\$0 - \$80,000	--	32
Mother's Race				
White	--	--	97	31
Black	--	--	3	1
Mother's Marital Status				
Married	--	--	84	27
Single	--	--	16	5
Parity				
first child	--	--	59	13
other than first	--	--	41	19

Table 1 continued

Variable	Median	Range	%	<u>n</u>
Method of Delivery				
Vaginal	--	--	88	25
Cesarean	--	--	22	7
Method of Feeding				
Breast	--	--	66	21
Bottle	--	--	28	9
Both	--	--	6	2
Estimated Gestational Age	40	38 - 43	--	32

---

Table 2

Pitch and duration characteristics of the Infant-Directed (ID) utterances

	<u>Utterances</u>			
	“What are you doing?”	“What are you doing?”	“Can you say something?”	“Can you say something?”
<u>Prosodic Features</u>	<u>rising</u>	<u>rising-falling</u>	<u>rising</u>	<u>rising-falling</u>
Average F <sub>0</sub> (Hertz):.....	205	205	240	247
F <sub>0</sub> Range (Hertz):.....	121-289	156-254	170-372	72-565
Duration (seconds):.....	.860	.960	1.100	1.520

Table 3

ANOVA Results with control, change, and order as between subject factors and trials as the within subject factor.

Source	<u>df</u>	<u>F</u>
<u>Between subjects</u>		
Control (A)	1	0.13
Change (B)	1	0.02
AB	1	3.30
Order (C)	1	1.43
AC	1	0.01
BC	1	0.01
ABC	1	0.82
between Ss error term	24	
<u>Within subjects</u>		
Trials (D)	1	6.71*
AD	1	0.39
BD	1	0.31
ABD	1	0.62
CD	1	1.36

Table 3 continued

ANOVA Results with control, change, and order as between subject factors and trials as the within subject factor.

---

Source	<u>df</u>	<u>F</u>
ACD	1	0.70
BCD	1	1.39
ABCD	1	1.59
within subjects error term	24	

---

---

\* $p < .05$ .

Figure 1

The functional changes in prosodic and linguistic aspects of ID speech (adapted from Fernald, 1992)

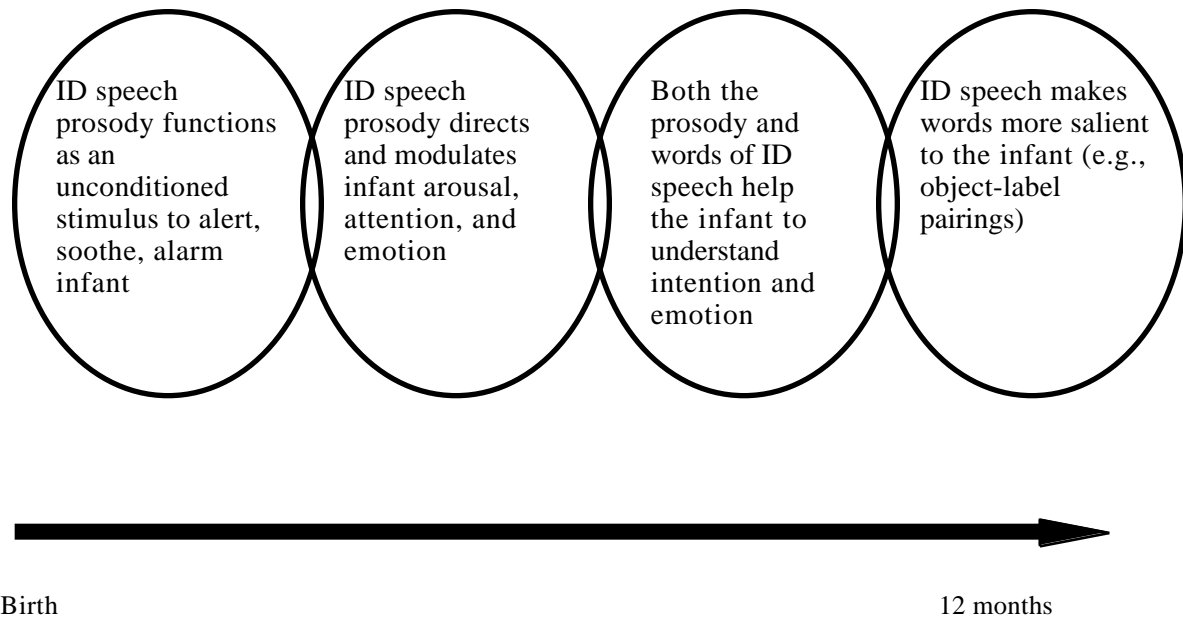


Figure 2

Graphic depiction of the sentence "What are you doing?" in a rising contour.

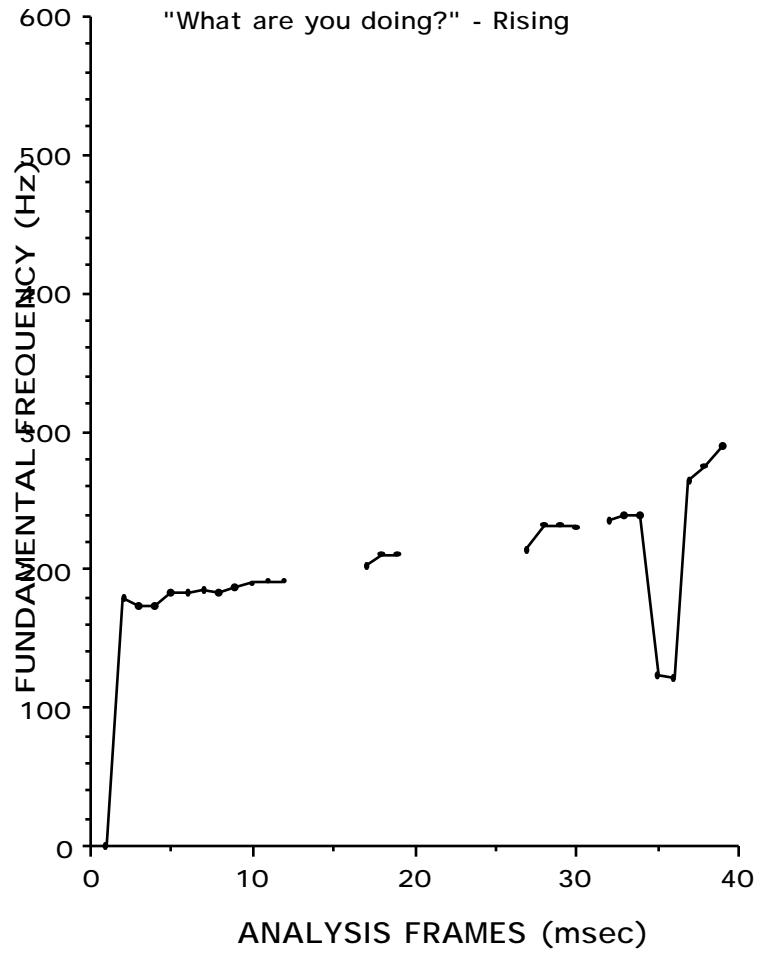


Figure 3

Graphic depiction of the sentence "What are you doing?" in a rising-falling contour.

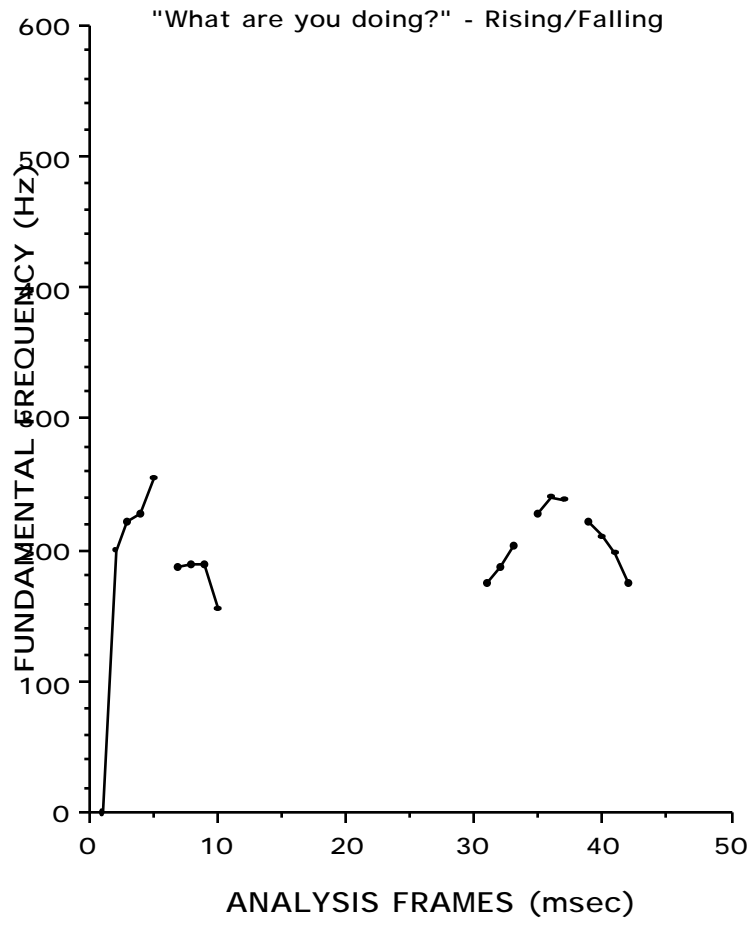




Figure 4

Graphic depiction of the sentence "Can you say something?" in a rising contour.

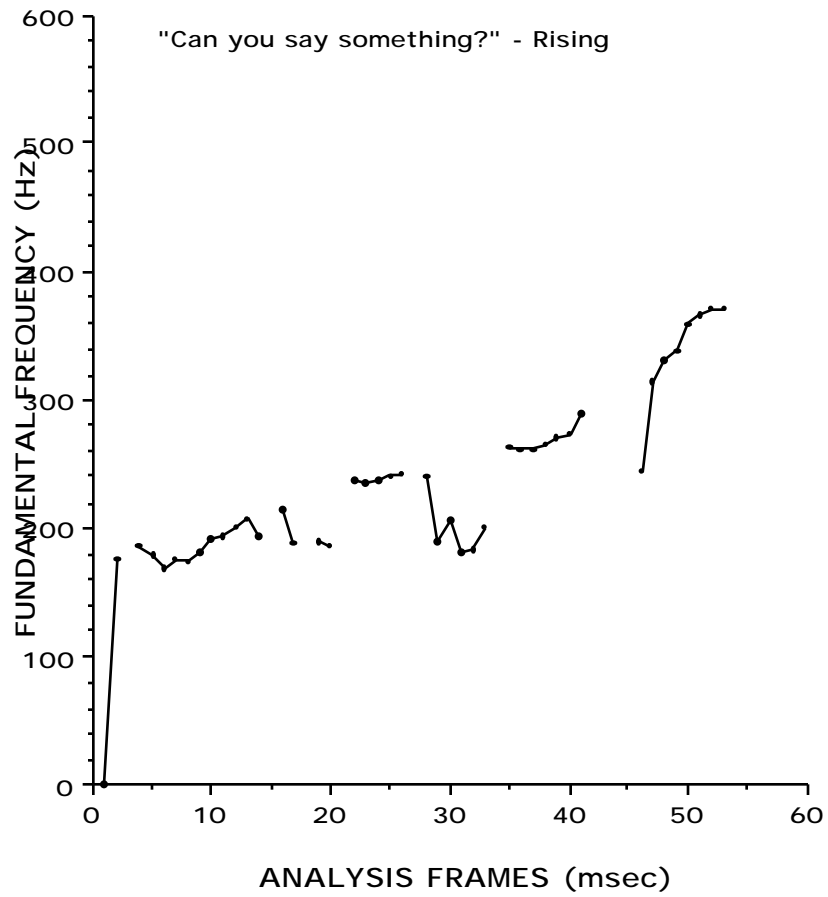


Figure 5

Graphic depiction of the sentence "Can you say something?" in a rising-falling contour.

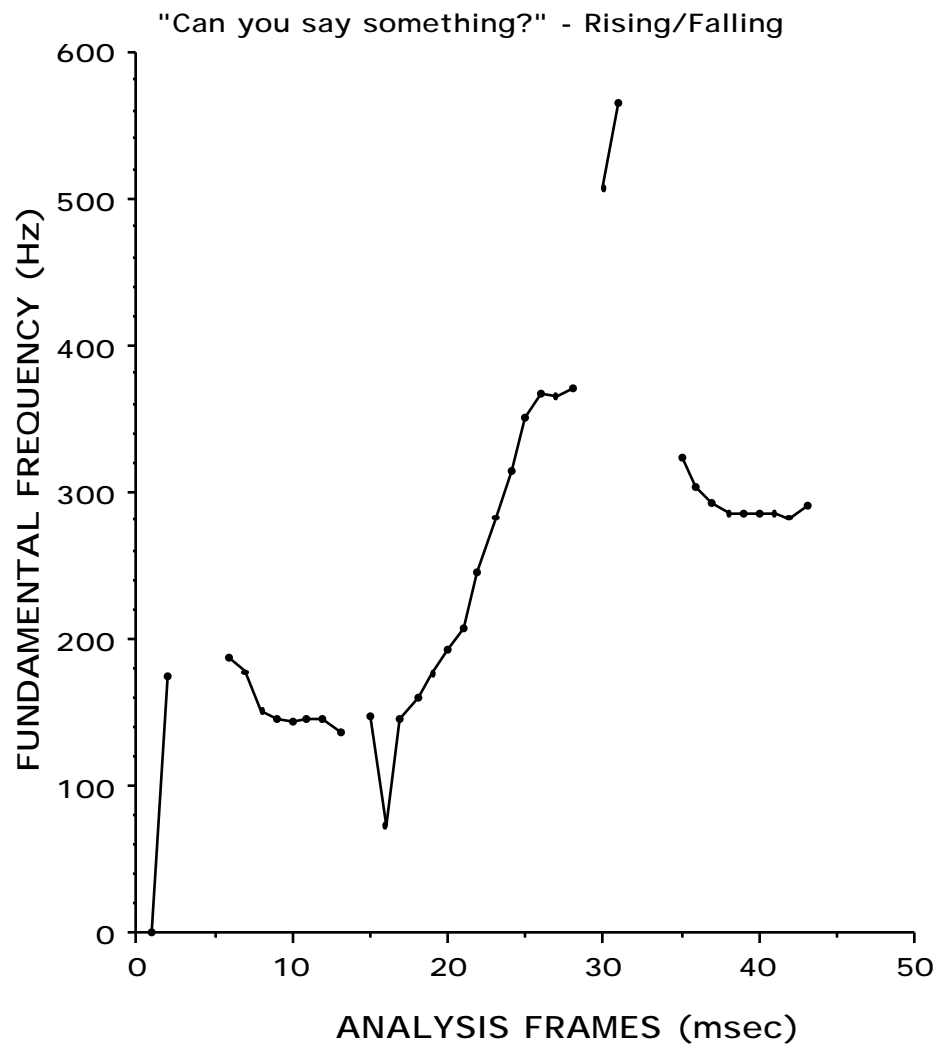


Figure 6

Schematic of apparatus

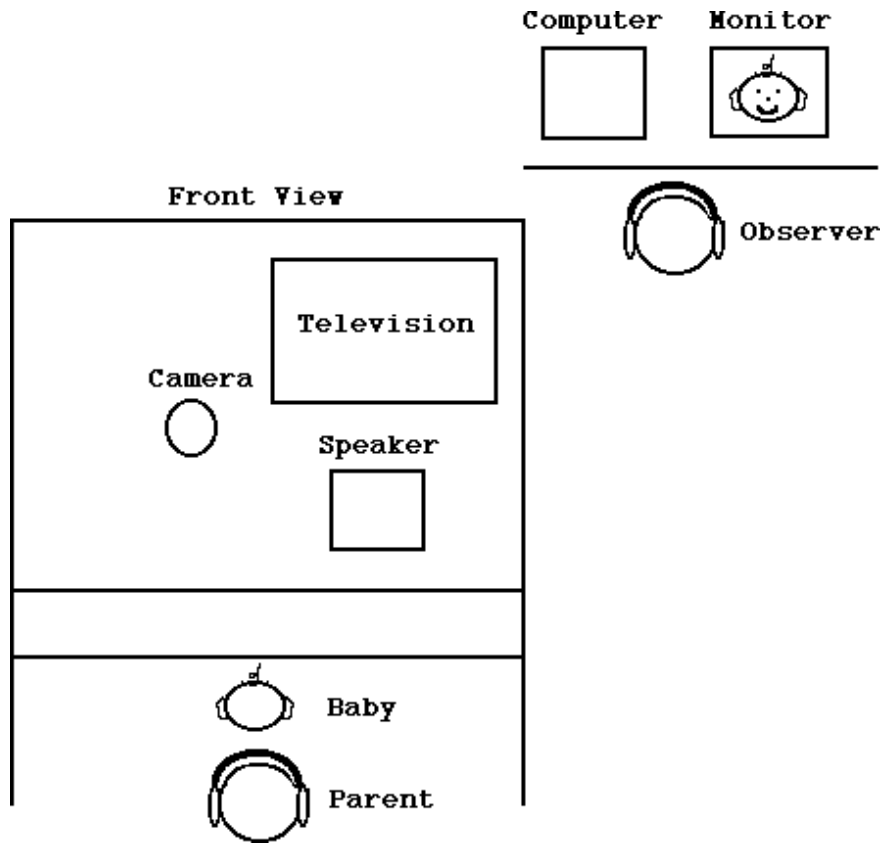
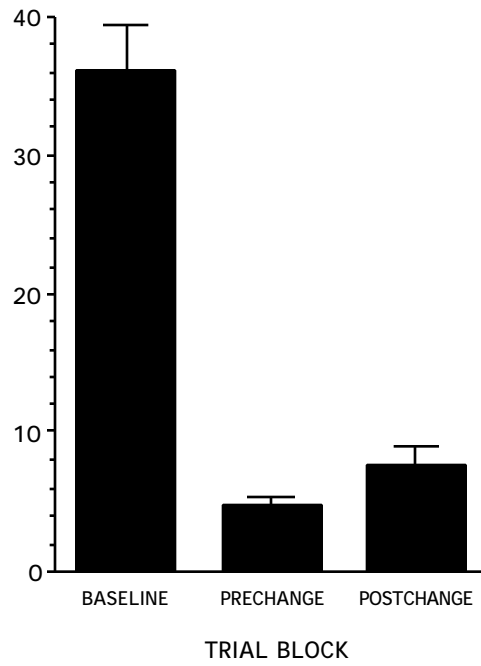


Figure 7

Mean looking times (in seconds) during the first three habituation trials (baseline), the last two criterion trials and the two postcriterion trials. Standard errors are also indicated.



Appendix A

FAMILY INFORMATION SHEET  
(All information is strictly confidential)

MOTHER'S AGE: \_\_\_\_\_

MOTHER'S OCCUPATION: \_\_\_\_\_

FATHER'S OCCUPATION: \_\_\_\_\_

MOTHER'S EDUCATION (in years): \_\_\_\_\_

FATHER'S EDUCATION (in years): \_\_\_\_\_

ESTIMATED FAMILY INCOME: \_\_\_\_\_

RACE: WHITE BLACK HISPANIC ASIAN

MARITAL STATUS: MARRIED SEPARATED DIVORCED SINGLE

PLEASE LIST THE SEX AND AGE OF YOUR OLDER CHILDREN (IF ANY):

	<u>SEX</u>	<u>PRESENT AGE</u>
1.	M F	_____
2.	M F	_____
3.	M F	_____
4.	M F	_____
5.	M F	_____

FOR YOUR MOST RECENT PREGNANCY, PLEASE NOTE THE FOLLOWING:

METHOD OF DELIVERY: VAGINAL CESAREAN

METHOD OF FEEDING: BREAST BOTTLE

ESTIMATED GESTATIONAL AGE AT BIRTH: \_\_\_\_\_

## References

- Aslin, R., Jusczyk, P., & Pisoni, D. (in press). Speech and auditory processing during infancy: Constraints on and precursors to language. To appear in W. Damon (series editor), Handbook of child psychology, Fifth edition. Volume 2: Cognition, perception & language. (D. Kuhn and R. Siegler, Eds.) New York: Wiley.
- Bertenthal, B.I., Haith, M.M., & Campos, J.J. (1983). The partial-lag design: A method for controlling spontaneous regression in the infant-controlled habituation paradigm. Infant Behavior and Development, *6*, 331-338.
- Colombo, J. & Horowitz, F.D. (1985). A parametric study of the infant control procedure. Infant Behavior and Development, *8*, 117-121.
- Cooper, R. P., Abraham, J., Berman, S., & Staska, M. (in press). The development of infant preference for motherese. Infant Behavior and Development.
- Cooper, R.P., & Aslin, R.N. (1990). Preference for infant-directed speech in the first month after birth. Child Development, *61*, 1584-1595.
- Cooper, R.P. & Aslin, R.N. (1994). Developmental differences in infant attention to the spectral properties of infant-directed speech. Child Development, *65*, 1663-1677.
- DeCasper, A.J. & Fifer, W.P. (1980). Of human bonding: Newborns prefer their mothers' voices. Science, *208*, 1174-6.
- Fernald, A. (1985). Four-month-old infants prefer to listen to motherese. Infant Behavior and Development, *8*, 181-95.
- Fernald, A. (1989). Intonation and communicative intent: Is the melody the message? Child Development, *60*, 1497-510.
- Fernald, A. (1991). Prosody in speech to children: prelinguistic and linguistic functions. Annals of Child Development, *8*, 43-80.
- Fernald, A. (1992). Human maternal vocalizations to infants as biologically relevant signals: An evolutionary perspective. In J.H. Barkow, L. Cosmides, & J. Tooby (Eds.), The adapted mind: Evolutionary psychology and the generation of culture. New York: Oxford University Press.
- Fernald, A. & Kuhl, P.K. (1987). Acoustic determinants of infant preference for motherese speech. Infant Behavior and Development, *10*, 279-93.
- Fernald, A. & McRoberts, G. (April 1991). Prosody and early lexical comprehension. Paper presented at the meeting of the Society for Research on Child Development, Seattle.
- Fernald, A. & Mazzie, C. (1991). Prosody and focus in speech to infants and adults. Developmental Psychology, *27*, 209-21.
- Fernald, A. & Simon, T. (1984). Expanded intonation contours in mothers' speech to newborns. Developmental Psychology, *20*, 104-113.
- Freeseaman, L.J., Colombo, J. & Coldren, J.T. (1993). Individual differences in infant visual attention: Four-month-olds' discrimination and generalization of global and local stimulus properties. Child Development, *64*, 1191-1203.
- Gibson, E. J. (1969). Principles of perceptual learning and development. New York: Appleton-Century-Crofts.

Hirsh-Pasek, K., Kemler Nelson, D.G., Jusczyk, P.W., Wright Cassidy, K., Duress, B., & Kennedy, L. (1987). Clauses are perceptual units for young infants. Cognition, *26*, 269-286.

Jusczyk, P.W., Pisoni, D.B., & Mullennix, J. (1992). Some consequences of stimulus variability on speech processing by 2-month old infants. Cognition, *43*, 253-291.

Kaplan, P.S., Goldstein, M.H., Huckleby, E.R., Owren, M.J., & Cooper, R.P. (1995). Dishabituation of visual attention by infant- versus adult-directed speech: Effects of frequency modulation and spectral composition. Infant Behavior and Development, *18*, 209-223.

Karzon, R.G. (1985). Discrimination of polysyllabic sequence by one- to four-month-old infants. Journal of Experimental Child Psychology, *39*, 326-342.

Mandel, D.R. & Jusczyk, P.W. (1996). When do infants' respond to their names in sentences? Poster presents at the International Conference on Infant Studies, Providence, RI.

Mandel, D.R., Jusczyk, P.W., & Pisoni, D.B. (1995). Infants' recognition of the sound patterns of their own names. Psychological Science, *6*, 314-317.

Mehler, J., Jusczyk, P., Lambertz, G., Halsted, N., Bertoni, J., & Amiel-Tison, C. (1988). A precursor of language acquisition in young infants. Cognition, *29*, 143-78.

Moon, C., Cooper, R.P., Fifer, W.P. (1993). Two-day-olds prefer their native language. Infant Behavior and Development, *16*, 495-500.

Moore, D. S., Spence, M. & Katz, G. (1997, in press). Six-month-olds' categorization of natural infant-directed utterances based on prosodic information. Developmental Psychology.

Papousek, M., Bornstein, M.H., Nuzzo, C., Papousek, H., & Symmes, D. (1990). Infant responses to prototypical melodic contours in parental speech. Infant Behavior and Development, *13*, 539-545.

Papousek, M., Papousek, H., & Haekel, M. (1987). Didactic adjustments in fathers' and mothers' speech to their three-month-old infants. Journal of Experimental Psychology: Learning, Memory, and Cognition, *19*, 309-328.

Pegg, J.E., Werker, J.F., & McLeod, P.J. (1992). Preference for infant-directed over adult-directed speech: evidence from 7-week-old infants. Infant Behavior and Development, *15*, 325-345.

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

Stern, D., Spieker, S., Barnett, R., & MacKain, K. (1983). The prosody of maternal speech: infant age and content related changes. Journal of Child Language, *10*, 1-15.

Sullivan, J.W., & Horowitz, F.D. (1983). The effects of intonation on infant attention: The role of the rising intonation contour. Journal of Child Language, *10*, 521-534.

Sullivan, J.W., & Horowitz, F.D. (1983). Infant intermodal perception and maternal multimodal stimulation: Implications for language development. In L. P. Lipsitt & C. Rovee-Collier (Eds.), Advances in infancy research, 2, 183-239. Norwood, NJ: Ablex.

Trehub, S.E., Bull, D., & Thorpe, L.A. (1984). Infants' perception of melodies: The role of melodic Contour. Child Development, 55, 821-830.

Werker, J.F., & McLeod, P.J. (1989). Infant preference for both male and female infant-directed talk: A developmental study of attentional and affective responsiveness. Canadian Journal of Psychology, 43, 230-246.



**VITA**

**Heather M. Theaux**

**Personal Information**

Born: November 10, 1972

Business Address: Department of Psychology  
Virginia Polytechnic Institute and State University  
Blacksburg, Virginia 24061-0436

Home: 1528 Sandy Circle  
Blacksburg, Virginia 24060

Home Phone: (540) 951-1925

**Education**

B.A. University of Massachusetts at Amherst, 1994  
Major Fields: Psychology, Sociology

M.S. Virginia Polytechnic Institute and State University, 1997  
Major Field: Developmental Psychology  
Thesis: Discrimination of Linguistic and Prosodic Information in Infant-Directed Speech by Six-Month-Olds.  
Major Advisor: Dr. Robin Panneton Cooper

**Professional Organizations**

Membership

International Society for Infant Studies  
American Psychological Society

**Conference Presentation**

Abraham, J.L., Theaux, H. & Cooper, R.P. (1996, April). Infants' preference for their mothers' AD speech or unfamiliar female ID speech. Poster presentation at the International Conference for Infant Studies, Providence, Rhode Island.

### Teaching Experience

- 1993      Educator, Ft. Polk, Joint Readiness Training Center, Family Advocacy Program, Leesville, LA 71446. Taught stress reduction and relaxation techniques to all military personnel.  
Supervisor: Pam Evans, FAP manager.
- 1994      Graduate Teaching Assistant, Virginia Tech Psychology Department. Taught Introductory Psychology Lab classes. Contact Jack Finney, Department Head, Psychology, Virginia Tech, Blacksburg, VA 24061-0436.
- 1995      Graduate Teaching Assistant, Virginia Tech Psychology Department. Taught Introductory Psychology Lab classes. Contact Jack Finney, Department Head, Psychology, Virginia Tech, Blacksburg, VA 24061-0436.
- 1996      Graduate Teaching Assistant, Virginia Tech Psychology Department. Spring 1996. Taught Introductory Psychology Lab classes. Contact Jack Finney, Department Head, Psychology, Virginia Tech, Blacksburg, VA 24061-0436.
- 1996      Graduate Teaching Assistant, Virginia Tech Psychology Department. Fall 1996. Taught Cognitive Psychology Lab classes. Contact Dr. Helen Crawford, Psychology, Virginia Tech, Blacksburg, VA 24061-0436.
- Current    Graduate Teaching Assistant, Virginia Tech Psychology Department. Spring 1997. Teaching Advanced Learning Lab classes. Contact Dr. Joseph Franchina, Department Head, Psychology, Virginia Tech, Blacksburg, VA 24061-0436.

### Research Experience

- 1992      Object Permanence in 6-Month-Old Infants. Supervised by Dr. Richard S. Bogartz, University of Massachusetts at Amherst, Amherst, MA 01003.
- 1993      Object Permanence in 6-Month-Old Infants. Supervised by Dr. Richard S. Bogartz, University of Massachusetts at Amherst, Amherst, MA 01003.

- 1993 Latent Inhibition and Blocking in Rats. Supervised by Dr. Joe Ayres, University of Massachusetts at Amherst, Amherst, MA 01003.
- 1994 Lack of preference for the paternal voice in 4-month-olds. Supervised by Dr. Robin P. Cooper, Virginia Tech, Blacksburg, VA 24061-0436.
- 1995 Infants' preferences for their mothers' AD speech or unfamiliar female ID speech. Supervised by Dr. Robin P. Cooper, Virginia Tech, Blacksburg, VA 24061-0436.
- 1996-present Thesis: Discrimination of Linguistic and Prosodic Information in Infant-Directed Speech by Six-Month-Olds. Supervised by Dr. Robin P. Cooper, Virginia Tech, Blacksburg, VA 24061-0436.