

**THE ROLE OF CONTEXT IN INFANT PREFERENCE FOR
FATHER'S VOICE**

by

Cynthia D. Ward

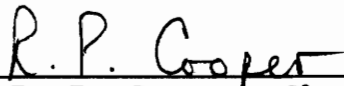
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(ABSTRACT)

The present study was designed to investigate whether infants prefer their fathers' voices over an unfamiliar male voice within the context of normal father-infant interaction, i.e., infant-directed (ID) speech. Twenty Caucasian male and female four-month-olds were tested in a visual-fixation preference procedure. Attentional preference was measured by the amount of time the infants watched a visual stimulus. It was found that infants did not show greater attentional or affective responsiveness to paternal ID over unfamiliar male ID speech samples. However, mothers and fathers appear to be very similar in their perception of father-infant interaction. According to these results, four-month-olds do not prefer their fathers' voices to that of an unfamiliar male. This finding contrast sharply with the literature on maternal voice preference. The data was interpreted as supporting the hypothesis that multimodal stimulus cues are necessary for paternal voice recognition in infancy.

To My Parents
Larry R. Ward
&
Wanda M. Wilson

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The Role of Context in Infant Preference
for Father's Voice

Introduction

During the first postnatal year, infants begin to form strong, emotional relationships with their caretakers, particularly their parents. Generally called "attachment," these relationships initially act to direct affiliative behaviors, such as smiling, vocalizing, looking, laughing, and proffering (Lamb, 1976). In addition, attachment relationships are thought to guide the infants in establishing internal working models of the self and the attachment figure, provide infants with a sense of security, and allow infants to learn a sense of trust through security- and autonomy-seeking signals (see Bretherton, 1987 for a review). Although research on attachment has primarily been focused on the mother-infant relationship, primary and secondary attachments have also been shown to fathers (Cohen & Campos, 1974; Lamb, 1977; Shaffer & Emerson, 1964).

According to John Bowlby's ethological theory of attachment (see Bretherton, 1987 for a review), infants begin this affiliative process by developing recognition of a particular individual(s). Such a recognition system can be based on one or several signature sensory cues. Given the impressive sensory abilities of young infants (Aslin,

1987) it seems plausible that this recognition system would emerge early in development. This appears to be the case for mother recognition. Young infants are capable of recognizing their mothers through several different sensory modalities including olfactory (Cernoch & Porter, 1985; Macfarlane, 1975), visual (Burnham, 1993), and auditory (DeCasper and Fifer, 1980; Fifer, 1987) cues. In contrast, little is known about the father recognition system.

The general purpose of this study was to explore the phenomenon of father recognition by infants, particularly when and under what conditions it occurs, by examining paternal voice preference in four-month-olds. Focusing on vocal preference was a logical place to start an examination of father recognition due to the early functioning of the auditory system (Querleu, Renard, Versyp, Paris-Delrue, & Crepin, 1988) as well as the possibility for early exposure to the paternal voice (i.e., prenatally) (Richards, Frentzen, Gerhardt, McCann, Abrams, 1992; Querleu, Renard, Boutteville, Crepin, 1989). It was suggested that recognition of the paternal voice should occur fairly early in development, but possibly only within certain contexts. This hypothesis receives some support from studies which demonstrate father-infant attachment within the first postnatal year.

Father-infant attachment

Father-infant attachment has been investigated by several researchers who have found that infants display attachment behaviors toward the father in the presence of a stranger. Generally, however, father attachment appears secondary to mother-infant attachment. For example, Cohen and Campos (1967) studied attachment in infants ages 10, 13, and 16 months. By using proximity-seeking behaviors, eye contact with strangers, and distress vocalizations, these authors measured the differential responses of infants to their mothers, fathers, and a stranger. At all three ages, responses toward the fathers were significantly greater than those to the stranger, but were secondary to the responses to mothers. In some respects, the infants treated the mother and father similarly in the single parent conditions. That is, father and mother both elicited a high degree of physical contact from their infants. Cohen and Campos (1967) concluded that the father is clearly an object of attachment for infants 10 months of age and older.

Shaffer and Emerson (1964) examined the attachment behaviors of Scottish infants through reports from mothers about separation protest in the home environment. Seventy-percent of infants in the age range of 9-10 months showed no attachment to their fathers but high exclusive attachment to their mothers. However, by 18 months, 75% of the infants

displayed father attachment. Thus, Shaffer and Emerson (1964) suggest that mother- and father-infant attachment follow different developmental time scales, with father attachment occurring later than mother attachment. The fact that Cohen and Campos (1967) did not find this age related factor may actually be due to the different methods of investigating attachment (i.e., laboratory experiment versus mothers' self reports).

In contrast, Lamb (1976; 1977) disagrees that father-infant attachment is an age related process, and that it is secondary to mother-infant attachment. Lamb (1977) explored attachment in infants 7, 8, 12, and 13 months of age by home observation. Lamb (1976) also observed attachment behaviors of 18-month-olds in a laboratory observation room. Both studies indicated no preference for either parent in display of attachment behaviors. That is, infants displayed attachment behaviors toward both parents without indicating any preference for one over the other. However, Lamb (1977) did find that infants exhibited more positive responses to father-infant play as compared to mother-infant play, and showed that by 18 months infants directed more affiliative behaviors (defined as smiling, vocalizing, looking, laughing and proffering) toward their fathers than toward their mothers, regardless of the presence or absence of their mothers. According to Lamb, infants develop attachment to

their fathers as early as 7 months of age.

To summarize this section, although father-infant attachment has not received much attention in the research on infant attachment (at least compared to infant-mother studies), what little evidence exists points to a discrepancy as to when the process actually occurs. These differences may be due to studying attachment in the lab versus through maternal-reports or home observations. For instance, when using maternal reports, it is the mother's perception of the father-infant relationship which is actually being recorded. This is different from an experimenter in the lab measuring some overt behavior, like degree of physical contact. Nevertheless, based on the studies on attachment previously discussed, it is safe to conclude that father-infant attachment is developed by 18 months of age and could possibly be intact as early as 7 months. Moreover, researchers seem to be in general agreement that mother-infant attachment occurs at an early age (i.e., in the second half year of life) (Ainsworth & Wittig, 1969; Bowlby, 1969; Spitz, 1965). All the aforementioned studies on attachment indicate that at every age studied, mother-infant attachment existed (Cohen & Campos, 1967; Lamb, 1976, 1977; Shaffer & Emerson, 1964). Since mother attachment is under way in the middle of the first postnatal year, infants' recognition of the mother

must be established early. Support for this early developing system comes from research which shows how even one-day-olds can recognize their mother's voice and prefer it to the voice of an unfamiliar female.

Maternal voice recognition in infancy

Mother voice recognition and preference appears early in development (DeCasper & Fifer, 1980; Fifer, 1987; Mills & Melhuish, 1974; Moon & Fifer, 1990; Stanley & Madsen, 1990). One of the first studies to examine maternal voice preference in infants comes from the work of Mills and Melhuish (1974). They tested infants approximately three weeks of age using a nonnutritive sucking technique, in which the infants were given a training opportunity to learn the contingency between sucking and voice. Data on discrimination between voices came from two three minute periods after training during which sucking produced the mother's voice and then a stranger's voice or vice versa. Results for the voice presentation showed that time spent sucking per minute and number of sucks per minute were greater when the mother's voice was contingent on sucking. More recent studies indicate that this maternal voice recognition is present within days after birth.

The first direct experimental evidence of early maternal voice preference in newborns comes from the work of DeCasper and Fifer (1980). In this experiment, a

nonnutritive sucking technique was used in which two and three-day-old infants could produce their own mothers' voices, or that of another mother's voice depending on their sucking pattern. First a baseline was used to determine the average pause duration between sucking bursts. After this baseline was established, five of the infants heard their mothers' voices reading a children's story if their pauses were less than the baseline median. If their pauses were greater than the median they heard an unfamiliar female's voice reading the same story. For the remaining five infants the contingency was switched. A preference for a particular voice would be indicated by an increase in the proportion of pauses capable of producing that particular voice. By this criterion, eight of the newborns preferred the maternal voice. DeCasper and Fifer then reversed the contingency for four of the infants and the infants in turn reversed their response patterns to again differentially produce their mothers' voices.

Using a different procedure, Fifer (in Fifer, 1987) replicated newborns' preference for the maternal voice. For half of the newborns in each group, sucking bursts which began during a tone produced their own mother's voice, whereas bursts which began during a no-tone period produced the other woman's voice. This condition was switched for the other infants. Individual analyses demonstrated that

infants responded more to the signal (either tone or silence) that produced their mothers' voices.

All of the maternal voice studies discussed above used recordings of women reading children's stories out loud. Moon and Fifer (1990) extended these findings by testing newborns with voice recordings of the mother and an unfamiliar female, both talking to another adult. Using a procedure similar to Fifer's (1987), they conducted three experiments in which newborns could listen to a) mother vs. silence, b) unfamiliar female vs. silence, and c) mother vs. unfamiliar female. Moon and Fifer found that newborns preferred both the maternal and unfamiliar female voices to silence, and mother over unfamiliar female. Thus, young infants prefer their mothers' voices in at least two different contexts. Newborns prefer the maternal voice when its prosodic features (e.g., pitch and rhythm) are exaggerated but also prefer the maternal voice as it occurs in an adult to adult context.

In a similar study, Stanley and Madsen (1990) tested two to eight-day-old infants for preference of mother's voice versus other female voice, other female voice versus music, and music versus mother's voice. Analysis of group mean listening times indicated that mother's voice was preferred over both music and other female voice.

Taken together, the studies on mother voice recognition

are strong evidence that even newborns have the auditory capabilities and experiential histories to recognize a familiar voice, specifically that of the mother. Such a recognition system is necessary, although probably not sufficient, to account for the early establishment of mother-infant attachment (Ainsworth & Wittig, 1969; Bowlby, 1969; Spitz, 1965). However, the process of father-infant attachment is not as clear (Lamb, 1977; Shaffer & Emerson, 1964). Perhaps the delayed onset of father-infant attachment is partially due to the undeveloped father-recognition system. One way to examine this recognition process is to look at infants' recognition of the paternal voice.

Paternal voice recognition in infancy

In comparison to the mother voice literature, the research on father voice recognition is virtually nonexistent, and what is in existence is difficult to interpret. For example, Brown (1979) tested four-month-old infants on their amount of vocalization to specific adults. Every group heard one adult voice, either the infant's mother, father, or a stranger male or female. In this study, the amount of infants' vocalizations to the different voices was the dependent measure. The infants showed a high amount of vocalization to the mother, stranger female, and stranger male voice. In contrast, the female infants

displayed a significant suppression of vocalization in the presence of their fathers' voices. Brown (1979) concluded that perhaps the father's voice was not reinforcing enough to produce any vocalizations, or it actually increased attentive responsiveness, which is characterized by a decrease in vocalization. Although this latter conclusion would lend support to some type of father voice recognition taking place, a closer examination of the experimental methodology renders any final analysis questionable.

For instance, it is not clear whether the observers in the Brown (1979) study were blind to the relationship of the speaker to the infant (i.e., parent or stranger). To the extent that the observers were aware of the relationship between speaker and infant, the possibility of experimenter bias existed. Additionally, Brown only found significant devocalizations to the father's voice from the female infants. However, no explanation for this gender-specific pattern was provided. Lastly, although Brown (1979) suggests that devocalization to the father's voice may be evidence for an attentional response, this interpretation calls into question the high amount of vocalization to the maternal voice. It is doubtful that this pattern reflects inattention to the mother's voice.

More recently, DeCasper and Prescott (1984) conducted a series of experiments examining paternal voice preference in

newborns. DeCasper and Prescott examined two-day-old female infants in a nonnutritive sucking technique, similar to the one employed by DeCasper and Fifer (1980). In this experiment infants heard their fathers' and unfamiliar males' voices reading a children's story. Preference for the paternal voice would be indicated by the frequency of the pauses that were reinforced by the paternal voice, and/or by significantly longer burst durations for the paternal voice. Neither of these dependent measures differed significantly as a function of voice, suggesting that newborn infants do not prefer their fathers' voices.

To summarize this section, very few studies exist involving father voice recognition. One study that attempted to examine infant vocalization to different adults was too methodologically flawed to reach any definite conclusions. The only other study that directly examined father voice preference did so with very young infants as well as a small number of infants (i.e., six subjects) and found a lack of paternal voice recognition. Perhaps the problem in studying father voice recognition is that the infants are simply not able to discriminate male voices. This would explain the negative results of DeCasper and Prescott (1984) since recognition necessitates discrimination. However, research in the area of infant auditory capabilities suggests that infants are capable of

such discriminations.

Infants' auditory discrimination abilities

Research has shown that newborn infants can discriminate female as well as male voices (DeCasper & Prescott, 1984; Miller, 1983). As part of the series of experiments conducted by DeCasper and Prescott (1984) to examine father voice preference, newborn female infants completed a habituation-dishabituation procedure to study male voice discrimination. The same male voice pairs that were used in DeCasper and Prescott's (1984) preference procedure described previously, were used in this discrimination study. Infants were allowed to habituate to one particular male voice. Following habituation, half of the infants received the second male voice (experimental group) and the other half continued to hear the same voice (control group). The data showed that the experimental groups' sucking rates increased in the dishabituation phase and the control groups' remained the same. Thus, DeCasper and Prescott (1984) concluded that the infants were able to discriminate between male voices.

Miller (1983) also found that infants are able to discriminate voices. She examined infants' voice gender categorization by exploring its development. Miller (1983) used two and six-month-olds in an infant-controlled visual-habituation paradigm. In this experiment the infants

controlled which voice they heard by how long they fixated on a visual display. Infants listened to between and within male and female voice combinations. During the familiarization phase the infants received several trials of auditory stimulation (i.e., male or female voice stimuli) until they habituated to criterion. The shift phase began after the habituation phase and consisted of the infants hearing novel or familiar auditory stimuli, depending on which experimental group they were in. Discrimination was assessed by the extent to which recovery of visual fixation after habituation was greater in the novel conditions than in the familiar condition. Two-month-olds dishabituated to both between-category and within-category changes, whereas six-month-olds only dishabituated to the between-category changes. Miller (1983) concluded that the six-month-olds demonstrated categorical voice discrimination, whereas two-month-olds did not seem to be able to ignore within-speaker variations, therefore they discriminated all stimulus changes.

Moreover, young infants (around three-months) are capable of discriminating all sorts of speech properties. For example, infants can discriminate intensity differences in multisyllabic utterances, variations in frequency of pure tones, small frequency sweeps, a change in pure-tone duration and a change in vowel duration, various toned

melodies, changes in melodic contour, and changes in the duration of noise bursts and intergroup intervals.

Regarding speech perception, young infants are capable of discriminating speech segments, including categorical perception of voiced and unvoiced consonants and phonetic segments in different syllable positions, in multisyllabic utterances, and without regard to syllable stress (see Aslin, 1987 for a review). Clearly infants have the auditory capability to discriminate very specific acoustic and speech properties.

The research on infant discrimination clearly demonstrates that infants discriminate various auditory stimuli, including non-paternal male voices. Therefore, the negative results found in the DeCasper and Prescott (1984) study cannot be explained by the inability of infants to discriminate voices. The question remains as to why the infants did not prefer their fathers' voices. Perhaps the male voices were simply not reinforcing to the infants. DeCasper and Prescott (1984) conducted a third experiment to test this hypothesis.

DeCasper and Prescott (1984) had infants complete a baseline sucking period, within which pauses were recorded. After this baseline period, infants that sucked slower than the baseline value received a male voice, whereas infants that sucked faster than baseline did not receive any voice.

All infants received different male voices. Results indicated that none of the pauses differed from their baseline values. DeCasper and Prescott (1984) concluded that the male voices lacked reinforcing value.

In contrast, Moon and Fifer (1988) found evidence that male voices are reinforcing for newborns. They looked at the reinforcing value of male voices as compared to silence by using a nonnutritive sucking choice procedure. Two syllables /a/ and /i/ served as the discriminative stimuli, and male voice and silence served as the reinforcers. Moon and Fifer (1988) reported that eight of twelve infants activated the male voice longer than quiet. They concluded that male voices act as reinforcers, but compared to female voices the reinforcing value is relatively weak. Although this seems contrary to the DeCasper and Prescott (1984) study, it seems plausible that the differences obtained may be due to the different methodologies used and/or the small number of subjects (i.e., six) in the DeCasper and Prescott (1984) study.

In sum, compared to mother recognition in infancy, little is known of paternal recognition. Young infants do not prefer their own father's voice, even though they discriminate male voices. It may be that the male voice is simply not a sufficient reinforcer for the infant, but this is unclear. Therefore, the one conclusion that can be drawn

is that the father voice recognition system is not developed early in infancy. This is in contrast to the maternal voice studies where recognition is intact as early as 24 hours after birth. It has been suggested that the early developing maternal recognition system could be due to extended prenatal experience (see Cooper & Aslin, 1989 and Fifer, 1987 for discussions). Therefore, it is possible that newborns' preference for the maternal voice and a lack of preference for the paternal voice is simply a function of differential exposure.

Experiential basis of voice recognition in infants

Audition in utero.

Several studies provide evidence that prenatal exposure may actually be the key to the understanding of early infant maternal voice recognition. It has been documented that not only is the auditory system fully functioning by the last trimester of pregnancy, but both internal and external noises are audible by the fetus (Querleu et al., 1988; Querleu et al., 1989; Richards, 1992). The reviews by Querleu et al. (1988; 1989) emphasize that the fetus is capable of hearing during the last 16 weeks of pregnancy. Although such structures as the middle ear may be impaired from fully functioning, several other anatomical structures are completely developed and functioning by the 20th week of gestation. Querleu et al. (1988; 1989) suggest that these

functioning structures, such as the inner ear and cochlea, enable audition to occur prenatally (i.e., during the last trimester).

Besides the functioning auditory system at 20 weeks, Querleu et al. (1989) and Richards et al. (1992) have studied the intrauterine sound environment of the human fetus and have found that both internal and external auditory stimulation are present. Querleu et al. (cited in Querleu et al., 1989) have conducted several studies to obtain a more detailed description of the human fetus' environment. These studies involved implanting an intrauterine hydrophone into pregnant women at the beginning of labor. The most recent recordings obtained by Querleu et al. suggest that the intrauterine environment consists of internal noises, such as the basal noise, and exterior noises, such as other human voices. In addition, Querleu et al. suggest that exterior voices emerge above the basal noise by 8 or 12dB, and the maternal voice emerges approximately 24dB above basal noise. According to Querleu et al. (1988) the intensity of the maternal voice transmitted to the uterine cavity is more superior than any exterior noise, and it is transmitted more often than any other noise.

Similarly, Richards et al. (1992) found that the intrauterine availability of the maternal voice is greater

than that of external male and female voices. Using a hydrophone, Richards et al. (1992) found that the mean enhancement of the maternal voice (i.e., over the sound pressure level measured in air) was 5.2 dB. In contrast, for exterior male and female voices the mean attenuation was 2.1 and 3.2 dB respectively. These results differ from the ones of Querleu et al. (1989) only in the amount of enhancement or attenuation of the maternal voice and exterior voices respectively. It is suggested however that the differences obtained may simply be due to methodological differences, such as differences in the recording and measurement of sound pressure levels in the air.

Moreover, Lecanuet, Granier-Deferre, Jacquet, Capponi and Ledru (1993) suggest that near term fetuses seem to respond to changes in external voice stimulation. Using a habituation/dishabituation procedure with heartrate as the dependent measure, fetuses approximately 40 weeks gestational age were presented with male and female voices uttering the same sentence. Some fetuses (experimental groups) habituated to one voice and then heard a new voice. Other fetuses (control groups) habituated to one voice and continued to experience that same voice. Lecanuet et al. (1993) found that the fetuses that heard the new voices experienced heartrate decelerations. Thus, near term fetuses could perceive a difference between the voice

characteristics of male and female speakers.

Although there may be some discrepancy as to the exact amount of enhancement or attenuation of voices, the above studies on the intrauterine sound environment of the human fetus provide convincing support that both internal and external voices are audible in utero. Further, the above studies also suggest that the maternal voice is more audible in utero than any other noise. Given this availability of the maternal voice, as well as the fully functioning auditory system of the fetus, it is suggested that the fetus can hear the maternal voice before birth, although the exact amount of exposure is unknown. Therefore, extended prenatal experiences with auditory stimuli could influence postnatal auditory perception.

Prenatal auditory experiences on postnatal perception.

Several studies provide an experiential basis of voice recognition in infants by suggesting that early maternal voice recognition may be initiated by prenatal exposure to the mother's voice (DeCasper & Spence, 1986; Moon & Fifer, 1990; Panneton, 1985; Spence & DeCasper, 1987). DeCasper and Spence (1986) had pregnant women read a particular target story aloud each day during their last six weeks of pregnancy. After birth, infants two days of age were tested using the nonnutritive sucking procedure, in which they were given the opportunity to hear the target story or a novel

story. The infants preferred to listen to the target story. According to DeCasper and Spence (1986) third trimester fetuses experience maternal speech sounds, which can influence postnatal preference.

Panneton (1985) had women sing a melody aloud once a day for the last 14 days of their pregnancy. Using a methodology similar to DeCasper and Spence's (1986), the newborns in Panneton's study could listen to either the melody sung by their expecting mothers, or a novel melody. Infants with exposure to the prenatal melody showed a significant preference for this melody over the novel one, whereas a control group of infants did not show a preference for either.

In addition, Moon and Fifer (1990) used simulations of prenatal versions of mother's voice and postnatal versions of mother's voice to examine whether neonates prefer an auditory stimulus which was present in utero (filtered version) versus one which was not (unfiltered version). The two versions of the mother's voice were presented contingent upon infant nonnutritive sucking. Infants approximately two days of age showed a preference for the filtered voice. In addition, Moon and Fifer (1990) conducted a subsequent experiment to test whether newborns respond preferentially to their mother's voice (filtered) versus an unfamiliar female voice also filtered. Again, infants preferred the

filtered version of the maternal voice.

Therefore, it seems as though prenatal experience with the maternal voice will influence postnatal perception. This applies not only for the maternal voice, but also to other internal sounds available to the fetus. For example, Panneton and DeCasper (1984) tested newborns in a nonnutritive sucking procedure in which the presence or absence of a tone produced either the recording of intrauterine heartbeats, or a male voice reading a nursery rhyme. The results of this study showed that newborns prefer to listen to an intrauterine heartbeat sound over a male voice (Panneton & DeCasper, 1984). This is further evidence for the impact of prenatal experience on postnatal perception.

To summarize this section on the experiential basis of infant voice recognition, late-term fetuses can hear and respond to various sounds, both interior and exterior to the mother. Specifically, the maternal voice is experienced at the greatest intensity, and more often than any other voice. What is not known, however, is the exact amount of time that is necessary for maternal voice recognition to take place. According to DeCasper and Spence (1980) two-day-olds could recognize a nursery rhyme that was read to them in utero for about six weeks. Panneton (1985) found that two weeks of prenatal exposure was enough for newborns to recognize the

target melody. Therefore, if exposure is the key to voice recognition and since we cannot be certain how much exposure is needed before recognition of the maternal voice takes place, a conservative estimate for evaluating paternal voice recognition is to equate the length of potential experience (i.e., approximately 15 weeks). A preliminary study in our laboratory was conducted to explore the length of postnatal exposure and its effect on paternal voice preference in infants.

Lack of paternal voice preference in four-month-olds

The purpose of this preliminary study was to examine paternal voice recognition in four-month-olds (Ward, Abraham, Cooper, 1995). Fathers' voices were recorded by an interviewer, who engaged the father in normal adult conversation. Twenty seconds of uninterrupted paternal speech was selected from each interview and recorded onto one of two channels of a 20-second endless loop cassette tape, with a different father's voice recorded onto the other channel. Twenty infants were tested in a visual-fixation based auditory preference procedure. The infants were placed in an infant seat in a four-sided enclosure which contained the screen of a monitor and the lens of a camcorder displayed through the front panel. When each infant fixated a visual display on the monitor, an observer watching the infant activated one channel of the audio

output. The infants were either presented with their own fathers' voices or an unfamiliar male voice depending on the channel activated. A trial was terminated when the infant looked away from the visual display. The next trial begin when the infant again fixated the display, but this time the voice not previously heard (i.e., on the opposite channel) was activated. The infants were able to control the duration of each trial by how long they fixated the visual display. Infants were tested with five trials of each voice type, for a total of ten trials. "Preference" was operationally defined as significantly longer mean looking times to the visual stimulus when looking was associated with a particular speech recording.

In order to test for paternal voice preference, the mean looking time on father trials and the mean looking time on other trials were calculated for each infant, and entered into a 2 X 2 mixed analysis of variance (ANOVA), with order (father first, other first) as the between subjects factor, and speech type (father/other) as the within subjects factor. The results of the ANOVA showed no significant main effects for order, $F(1,18)=.18$, speech type, $F(1,18)=1.6$, or the order x speech type interaction, $F(1,18)=.80$, all p values $> .05$. Also, an additional comparison was conducted on the first trials of the sessions, as a function of whether the infants heard their own father's voice or that

of another male. This test also showed no significant difference in looking times, $t(18)=1.13$, $p > .05$.

In addition, the infants were also video taped during the sessions. Experimenters viewed each trial and coded the infants' emotions based on facial expressions. No differences in affective responsiveness for the paternal voices and the unfamiliar male voices were found, $t(17)=.50$, $p > .05$. Results of the emotion coding support the above claim that infants do not prefer their fathers' voices over an unfamiliar male voice.

Several explanations may account for these negative results. First, even though four-month-olds presumably have early postnatal experience with the paternal voice, recognition failed to take place. According to some researchers, this may be due to the low incidence of vocalization of fathers to their infants during the first months of life (Rebelsky & Hanks, 1971). Rebelsky and Hanks (1971) collected fathers' verbal interactions with their infants by attaching a microphone to the infant for a 24-hour period every two weeks. This collection started when the infants were approximately two weeks old and continued until they were three months old. The data indicated that fathers spent relatively little time interacting with and vocalizing to their infants. Additionally, they seem to behave differently to male and female infants. Fathers of

female infants seem to verbalize more than fathers of male infants during the first month, whereas by three months the patterned is reversed. At three months fathers of male infants vocalize somewhat more than do fathers of female infants. Rebelsky and Hanks (1971) suggested that initially fathers could be responding to the role of father-of-daughter, which may be perceived as a more nurturant, verbal role than father-of-son.

A second possible explanation for the negative results found in our preliminary paternal-voice study could be that infants need to hear their father's voice in a particular context in order for recognition to take place. Using father adult-directed (AD) speech may have increased the difficulty of the task, since prosodic features between two male voices will not differ as much from each other when speaking AD as when speaking infant-directed (ID) speech. We do know from the work of DeCasper and Prescott (1984) and Miller (1983) that infants can discriminate male voices. However, neither of these studies used father AD speech samples. DeCasper and Prescott used recordings of fathers reading a children's story, and Miller used recordings of fathers saying "hi" to their infants. Additionally, infants may only know their father's voice in the context in which they typically experience it. For instance, it has repeatedly been documented that both males and females make

prosodic modifications in speech when addressing infants (Fernald, Taeschner, Dunn, Papousek, Boysson-Bardies, & Fukui, 1989; Papousek, Papousek, & Haekel, 1987).

Contextual constraints on paternal voice recognition

These prosodic modifications (typically called infant-directed-ID speech) made by both males and females when addressing infants include higher fundamental frequency (pitch), greater pitch variability, shorter utterances, longer pauses, and slow tempo of articulation (Fernald et al., 1989; Papousek et al., 1987). Several researchers have found that infants prefer ID speech over AD speech (Cooper & Aslin, 1990; Fernald, 1985; Pegg, Werker, & McLeod, 1992; Werker & McLeod, 1989).

Fernald (1985) tested four-month-olds in an operant head-turning procedure in which infants were given a choice between listening to a variety of infant-directed and adult-directed speech samples spoken by four unfamiliar women. The dependent measure was the number of head turns to produce a particular speech. Infants turned their heads more often in the direction necessary to turn on the female ID speech.

Similar results were obtained by Cooper and Aslin (1990) who tested one-month-olds and newborns. In their procedure, the infants controlled which voice they heard by how long they fixated a visual stimulus. As in Fernald

(1985), infants listened to both female ID and female AD speech. Results showed that both one-month-olds and newborns preferred female ID speech (Cooper & Aslin, 1990).

Therefore, it is quite clear that infants from newborns to at least four months prefer ID speech. Recall that this particular type of speech is spoken by both females and males when interacting with their infants (Fernald et al., 1989; Papousek et al., 1987). In addition, it must be emphasized that fathers use ID speech with infants, but not as much as mothers do (Fernald et al., 1989). Given that infants like ID speech and they hear it from females as well as males, it seems possible that they may prefer ID speech when spoken by males. Werker and McLeod (1989) and Pegg, Werker, and McLeod (1992) tested this hypothesis.

The first experiment to demonstrate that infants respond preferentially to male ID over male AD speech was done by Werker and McLeod (1989). By using a sequential preferential looking procedure, they found that infants from four to nine months old respond preferentially to ID speech regardless of the sex of the speaker. In addition, Werker and McLeod (1989) examined the infants' affective responsiveness to the different speech types and the sex of speaker. Affective responsiveness was measured by videotaping the infants, and having coders examine the infant's interaction style and his\her emotional

expressiveness. Results revealed that the younger infants showed more affective responsiveness to female ID but not male ID speech.

The attentional preference for ID speech in males has also been demonstrated in infants as young as seven weeks (Pegg, Werker, & McLeod, 1992). Using a habituation-dishabituation procedure, seven-week-old infants discriminated both male and female AD and ID speech samples. Attentional preference for ID over AD speech was examined in a comparison of the mean looking times during the initial habituation trials across the four experimental groups. The dependent variable was the mean of the two highest of the first three looks of the habituation phase. Results indicated that there were no significant interactions. Therefore, Pegg et al. (1992) concluded that seven-week-old infants demonstrate an attentional preference for ID over AD speech regardless of speaker gender. This is the first study to demonstrate that infants younger than four months preferentially respond to male ID speech.

In sum, infants from newborns to at least nine months prefer female ID speech. Likewise, it has been shown that infants as young as seven weeks preferentially respond to male, as well as female, ID speech. Thus, studies using prosodic modifications in speech indicate that the male voice does act as a reinforcer in the context of ID speech.

Recall that other studies showed a discrepancy as to whether the male voice acted as a reinforcer (DeCasper & Prescott, 1984; Moon & Fifer, 1988). Perhaps in order for infants to respond preferentially to male speech, the speech must be within a certain context which is more reinforcing. Support for this hypothesis comes from research that has shown maternal voice recognition may be contextual constrained.

For instance, there is evidence which indicates that older infants prefer their mothers' voices if they hear them in the context of ID speech as opposed to AD speech. Mehler, Bertoncini, Barriere, and Jassik-Gerschenfeld (1978) used a nonnutritive sucking technique to assess four- to six-week-olds' preference for their mothers' voices. The infants were given a choice between listening to their mother speak in monotone (i.e., reading a book backwards), or in well-intonated speech. Mehler et al. found that infants would suck more for their own mothers' voices only under the intonated condition.

More recently, Cooper, Abraham, Berman, and Staska (1995) tested one-month-olds in an infant controlled auditory preference procedure. In one experiment these infants were given the choice to listen to their mother speaking AD or ID speech. No significant preference was found for either type of maternal speech. A second group of one-month-olds was given the choice of listening to AD or ID

speech spoken by an unfamiliar female. In this second experiment a significant preference for ID speech was found. A third experiment looked at preference for maternal ID or AD speech in four-month-olds. Results revealed a preference for maternal ID over maternal AD speech in four-month-olds. Thus, preference for ID over AD speech in one-month-olds occurred only when the speaker was unfamiliar to the infants, whereas four-month-olds demonstrated a preference for ID over AD speech when spoken by their mothers. Cooper et al. (1995) concluded that maternal recognition in early infancy may override the infant's interest in the exaggerated prosody of ID speech. Thus, it seems as though recognition of mother's voice may be more complex than was once thought. Infants seem to show differential preference for the maternal voice depending on age and the context with which the maternal voice is encountered.

Rationale for the present study

In sum, we know that infants prefer their mothers' voices over another female voice from birth. We also know that infants prefer infant-directed speech spoken by a female. Moreover, studies suggest that there may be some contextual constraints on maternal voice recognition (Cooper et al., 1995; Mehler et al., 1978). Nevertheless, it is quite clear that maternal voice recognition takes place early in development. What is unclear, however, is when the

process for paternal voice recognition occurs. Based on the attachment literature, we know that this process must occur at least before 18 months and maybe even as early as seven months. We know seven week old infants respond preferentially to male ID speech over male AD speech. This highlights the point that the male voice can act as a reinforcer. Additionally, we know that neither newborns nor four-month-olds indicate any preference for the paternal voice over that of an unfamiliar male voice (DeCasper & Prescott, 1984; Ward, Abraham, Cooper, 1995).

Thus, given this information regarding infant voice preference, it is possible that we have been studying the paternal voice recognition system out of context. As mentioned, part of father-infant interaction consist of the father speaking ID speech to the infant (Fernald et al., 1989; Papousek, Papousek, & Haekel, 1987). However, the few studies that have examined paternal voice preference have either not included the father speaking ID speech (DeCasper & Prescott, 1984) or were too methodologically flawed to draw any final conclusions (Brown, 1979). Therefore, the question yet to be answered is whether infants prefer their father's voice within the context of normal father-infant interaction, i.e., ID speech.

Also of interest to the present study is the finding that young infants prefer the maternal voice more when the

mother speaks normal AD speech, but as the infants get older they prefer maternal ID over maternal AD speech (Cooper et al., 1995). As Cooper et al. point out, perhaps it is behaviorally adaptive for maternal voice recognition in early infancy to override the infant's interest in exaggerated prosody of speech, since the infant is becoming familiar with the variety of speaking patterns in which the mother engages. Perhaps this process of getting familiar with the maternal voice is facilitated by extended prenatal exposure. In contrast, recall that the amount of exposure with the paternal voice prenatally is not fully understood, even though we know fetuses can hear exterior voices. Infants may not have enough prenatal exposure with the paternal voice to show any paternal voice preference as newborns. However, because older infants seem to prefer maternal ID over maternal AD speech, then perhaps this is also true of father voice recognition. Therefore, the present study examined father voice recognition in four-month-olds using paternal ID speech.

Purpose of the study

The primary goal of the study was to test the hypothesis that if given postnatal exposure with the paternal voice (i.e., equate length with prenatal maternal voice exposure, approximately 15 weeks) infants would show a preference for their fathers' voices within the context of

ID speech. In order to test this hypothesis, fathers' voices were recorded while they were interacting with their infants. Subsequently, the infants were tested to see whether they preferred their fathers' voices over unfamiliar male voices. If father voice recognition is contextually constrained, then these infants should prefer their fathers' voices over unfamiliar male voices. Additionally, recall that previous studies have shown that infants show more affective responsiveness to maternal ID over unfamiliar female ID speech. However, this affective responsiveness has not been found using the paternal voice. Therefore, a secondary goal of the present study was to examine infant affective responsiveness to the paternal voice. It was hypothesized that infants would exhibit more affective responsiveness to the paternal ID speech over unfamiliar male ID speech.

Method

Subjects

Twenty-nine infants were tested in the preference procedure, but only twenty infants successfully completed the session. Four infants had to be eliminated due to crying, four infants were eliminated for not meeting the testing criterion (to be discussed below) and one was eliminated due to equipment failure. Thus, a total of 20 Caucasian males (11) and females (9) comprised the final

sample of subjects for this study. Average age of these infants was 127.7 days.

Infants were recruited from the Blacksburg, Christiansburg, and Radford areas through the local birth announcements in the Roanoke Times and World News. Upon receipt of the birth announcements, the parents were sent a letter describing the study (see Appendix A). A few days after the letter was mailed the parents were contacted by phone. This initial contact was used to determine whether the parents were interested in the study, to clarify any questions they had and, if the parents were interested, to try and set up a home interview time. After the interview, the parents were contacted by phone to schedule a session time. Testing sessions were scheduled during a time of day when the parents reported that their infant was usually awake and happy. Additionally, on the day of testing the parents were contacted to make sure the infant had a good night and was healthy.

Demographic information from 18 of the 20 infants was obtained via a questionnaire given on the day of testing (see Table 1). Average age of the infants' parents was 29.22 years and 33.056 years for the mother and father respectively. Thirty-nine percent of the infants were first borns. Sixty-seven percent of the mothers had vaginal deliveries. Fifty percent of the parents reported that

their infants were breast fed, while 17% reported bottle feeding, 28% reported both, and 5% failed to answer the question.

Regarding education level, forty-four percent of mothers and 44% of fathers reported having a college degree. This was followed by a graduate degree (33% of mothers and 28% of fathers), partial college (11% of mothers and 22% of fathers), a high school degree (6% of mothers and 6% of fathers) and completion of junior high school (6% of mothers). The most frequently reported combined net yearly income was \$40,001-50,000. Thirty-three percent of the parents reported this income interval as their combined net yearly income (see Table 1).

Additionally, the questionnaire asked for the occupation of both parents. In 78% of the families both the mother and the father were employed. All 78% of these working mothers were employed in white-collar positions, whereas 72% of the fathers were white-collar and 17% were blue-collar. Eleven percent of the families were single income families, with the father being the employed parent. The rest of the sample (11%) consisted of the mother being unemployed and the father being a student or graduate student.

Speech samples

Paternal infant-directed (ID) speech samples were recorded in a 20 to 30 minute home visit, during which the infant was present. The father of each infant wore a small, unobtrusive lapel microphone (Sony, Model ECM-011) which was connected to a high-quality cassette recorder (Sony, Model WM-D6C). Prior to the interview the father was instructed to talk directly to the infant. During times when the father was interacting with the infant the experimenter quietly listened. If the father did not talk to the infant within the first 15 minutes of the interview, the experimenter specifically asked the father to direct the infant's attention to some object. During the interview every effort was made by the experimenter to avoid interacting with the infant. This was to insure that the father did not pattern his style of infant-directed speech after the interviewer. In addition, the father was asked to fill out a questionnaire regarding the amount of time he spends interacting with and vocalizing to the infant, as well as the types of activities that he normally engages in with the infant (see Appendix B). The mother was also asked to fill out a similar questionnaire regarding the amount of time the father spends interacting with and vocalizing to the infant (see Appendix C). This mother questionnaire was used in order to obtain multiple estimates of possible

infant exposure to the paternal voice and, when possible, was filled out at the same time the father questionnaire was completed. In addition, the father completed an informed consent form (see Appendix D).

Upon completion of the interview, 20 seconds of uninterrupted high quality paternal ID speech utterances were selected to use as stimuli in the study. Each father's speech utterances were then re-recorded onto one of two channels of an endless loop tape for playback to their infant. A different father's voice was recorded onto the second channel.

Apparatus

In the laboratory, the parent was seated in a chair facing a black wooden panel (80-cm (length) X 80-cm (width) X 60-cm (height)). To the parent's left and rear was a white wall, and to his/her right was a black covering (piece of cardboard). This covering was used in order to restrict the infant's peripheral field of view. Each infant was held on their parent's lap and faced a front wooden panel. Separating the parent and the infant from the front panel, and extending from the bottom of the front panel, was a 40-cm X 80-cm wooden shelf painted black and covered with a white foam pad. This shelf was often used by the infant for support and as a safe place to touch. Inside the enclosure was a custom-built interface, an Emerson VCR-875

videocassette player/recorder, a 13" Mitsubishi (model #CS1347R) color television monitor, a Minimus-7 loudspeaker, and a Panasonic VHS camcorder (model #AG-HT4).

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 stimulus tape of concentric colored circles was played on the VCR and was presented via the television monitor to the infant. The loudspeaker was also displayed through a cut-out in the front panel directly above the television monitor, and played the auditory stimuli (i.e., paternal ID speech utterances or stranger male ID speech utterances). Each infant's activity was also videotaped with the Panasonic camcorder through a third cut-out in the panel.

An observer used a small 5" JVC (model #TM22U) color television monitor to observe the infant during testing. In addition, a small red signal light was placed in front of the observer (attached to the bottom of the 5" monitor) which indicated when the display monitor was on. In addition, the observer had access to a keyboard of a MacIntosh SE-30 Computer. The computer controlled the videocassette player, the signal light and recorded onsets and offsets of infant visual fixations in 100ths of a second by way of the custom-built interface. The interface also controlled independent access to the channels of a Tascam

cassette recorder. The audio output from the cassette recorder was amplified and presented to the infant through the loudspeaker by way of the interface.

Procedure

Each infant was tested at the Infant Speech Laboratory at Virginia Polytechnic Institute and State University. The procedure used was a visual-fixation-based auditory-preference procedure. Using this procedure, infants were able to activate either the recording of paternal ID speech utterances or unfamiliar male ID speech utterances. In the present study, the amount of time an infant spent looking at a visual display (colored circles) while listening to the different auditory stimuli was the dependent measure. "Preference" was operationally defined as significantly longer mean looking times to the visual stimulus when looking was associated with a particular speech recording.

Once happy and alert each infant was held in the lap of their mother or father, depending on the caregiver who was present. The caregiver wore headphones over which continuous vocal music was played to mask the speech sounds being presented. In addition, instructions were given to the caregiver to hold the infant firmly, so as to decrease the possibility of the infant moving out of the observer's field of view, and to avoid any other contact with the infant other than holding him/her. If an infant was asleep

upon arrival, the parents and/or experimenter attempted to awaken the infant using gentle massage, speech, turning off the overhead lights, and undressing the infant. If the infant was fussy, a diaper change, feeding, or rocking was used in an attempt to soothe the infant. If any infant could not be calmed or awakened, the session was terminated. If the infant could be brought to an awake, alert, non-fussy state, the procedure continued. During the adjustment period just described, the procedure was fully explained to each caregiver, and they were asked to sign a consent form (see Appendix E) and fill out a demographic questionnaire (see Appendix F).

During the session an observer watched the infant on the 5" color monitor and wore earphones over which continuous vocal music was played in order to eliminate their knowledge of the speech recordings. After the parent and infant were situated, the observer watched the infant until he/she was looking forward towards the television monitor, and then the observer depressed a key to turn on the stimulus display (colored circles). When the observer judged that the infant was looking at the circles, he/she depressed the key which turned on channel 1 (or 2) of the tape recorder and either paternal ID or unfamiliar male ID speech utterances were played over the loudspeaker. The speech remained on for the duration of the look. When the

infant was judged by the observer to look away from the circles, the observer depressed the key to signal the end of a look. Both the speech recording and the visual stimulus were then terminated. This sequence was considered to be one trial, with trial length being determined by the infant's looking time.

The second trial accessed Channel 2 (or 1) with the subsequent presentation of the speech type that was not played in Trial 1. The subjects were randomly assigned to receive either the paternal ID or other ID speech first, with the remainder of the session continuing with the presentation of paternal ID or other ID speech alternating across trials. Trials continued until a total of 10 trials (5 each of paternal ID and other ID) were completed, with the contingency that each trial must be at least 2 seconds in duration. Additionally, infants were given the opportunity to complete up to 12 (6 each of paternal ID and other ID) trials, but in order to be included in the analysis they must have successfully completed at least 10 trials. Also, if the infant closed his/her eyes or cried for more than 20 consecutive seconds, the session was terminated and the data for that session were not included in the analyses.

Results

Attentional responsiveness (looking time)

To determine whether the infants looked longer at the visual display during either the presentation of the paternal ID or unfamiliar male ID voices, mean looking times to both speech types were calculated by dividing the sum of time spent looking during the presentation of each speech type by the number of trials of that speech type. A mixed 2 X 2 repeated measures analysis of variance (ANOVA) was computed on the infants' mean looking times, with order [paternal ID first, unfamiliar ID first] as the between-subjects factor and speech type [paternal ID, unfamiliar ID] as the within-subjects factor. The results showed no significant main effects for order, $F(1, 18) = 1.15$, speech type, $F(1, 18) = .17$, or the order X speech type interaction, $F(1, 18) = .06$, all p values $> .05$. Mean looking times for speech type were $M(\text{dad}) = 15.14$ sec, $SD = 7.54$, and $M(\text{other}) = 14.26$, $SD = 5.64$. The overall means for speech types and their standard deviations are shown in Figure 1.

Insert Figure 1 Here

Based on prior work using a similar procedure, an additional comparison was conducted on the first trials of the sessions as a function of whether the infants heard

their own father's voice or that of another male. Previous researchers have shown that infants often exhibit a significant difference in looking time when just the first look is analyzed (Berman, 1989, Cooper & Aslin, 1990, Pegg et al., 1992). For example, Cooper & Aslin (1990) found that one-month-olds and newborns look longer on the first trial when they hear female ID speech first (compared to AD speech first). Berman (1989) found a similar effect in one-month-olds when maternal AD speech (as opposed to maternal ID speech) was heard first. In addition, Pegg et al. (1992) found that infants who heard ID speech during the first trials of an habituation procedure looked longer during those trials (i.e., had mean looking times greater than the average looking time on the first trials across both groups) than the infants who heard AD speech first. In addition, this same pattern was found for speaker gender. That is, the infants who heard the female speaker first looked longer (on average) during the first habituation trials than the infants who heard the male speaker first. Therefore, based on this prior work, a comparison was done on the first trials as a function of speech type. However, this test also showed no significant difference in looking times, (\underline{M} (dad first) = 21.94, \underline{SD} = 21.48, \underline{M} (other first) = 23.35, \underline{SD} = 18.52), \underline{t} (18) = -.16, \underline{p} > .05. The mean looking times on the first trials and their standard deviations are shown

in Figure 2.

Insert Figure 2 Here

Affective responsiveness

Infant affect was analyzed using a scale devised by Werker and McLeod (1989) to rate the degree to which the infants appeared emotionally responsive to the vocal samples. Infants were rated on a 9-point Likert scale that ranged from "negative/unpleasant to positive/pleasant" (see Appendix G). A paired t-test was conducted on the means of these ratings across all trials. Due to equipment error, the information for affective analysis was only available for fourteen of the twenty infants. Results showed no differences in affective responsiveness for the paternal voices ($M = 5.0$, $SD = .31$) and the unfamiliar male voices ($M = 4.9$, $SD = .20$), $t(13) = 1.18$, $p > .05$. The means obtained in this analysis indicate that neither the father nor the unfamiliar male voice elicited an affective response in either a positive or negative direction. That is, on average, infants maintained a neutral facial expression when listening to both speech recordings. The mean affective ratings as a function of speaker and their standard deviations are shown in Figure 3. Percent agreement was used to assess interobserver reliability for the affective ratings. Percent agreement was calculated for 11 of the 14

infants and was found to be .72.

Insert Figure 3 Here

Mother and father questionnaires

Questionnaires were given to both the mother and the father to assess the amount of time the father spends with the infant, how much he vocalizes to him or her and the typical activities he engages in with the infant (see Appendix B and C). Table 2 contains the information obtained from these questionnaires. The amount of time spent during the weekday and the weekend was broken up into four intervals (0-1 hour, 2-3 hours, 4-5 hours, > 5 hours). Fifty percent of mothers and 45% of fathers report that fathers spend 2-3 hours with their infants during the weekday. Likewise, sixty-five percent of mothers and 60% of fathers report that the fathers spend more than five hours with their infant on any given weekend day.

In addition, mothers and fathers were also asked to rate how much the father vocalizes to the infant on a given day. These ratings were done on a 7-point Likert scale ranging from 1 "vocalize very little," 4 "vocalize somewhat," and 7 "vocalize a lot." Results showed no difference between the mothers' ($M = 5.75$, $SD = .97$) and fathers' ($M = 5.25$, $SD = .91$) reports of amount of paternal vocalization ($t(38) = -1.68$, $p > .05$) (see Table 2).

Further analysis using the questionnaire was done to see if infants' looking times to the two voices (dad and other) correlated with fathers' and mothers' reports of time spent with the infant (weekday and weekend day) and vocalization time (see Table 3). First, a relative measure of looking time was obtained. The mean amount of looking time to other was subtracted from the mean amount of looking time to dad in order to obtain a difference score. Next, the intervals of time spent for both weekday and weekend day were given a number 1-4, with 1 being the interval 0-1 hour, 2 being the interval 2-3 hours, 3 being the interval 4-5 hours, and 5 being the interval > 5 hours. The correlation between the difference score and the amount of time fathers spend on a given weekday with their infant was lower than the same correlation using the maternal report, $r = .074$ and $r = .42$ respectively. For the correlation between the difference score and the amount of time spent on a weekend day, fathers' reports yielded a correlation of $r = .034$ and mothers' reports yielded a correlation of $r = .164$. An additional correlation was conducted on the difference score and the fathers' and mothers' reports of paternal vocalization time. As with the other correlations, this analysis showed extremely low positive correlations of $r = .064$ for the fathers' reports and $r = .022$ for the mothers' reports.

Additionally, various activities were listed on the bottom of the questionnaire and the mothers and fathers circled the activities that the father typically engaged in with the infant. The most frequently reported activity was "vocal play." The least reported activity was "reading." Table 2 lists all the activities and the percentage of mothers and fathers who reported that the father participates in these activities with the infant.

Acoustic analysis

In order to verify that the male ID speech samples were different from the male AD speech samples used in a previous study, mean fundamental frequency (Fo) (i.e., pitch) calculated in Hz, Fo range (i.e., Fo maximum-Fo minimum), and utterance duration (measured in msec) were analyzed using Micro Speech Lab software. Utterances were analyzed at 20,000 samples per second with a frame size of 20 msec. An unpaired t-test was then done on each of the above parameters for the male ID and male AD speech samples. Significant differences were found on all parameters. Mean Fo for the male ID speech samples (\underline{M} = 161.78, \underline{SD} = 31.44) was greater than the male AD speech samples (\underline{M} = 119.74, \underline{SD} = 17.56), $\underline{t}(186) = -11.14$, $p < .01$. Fo range was also greater for male ID (\underline{M} = 153.04, \underline{SD} = 60.44) than for male AD (\underline{M} = 69, \underline{SD} = 34.37) speech samples, $\underline{t}(186) = -11.545$, $p < .01$. In addition, speech utterance duration was longer

for the AD utterances ($\underline{M} = 1.47$, $\underline{SD} = .79$) than the ID utterances ($\underline{M} = 1.11$, $\underline{SD} = .62$), $t(186) = 3.48$, $p < .01$. The mean F_0 as a function of speech type and the standard deviations are shown in Figure 4.

Insert Figure 4 Here

Discussion

The present study did not support the hypothesis that four-month-olds, if given sufficient postnatal exposure with the paternal voice (i.e., equate length with prenatal maternal voice exposure) would show a preference for their fathers' voices over an unfamiliar male voice within the context of ID speech. In addition, the second hypothesis that infants would exhibit more affective responsiveness to paternal ID speech over unfamiliar male ID speech was also not supported by the current study. These findings extend and support previous findings that newborns and four-month-olds do not show a preference for their own father's voice over another unfamiliar male voice (DeCasper & Prescott, 1984; Ward, Abraham, & Cooper, 1995). Thus, in three different contexts (i.e., reading a children's story, AD speech, and ID speech) non-significant results have been found when examining paternal voice preferences in infants. These results stand in sharp contrast to what we know of maternal voice preference. Infants prefer to listen to the

maternal voice even when heard in a variety of different contexts (Cooper et al., 1995; DeCasper & Fifer, 1980; Fifer, 1987; Mehler et al., 1978; Mills & Melhuish, 1974; Moon & Fifer, 1990; Stanley & Madsen, 1990). Therefore, it is surprising that by four months infants still do not seem to prefer their dads' voices over another male voice, especially when the paternal voices were extracted from the context of normal father-infant interactions. Several explanations may account for the current finding.

First, the lack of preference in the current study calls into question whether the infants could discriminate the male voice samples. Had a preference been demonstrated, then discrimination would have been assumed given that preference necessitates discrimination. Given the present non-significant results, however, it is necessary to determine whether or not the infants could differentiate the male voices. If they can not distinguish the male voice pairs, then obviously they will not show a preference for one over the other. Therefore, we are currently conducting an additional experiment in our laboratory to determine if four-month-olds discriminate the male voice pairs used in the present study.

Given the results of other studies, however, it seems unlikely that infants at four months will not be able to discriminate male voices. For instance, three-month-olds

discriminate all sorts of speech properties (e.g., variations in frequency of pure tones and changes in melodic contours) (see Aslin, 1987 for a review). Additionally, two-month-olds discriminate within and between male and female voice category changes and six-month-olds discriminate between-category voice changes (Miller, 1983). More relevant to the present study, however, is the finding by DeCasper and Prescott (1984) that newborns can discriminate non-paternal male voices. It seems reasonable to expect that four-month-olds also possess this ability. If lack of discrimination is not the answer, then an alternative explanation is required to explain the current findings.

A second possibility for the present results could be related to infants' experiences. That is, it is possible that four months is simply not enough exposure to the paternal voice for recognition to develop. In the present study it was reported by both mothers and fathers that on any given weekday fathers are spending only 2-3 hours interacting with their infants and during this time the fathers are vocalizing only moderately. In contrast, during the last trimester of pregnancy infants can hear the maternal voice (Querleu et al., 1988; Querleu et al., 1989; Richards, 1992). Thus, the fetus is with the mother 24 hours a day and can hear her every time she speaks for

approximately the last 15 weeks of pregnancy. Granted, pregnant women are not vocalizing constantly, but they are probably talking more in the presence of the fetus prenatally than fathers are talking in the presence of the infant postnatally. Therefore, the argument could be made that lack of sufficient exposure to the father's voice accounts for the lack of paternal voice preference in four-month-olds.

This interpretation is somewhat contradicted by research which shows that little exposure is needed for preferences to arise. For instance, DeCasper and Spence (1986) found that when pregnant women read a story once a day for six weeks, their newborns preferred the familiar story over an unfamiliar story. Similarly, Panneton (1985) showed that when pregnant women sang a melody once a day for two weeks, their newborns preferred that melody over an unfamiliar melody. Thus, it is plausible that interacting 2-3 hours per weekday and greater than five hours per weekend day, while vocalizing moderately, would be sufficient for a recognition system for father to have developed.

Regardless, there is the additional potential that infants at four months have experienced other male voices close to the same amount that they have experienced their own fathers' voices. The problem is not necessarily that

infants do not experience the paternal voice, they simply also experience other male voices as well which could lead to showing no preference for one over the other when given the choice to listen to both. Thus, the paternal voice is essentially competing with other male voices present in the infant's postnatal environment.

One way to assess how much competition is really taking place is to obtain an estimate of how much the infant is experiencing the paternal voice compared to other male voices. The current study only assessed father-infant interaction via questionnaires. Perhaps there is a better way to look at father-infant interaction that would allow an examination of other interactions (i.e., what the paternal voice is competing with) as well. The questionnaire data in the present study showed that maternal and paternal perception of father-infant interaction did not differ from one another. That is, mothers' reports of time spent, vocalization amount, and father-infant activities were very similar to the fathers' self reports. However, these findings differ markedly from those found by Rebelsky and Hanks (1971). Rebelsky and Hanks found that fathers interact with and vocalize to their infants very little throughout the first three months of postnatal life. However, they used actual voice recordings in the home to assess father-infant interaction, as opposed to self-

reports. Therefore, the difference between the current study and Rebelsky and Hanks (1971) in assessing time spent and vocalization amount may be due to the differences in perception versus actual behavior. Given this discrepancy, it may be interesting to redo the Rebelsky and Hanks study, especially since it is outdated. This would not only allow us to obtain a more accurate measure of how much fathers are interacting with and vocalizing to their infants, but would also allow us to assess how much infants are experiencing the paternal voice relative to other male voices (i.e., whether competition is occurring).

In addition, not only would a replication of Rebelsky and Hanks afford us the opportunity to compare infant exposure to the paternal voice with exposure to other male voices, but it would also allow a comparison of maternal voice exposure. This would be an interesting factor to consider especially since we already know that infants prefer the maternal voice over an unfamiliar female voice (DeCasper & Fifer, 1980; Fifer, 1987; Mills & Melhuish, 1974; Moon & Fifer, 1990; Stanley & Madsen, 1990) and that four-month-olds, but not one-month-olds, prefer maternal ID speech over maternal AD speech (Cooper et al., 1995). By replicating Rebelsky and Hanks, we could examine the differences between mother-infant and father-infant interaction across the first few months of postnatal life.

There may be a completely different dynamic occurring between fathers and infants that could account for the lack of preference observed in the current study. A questionnaire analysis similar to the one done in the present study could also be used to assess mother- and father-infant interaction. That is, mothers and fathers could fill out a questionnaire about themselves and about their spouse. This would not only supplement the actual recordings obtained in the home, but would allow a cross comparison of maternal and paternal perceptions. It is suggested that by having multiple accounts (i.e., actual behavior and multiple perceptions) of what is taking place for the infant across the first four months of postnatal life, we can obtain a better understanding of just how good a perceptual target dad's voice is for the infant.

Lastly, the lack of father voice preference in this study may be attributable to the nature of the testing situation itself. The typical father-infant interaction provides more than just auditory stimulation for the infant. Other cues such as tactile, olfactory, and visual are also available. It is possible that paternal recognition requires the availability of multimodal cues in order for preference to emerge.

This hypothesis is supported by several researchers who have found that multisensory interactions facilitate

knowledge in general and the recognition process in particular (Burnham, 1993; Kurzweil, 1988; Spelke & Owsley, 1979). For example, Burnham (1993) investigated visual discrimination of the maternal face and unfamiliar female face by infants aged 1, 3, and 5 months. Through a series of experiments she concluded that visual recognition of mother is facilitated by the addition of speech.

Similarly, Kurzweil (1983) observed 2- to 3-day-olds, three-week-olds, and three-month-olds as they interacted with two stranger females and their mother. These interactions involved auditory, visual and tactile information. Results showed that the three-month-olds showed different visual responses to the mother and strangers. She concludes that three-month-olds find the two strangers equivalent (i.e., infants responded to the strangers similarly), but the mother significantly different from the two strangers. Kurzweil's main point is that infants are able to recognize and distinguish their mother despite the variety of stimulation involved. However, the argument could be made that the reason the infants in Kurzweil's study treated the strangers similarly and mom differently was due to the multisensory information available. That is, the culmination of maternal sensory cues enabled the infant to recognize the familiar caregiver and hence facilitated a different infant response.

Interpreted this way, Kurzweil's study supports the notion that recognition is facilitated by multisensory cues.

Spelke and Owsley (1979) conducted two experiments, one with 3 1/2, 5 1/2, and 7 1/2 month old infants, and one using four-month-olds. Visually, infants were exposed to both parents seated to the right or left of the infant. Acoustically, the infants heard their parents voices over a loud speaker. In both experiments infants at all ages looked initially and eventually more often at the parent whose voice they heard. Spelke and Owsley interpret this finding as the ability of infants to use knowledge they have about a parent's auditory and visual characteristics to guide intermodal exploration. That is, the infants searched for information through multiple perceptual systems.

Taken together, the above studies show the importance of multisensory cues in facilitating recognition. The infants in the current study were exposed to an auditory cue (ID speech). However, the visual cue used was concentric colored circles. It is suggested that if this visual stimulus had been a face (i.e., the face corresponding to the particular voice heard) then different results may have been obtained. To test this hypothesis, it would first be necessary to test the infants using just faces (i.e., paternal face versus unfamiliar male face) in order to discern face recognition from face plus voice recognition.

If infants do not show a preference for either face, then the faces could be coupled with the voices to see if this culmination of cues gives rise to father being recognized and preferred over an unfamiliar male.

In the current study the hypothesis that four-month-olds would display more positive affective responsiveness to the paternal voice over the unfamiliar male voice was not supported. Rather, the facial affect of the infants across both conditions was neutral. In contrast, Werker and McLeod (1989) found positive affective responsiveness to female ID speech. In their study the stimuli were video recordings of females and males speaking either ID or AD speech. Thus, the infants did not see a static visual display as was the case in the current study. Perhaps multisensory information is necessary not only for attentional preference but also for affective responsiveness as well. It must be pointed out, however, that Werker and McLeod did not find affective responsiveness to male ID speech. This finding calls into question whether adding this dimension (i.e., faces) to the current study would change our affectiveness ratings.

In conclusion, this study adds to the information which exists on father-infant interaction in general and paternal voice preference in particular. Both of these areas are significantly lacking in regards to what we know and do not know about fathers and infants. This study has also allowed

us to ask questions concerning father-infant interaction that were previously not asked (e.g., the possible necessity of multisensory cues for father preference). Finally, this study provided the first account of father-infant interaction through maternal and paternal reports. Taken together, the current study seems to have been a necessary step in the whole process of uncovering what fathers actually do with their infants and how infants respond.

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Appendix A

INFANT SPEECH STUDY PROGRAM

DEPARTMENT OF PSYCHOLOGY
VIRGINIA TECH

Dear Parent(s):

Soon after infants are born, they can recognize many different sounds and voices. For instance, we now know that babies only a few days old would rather listen to their own mothers' voices than to the voice of another woman. Even though babies this age are not yet talking on their own, we believe that they are listening to the speech of their parents and other people around them. In the Department of Psychology at Virginia Tech, we are examining young infants to see what other kinds of speech sounds babies recognize in their first months after birth. This information is very important for our understanding of how infants learn language.

Currently, we are investigating infants' recognition of their fathers' voices, an area of study that has been largely neglected in this field. Your participation would involve having one of our assistants visit the father and the infant in the home in order to record the father's voice. A subsequent visit to the Infant Speech Study Program (located next to Bogen's restaurant; a map is attached for your convenience) would then be scheduled when your baby is between 16 and 20 weeks old so that we can observe your infant to see how responsive your baby is to the father's voice. This test lasts for approximately 15 minutes, but we schedule a full hour appointment with you to give you and your baby time to get settled without feeling rushed. We schedule this appointment at a time that is most conducive to your (and your baby's) schedule. If you have older children and would like to bring them along, we offer free babysitting for your convenience. We have a waiting room with toys for your older child(ren) that is located next to our observation room.

If you would like to schedule an appointment for your infant or find out more about our work, please feel free to call us at either 231-3972 or 231-5938. We hope to see you and your baby soon!

Sincerely,

Cynthia D. Ward
Graduate Student

Robin Panneton Cooper, Ph.D.
Assistant Professor

Appendix C

MOTHER QUESTIONNAIRE

Mother's Name _____

1. Was the father present at the birth of the child? yes no

2. If the child is bottle fed, how many times does the father feed him/her in a 24-hour period? (circle)

1 2 3 4 5 (or more) times

3. Approximately how much time in a given weekday, (Mon-Fri) does the father spend with the infant? (circle)

0-1 hour
2-3 hours
4-5 hours
>5 hours

4. Approximately how much time in a given weekend day does the father spend with the infant? (circle)

0-1 hour
2-3 hours
4-5 hours
>5 hours

5. Of the time that the father spends on a given day with the infant, please indicate generally how much he vocalizes to the infant:

(circle the appropriate number)

1	2	3	4	5	6	7
vocalize very little			vocalize somewhat			vocalize a lot

6. Circle all the activities that the father typically engages in with the infant:

vocal play	burping	consoling	reading
physical play	bathing	rocking	putting to sleep
feeding	diaper changing		

Appendix D

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY Informed Consent for Participants of Investigative Projects

Title of Project Infant Preference for Father's Voice
Principle Investigator Cynthia Dione Ward

I. THE PURPOSE OF THIS RESEARCH/PROJECT

You and your infant are invited to participate in a voice recognition study. The purpose of this study is to investigate 4-month-old infants' recognition of their fathers' voices.

II. PROCEDURES

A lapel microphone will be attached to your collar at the beginning of the interview and remain running throughout the visit. You will be asked to directly interact with your infant as you normally do during everyday activities. Your interaction with your infant will be recorded on an audio cassette recorder. You will also be asked to fill out an information sheet about the amount of time you spend with your infant, the amount of time you spend vocalizing to your infant, and the activities you typically engage in with your infant. There are no apparent risks to your infant or to yourself for participation in this study.

III. BENEFITS OF THIS PROJECT

Your participation in this study benefits the field of infant speech perception. Specifically, this study will further our understanding of when infants can recognize the voice of their father.

IV. EXTENT OF ANONYMITY AND CONFIDENTIALITY

All of the information gathered in this study will be kept confidential and the results will not be released without parental consent. The information you provide will have your name removed, and only a subject number will identify you during the re-recording of parts of the tape and during the infant testing. Your informed consent will be kept separate from your interview tapes. However, the results of this project may be used for scientific and/or educational purposes, presented at scientific meetings, and/or published in a scientific journal. In addition, due to the nature of the study, when the infants are brought in to listen to their fathers' voices, they must be given a choice between two male voices. One male voice will be the infant's own father's, but the other male voice will be another infant's father. Therefore, your voice recording may also be used in testing other infants in the study. If you would like, you will be sent a summary of this work when this project is completed.

As mentioned, the interview will be taped on a tape recorder, and only your subject number will be used so that you will not be identified. Additionally, your tape will be stored at the Infant Speech Lab and erased after five years. Your tape will only be reviewed by trained undergraduate or graduate lab assistants and Dr. Cooper.

Appendix D (cont.)

V. FREEDOM TO WITHDRAW

You have the right to terminate your involvement in this study at anytime and for any reason, if you so choose.

VI. APPROVAL OF RESEARCH

This project has been approved by the Human Subjects Committee of the Department of Psychology and the Institutional Review Board of Virginia Tech.

VII. FATHER'S PERMISSION

I have read and understand the informed consent and conditions of this project. I have been given an opportunity to ask further questions about this procedure and I understand I have the right to end this session for any reason if I so choose.

If I have any questions regarding this research and its conduct, I should contact one of the persons named below. Given these procedures and conditions, I give my permission to Cynthia Ward, Dr. Cooper, and their co-workers to test my son/daughter.

Cynthia D. Ward, Principle Investigator	231-8143
Dr. R. P. Cooper, Faculty Advisor	231-5938
Dr. E. Eisler, Chair, Human Subjects Committee	231-7001
Dr. Ernest R. Stout, Chair, Institutional Review Board	231-9359

Signature of Father/Date

Appendix E

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Informed Consent for Participants of Investigative Projects

Title of Project Infant Preference for Father's Voice
Principle Investigator Cynthia Dione Ward

I. THE PURPOSE OF THIS RESEARCH/PROJECT

You and your infant are invited to participate in a voice recognition study. The purpose of this study is to investigate 4-month-old infants' recognition of their fathers' voices.

II. PROCEDURES

Your infant will be tested for approximately 15 minutes, provided that he/she is in an awake, alert, and quiet state. The baby will be held in your lap. The baby will view a video screen on which colored circles will appear. When the infant looks at this screen, a loudspeaker located above the screen will present a recording of a male voice. The infant can control the length of this recording by the time that he/she looks at the screen. The sound level of the speech played to the infant will be no louder than the sounds heard by infants in their typical home environment (i.e., @ 65 dB). If your infant cries or falls asleep, testing will be discontinued. Also, each infant will be videotaped during his/her session for subsequent coding of their facial expressions. There are no apparent risks to your infant or to yourself for participation in this study.

III. BENEFITS OF THIS PROJECT

Your participation in this study benefits the field of infant speech perception. Specifically, this study will further our understanding of when infants can recognize the voice of their father.

IV. EXTENT OF ANONYMITY AND CONFIDENTIALITY

All of the information gathered in this study will be kept confidential and the results will not be released without parental consent. The information your infant provides will have his/her name removed, and only a subject number will identify him/her during analyses and any written reports. Your informed consent will be kept separate from your infant's information. However, the results of this project may be used for scientific and/or educational purposes, presented at scientific meetings and/or published in a scientific journal. If you would like, you will be sent a summary of this work when this project is completed.

As mentioned, the experiment will be videotaped. However, these tapes will only be reviewed by the researchers directly involved in the study. The videotape will be stored at the Infant Speech Lab and erased after five years.

Appendix E (cont.)

V. FREEDOM TO WITHDRAW

You have the right to terminate your involvement in this study at anytime and for any reason, if you so choose.

VI. APPROVAL OF RESEARCH

This project has been approved by the Human Subjects Committee of the Department of Psychology and the Institutional Review Board of Virginia Tech.

VII. SUBJECT'S PERMISSION

I have read and understand the informed consent and conditions of this project. I have been given an opportunity to ask further questions about this procedure and I understand I have the right to end this session for any reason if I so choose.

If I have any questions regarding this research and its conduct, I should contact one of the persons named below. Given these procedures and conditions, I give my permission to Cynthia Ward, Dr. Cooper, and their co-workers to test my son/daughter.

Cynthia D. Ward, Principle Investigator	231-8143
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Dr. E. Eisler, Chair, Human Subjects Committee	231-7001
Dr. Ernest R. Stout, Chair, Institutional Review Board	231-9359

Signature of Parent/Date

Appendix F

Demographic Information

1. Mother's age at child's birth _____
Father's age at child's birth _____
2. Type of delivery: vaginal _____ c-section _____
3. Type of feeding: breast _____ bottle _____
4. Number of brothers and sisters:
Brothers _____ Ages _____
Sisters _____ Ages _____
5. Parents' highest level of education: **Mother** **Father**
Less than seventh grade _____
Junior High School (9th grade) _____
Partial High School (10th or 11th grade) _____
High School Graduate _____
College Graduate _____
Graduate Degree _____
6. Number of persons living in household _____
7. Mother's occupation _____
Father's occupation _____
8. Combined Net Yearly Income:
\$ 0-10,000 _____ \$ 50,001-60,000 _____
\$ 10,001-20,000 _____ \$ 60,001-70,000 _____
\$ 20,001-30,000 _____ \$ 70,001-80,000 _____
\$ 30,001-40,000 _____ \$ 80,001-90,000 _____
\$ 40,001-50,000 _____ \$ 90,000 and up _____

Appendix G

INFANT EMOTION CODING SHEET (WERKER & MCLEOD, 1989)

Infant Name _____ Gender M F
Birthdate ____/____/____ Session Date ____/____/____
Observer _____

Observe the infant during each trial and then answer the following question:
What is your perception of the infant's predominant emotional state?
Use the following scale to guide you in assessing each trial.

1-----2-----3-----4-----5-----6-----7-----8-----9
neg/unpleasant pos/pleasant
(distressed, agitated) (happy, excited)

- 1 1-----2-----3-----4-----5-----6-----7-----8-----9

- 2 1-----2-----3-----4-----5-----6-----7-----8-----9

- 3 1-----2-----3-----4-----5-----6-----7-----8-----9

- 4 1-----2-----3-----4-----5-----6-----7-----8-----9

- 5 1-----2-----3-----4-----5-----6-----7-----8-----9

- 6 1-----2-----3-----4-----5-----6-----7-----8-----9

- 7 1-----2-----3-----4-----5-----6-----7-----8-----9

- 8 1-----2-----3-----4-----5-----6-----7-----8-----9

- 9 1-----2-----3-----4-----5-----6-----7-----8-----9

- 10 1-----2-----3-----4-----5-----6-----7-----8-----9

- 11 1-----2-----3-----4-----5-----6-----7-----8-----9

- 12 1-----2-----3-----4-----5-----6-----7-----8-----9

Table 1

Parents' Demographic Data

		mother (n=18)	%	father (n=18)	%
Age:	14-20	2	11%	2	11%
	21-30	7	39%	3	17%
	31-40	9	50%	13	72%
Parity: ^a	prima	7	39%	--	--
	multi	11	61%	--	--
Number of children: ^a	1	7	39%	--	--
	2	8	44%	--	--
	3	2	11%	--	--
	4	1	6%	--	--
Type of delivery: ^a	vaginal	12	67%	--	--
	caesarean	6	33%	--	--
Type of feeding: ^a	breast	9	50%	--	--
	bottle	3	17%	--	--
	both	5	28%	--	--
	not given	1	5%	--	--
Education:	jr. high	1	6%	0	0%
	h.s. grad	1	6%	1	6%
	part coll.	2	11%	4	22%
	coll. grad.	8	44%	8	44%
	grad. deg.	6	33%	5	28%
Occupation:	white collar	14	78%	13	72%
	blue collar	0	0%	3	17%
	grad. student	0	0%	2	11%
	unemployed	4	22%	0	0%
Income: ^a	0-10,000	1	6%	--	--
	10-20,000	1	6%	--	--
	20-30,000	3	16%	--	--
	40-50,000	6	33%	--	--
	50-60,000	2	11%	--	--
	60-70,000	2	11%	--	--
	70-80,000	1	6%	--	--
	90,000+	2	11%	--	--

^aThis information is the same for both parents and is only reported under mother.

Table 2

Questionnaire Data on Father-Infant Interaction

		mother report (<u>n</u> =20)	%	father report (<u>n</u> =20)	%
Present at child's birth:	yes	20	100%	20	100%
	no	0	0%	0	0%
Time spent weekday:	0-1 hr	2	10%	1	5%
	2-3 hrs	10	50%	9	45%
	4-5 hrs	3	15%	4	20%
	>5 hrs	5	25%	6	30%
Time spent weekend day:	0-1 hr	1	5%	1	5%
	2-3 hrs	1	5%	3	15%
	4-5 hrs	5	25%	4	20%
	>5 hrs	13	65%	12	60%
Vocalization amount:	moderate ^a	8	40%	15	75%
	a lot ^b	12	60%	5	25%
Father-infant activities:	vocal play	20	100%	20	100%
	burping	13	65%	15	75%
	consoling	17	85%	17	85%
	reading	5	25%	8	40%
	physical play	20	100%	18	90%
	bathing	15	75%	13	65%
	rocking	15	75%	15	75%
	put to sleep	12	60%	13	65%
	feeding	10	50%	11	55%
	changing	19	95%	19	95%

^aDefined as reporting a 4 or 5 on a scale from 1-7.

^bDefined as reporting a 6 or a 7 on a scale from 1-7.

Table 3

Correlations Between Parental Reports of Paternal Time Spent/Vocalization Amount and Relative Looking Time

	Relative Looking Time	
	mother	father
	report (<u>n</u> =20)	report (<u>n</u> =20)
Time spent weekday	.42	.07
Time spent weekend day	.16	.03
Vocalization amount	.02	.06

Figure Captions

Figure 1. Mean looking times (in sec) of 4-month-olds to paternal infant-directed (ID) speech (\underline{M} = 15.14, \underline{SD} = 7.54) and to unfamiliar male ID speech (\underline{M} = 14.26, \underline{SD} = 5.64).

Figure 2. Mean looking times (in sec) of 4-month-olds on initial trials, dependent on whether that first look produced paternal infant-directed (ID) speech (\underline{M} = 21.94, \underline{SD} = 21.48) or unfamiliar male ID speech (\underline{M} = 23.35, \underline{SD} = 18.52).

Figure 3. Mean affective ratings, based on a scale from 1 to 9, of 4-month-olds to paternal infant-directed (ID) speech (\underline{M} = 5.0, \underline{SD} = .31) and to unfamiliar male ID speech (\underline{M} = 4.9, \underline{SD} = .20).

Figure 4. Mean fundamental frequency (Fo) (in Hz) for male infant-directed (ID) (\underline{M} = 161.78, \underline{SD} = 31.44) and male adult-directed (AD) (\underline{M} = 119.74, \underline{SD} = 17.56) speech samples.

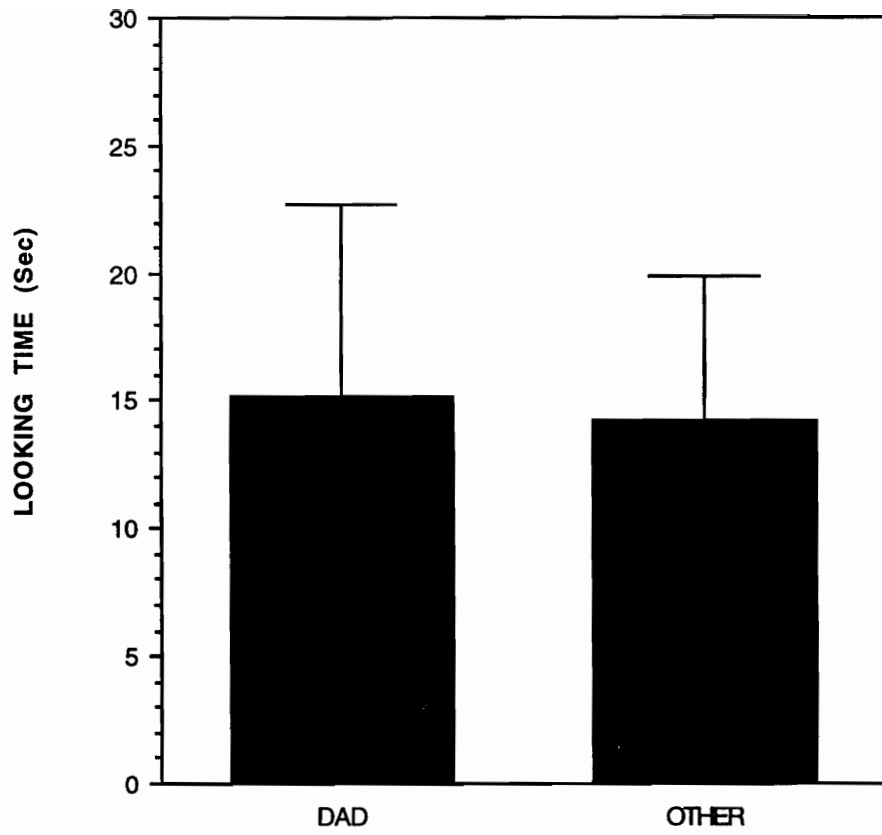


Figure 1.

AVERAGE LOOKING TIME

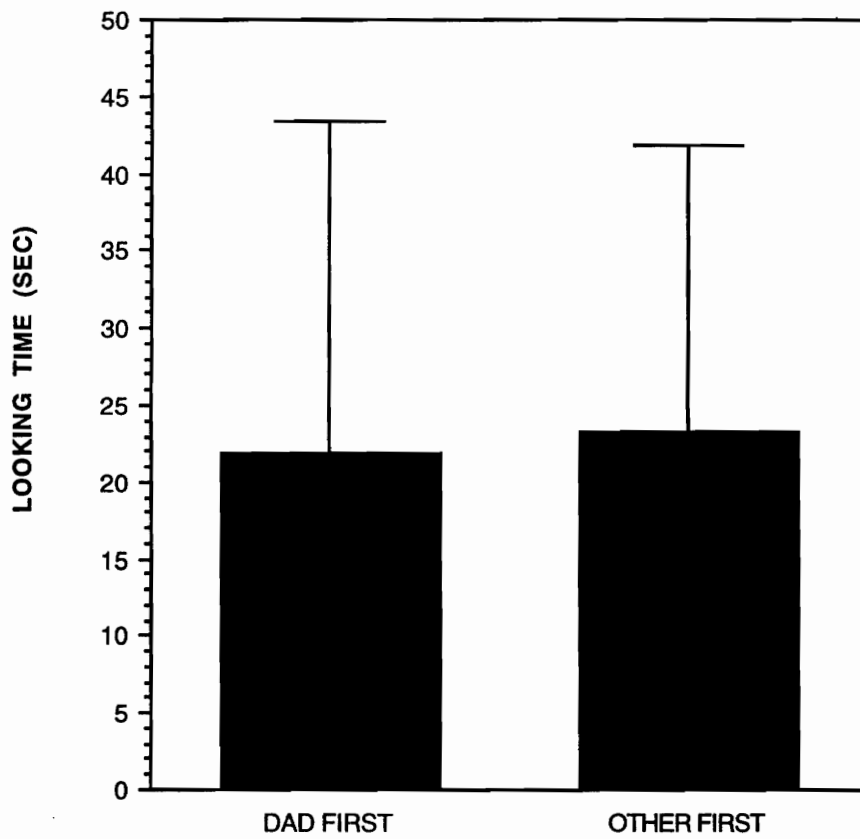


Figure 2.

AVERAGE LOOKING TIME ON FIRST LOOK

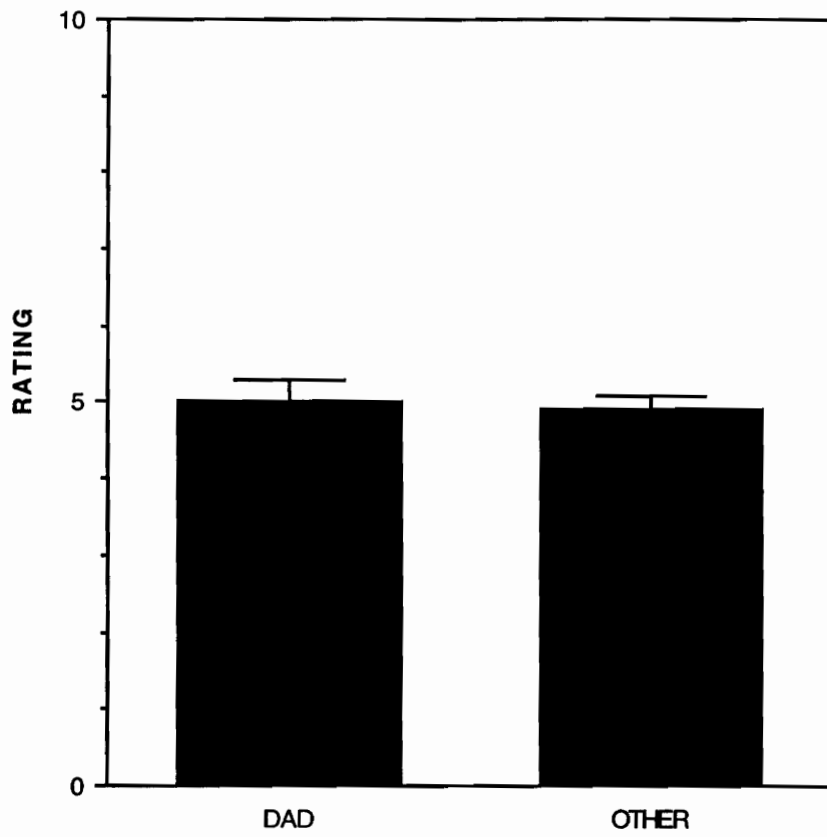


Figure 3.

AVERAGE AFFECTIVE RESPONSIVENESS

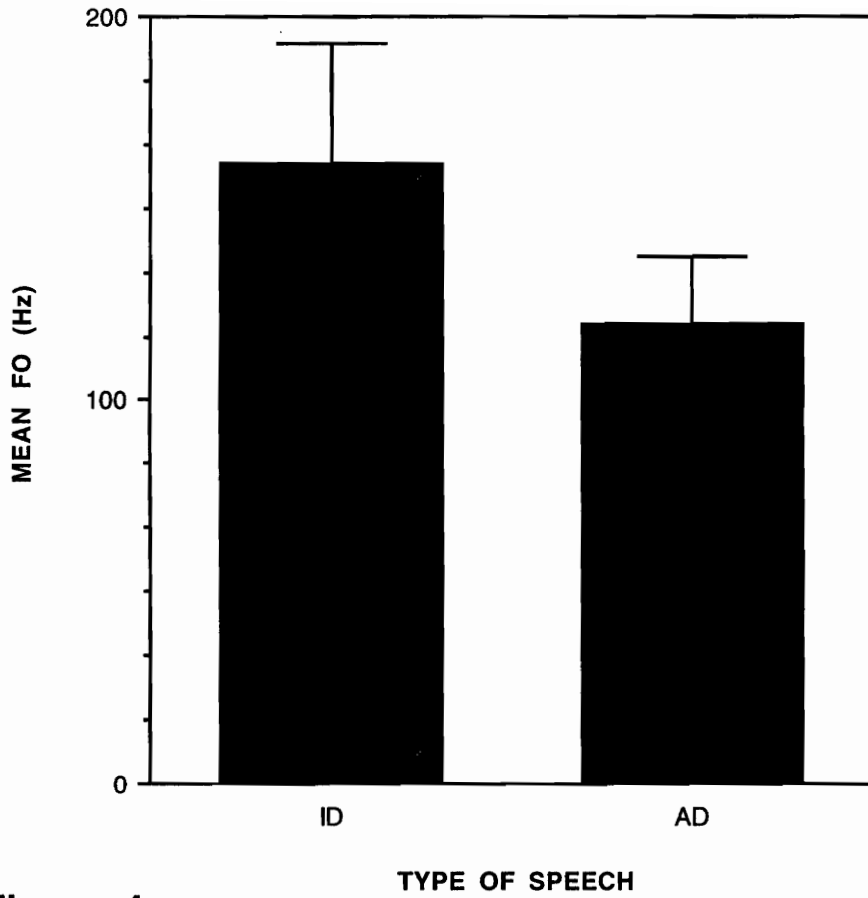


Figure 4.

AVERAGE PITCH

Vita

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CONFERENCE PRESENTATIONS

Ward, C. D., Abraham, J. L., & Cooper, R. P. (1995, March). Lack of preference for the paternal voice in four-month-olds. Poster accepted for presentation at the Biennial Meeting of the Society for Research in Child Development, Indianapolis, Indiana.

Ward, C. D., McCartney, J., & Cooper, R. P. (1995, October). Infants' recognition of the paternal voice: Lack of preference in adult-directed and infant-directed contexts. Poster submitted to the 10th Biennial International Conference for Infant Studies, Providence, Rhode Island.

Vita (cont.)

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