

THE ROLE OF MULTISENSORY INFORMATION IN INFANTS' RECOGNITION OF
THEIR FATHERS

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(ABSTRACT)

The present study was designed to investigate the development of infants' recognition of their fathers, specifically examining the role of multisensory information (visual and auditory cues). All infants were 4-months-old and were tested in a visual-fixation preference procedure. The two measures of interest were attention and affective responsiveness. Preference was measured by the amount of time the infants watched a visual stimulus. In Experiments 1 and 2 this stimulus was the paternal face. In Experiment 2 the paternal face was also accompanied by the paternal voice. In Experiment 3, the stimulus was the maternal face plus voice. Affective responsiveness was coded for hedonic tone, interest and excitement. It was found that infants showed more positive affect towards their fathers' faces (Experiment 1) and faces plus voices (Experiment 2), $p < .05$. In Experiment 3, results showed that infants preferred their mothers' faces plus voices over an unfamiliar female face plus voice when the first trial was excluded from the analysis, $p < .05$. These findings not only support the literature on infants' recognition of their mothers, but they also contribute to the increasing body of

information on infants and their fathers. The findings are interpreted as supporting the hypothesis that the developmental pattern of father recognition is qualitatively and quantitatively different from that of mother recognition.

To My Husband
Christopher D. Holt
And My Parents
Larry R. Ward
&
Wanda M. Wilson

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The Role of Multisensory Information in Infants' Recognition of their Fathers

Introduction

During the year after birth, infants typically form their first relationships with their caretakers. However, evidence indicates that the father-infant relationship is typically both quantitatively and qualitatively different from the mother-infant relationship (e.g., Bridges & Connell, 1991; Lamb, 1977a). In spite of these differences, infants still form attachments to their fathers at approximately the same time (i.e., 7 months) as they form attachments to their mothers (e.g., Lamb, 1977a). Given this attachment finding, infants must develop some sort of recognition system for the mother and the father prior to seven months, since attachment necessitates recognition. Evidence for early maternal recognition is abundant (e.g., DeCasper & Fifer, 1980). However, the development of a recognition system for the father is less clear (e.g., Ward & Cooper, 1998). Therefore, the purpose of the present study was to investigate the development of infants' recognition of their fathers, specifically examining the role of multisensory information (visual and auditory cues). However, before an understanding of the paternal recognition system can be achieved, the unique father-infant relationship must be explored.

Father-infant interaction

Gone are the days when Lamb (1975) suggested fathers were the "forgotten contributors of child development" (e.g., Akande,

1994). Since the 1970's research on the infant-father relationship has been steadily increasing (see McGreal, 1981; Russell & Radojevic, 1992 for reviews). The culmination of research on infants and fathers suggests that the father plays a differential role in child development compared to the mother.

Overall, cross-cultural research suggests that fathers are less involved with their infants (e.g., Lamb, 1981; McVeigh, 1992; Palmer & Bridges, 1995, Reblesky & Hanks, 1971; Roopnarine et al., 1995; Scholz & Samuels, 1992). For example, Reblesky and Hanks (1971) studied fathers and infants across the first three months of life via in-home microphone recordings. Their results showed that fathers spent relatively little time interacting with their infants, reporting that the father with the most interactions only spent approximately 10 minutes 26 seconds with his infant each day (Reblesky & Hanks, 1971).

Similarly, Scholz and Samuels (1992) found, via use of a Baby Diary, that Australian mothers were the primary caregivers, spending on average about 6.5 hours a day taking care of their infants, whereas Australian fathers spent about 1.75 hours per day in infant involvement. Likewise, McVeigh (1992) studied the father's role in infant development by comparing father- and mother-infant interaction in a laboratory setting. McVeigh found that the mother exceeded the father on all interaction variables, with the only possible exception being "intrusive play."

Another cross-cultural finding is that mothers (compared to fathers) spend more time vocalizing to, showing affection toward,

smiling at and holding their infants (Field, 1978; Frodi, Lamb, Hwang, & Frodi, 1983; Lamb, 1977a, 1981). For instance, Frodi et al. (1983) studied 8-month-olds interacting with their parents in their home setting. It was found that mothers were more likely to hold, care for, vocalize to and smile/show affection to their infants, regardless of whether the family was classified as nontraditional (i.e., the father spending more than a month out of the first nine months as sole caretaker) or traditional (i.e., the father spending less than one month as sole caretaker). Similar results have been found by Lamb (1977a) with American mothers and fathers.

More recently this same difference between mother- and father-infant interaction has been demonstrated in a laboratory setting (McVeigh, 1992). McVeigh found that fathers did not make eye contact with or make faces at their 4- to 8-month-olds. Additionally, the fathers were less likely than mothers to engage in intense vocalization to the infant, including high-pitch vocalizations and laughing. This finding supports previous research which found that even though fathers do speak to their infants in what is referred to as infant-directed (ID) speech (i.e., speech characterized by higher pitch, greater pitch variability, longer pauses, and slow tempo of articulation, Fernald, Taescher, Dunn, Papousek, de Boysson-Bardies, & Fukui, 1989; Papousek, Papousek, & Haekel, 1987), mothers use ID speech more than fathers (Fernald et al., 1989).

Generally, research indicates that American fathers are less

of a "caretaker" and more of a "playmate," (Bridges & Connell, 1991; Lamb, 1977a; Lamb, 1980; Russell, 1983; Russell & Radojevic, 1992). For instance, Russell (1983) suggests that fathers spend much less time in routine caregiving than mothers and are particularly less likely to perform physical caregiving tasks (e.g., changing diapers). He also reports that not only are fathers more likely to play with their infants, but the type of play activities are different than those of the mother. Lamb (1977a) studied the interaction of infants and parents via home observation across the first year of life (i.e., 7, 8, 12, and 13 months) and found that fathers were not only more likely to play with their infants, but the infants responded more positively to father play versus mother play.

Interestingly, this "play" role of the father does not appear to be a cross-cultural phenomenon (Frodi et al., 1983; Hossain & Roopnarine 1994; Lamb, Frodi, Hwang, Frodi, & Steinberg, 1982; Roopnarine et al., 1995). Both Swedish (Frodi et al., 1983; Lamb, et al., 1982) and Jamaican (Roopnarine et al., 1995) parents show no differences in the amount of parent-infant play. In the Jamaican sample, both mothers and fathers spent more time in play with their infants than in typical "caregiving" behaviors (e.g., feeding and cleaning). Similarly, African-American fathers living in the United States did not differ in the amount of time in which they played with their infants compared to mothers, but the fathers were more likely to spend time in play activities versus feeding and cleaning

activities when compared with mothers (Hossain & Roopnarine, 1994).

When examining the father-infant attachment literature, research indicates that, in general, infants respond to their fathers with more affiliative behaviors (e.g., smiling, vocalizing, looking, laughing and proffering), as opposed to attachment behaviors (e.g., proximity seeking, touching, approaching, fussing). Moreover, affiliative behaviors towards the father occur regardless of the presence or absence of the mother (Bridges & Connell, 1991; Lamb, 1976; 1977a). This tendency to show affiliative behaviors toward fathers underscores fathers' participation in social interaction (e.g., play) and lack of interaction in typical caretaking responsibilities (e.g., feeding) (Bridges & Connell, 1991; Lamb, 1976; 1977a). However, at least one cross-cultural study found that more attachment and affiliative behaviors were directed towards mothers versus fathers (Frodi et al., 1983). However, most of the attachment research done cross-culturally a) has looked at parent-infant relationships and not attachment versus affiliative behaviors per se (e.g., Hossain & Roopnarine, 1994; Roopnarine et al., 1995), b) does not differentiate attachment versus affiliative behaviors (e.g., Oppenheim, Sagi, & Lamb, 1988), and/or c) has only assessed infant maternal attachment (e.g., Nakagawa, Lamb, & Miyaki, 1992; Nakagawa, Teti, & Lamb, 1992). Therefore, assessing attachment versus affiliative behaviors cross-culturally is problematic given the lack of studies which look at

both types of infant behaviors (i.e., attachment and affiliative) in response to both parents.

The attachment literature also shows that despite the more affiliative behaviors directed towards the father and attachment behaviors toward the mother, infants do form attachments to their fathers (Cohen & Campos, 1967; Lamb, 1977a; Shaffer & Emerson, 1964). Lamb (1976, 1977a) suggests that father attachment is formed about the same time as mother attachment (i.e., 7 months). Moreover, it does appear that the attachment to father is secondary to that of mother (Cohen & Campos, 1967), even under stressful situations for 12- to 18-month-olds (but not for 8- or 24-month-olds) (Lamb, 1977b; 1978).

Thus, the picture that emerges regarding the father-infant relationship is one that seems both quantitatively and qualitatively different from the mother-infant relationship, when studied in attachment paradigms and/or more observational paradigms. Because maternal- and paternal-infant attachment emerge during the later half of the first year of life, infants recognition of the mother and the father must be established fairly early in development (i.e., prior to 7 months), given that attachment necessitates recognition. Because of the qualitative/quantitative differences between paternal- and maternal-infant interaction across the first year of life, it seems plausible that the maternal recognition system would follow a different developmental path than that of the paternal recognition system. Evidence thus far supports this hypothesis

(e.g., Ward & Cooper, 1998).

Infants' recognition of their mothers

Not only does the maternal recognition system seem to be established early in human development, but young infants are capable of recognizing their mothers through several different sensory modalities, including olfactory (Cernoch & Porter, 1985; Macfarlane, 1975), visual (Bushnell, Sai, & Mullin, 1989; Pascalis et al., 1995; Walton, Bower, & Bower, 1992), and auditory (e.g., DeCasper & Fifer, 1980; Fifer, 1987) cues. However, few studies have attempted to assess maternal recognition outside of the auditory and visual domains.

Maternal auditory recognition. For example, one of the first studies to examine maternal recognition comes from the work of Mills and Melhuish (1974). They studied maternal voice recognition in 3-week-olds by initially training the infants to learn a contingency between sucking and hearing a voice. After training and for two three-minute periods, the infants heard either their mothers' voice or a stranger female voice whenever they sucked. Mills and Melhuish found that time spent sucking per minute and the number of sucks per minute were greater when the mother's voice was contingent on sucking. More recent studies suggest that this recognition is present within days after birth.

DeCasper and Fifer (1980) studied ten 2- and 3-day-old infants using a sucking technique in which infants' sucking could produce their own mother's voice or that of another mother's

voice. Five of the infants could hear their own mother's voice reading a children's story if their sucking rates decreased from their baseline rate. If their sucking rates increased, they heard the other female's voice. This contingency was switched for the remaining 5 infants. The results of this study showed that regardless of which contingency they were under, the newborns significantly changed their sucking patterns in order to hear their own mother's voice more often. In addition, DeCasper and Fifer reversed the contingency for four of the infants and the infants in turn reversed their response patterns to again differentially produce the maternal voice.

Fifer (in Fifer, 1987) replicated newborns' preferences 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 an unfamiliar female voice. This condition was switched for the other infants. 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 (1990a) 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.

Similarly, Stanley and Madsen (1990) tested 2- to 8-day-olds for preference of the maternal 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.

Recently, Cooper, Abraham, Berman, and Staska (1995) tested both 1-month-olds' and 4-month-olds' preferences for recordings of their mothers' ID versus AD speech. Although the 1-month-olds showed no preference, the 4-month-olds showed a preference for the maternal voice when she was using ID speech.

The above studies indicate that young infants recognize their mothers through auditory cues in multiple contexts. Thus, infants have the auditory capabilities and experiential histories to recognize a familiar voice. Interestingly, infants also have the visual abilities to recognize a familiar face early in development.

Maternal visual recognition. Several researchers have shown that infants recognize their mothers' faces (Bushnell et al., 1989; Field, 1985; Pascalis et al., 1995; Sherrod, 1979; Walton et al., 1992). For example, Field, Cohen, Garcia, and Greenberg (1984, in Field, 1985) found that neonates looked significantly longer at their mothers' faces over a stranger female face.

Similarly, Walton et al. (1992) tested newborns for their preference of their own mothers' faces versus another mother's face by implementing a contingency between sucking and viewing a visual display. Walton et al. found that the newborns significantly increased their sucking in order to see an image of their mothers' faces.

Bushnell et al. (1989) tested 40 neonates' responses to their own mothers' faces versus a female stranger face. The infants viewed the faces through an opening in a screen. These authors matched the women for their hair and complexion because a preference for one person over another may be due to external cues and/or contrast cues (see Morton, 1993). Also, olfactory information was masked and the women were asked not to move or vocalize. In spite of such controls, results showed that neonates preferred to fixate the maternal face significantly more than that of the stranger female. Therefore, Bushnell et al. (1989) concluded that visual information alone is enough for infants as young as 1.7 days to recognize and prefer their own mothers' faces.

In contrast, Sherrod (1979) did not find a preference for the maternal face in young infants. Using live displays of mothers' faces presented behind a one-way window, he found that neither 1-month-olds nor 3-month-olds showed a preference for the maternal face. Surprisingly, by five months of age, infants preferred the strangers' faces over their own mothers' faces.

Melhuish (1982) presented faces to infants via an opening in

an observation chamber, and found that 1-month-olds showed a preference for a dark hairline. However, these infants did not show a preference for their mothers' faces. Melhuish (1982) concluded that 1-month-olds were sensitive to high contrast, which is what we would expect given infants' visual capabilities at one month (see Aslin, 1987), but were not sensitive to the internal facial features of the mother.

More recently, Pascalis et al. (1995) used a preferential looking procedure, not unlike that of Bushnell et al. (1989), in which newborns were tested for the recognition of their mothers' faces. Results of preferential fixations showed that newborns preferred to look at their mothers' faces over stranger female faces. Furthermore, Pascalis et al. extended their study to examine which aspects of the maternal face are essential for recognition. In a second experiment, these authors tested another group of newborns for recognition of the maternal face. In this experiment, however, all women were wearing scarves around their heads to eliminate external features and face-hair contrast. In this condition, the neonates did not show a preference for their mother's own face. This finding has been replicated by Morton (1992), who also found that by 40 days of age infants appeared to show more of an interest in the mother's face versus the unfamiliar female face even when only the internal features were visible.

Therefore, infant maternal face preference seems to follow a more complex developmental trajectory than has been previously

thought. Generally speaking, it can be concluded that around 3 to 4 months of age, the infant maternal recognition system via the visual modality has developed. In contrast, this does not appear to be the case for the paternal recognition system.

Infants' recognition of their fathers

In comparison to the literature on infant maternal recognition, the literature on infant paternal recognition is virtually nonexistent. The few studies which do exist have only examined recognition of the father via auditory cues. Given certain methodological shortcomings, it is also difficult to interpret the findings of some of the studies that have been conducted.

Paternal auditory recognition. Brown (1979) examined the amount of vocalization of 4-month-olds to specific adults. The infants were divided into four groups, with equal numbers of males and females in each group. Every group heard one adult voice (either the maternal or paternal voice) or the voice of an unfamiliar male or female. Results showed that infants displayed a high amount of vocalization to the mother, stranger female and stranger male voice. In contrast, however, the females showed suppression of their vocalizations in the presence of their own fathers' voices. Brown (1979) concluded that perhaps the father's voice was not reinforcing enough to produce any vocalizations, or it actually increased the infants' 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 (at least for female infants), 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. In addition, 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 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. Therefore, results from Brown (1979) are too inconclusive and methodologically flawed to reach any definite conclusions regarding infants' recognition of the paternal voice.

DeCasper and Prescott (1984) conducted a series of experiments examining paternal voice preference in newborns. In their study, female newborns could listen to their fathers' voices or a stranger male voice reading a children's story contingent on their sucking. The dependent measures were the frequency of pauses that were reinforced by the paternal voice, and/or significantly longer burst durations for the paternal voice. Results showed that both measures did not differ

significantly as a function of voice. This study stands in contrast to one by DeCasper and Fifer (1980) which found that newborns prefer the maternal voice.

More recently, a series of studies in our lab were conducted to investigate infant recognition of the father's voice (Ward & Cooper, 1998). We tested 4-month-olds in an attempt to equate the postnatal exposure to the paternal voice with the approximate prenatal exposure to the maternal voice, i.e., approximately 15 weeks (Querleu, Renard, Boutteville, Crepin, 1989; Querleu, Renard, Versyp, Paris-Delrue, & Crepin, 1988; Richards, Frentzen, Gerhardt, McCann, Abrams, 1992), because one possible reason that newborns prefer the maternal voice is prenatal exposure (see DeCasper & Spence, 1986; Moon & Fifer, 1990b; Panneton, 1985; and Spence & DeCasper, 1987 for research on prenatal auditory experiences and postnatal perception).

In the first two experiments, 4-month-olds were tested for their preference for the paternal voice over an unfamiliar male voice in two separate contexts. Fathers' voices were recorded as they engaged in conversation with another adult (Experiment 1) and as they interacted with their infants (Experiment 2). In both experiments, the infants were able to control the duration of each voice presentation by how long they fixated a visual display.

Results from both experiments showed that the infants did not look longer on trials that resulted in hearing their fathers' voices compared to those trials that resulted in the unfamiliar

male's voice. Moreover, infants did not display differential affective responsiveness as a function of voice type (paternal versus stranger) in either experiment (as coded from their facial expressions).

These findings from our laboratory, coupled with the non-significant (i.e., DeCasper & Prescott, 1984) and inconclusive (i.e., Brown, 1979) results from previous studies, suggest that infants do not recognize their fathers' voices during early infancy. This stands in contrast to what we know about infants' recognition of their mothers' voices. Several explanations may account for infants' lack of preference for the paternal voice.

First, the lack of paternal voice preference calls in to question the ability of young infants to discriminate male voices. That is, infants may not be able to tell the difference between two male voices. Given that recognition necessitates discrimination, a lack of discrimination would explain why infants show no recognition of the paternal voice. However, research in the area of infant auditory capabilities suggests that lack of discrimination is not a likely explanation.

After finding no preference for the paternal voice, DeCasper and Prescott (1984) investigated newborns' abilities to discriminate male voices. Using a habituation procedure, all of the infants heard one male voice until their sucking rates decreased (i.e., habituated). After habituation, half of the infants were presented with a novel male voice whereas the other half continued to hear the familiar voice. Results showed that

the experimental group's sucking rates significantly increased to the novel voice whereas the control group's sucking rates did not change.

In a similar vein, Ward and Cooper (1998) tested 30 4-month-olds for their ability to discriminate male voices. Each infant heard an unfamiliar male voice on successive trials until looking habituated. After meeting the habituation criterion, half of the infants received a novel male voice, whereas the other half received two additional habituation trials and then heard the novel voice. The comparison of pre-change and post-change looking times (regardless of extra trials) showed that these infants discriminated the males voice pairs.

Moreover, young infants (around 3 months) can discriminate a multitude 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). Therefore, the lack of paternal voice recognition does not appear to be due to a lack of discrimination, given the impressive

auditory discrimination abilities of young infants.

A second explanation for the lack of paternal voice preference could be due to infants' experiences. That is, the argument could be made that four months is simply not enough exposure to the paternal voice for recognition to take place. However, this too seems like an unlikely explanation. For example, research shows that very little exposure is needed for preferences to arise. 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. Furthermore, Ward and Cooper (1998) found that both mothers and fathers report that fathers spend 2-3 hours per weekday interacting with their infants, and during this interaction time they vocalize moderately. Thus, it seems plausible that this amount of exposure (i.e., 2-3 hours per weekday) would be sufficient for recognition of the father's voice to develop.

Lastly, the lack of paternal recognition in 4-month-olds (Ward & Cooper, 1998) may stem from the testing situation itself. The typical father-infant interaction provides more than auditory stimulation for the infant. Other cues such as tactile, olfactory, and visual are also available. It is possible that assessing paternal recognition requires the availability of multimodal cues (e.g., auditory and visual) in order for

preferences to emerge. This hypothesis is supported by research which highlights a) the impressive visual abilities of young infants and the primacy of the visual system (e.g., Aslin, 1987; Lewkowicz, 1996; Nelson, 1985; Zucker, 1985), (b) that infants can and do integrate sensory information (e.g., Lewkowicz & Lickliter, 1994), and c) that multimodal stimulus cues aid in recognition (e.g., Burnham, 1993; Kurzweil, 1988; Spelke & Owsley, 1979).

Infant visual discrimination and visual primacy

As mentioned earlier, the literature concerning infant recognition of the paternal face is lacking. To date, there have been no studies published assessing paternal recognition via the visual modality (compared to those cited earlier on maternal face recognition). However, infants show other forms of complex discriminatory abilities. For instance, Nelson (1985; 1987) reviewed several studies indicating that young infants (i.e., prior to four months) demonstrate the ability to discriminate facial expressions. However, Nelson points out that this early discrimination is a) based only on examining certain characteristics of the face in relation to different facial expressions (e.g., eye and brow changes) and not necessarily a perception of the complete facial expression per se (i.e., they attend to facial features and not to the complete gestalt), and b) only evident using certain stimulus configurations (e.g., photographic faces) and only with certain emotional expressions (Nelson, 1985; 1987).

Moreover, Aslin (1987) summarized the data on the visual abilities of infants from newborns to preschool age. For example, newborns show a preference (which implies discrimination) for patterns as opposed to plain fields and large features with high contrast versus small features with low contrast. Around two to three months of age infants show discrimination of schematic and scrambled faces, facial expressions, facial features, and shapes. At four months of age infants discriminate changes in the internal, external and internal plus external elements of a pattern.

Taken together, the information regarding infant visual discrimination suggests that infants possess the ability to discriminate all sorts of visual properties and this varies across development (Aslin, 1987). In addition to these discrimination studies, there is some evidence in the literature which suggests that infants are particularly sensitive to visual information compared to other modalities (e.g., auditory).

Visual primacy. Recent research suggests that the visual system actually shows primacy over the auditory system early in development. For example, Lewkowicz (1996) habituated infants (ages 4, 6 and 8 months) to a full face of a female speaker reciting a passage from a textbook. Habituation was followed by the presentation of a change in the auditory component (same face, different voice), visual component (different face same voice), auditory/visual components combined (different face and voice) or no change. The results showed that 4-month-olds did not

significantly increase their responding to any of the changes, whereas 6- and 8-month-olds responded to the changes in the visual and combined visual-auditory components.

In a second experiment Lewkowicz (1996) habituated another group of 4-, 6-, and 8-month-olds, but this time to a male face-voice display. In the three novel conditions, the infants were tested with a female face-voice display. The results showed that all three age groups discriminated the changes in the visual component as well as the auditory-visual component, but did not discriminate the change in auditory component alone.

Taken together, these findings support the idea that in order to "capture" the paternal recognition system, it is necessary to test infants in a multimodal context. This hypothesis is strengthened by research which suggest that infants can and do integrate sensory information.

Infant intersensory integration

Several researchers have examined the abilities of young infants to integrate information about the properties of events from several different sensory modalities (Bahrick & Pickens, 1994; Lewkowicz & Lickliter, 1994; Meltzoff & Kuhl, 1994; Rose, 1994; Rose & Ruff, 1987; Spelke, 1985; Sullivan & Horowitz, 1983). However, the majority of studies on intersensory integration have focused on auditory-visual relations.

One general finding in the literature is that infants show increases in distress signs (e.g., crying) and exploratory looking behavior (interpreted as trying to "resolve" the

discrepancy through searching) when their mothers' faces were not in the same spatial location as her voice (see Sullivan & Horowitz, 1983 for a review).

Further evidence of face-voice integration comes from research examining infants' ability to match facial expressions with their appropriate sounds (Bahrick & Pickens, 1994; Meltzoff & Kuhl, 1994; Walker, 1982; Walker-Andrews, 1986). For instance, 5- and 7-month-olds can match the corresponding soundtrack to both happy and sad facial expressions. Four- and 5-month-olds can match sounds of syllables (e.g., /i/ and /a/ or /i/ and /u/) with the appropriate facial configuration that accompanies the sound. These findings have been extended to disyllables (e.g., /bebi/ and /zuzi/), native and foreign phonetic units and even to nursery rhymes (see Meltzoff & Kuhl, 1994; Pickens, Field, Nawrocki, Martinez, Soutullo, & Gonzalez, 1994).

Thus, evidence clearly indicates that by four months of age and perhaps even earlier, infants integrate sensory information. In addition, older infants are able to make more complex integrations and can learn arbitrary associations. However, demonstrating that infants can integrate information across modalities does not necessarily mean that intersensory functioning facilitates infant perception and recognition of objects, people, and events. To support this hypothesis, it would have to be shown that infants do in fact use multisensory information to aid in recognition.

Multimodal recognition in infants

Several researchers have found that multisensory interactions facilitate knowledge in general and the recognition process in particular (Burnham, 1993; Gusella, Muir, & Tronick, 1988; Hains & Muir, 1996; Kurzweil, 1988; Muir & Hains, 1993; Stack & Muir, 1992; Spelke & Owsley, 1979). For example, Muir has conducted several studies that indicate the importance of multimodal cues in infant affect and attention (Gusella et al., 1988; Hains & Muir, 1996; Muir & Hains, 1993; Stack & Muir, 1992). Muir's studies typically employ the use of the still face (SF) paradigm. That is, when adults interact with infants and use accompanying facial expressions, infants typically will show positive affect and attention. However, when the adult poses a neutral face, the infants show decreases in smiling and looking. Using variants of this procedure, Muir has been able to show the importance of multisensory cues in adult-infant interactions.

Although previous results (e.g., Gusella et al., 1988) suggest that the SF effect is primarily driven by facial expressions, some of Muir's most recent work suggest that facial expressions are not the only determinants of infants' response to adult interaction. For instance, Stack and Muir (1992) found that when the SF is presented with tactile stimulation, the SF effect does not occur. Muir and Hains (1993) presented infants with interactive human faces plus speech or with interactive puppets having synthesized melodic sounds in place of the voice. The authors found that the infants smiled only in the interactive

human face plus voice conditions. Muir and Hains (1993) also cite evidence which showed that an inverted face plus voice elicited more smiling from infants than an inverted silent face. Plus, the infants smiled to an adult voice alone condition (adult behind red circular pattern) as much as they smiled to a silent upright interacting face.

Spelke and Owsley (1979) exposed infants to both of their parents seated side by side, and presented the parents' voices over a loud speaker located between them. The infants looked initially and eventually more often at the parent whose voice they heard.

In a similar vein, Burnham (1993) investigated visual discrimination of the maternal face and unfamiliar female face by infants aged 1-, 3-, and 5-months. Infants were given the opportunity to see both faces (mother's and stranger's) through a one-way glass, both with and without the accompaniment of voices. The results showed that all of the groups looked differentially at the mother and stranger only when speech was present.

When taken collectively, the results of the studies cited above indicate a dynamic relationship between faces and voices, and the effects of this dynamic on infant attention. It is the present argument that the importance of multisensory information can not be ruled out given evidence which suggests that speech does in fact facilitate infant discrimination and recognition of faces.

Rationale for the present study

The finding that multisensory information is not necessary for maternal recognition may be due to the experiences of infants with their mothers compared to their fathers. As mentioned, part of the reason that newborns show a preference for the maternal voice is due to the experience with her voice prenatally. Therefore, fetuses have the opportunity to learn about the mother's voice prior to birth and this actually reduces the competition with the other modalities postnatally. However, the infant's postnatal experiences with the paternal voice occur primarily in competition with other sensory cues (e.g., visual). Therefore, the purpose of the present study was to examine paternal recognition in 4-month-olds using multisensory cues (auditory + visual).

The primary goal of the study was to test the hypothesis that four-month-old infants would show a preference for their fathers' faces plus voices, over a stranger male's face plus voice. Before testing this multisensory hypothesis, it was first necessary to examine infants' preferences for paternal faces, in order to discern face recognition from face plus voice recognition. Experiment 1 was therefore designed to test infants' preferences for their fathers' faces. If multisensory information is in fact necessary for infants at four-months to show a preference for their father over a stranger male, then the stimuli in Experiment 1 (face only) would not be sufficient to show a paternal preference.

Experiment 1

Method

Participants

A total of 18 infants (10 males and 8 females; M age = 128.22 days, SD = 6.72) and their fathers comprised the final sample of subjects for this study. An additional 8 infants were excluded from the final sample for the following reasons: 3 infants cried for more than 20 consecutive seconds, 3 infants did not look at the visual display and 2 infants' data were lost due to equipment failure. Most subjects were from predominantly White, middle-class, college-educated families (see Table 1 for demographic information).

Insert Table 1 about here

Infants were recruited from the Blacksburg, Christiansburg, and Radford areas through 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 (or confirm) 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. All home interviews were conducted by the principle experimenter and were scheduled at a time convenient

for the father and mother. Following 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 infants were usually awake, happy, and alert.

Home visits

Each father was videotaped for approximately 2 minutes in an en face position with a Panasonic VHS camcorder (model AG-HT4) or a Sony Hi-8 camcorder (model TR-91 or TRV-72) during a 60-75 minute home visit. The father wore a black piece of material draped across his shoulders to mask clothing and a piece of white cardboard was held up behind the father's head in order to control for background. In addition, the father was asked to fill out a questionnaire regarding the amount of time he interacts with and vocalizes to the infant, as well as the types of activities that he normally engages in with the infant (see Appendix B). He was also asked to fill out a similar questionnaire on the mother. Likewise, the mother was also asked to fill out the same questionnaire regarding the amount of time the father spends interacting with and vocalizing to the infant as well as a questionnaire on herself. These questionnaires were used to compare parental perceptions of mother-infant interaction and father-infant interaction, and to obtain estimates of infants' exposure to the paternal voice.

Video display

Upon completion of the interview, 10 seconds of the 2-minute video segment of dad's face was digitized using Adobe Premier

software. After digitization, the segment was retaped for 30 minutes onto a VHS tape for testing.

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 right and rear was a white wall, and to his/her left was a black covering (a piece of cardboard). This covering was used to restrict the infant's peripheral field of view. Each infant was held on their parent's lap and faced the 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 used by the infants for support and as a safe place to touch. The front wooden panel was one side of a black wooden enclosure. Inside the enclosure was a custom-built interface, a 13" Mitsubishi (model CS1347R) color television monitor, a Minimus-7 loudspeaker, and a Panasonic VHS camcorder (model AG-HT4). Directly beside the enclosure was a table on which there were two videocassette player/recorders (Panasonic, model AG-1960 and Sanyo, VHR-5214),

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. The fathers' and other males' faces were presented on this monitor via the cut-out in the panel.

An observer used a 16.5 cm by 14 cm black-and-white

television monitor (Magnavox, Model RX4030-WA02) to observe the infant during testing. In addition, a small red signal light was placed in front of the observer (attached to the top of the monitor) which was used to indicate when the display monitor was on. The observer had access to a keyboard of a Power Macintosh 7500 Computer which controlled the videocassette players, the signal light and recorded onsets and offsets of infant visual fixations in 100ths of a second by way of the custom-built interface.

Procedure

An infant-controlled visual-fixation preference procedure was used. Infants were able to activate either the recording of the paternal face/other male face whenever they visually fixated the visual display. The dependent measures of primary interest were attentional preference and affect. Attentional preference was operationally defined as significantly longer mean looking times to the visual stimulus when looking was associated with a particular face recording. Infants were recorded on the VHS camcorder through a cut-out in the front wooden panel. Affective responsiveness was coded from these tape recordings.

Upon arrival, the parent read and signed an informed consent form (see Appendix C) and filled out a demographic questionnaire (see Appendix D). If an infant was asleep upon arrival, the parents and/or experimenter attempted to awaken the infant using a 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 an infant could be brought to an awake, alert, non-fussy state, the procedure continued.

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 any sounds the baby made (e.g., cooing) which may have initiated some response from the parent. In addition, each parent wore a pair of sunglasses with painted, non-transparent lenses so as to block their viewing of the color monitor that the infant watched. 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.

During the session an observer watched the infant on a color monitor and wore earphones over which continuous vocal music 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 VCRs. One VCR (VCR A) contained one face recording (either paternal or unfamiliar) and the second VCR (VCR B) contained a different recording (either paternal or unfamiliar). A switchbox (with two channels, A and B), located on top of the VCRs, was used to display one (of the two)

videotapes to the infant. If switch A was pushed down then the video in VCR A was displayed and likewise for switch B. The stimulus event remained on for the duration of the look. When the infant was judged by the observer to look away from the display, the observer depressed a key to signal the end of a look, and the stimulus was terminated. This sequence was considered one trial, with trial length being determined by the infant's looking time.

For the second trial, the observer again depressed a key to activate the VCRs and the principle investigator used the switchbox to transmit the stimulus that was not used during Trial 1. The subjects in Experiment 1 were randomly assigned to receive either the paternal face or other male face first, with the remainder of the session continuing with the presentation of paternal face or other face alternating across trials. Trials continued until a total of 10 trials (five of each) were completed, with the contingency that each trial must have been at least 2 seconds in duration. 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 was not included in the final analyses.

Results and discussion

Attentional responsiveness (looking time). To determine whether the infants looked longer at the visual display during either the presentation of the paternal face or the unfamiliar male face, mean looking times to both stimulus types were

calculated by dividing the sum of time spent looking during the presentation of each stimulus event by the number of trials of that event. A mixed 2 X 2 analysis of variance (ANOVA) was computed on the infants' mean looking times, with order (paternal first, unfamiliar first) as the between-subjects factor and stimulus type (i.e., paternal face, unfamiliar face) as the within-subjects factor. The results showed no significant main effects for order ($M(\text{dad first}) = 15.07 \text{ sec}$, $SD = 8.07$; $M(\text{other first}) = 20.99 \text{ sec}$, $SD = 17.20$), $F(1,16) = 1.63$, face type ($M(\text{dad}) = 16.05 \text{ sec}$, $SD = 8.33$, and $M(\text{other}) = 19.35 \text{ sec}$, $SD = 16.65$), $F(1,16) = .76$, or the order x face type interaction (Dad first $M(\text{dad}) = 16.56$, $SD = 9.77$, $M(\text{other}) = 13.59$, $SD = 6.09$; Other first $M(\text{dad}) = 15.42$, $SD = 6.69$, $M(\text{other}) = 26.56$, $SD = 22.77$), $F(1,16) = 3.41$, all p -values $> .05$.

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 saw their own father's display or that of another male. Previous researchers have shown that infants often exhibit a significant difference in looking time on the first trial depending on the information that is available (Berman, 1989; Cooper & Aslin, 1990, Pegg, Werker, & McLeod, 1992). However, this test also showed no significant difference in looking times, ($M(\text{dad first}) = 32.86 \text{ sec}$, $SD = 37.46$, $M(\text{other first}) = 65.02 \text{ sec}$, $SD = 90.56$), $t(16) = -1.03$, $p > .05$.

Affective responsiveness. Infant affect was analyzed using a scale devised by Osofsky, Culp, Hann and Carter (1988). Blind

raters judged the infants for positive hedonic tone, negative hedonic tone, interest and excitement. Infants could have received a rating of 1-4 on positive hedonic tone, ranging from negative or neutral hedonic tone (1) to vigorous smiles with laughter (4). Infants also received a rating of 1-4 on negative hedonic tone, ranging from positive or neutral hedonic tone (1) to marked distress in face and voice (4). Interest was rated from 1 (dull and dazed looking) to 5 (focused looking and active involvement with object or person). Excitement was rated as 1 (brief with body movements only) to 4 (body movements and non-neutral vocalizations that continued for greater than 5 seconds). (see Appendix E for a complete description of these measures).

A paired t-test was conducted on the means of the ratings across all trials for each of the four categories. Results indicated that the infants showed more positive hedonic tone toward the display of their own fathers' faces over that of an unfamiliar male, $t(17) = 2.23$, $p < .05$. The means were as follows, $M(\text{dad}) = 1.41$, $SD = .53$, $M(\text{other}) = 1.32$, $SD = .53$.

All other measures of affective responsiveness (i.e., negative hedonic tone ($M(\text{dad}) = 1.09$, $SD = .21$; $M(\text{other}) = 1.08$, $SD = .14$), interest ($M(\text{dad}) = 3.85$, $SD = .32$; $M(\text{other}) = 3.89$, $SD = .26$) and excitement ($M(\text{dad}) = 1.69$, $SD = .59$; $M(\text{other}) = 1.66$, $SD = .65$) failed to show a significant difference between the paternal face and the face of an unfamiliar male, all p -values $> .05$. Percent agreement was calculated for 5 of the 18 infants and was found to be .87 (positive affect), .97 (negative affect),

.75 (interest) and .80 (excitement).

The 4-month-olds in this experiment did not show a preference for their own fathers' faces over an unfamiliar male face. Given the argument mentioned previously (i.e., that multisensory cues are necessary for infant paternal recognition), this finding was not surprising. That is, based on previous research, it has been shown that newborns and 4-month-olds do not recognize their fathers' voices in several different contexts; when reading a children's story (DeCasper & Prescott, 1984) when hearing their father speaking to another adult and when hearing their father speak to them (Ward & Cooper, 1998). Based on these findings using the auditory and visual modalities alone, it can be concluded that using just one modality does not appear to be sufficient for obtaining paternal preference in four-month-olds.

Furthermore, several researchers have found that multisensory interactions facilitate knowledge in general and the recognition process in particular (e.g., Burnham, 1993). Therefore, the second experiment was designed to include multimodal stimulus cues to assess infants' recognition of their fathers.

Experiment 2

Method

Participants

A total of 18 infants (11 males and 7 females; M age = 132.94 days, SD = 5.68) and their fathers comprised the final sample of subjects for this study. An additional 12 infants were

excluded from the final sample for the following reasons: 3 infants cried, 2 infants' data were lost due to equipment failure, 4 infants were excluded due to experimenter error and 3 infants were excluded for being too old to participate in the study. Most subjects were from predominantly White, middle-class, college-educated families (see Table 2 for demographic information).

Insert Table 2 about here

Infants for Experiment 2 were recruited in the same manner as Experiment 1.

Home visits

During the home visits, the father's face was recorded as in Experiment 1. However, in addition to the video recordings, the father's voice was recorded as he interacted with his infant (i.e., ID speech). 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). Fathers' voices were recorded by the principle investigator who directed the father to engage in interaction with his infant. 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. Voice recordings usually lasted between 15 and 40 minutes depending on the amount of interruption and the amount of

dialogue from the father. As in Experiment 1, both mother and father were asked to fill out questionnaires about themselves and about each other (see Appendix B).

Video/audio displays

As in Experiment 1, 10 seconds of the 2 minute video segment of dad's face was digitized using Adobe Premier software and retaped for 30 minutes onto a VHS tape for testing. For the audio recordings, 20 seconds of uninterrupted high quality paternal speech 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 and procedure

Generally, the same apparatus as that reported in Experiment 1 was used in this second experiment. However, in Experiment 2 the auditory stimuli (i.e., fathers' and strangers' speech segments) were presented over a loudspeaker located behind a cut-out in the front panel directly below the television monitor. In addition, the interface (located inside the wooden enclosure) also controlled independent access to the channels of a Tascam cassette recorder.

The procedure was the same as in Experiment 1, except in the current experiment the infants were presented with the paternal face plus voice/stranger male face plus voice. That is, as in Experiment 2, the observer depressed a key to activate the VCRs

to display a face (either paternal face or stranger face) to the infant. Once the infant was considered to be looking at the display (as judged by the observer), the observer again depressed the key to turn on Channel 1 (or 2) of the tape recorder and either paternal speech or unfamiliar male speech utterances were played over the loudspeaker. The speech corresponded to whatever face was on the screen and remained on for the duration of the look. When the infant was judged by the observer to look away from the facial/vocal display, 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. As in Experiment 1, the subjects were randomly assigned to receive either the paternal face/voice first or the unfamiliar face/voice first, with the remainder of the session continuing with the presentation of paternal face/voice or other face/voice alternating across trials. Again, trials continued until a total of 10 trials (5 each of paternal face/voice and other face/voice) were completed. As in Experiment 1, infants were videotaped for later affective coding.

Results and discussion

Attentional responsiveness (looking time). To determine whether the infants looked longer at the presentation of the

paternal face/voice or the unfamiliar male face/voice, mean looking times to both stimulus types were calculated by dividing the sum of time spent looking during the presentation of each stimulus event by the number of trials of that event. A mixed 2 X 2 ANOVA was computed on the infants' mean looking times, with order (paternal first, unfamiliar first) as the between-subjects factor and stimulus type (i.e., paternal face/voice, unfamiliar face/voice) as the within-subjects factor. The results showed no significant main effects for order ($M(\text{dad first}) = 30.47$, $SD = 17.16$, $M(\text{other first}) = 24.63$, $SD = 15.94$), $F(1,16) = .36$, face/voice type ($M(\text{dad}) = 27.34$ sec, $SD = 16.27$, and $M(\text{other}) = 27.12$ sec, $SD = 17.23$), $F(1,16) = .97$, or the order x voice type interaction (Dad first $M(\text{dad}) = 33.53$, $SD = 21.63$, $M(\text{other}) = 27.41$, $SD = 11.89$; Other first $M(\text{dad}) = 22.39$, $SD = 8.66$, $M(\text{other}) = 26.88$, $SD = 21.22$), $F(1,16) = .31$, all p -values $> .05$.

As in Experiment 1, an additional comparison was conducted on the first trials of the sessions (all trials) as a function of whether the infants saw/heard their own father's display or that of another male. However, this test also showed no significant difference in looking times, ($M(\text{dad first}) = 63.79$ sec, $SD = 74.21$, $M(\text{other first}) = 57.68$ sec, $SD = 74.64$), $t(16) = .17$, $p > .05$.

Affective responsiveness. As in Experiment 1, infant affective responsiveness was analyzed for positive hedonic tone, negative hedonic tone, interest and excitement. A paired t-test

was conducted on the means of the ratings across all trials for each of the four categories. Results indicated that the infants showed more positive hedonic tone towards the display of their own fathers' faces plus voices over that of an unfamiliar male, $t(17) = 2.62, p < .05$. The means were as follows, M (dad) = 1.70, $SD = .47$, M (other) = 1.54, $SD = .42$.

All other measures of affective responsiveness (i.e., negative hedonic tone (M (dad) = 1.13, $SD = .23$, M (other) = 1.09, $SD = .19$), interest (M (dad) = 3.84, $SD = .29$, M (other) = 3.89, $SD = .27$) and excitement (M (dad) = 1.54, $SD = .59$, M (other) = 1.39, $SD = .37$) failed to show a significant difference between the paternal face/voice and the face/voice of an unfamiliar male, all p -values $> .05$. Percent agreement was calculated for 5 of the 18 infants and was found to be .78, .98, .90 and .87 for positive affect, negative affect, interest and excitement respectively.

The 4-month-olds showed no evidence of an attentional preference for the paternal face/voice over an unfamiliar face/voice. Given that preference has not been indicated in previous studies looking at the auditory modality alone (e.g., Ward & Cooper, 1998) coupled with the a) research supporting multimodal stimulus cues (e.g., Burnham, 1993) for infant recognition and b) insignificant results from Experiment 1, this finding (i.e., that infants did not look significantly longer at the paternal face/voice over the unfamiliar face/voice) is surprising.

One explanation for the present finding may be procedural

insensitivity. That is, it could be that the infant-controlled visual-fixation procedure is insufficient in being able to assess preference for familiar faces and voices at 4-months. This explanation seems unlikely given that this same procedure has produced significant results in previous studies with younger children and with 4-month-olds (Cooper, Abraham, Berman & Staska, 1997). However, none of these studies have used faces as visual stimuli. Therefore, the purpose of Experiment 3 was to test 4-month-olds using the same procedure, but using facial and vocal stimuli that had already been shown in other studies to elicit infant preference (i.e., the maternal face and voice). Thus, Experiment 3 was designed to test 4-month-olds preference for the maternal face plus voice. It was hypothesized that 4-month-olds would show a preference for their own mothers' faces plus voices over a stranger female face plus voice.

Experiment 3

Method

Participants

A total of 18 infants (12 males and 6 females; M age = 128.89 days, SD = 8.68) and their mothers comprised the final sample of subjects for this study. In addition, one infant was excluded from the study due to difficulty in coding. As in Experiments 1 and 2, most subjects were from predominantly White, middle-class, college-educated families (see Table 3 for demographic information).

Insert Table 3 about here

Infants for Experiment 3 were recruited in the same matter as Experiments 1 and 2 (see Appendix F for a copy of the letter sent to the mothers).

Video/audio displays

As in Experiments 1 and 2, 10 seconds of the 2 minute video segment were digitized and retaped for 30 minutes onto a VHS tape for testing. For the audio recordings, 20 seconds of uninterrupted speech were selected and then re-recorded onto one of two channels of an endless loop tape for playback to their infant. The only difference in Experiment 3 was the video/audio recordings were of the mothers. The tapes for Experiment 3 were also obtained by home visits.

Apparatus and procedure

The exact same apparatus and procedure was used for Experiment 3 as was used in Experiment 2 (see Appendix G for a copy of the informed consent form given in this study). The only difference in the present Experiment was that infants were presented with the maternal face plus voice/stranger female face plus voice.

Results and discussion

Attentional responsiveness (looking time). To determine whether the infants looked longer at the presentation of the maternal face/voice or the unfamiliar female face/voice, mean

looking times to both stimulus types were calculated by dividing the sum of time spent looking during the presentation of each stimulus event by the number of trials of that event. A mixed 2 X 2 ANOVA was computed on the infants' mean looking times, with order (maternal first, unfamiliar first) as the between-subjects factor and stimulus type (i.e., maternal face/voice, unfamiliar face/voice) as the within-subjects factor.

The results showed no significant main effects for order ($M(\text{mom first}) = 18.03$, $SD = 12.49$, $M(\text{other first}) = 20.07$, $SD = 11.08$), $F(1,16) = .24$ or face/voice type ($M(\text{mom}) = 20.75$ sec, $SD = 12.60$, and $M(\text{other}) = 17.13$ sec, $SD = 10.91$), $F(1,16) = 1.12$, all p -values $> .05$. However, results did show a significant order X speech/face type interaction, $F(1,16) = 4.7$, $p < .05$. The mean looking time to mother face/voice when mother was presented first was 23.16 s ($SD = 15.47$) which was significantly greater than the mean to other face/voice ($M = 12.9$, $SD = 5.6$, $p < .05$). However, the means for mother face/voice (17.74 sec, $SD = 7.69$) and other face/voice (22.41, $SD = 13.84$) were not significantly different when other was presented first.

Insert Figure 1 about here

An additional comparison was done on the mean looking times to both mother and other displays with the first look eliminated from the data. After the removal of the first trial, mean looking times were calculated by dividing the sum of time spent

looking during the presentation of each stimulus event by the number of trials of that event. A mixed 2 X 2 ANOVA was computed on the infants' mean looking times, with order (maternal first, unfamiliar first) as the between-subjects factor and stimulus type (i.e., maternal face/voice, unfamiliar face/voice) as the within-subjects factor. The results showed no significant main effects for order ($M(\text{mom first}) = 16.62$, $SD = 9.89$, $M(\text{other first}) = 16.15$, $SD = 6.33$), $F(1,16) = .03$ or the order X speech type interaction (Mom first $M(\text{mom}) = 20.35$, $SD = 12.02$, $M(\text{other}) = 12.90$, $SD = 5.61$; Other First $M(\text{mom}) = 17.74$, $SD = 7.69$, $M(\text{other}) = 14.56$, $SD = 4.58$), $F(1,16) = .66$, all p -values $> .05$. However, this analysis did show a main effect for speech/face type $F(1,16) = 4.53$, $p < .05$. Means for speech/face type were $M(\text{mom}) = 19.19$ sec, $SD = 10.13$, $M(\text{other}) = 13.64$ sec, $SD = 5.10$.

Insert Figure 2 about here

As in Experiments 1 and 2, an additional comparison was conducted on the first trials of the sessions (all trials) as a function of whether the infants saw/heard their own mother's display or that of another female. However this test showed no significant difference in looking times, ($M(\text{mother}) = 37.21$ sec, $SD = 37.69$; $M(\text{other}) = 54.88$ sec, $SD = 47.48$), $t(16) = -.79$, $p > .05$).

Affective responsiveness. Results failed to indicate a significant difference in positive hedonic tone ($M(\text{mom}) = 1.84$,

SD = .75; M(other) = 1.77, SD = .75), negative hedonic tone (M(mom) = 1.15, SD = .33, M(other) = 1.08, SD = .28), interest (M(mom) = 3.74, SD = .43, M(other) = 3.87, SD = .25) or excitement (M(mom) = 1.49, SD = .46; M(other) = 1.52, SD = .67) as a function of stimulus display (mother face/voice or other face/voice), all p-values > .05. Percent agreement was calculated for 5 of the 18 infants and was found to be .92 (positive affect), .95 (negative affect), .90 (interest) and .93 (excitement). Please see Table 4 for the means and standard deviation for positive emotion across all three experiments.

Insert Table 4 about here

In addition, several post-hoc analyses were conducted on the emotion coding. An unpaired t-test was conducted comparing mom positive hedonic tone (Exp. 3) and dad positive hedonic tone (Exp. 2). Results showed no significant difference between positive affect to mom (M(mom) = 1.84, SD = .75) and dad (M(dad) = 1.70, SD = .47). Results also failed to indicate a significant difference in positive affect between the stranger male face+voice (Exp. 2) (M = 1.54, SD = .42) and the stranger female face+voice (Exp. 3) (M = 1.77, SD = .75).

Results of the third experiment showed that 4-month-olds, when the first trial was excluded, did show a preference for the maternal face/voice over an unfamiliar female face/voice. This supports previous literature on maternal recognition in infancy

(e.g., DeCasper & Fifer, 1980; Pascalis et al., 1995) and indicates that the procedure was sensitive enough to obtain preference for familiar faces in 4-month-olds.

Questionnaire analyses

In all three experiments questionnaires were given to both the mother and the father to assess a) the percentage of fathers that were present at the birth of the infant, b) the number of times each parent feeds the infant within a 24-hour period, c) the amount of time the father and mother spend with the infant, d) how much they vocalize to him or her and e) the typical activities they engage in with the infant (see Appendix B for a sample).

Questionnaire data were obtained from 14, 16 and 14 (Experiments 1, 2 and 3 respectively) out of the 18 parents who participated. From these questionnaires, almost all fathers reported being present at the birth of the infant: 85.71% (Experiment 1), 93.8% (Experiment 2), 100% (Experiment 3).

The average amount of time fathers reported feeding the infant within a 24-hour period was $M = 2.43$, $SD = .98$ (Experiment 1), $M = 2.0$, $SD = 1.5$ (Experiment 2), $M = 1.25$, $SD = 1.04$ (Experiment 3). In contrast, mothers reported feeding the infant an average of $M = 4.36$ times, $SD = 1.01$ (Exp. 1), $M = 4.69$, $SD = .70$ (Exp. 2), $M = 4.79$ times, $SD = .43$ (Exp. 3).

The amount of time spent during the week and weekend were divided into 10 1-hour intervals (with an eleventh interval marked "> 10 hours"). Parents were asked to estimate the amount

of time that they and their spouses spend (on average) with their infants during these two time periods. T-tests were conducted to compare the mean amount of time spent reported by each parent's self-reports. Results showed that mothers reported spending more time with their infants ($M = 7.43$ hrs, $SD = 2.85$ -Exp. 1), ($M = 9.56$ hrs, $SD = 2.25$ -Exp. 2), ($M = 6.82$ hrs, $SD = 2.44$ -Exp. 3) during the week day than fathers reported spending with their infants ($M = 3.79$ hrs, $SD = 3.45$ -Exp. 1), ($M = 3.56$ hrs, $SD = 3.05$ -Exp. 2), ($M = 3.27$ hrs, $SD = 1.56$ -Exp. 3), all p 's < .05. Likewise, mothers reported spending more time ($M = 8.36$ hrs, $SD = 2.87$ -Exp. 1), ($M = 10.44$, $SD = 1.41$ -Exp. 2), ($M = 9.21$, $SD = 2.19$ -Exp. 3) with their infants on an average weekend day than fathers reported ($M = 4.79$, $SD = 2.99$ -Exp. 1), ($M = 5.63$, $SD = 2.71$ -Exp. 2), ($M = 5$, $SD = 3.51$ -Exp. 3), all p 's < .05.

T-tests on the difference scores (with the population mean set at 0) comparing the father's partner questionnaire (i.e., about the mother) and the mother's self-report questionnaire were conducted in all three experiments in order to assess the father's perception of the time the mother spends with the infant versus the mother's perception of the time she spends with the infant. These same analyses were also repeated for the mother's partner questionnaire (i.e., about dad) versus the father's self-report questionnaire. Generally speaking, there were no significant differences between fathers' and mothers' self-reports and other-reports about time spent with their infants.

In addition, mothers and fathers were asked to rate how much

they (and their partner) vocalized to the infant on a given day during their typical interactions. These ratings were done on an 8-point Likert scale ranging from 0 "do not talk," to 4 "talk a fair amount," to 8 "talk all the time." A t-test was conducted on these means comparing mother and father self-reports. Results indicated that mothers reported vocalizing more to their infants ($M = 6.36$, $SD = 1.00$ -Exp. 1), ($M = 6.06$, $SD = 1.24$ -Exp. 2), ($M = 5.86$, $SD = 1.17$ -Exp. 3) than fathers reported ($M = 5.57$, $SD = 1.02$ -Exp. 1), ($M = 5.0$, $SD = 1.41$ -Exp. 2), ($M = 4.86$, $SD = 1.46$ -Exp. 3), all p 's < .05.

Parents were also asked to rank a list of 10 activities with 1 being the activity they engage in most with their infant and 10 being the activity they engage in least with their infant. Generally speaking, fathers reported spending more time in play activities (e.g., vocal play) whereas mothers reported spending more time feeding their infants. According to most parents, reading is the activity that they engaged in least with their infants (see Table 4 for the means and standard deviations of these rankings for all three experiments).

Insert Table 5 about here

General Discussion

The results of the first two experiments reported here found no differential attention in 4-month-olds to their fathers and unfamiliar males when the displays consisted of faces only

(Experiment 1) or faces and voices (Experiment 2). These findings extend and support previous research which found that infants of different ages did not attend more to their fathers' voices over unfamiliar male voices (DeCasper & Prescott, 1984; Ward & Cooper, 1998). Thus, several studies have now found that infants do not show differential attention to displays of their fathers when provided with unimodal information.

Because 4-month-olds were presented with multimodal information (i.e., face+voice) in Experiment 2, the lack of differential attention was quite surprising. It has previously been shown that multisensory interaction facilitates knowledge in general and the recognition process in particular (e.g., Burnham, 1993; Kurzweil, 1988; Spelke & Owsley, 1979). However, the 4-month-olds in both Experiments 1 and 2 did show more positive affect toward their own fathers' faces (Experiment 1) and faces/voices (Experiment 2) over an unfamiliar male face (face plus voice). This finding adds to the research which has found that infants displayed more affective responsiveness to certain faces and voices (e.g., Werker and McLeod, 1989). Furthermore, this finding also presents evidence that infants at 4-months recognize their dad. That is, recognition using attentional preference (i.e., looking time) was not found. Thus, infants at 4-months may not look longer to their fathers (i.e., prefer him over a stranger male) but they appear to be able to recognize their father (i.e., by showing him more positive affect).

In addition, the results of Experiment 3 found that 4-month-

old infants did show a preference for their own mothers' faces and voices over the face and voice of a female stranger (i.e., the face+voice of some other infant's mother). This finding supports the literature on maternal recognition. That is, several researchers have shown a maternal preference in various different contexts (e.g., auditory and visual modalities; e.g., Burnham, 1993; DeCasper & Fifer, 1980; Pascalis et al., 1995).

In addition, the present study found that mothers not only spent more time with their infants (both weekday and weekend day), but they also vocalized more to their infants than fathers. Furthermore, the perception of both parents regarding the amount of time each other spent with the infant (weekday and weekend day) was similar to the actual time each parent reported that they spent with their infant. It was also found that mothers spent more time in typical caretaking tasks (e.g., feeding) whereas fathers spent most of their time with their infants in play activities (e.g., vocal play). These findings support previous research which found that fathers and mothers interacted differentially (qualitatively and quantitatively) with their infants (e.g., Frodi et al., 1983; McVeigh, 1992; Reblesky & Hanks, 1971; Scholz & Samuels, 1992).

One explanation for the present findings could be that paternal recognition follows a different developmental trajectory than that of maternal recognition. That is, the way infants develop a recognition system of their fathers may be different than the way they develop one with their mothers. It has already

been shown that even newborns prefer their own mothers' voices (e.g., DeCasper & Fifer, 1980; Moon & Fifer, 1990) and faces (e.g., Bushnell et al., 1989; Walton et al., 1992). Thus, infants have shown a preference for their mothers using unimodal information early in development, and have shown maternal preference using multisensory information at 4-months.

The ability of infants to respond differentially to their mothers when only hearing her voice could be due to their experience with the maternal voice prenatally (Querleu et al., 1988; Querleu et al., 1989; Richards, 1992). Granted, infants also hear other external sounds prenatally, but these sounds are not present in the prenatal environment like the sound of the maternal voice (i.e., the maternal voice is the "loudest" compared to external noises).

Thus, postnatally, infants prefer their mothers voices which then may facilitate a preference for the maternal face (i.e., they quickly match the preferred voice with the appropriate face; e.g., Spelke & Owlsey, 1979). In contrast, infants do not have this same experience with the paternal voice and face. In fact, the argument could be made that infants are experiencing many other faces and voices (including other male faces and voices) during their initial experience with their fathers. Therefore, the problem may not be insufficient exposure to the paternal face/voice, but competition with other faces and voices that occur postnatally. It is this competition (and perhaps lack of exposure prenatally) that accounts for the different

developmental trajectories seen for infant maternal and paternal recognition.

A second explanation for these results could be that the role of the father in infant development is both quantitatively and qualitatively different from that of the mother. That is, the results of the questionnaire analyses support previous literature on the role of the father versus the mother in infant development. Generally, research has indicated that American fathers are less of a "caretaker" and more of a "playmate," whereas mothers are more of a "caretaker" (e.g., Bridges & Connell, 1991; Hossain & Roopnarine, 1994; Lamb, 1977a, 1980). In the current study, mothers reported not only spending more time with their infants both on weekdays and weekend days than fathers reported, but they also reported spending most of their time in caretaking roles (i.e., feeding). However, fathers reported spending more time in "playmate" activities (e.g., vocal play).

Furthermore, when examining the father-infant attachment literature, research indicates that infants respond to their fathers with more affiliative behaviors (e.g., smiling) as opposed to attachment behaviors (e.g., proximity seeking), which are shown more to mothers. The current finding that infants showed more positive affect to their fathers compared to an unfamiliar male underscores these differential roles. That is, perhaps infants recognize their father as being the "playmate" and hence show more affiliative behaviors to him versus the other

male. However, with mothers, infants show more attention versus affect, indicating that they prefer to look at their own mother (i.e., attend to her longer) because she assumes the role of the primary caretaker and attachment figure. One way to test this hypothesis is to examine infants' preferences for the paternal face+voice versus the maternal face+voice. If the current hypothesis is correct, then infants should show more attention to their mothers (i.e., they should look longer) but show more positive affect to their fathers.

A third possible explanation for the current findings could be the lack of available information in the stimulus displays. That is, the infants in the present experiment saw their fathers' faces in a relatively motionless display while they heard his voice by way of a loudspeaker located beneath the monitor. Therefore, the infants were not attending to a dynamic display (i.e., the face and mouth were not moving as the voice was being presented to the infant). Thus, the displays used in the present study may not have been sufficient to obtain a preference for father given that when infants interact with their fathers, they are usually experiencing the movement of his face as he talks to them.

Contrary to the argument above, we did find that 4-month-olds preferred their mothers' face+voice using such a non-dynamic display (Experiment 3). This suggests that the display was sensitive enough to elicit a preference for a particular face/voice.

In conclusion, the present study adds to information that exists on father-infant and mother-infant interaction in general and recognition in particular. Especially within the area of paternal interaction/recognition, this type of information is significantly lacking in regards to what we know and do not know about fathers and their infants. Although infants clearly develop the ability to recognize their caretakers, particularly their mothers, it appears that the pathways to recognition are significantly different from one another. Future studies will need to elucidate both the common and unique experiences that give rise to infants' recognition of their parents.

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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 faces and voices. For instance, we now know that babies only a few days old would rather listen to their own mothers' voices and look at their mothers' faces. In the Department of Psychology at Virginia Tech, we are interested in learning more about the early relationship between fathers and their infants.

Currently, we are investigating infants' recognition of their fathers' faces and voices, an area of study that has been largely neglected in this field. Your participation would involve having one of us visit the father and the infant in the home in order to briefly videotape the father. 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 face and 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.
Associate Professor

Appendix B

QUESTIONNAIRE

Father's Name: _____

1. Were you present at the birth of the child? yes no

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

1 2 3 4 5 (or more) times

3. Approximately how much time PER WEEK DAY (Monday through Friday) do you spend with your infant? (please circle the appropriate number):

0-30 min	6 hours
1 hour	7 hours
2 hours	8 hours
3 hours	9 hours
4 hours	10 hours
5 hours	> 10 hours

4. Approximately how much time PER WEEKEND DAY (Saturday-Sunday) do you spend with your infant? (please circle the appropriate number):

0-30 min	6 hours
1 hour	7 hours
2 hours	8 hours
3 hours	9 hours
4 hours	10 hours
5 hours	> 10 hours

Appendix B (cont.)

5. Generally speaking, how much do you talk to your infant during your daily interactions? (please circle the appropriate number):

0	1	2	3	4	5	6	7	8
no		talk a		talk a		talk a lot		talk most
talking		little bit		fair amount		of the time		of the time

6. We are interested in the typical activities that you engage in with your infant. Please rank the following activities, starting with 1 = most frequent, 2 = next most frequent, and so on up to 10 = least frequent.

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

Appendix C

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
INFORMED CONSENT FORM
(LAB COPY)

TITLE: The Role of Multisensory Information in Infants' Recognition of their Fathers

PRINCIPAL INVESTIGATORS: Dr. Robin Panneton Cooper, Ms. Cynthia Ward

I. RESEARCH PURPOSE AND BENEFIT

The purpose of this project is to investigate 4-month-old infants' recognition of the facial and vocal characteristics of their fathers. Your participation in this study benefits the study of early auditory perception, particularly our understanding of infant speech/face recognition.

II. PROCEDURES

Your infant will be tested for approximately 20 minutes, provided that he/she is quiet and awake. The baby will be held by the parent in her/his lap, facing an open-air enclosure. The baby will view a video screen on which either male faces or faces plus voices will appear. When the infant looks at this screen, a recording of either their father's face (or face+voice) or the face (or face+voice) of an unfamiliar male will begin. The infant can see this display as long as he/she looks at the screen. The loudness of the voice played to the infant is no more than that heard by infants in their typical home environment. We will be videotaping each infant during this procedure for subsequent coding of their facial expressions. If for any reason your infant cries or falls asleep, testing will be discontinued. There are no apparent risks to your infant or to yourself for participation in this study. However, you have the right to terminate your involvement in this study at anytime and for any reason, if you so choose.

III. CONFIDENTIALITY

All of the information gathered in this study will be kept confidential and the results will not be released without parental consent. 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. You will be sent a summary of this work when this project is completed. Also, the videotapes of the infant and the infant's father will be destroyed in 2 years from the time that these data are collected.

Appendix C (cont.)

IV. RESEARCH APPROVAL

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. I have indicated that my infant has no history of prenatal or postnatal problems, and is in good health at this time. This project has been approved by the Human Subjects Committee of the Department of Psychology and the Institutional Review Board of Virginia Tech. 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 Dr. Cooper and her co-workers to test my son\daughter.

Dr. Robin Panneton Cooper, Principle Investigator 231-5938
Ms. Cynthia D. Ward, Co-Investigator 953-2534
Dr. R. J. Harvey, Chair, Human Subjects Committee 231-7030
Dr. Thomas Hurd, Chair, Institutional Review Board 231-9359

Signature of Parent

Date

Appendix D

Please fill out the following information:

1. Mother's age at infant's birth _____
Father's age at infant'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 _____

Appendix D (cont.)

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 E

INFANT EMOTION CODING SCALES
(Osofsky et al., 1988)

Infant Positive Hedonic Tone

Rating is based on highest possible level present, regardless of duration or frequency.

- Laughter (4) Vigorous smiles with laughter and/or clearly highly pleasurable vocalizations (i.e., happy gurgling, pleasure screeches, or laughter).
- Smile (3) Warm smile accompanied by eye involvement (i.e., sparkling eyes) and/or clearly pleasant vocalizations (i.e., cooing) but not laughter or screeches.
- Interest (2) Fleeting smiles without whole body involvement (i.e., without eye involvement or approach behavior), excitement in body movements without accompanying warm smiles or positive vocalizations and/or positive interest and attentiveness which may include vocalizations.
- None (1) None of the above (hedonic tone may be negative or neutral).

Infant Negative Hedonic Tone

Rating is based on highest possible level present, regardless of duration or frequency.

- Marked (4) Marked distress in face and voice. Full-blown cry, accompanied by appropriate facial expressions (i.e., screwing up face, closed eyes, maybe tears).
- Fuss (3) Whimpering or fussing with appropriate facial expression. Both fuss and whimper involve a string of negative vocalizations, not just single vocalizations.
- Frown/
Protest (2) Pouting, pre-cry face, or clearly distinguishable distress frown, and brief negative vocalizations (i.e., grunt, protest or frustration sounds-these tend to be in single bursts with a strident tone or vocal tensions).

Appendix E (cont.)

None (1)

None of the above (hedonic tone may be positive or neutral). May include concentration frown or other frowns not clearly distinguishable as distress frown, sobering of face with brief, negative vocalizations.

Interest

- 1 Dull and dazed looking; unsure if the child is actually seeing anything.
- 2 Dazed looking.
- 3 Dazed looking with some focused looking at objects or persons.
- 4 Focused looking at an object or person.
- 5 Focused looking and active involvement with object or person.

Excitement

- 1 Brief with body movements only.
- 2 Brief, with body movements and neutral vocalizations.
- 3 Brief, with body movements and non-neutral vocalizations.
- 4 Continues for greater than 5 seconds, with body movements and non-neutral vocalizations.

Appendix F

INFANT SPEECH STUDY PROGRAM
Department of Psychology, Virginia Tech

Dear Parent(s):

Soon after infants are born, they can recognize many different faces and voices. For instance, we now know that babies only a few days old would rather listen to their own mothers' voices and look at their mothers' faces. In the Department of Psychology at Virginia Tech, we are interested in learning more about the early relationship between mothers and their infants.

Currently, we are investigating infants' recognition of their mothers' faces and voices. Your participation would involve having one of us visit the mother and the infant in the home in order to briefly videotape the mother's face and 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 mother's face and 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.
Associate Professor

Appendix G

**VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
INFORMED CONSENT FORM
(LAB COPY)**

TITLE: The Role of Multisensory Information in Infants' Recognition of their Mothers

PRINCIPAL INVESTIGATORS: Dr. Robin Panneton Cooper, Ms. Cynthia Ward

I. RESEARCH PURPOSE AND BENEFIT

The purpose of this project is to investigate 4-month-old infants' recognition of the facial and vocal characteristics of their mothers. Your participation in this study benefits the study of early auditory perception, particularly our understanding of infant speech/face recognition.

II. PROCEDURES

Your infant will be tested for approximately 20 minutes, provided that he/she is quiet and awake. The baby will be held by the parent in her/his lap, facing an open-air enclosure. The baby will view a video screen on which either female faces will appear. When the infant looks at this screen, a recording of either their mother's face and voice or the face and voice of an unfamiliar female will begin. The infant can hear this face/voice as long as he/she looks at the screen. The loudness of the voice played to the infant is no more than that heard by infants in their typical home environment. We will be videotaping each infant during this procedure for subsequent coding of their facial expressions. If for any reason your infant cries or falls asleep, testing will be discontinued. There are no apparent risks to your infant or to yourself for participation in this study. However, you have the right to terminate your involvement in this study at anytime and for any reason, if you so choose.

III. CONFIDENTIALITY

All of the information gathered in this study will be kept confidential and the results will not be released without parental consent. 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. You will be sent a summary of this work when this project is completed. Also, the videotapes of the infant and the infant's mother will be destroyed in 2 years from the time that these data are collected.

Appendix G (cont.)

IV. RESEARCH APPROVAL

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. I have indicated that my infant has no history of prenatal or postnatal problems, and is in good health at this time. This project has been approved by the Human Subjects Committee of the Department of Psychology and the Institutional Review Board of Virginia Tech. 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 Dr. Cooper and her co-workers to test my son\daughter.

Dr. Robin Panneton Cooper, Principle Investigator	231-5938
Ms. Cynthia D. Ward, Co-Investigator	953-2534
Dr. R. J. Harvey, Chair, Human Subjects Committee	231-7030
Dr. Thomas Hurd, Chair, Institutional Review Board	231-9359

Signature of Parent

Date

Table 1

Experiment 1Parents' Demographic Data

		Mother (<u>n</u> =18)	%	Father (<u>n</u> =18)	%
Age:	21-30	8	44.4	6	33.3
	31-40	10	55.6	12	66.7
Number of Children: ^a	1	7	38.9	--	--
	2	9	50.0	--	--
	3	1	5.6	--	--
	4	1	5.6	--	--
Type of Delivery: ^a	vaginal	16	88.9	--	--
	cesarean	2	11.1	--	--
Type of Feeding: ^a	breast	13	72.2	--	--
	bottle	4	22.2	--	--
	both	1	5.6	--	--
Education:	high-school grad	2	11.1	3	16.6
	partial college	1	5.6	1	5.6
	college grad	10	55.6	7	38.9
	grad degree	5	27.7	7	38.9
Occupation:	white collar	7	38.9	13	72.2
	blue collar	2	11.1	3	16.7
	grad student	1	5.6	2	11.1
	unemployed	8	44.4	0	0.0
Income: ^a	10,000-20,000	2	11.1	--	--
	21,000-30,000	3	16.6	--	--
	31,000-40,000	5	27.8	--	--
	41,000-50,000	2	11.1	--	--
	51,000-60,000	3	16.6	--	--
	61,000-70,000	0	0.0	--	--
	71,000-80,000	1	5.6	--	--
	81,000-90,000	1	5.6	--	--
91,000 and up	1	5.6	--	--	

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

Table 2

Experiment 2Parents' Demographic Data

		Mother (<u>n</u> =17)	%	Father (<u>n</u> =17)	%
Age:	21-30	7	41.2	5	29.4
	31-40	10	58.8	10	58.8
	41-50	0	0.0	2	11.8
Number of Children: ^a	1	7	41.2	--	--
	2	6	35.3	--	--
	3	4	23.5	--	--
Type of Delivery: ^a	vaginal	11	64.7	--	--
	cesarean	6	35.3	--	--
Type of Feeding: ^a	breast	10	58.8	--	--
	bottle	2	11.8	--	--
	both	5	29.4	--	--
Education:	junior high	1	5.9	0	0.0
	partial high	1	5.9	0	0.0
	high-school grad	1	5.9	3	17.6
	college grad	6	35.3	6	35.3
	grad degree	8	47.0	8	47.1
Occupation:	white collar	7	41.2	14	82.4
	blue collar	3	17.6	3	17.6
	grad student	1	5.9	0	0.0
	unemployed	6	35.3	0	0.0
Income: ^a	10,000-20,000	1	5.9	--	--
	21,000-30,000	3	17.6	--	--
	31,000-40,000	3	17.6	--	--
	41,000-50,000	1	5.9	--	--
	51,000-60,000	4	23.5	--	--
	61,000-70,000	1	5.9	--	--
	71,000-80,000	0	0.0	--	--
	81,000-90,000	2	11.8	--	--
91,000 and up	2	8.3	--	--	

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

Table 3

Experiment 3Parents' Demographic Data

		Mother (<u>n</u> =17)	%	Father (<u>n</u> =17)	%
Age:	21-30	9	52.9	7	41.2
	31-40	8	47.1	9	52.9
	41-50	0	0.0	1	5.9
Number of Children: ^a	1	8	47.1	--	--
	2	6	35.3	--	--
	3	3	17.6	--	--
Type of Delivery: ^a	vaginal	13	76.5	--	--
	cesarean	4	23.5	--	--
Type of Feeding: ^a	breast	14	82.3	--	--
	bottle	1	5.9	--	--
	both	2	11.8	--	--
Education:	high-school grad	2	11.8	1	5.9
	college grad	9	52.9	5	29.4
	partial grad	0	0.0	1	5.9
	grad degree	6	35.3	10	58.8
Occupation:	white collar	10	58.8	17	100.0
	blue collar	0	0.0	0	0.0
	unemployed	7	41.2	0	0.0
Income: ^a	10,000-20,000	2	11.8	--	--
	21,000-30,000	2	11.8	--	--
	31,000-40,000	2	11.8	--	--
	41,000-50,000	3	17.6	--	--
	51,000-60,000	7	41.2	--	--
	61,000-70,000	0	0.0	--	--
	71,000-80,000	0	0.0	--	--
	81,000-90,000	0	0.0	--	--
	91,000 and up	1	5.8	--	--

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

Table 4

Means and Standard Deviations for Positive Emotion

	Parent		Other	
	Mean	SD	Mean	SD
Dad Face	1.41	.53	1.32	.53
Dad Face/Voice	1.70	.47	1.54	.42
Mom Face/Voice	1.84	.75	1.77	.75

Table 5

Mean's and Standard Deviations of the Activity Rankings Across All Three Experiments

	Experiment 1		Experiment 2		Experiment 3	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
Bathing						
Mother	8.00	1.18	8.06	2.57	7.53	2.03
Father	7.47	2.59	7.56	2.00	7.40	2.20
Burping						
Mother	5.43	3.00	6.13	2.75	5.80	2.70
Father	5.79	2.39	5.69	2.47	5.13	1.96
Consoling						
Mother	6.14	2.14	4.88	2.28	5.73	2.22
Father	6.07	2.19	5.06	2.44	5.00	2.51
Diaper Changing						
Mother	4.21	1.63	5.19	1.68	4.40	1.84
Father	5.8	2.51	5.63	2.19	5.13	1.77
Feeding						
Mother	2.57	1.83	2.25	1.44	2.00	2.27
Father	6.21	3.43	7.50	3.18	5.20	3.39
Physical Play						
Mother	4.36	2.06	5.31	2.70	5.47	2.39
Father	2.40	1.50	2.75	1.77	2.53	1.60

Table 5 (cont.)

Mean's and Standard Deviations of the Activity Rankings Across All Three Experiments

	Experiment 1		Experiment 2		Experiment 3	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
Putting to Sleep						
Mother	6.86	2.18	6.38	1.96	6.33	2.80
Father	5.93	2.09	6.19	1.91	7.27	2.05
Reading						
Mother	8.71	1.64	8.13	2.16	8.20	1.94
Father	8.36	1.65	7.31	1.96	8.13	2.48
Rocking						
Mother	6.71	3.12	7.00	2.50	6.93	2.25
Father	5.93	2.92	5.94	2.57	6.20	2.70
Vocal Play						
Mother	2.79	2.39	2.13	1.78	2.87	1.85
Father	2.07	1.53	1.38	.620	3.00	2.60

Figure Captions

Figure 1. Average looking time to mother face/voice and other female face/voice by order. Means when mother was heard first were (\underline{M} (mom) = 23.16 sec, \underline{SD} = 15.47; \underline{M} (other) = 12.9, \underline{SD} = 5.6). Means when stranger female was heard first were (\underline{M} (mom) = 17.74 sec, \underline{SD} = 7.69; \underline{M} (other) = 22.41, \underline{SD} = 13.84).

Figure 2. Average looking time to mother's face/voice (\underline{M} = 19.19, \underline{SD} = 10.13) and stranger female face/voice (\underline{M} = 13.64, \underline{SD} = 5.10) when the first trials were removed from the analyses.

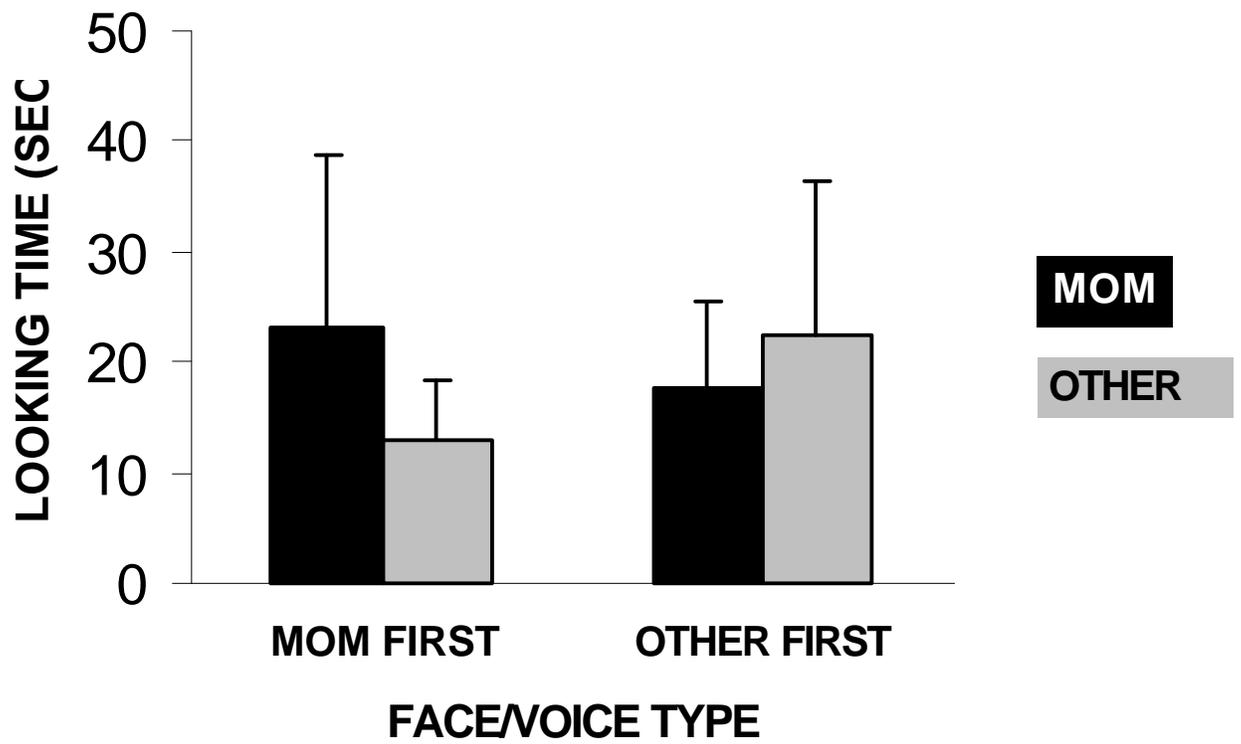


Figure 1.

AVERAGE LOOKING TIME BY ORDER

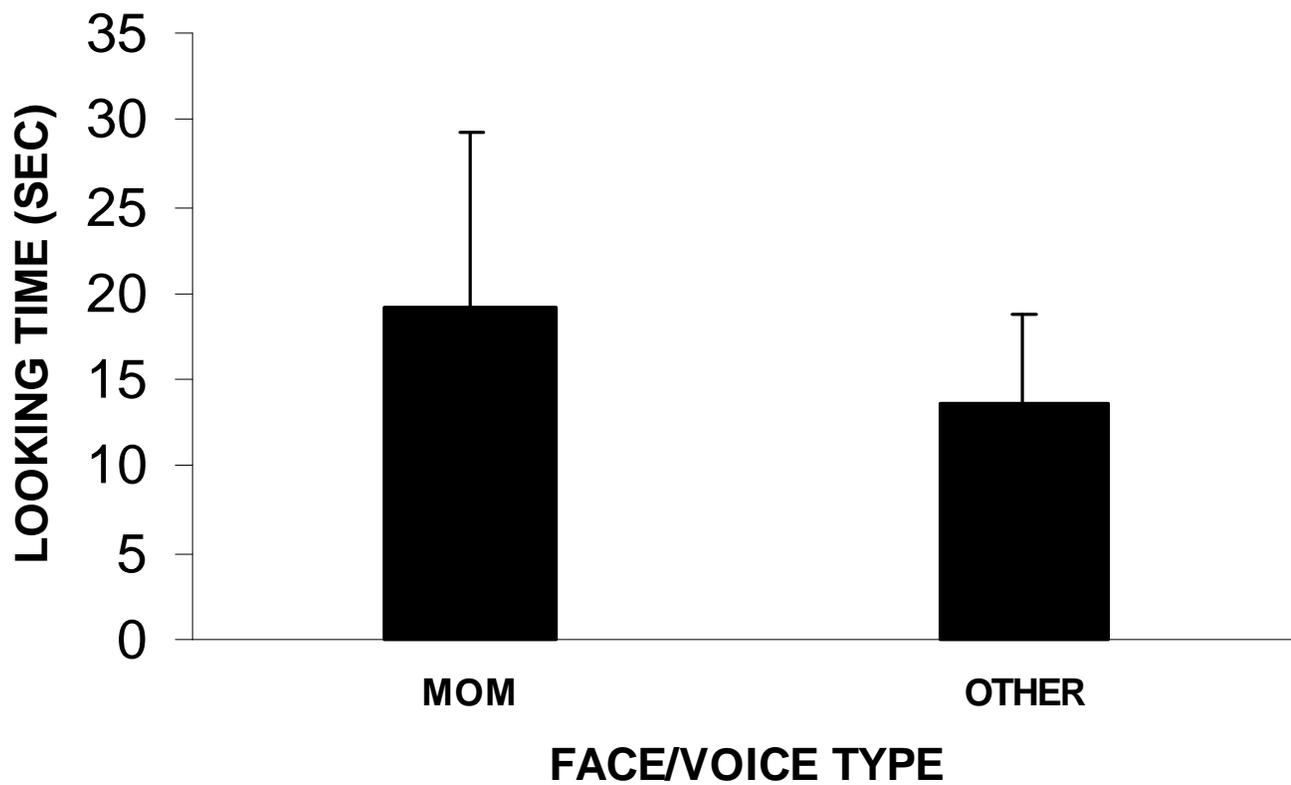


Figure 2.

AVERAGE LOOKING TIME WITHOUT FIRST LOOKS

Vita

Cynthia D. Ward

PERSONAL INFORMATION

Born: August 31, 1970

Business Address: Department of Psychology
1971 University Blvd.
Lynchburg, Virginia 24502-2269

Business Phone: (804) 582-2308

Home Address: P.O. Box 58
Keysville, Virginia 23947

Home Phone: (804) 736-8717

E-mail Address: cynward@aol.com

EDUCATION AND ACADEMIC HONORS

Ph.D. Virginia Polytechnic Institute and State University, 1998
Major field: Developmental Psychology, QCA=3.97

Dissertation: The Role of Multisensory Information in Infants' Recognition
of their Fathers
_____ Major Advisor: Dr. Robin Panneton Cooper

M.S. Virginia Polytechnic Institute and State University, 1995
Major field: Developmental Psychology; QCA=3.97

Thesis: The Role of Context in Infant Preference for Father's Voice.
Major Advisor: Dr. Robin Panneton Cooper

B.S. Ferrum College, 1992
Major field: Psychology; QCA=4.0

Honors: Valedictorian; Honors Graduate-Summa cum Laude;
Carl Jung Psychology Award

Undergraduate
study University of Virginia, 1988

TEACHING EXPERIENCE

Fall 1998 Instructor, General Psychology, Liberty University, Lynchburg, Virginia

Fall 1998 Instructor, Developmental Psychology, Liberty University, Lynchburg
Virginia

Fall 1998 Instructor, Principles of Psychology, Southside Virginia Community College,
Keysville, Virginia

Fall 1997-
Spring 1998 Instructor, Social Psychology, Virginia Polytechnic Institute and State
University, Blacksburg, Virginia

Fall 1996-
Spring 1997
(Spring/Summer
1998) Instructor, Developmental Psychology, Virginia Polytechnic Institute and
State University, Blacksburg, Virginia

Fall 1994-
Spring 1996 Instructor, Advanced Developmental Psychology Laboratory, Virginia
Polytechnic Institute and State University, Blacksburg, Virginia

(Summer 1997)
Spring 1994 Graduate Teaching Assistant, Physiological Psychology, Virginia Polytechnic
Institute and State University, Blacksburg, Virginia

Fall 1993
Institute Instructor, Introduction to Psychology Laboratory, Virginia Polytechnic
and State University, Blacksburg, Virginia

1992-1993 Instructor, Head Start, Lynchburg, Virginia

GRADUATE AWARDS

Graduate Student Assembly, Travel Award, 1995, Virginia Polytechnic Institute and State
University

Graduate Student Assembly, Travel Award, 1996, Virginia Polytechnic Institute and State
University

Graduate Student Assembly, Travel Award, 1998, Virginia Polytechnic Institute and State
University

PROFESSIONAL ORGANIZATIONS

Membership

International Society for Infant Studies
Developmental Science Society

PUBLISHED PAPERS AND ABSTRACTS

Ward, C. D. & Cooper, R. P. (1998). Infants' recognition of the paternal voice: Lack of preference in adult-directed and infant-directed contexts. Developmental Psychobiology. (under review).

Ward, C. D., Phillips, P. M., & Cooper, R. P. (April, 1998). Lack of preference for the paternal face in four-month-olds. Infant Behavior and Development, 21, 743.

Ward, C. D., McCartney, J., & Cooper, R. P. (April, 1996). Infants' recognition of the paternal voice: Lack of preference in adult-directed and infant-directed contexts. Tenth International Conference on Infant Studies, 19, 805.

Ward, C. D., Abraham, J. L., & Cooper, R. P. (March, 1995). Lack of preference for the paternal voice in four-month-olds. Society for Research in Child Development Abstracts, 10, 740.

CONFERENCE PRESENTATIONS

Ward, C. D., Phillips, P. M., & Cooper, R. P. (April, 1998). Lack of preference for the paternal face in four-month-olds. Poster accepted for presentation at the Biennial Meeting of the International Conference for Infant Studies, Atlanta, Georgia.

Ward, C. D., McCartney, J., & Cooper, R. P. (April, 1996). Infants' recognition of the paternal voice: Lack of preference in adult-directed and infant-directed contexts. Poster accepted for presentation at the Biennial Meeting of the International Conference for Infant Studies, Providence, Rhode Island.

Ward, C. D., Abraham, J. L., & Cooper, R. P. (March, 1995). 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.

REFERENCES

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Dr. Robert E. Lickliter, Professor
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