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ABSTRACT

A report is presented which relates to a general hypothesis suggested by previous data on visual response to faces that in the first weeks of life infants develop expectations regarding the human face. Three predictions were made: (1) Silent human faces would elicit less direct regard than faces accompanied by voices; (2) A familiar face would evoke more direct regard than the unfamiliar one; and (3) "Matched" face-voice combinations would evoke more direct regard than "mismatched" combinations. To test these predictions, the ocular responses of 19 full-term, normal female infants were observed once a week from age two weeks through seven weeks in a repeated measures design. Results indicate that the infants studied underwent very early learning. (CK)

# Mother-Stranger Discrimination in the Early Weeks of Life[1]

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This preliminary report relates to the general hypothesis, suggested by previous data on visual respons to faces (Carpenter, Tecce, Stechler and Friedman, 1970; Carpenter, 1972) that in the first weeks of life infants develop expectations regarding the human face, including expectations for faces to be accompanied by other sensory input, e.g., speech. Pilot data also indicated that the specific face of the mother may come to be recognised in the early weeks of life. If early learning of specific faces, and expectations relating to faces does occur, experience which does not conform to expectation might lead to perceptual conflict and therefore to withdrawal in the terms elaborated by Hebb(1946), Berlyne (1960), and Hunt(1965). In the present context of early visual behaviour, withdrawal would be in the form of aversive ocular response and hence reduced attention time.

Within this hypothetical framework, three predictions were made: first, silent human faces would elicit less direct regard than faces accompanied by voices, since in normal experience faces frequently occur with voices; second, a familiar face would evoke more direct regard than an unfamiliar face; and third, "matched" face-voice combinations would evoke more direct regard than "mismatched" combinations, for example, when both face and voice are familiar there would be more direct looking than when a familiar face is coupled with an unfamiliar voice.

## METHOD

To test these predictions, the ocular responses of nineteen full-term, normal female infants born in St. Mary's Hospital, Paddington, were observed once a week from age two weeks through seven weeks in a repeated measures design. The six experimental conditions were: mother's face(Mf); female stranger's face(Sf)--(the experimenter's face); mother's face and voice(MfMv); stranger's face and voice(SfSv); mother's face--stranger's voice(MfSv); and stranger's face--mother's voice(SfMv). Order of presentation was randomized across subjects; each S received two runs of the six conditions at each session. Stimulus presentations lasted 30 seconds with an interstimulus interval of 25 seconds.



[1] This paper was presented at the Biennial Meeting of the Society for Research in Child Development, Philadelphia, March 1973. The author wishes to express her gratitude to Dr. J. Anthony Ambrose for his support of this research and to Mr. Edward Melhuish who was the research assistant in the study.

Faces were presented live. Voices were presented from tape recordings via a hi-fi amplifier-speaker system. The loud speaker was placed facing upward, 26 inches below the speaker's face. (Subjectively, this position provided the best illusion of speech coming from the "speaker's" mouth). The mother or stranger mimed the words coming from the loud speaker. Tape recordings were used to control content of speech and decibel level, and to allow face and voice combinations to be "mismatched". The set paragraph spoken repeatedly both by mother and stranger was "Hello baby! How are you? How are you today? Have you been a good girl? You are a nice baby. You're a very nice girl." Sound pressure level of the voices was equated for average maximum decibel level per five seconds of speech. The average maximum level at the infant's ears was 72 db for stranger and the average across mothers was also 72 db with a range of 69-75.

The subject was placed in an infant seat in a dark green unpatterned testing chamber. The infant's eyes were 10 to 12 inches from the 8½ x 10 inch stimulus port. Dim blinking lights were mounted on the door to serve as an interstimulus stimulus. When the infant was looking forward at the lights the door was opened and the appropriate face came into place. When the infant looked at the face, the 30" timer was started. Starting the timer simultaneously activated the appropriate tape recorder in the voice conditions.

Infants' ocular responses were recorded by two observers at all sessions. Ocular behaviour was divided into four categories: 1) direct looking at some part of the stimulus face; 2) peripheral viewing, coded when the eyes were directed away from the face--including eye orientation of approximately 10 to 45 degrees either side of midline, or fixation above hairline or below chin; 3) looking away, which involved turning of head 45 degrees or more from midline, such that the stimulus was out of the visual field; and 4) closing eyes, coded when eye lids covered the pupils. The inter-observer reliabilities for these categories based on 107 experimental sessions were: .89 for direct looking, .86 for peripheral viewing, .76 for looking away and .997 for closing eyes.

## RESULTS

The data reported here represent the average of the two observers' codings. Results for direct looking at the six experimental conditions for weeks 2 through 7 can be seen in Figure 1. For preliminary analysis, data were collapsed over weeks. Analysis of variance for 5 orthogonal contrasts revealed the following findings. Infants reliably differentiated the two faces in the direction of more attention to mother's face ($F(1,18)=83.65, p<.0001$). "Matched" vs "mismatched" face and voice combinations were not reliably different. That is, response to MfMv was not reliably different from MfSv, and the same obtained for the stranger conditions. Pooled face and voice combinations were reliably differentiated from faces without voices in the predicted direction in both cases. That is, mother's face with a voice received more direct looking than mother's face without voice ($F(1,18)=18.30, p<.0005$). Likewise, stranger's face with a voice received more attention than stranger's face without voice ($F(1,18) = 8.66$, $p < .009$).

Peripheral viewing results can be seen in Figure 2. Analysis of variance for the five orthogonal contrasts yielded the same three significant contrasts as for direct looking. [M vs S: $F(1,18) = 36.47$, $p < .0001$; Voice vs No Voice (M): $F(1,18) = 14.49$, $p < .001$; Voice vs No Voice (S): $F(1,18) = 8.44$, $p < .009$]. The direction of the differences is opposite to those for direct looking as direct looking and peripheral viewing are negatively correlated.

Closing eyes and looking away occurred infrequently and for relatively short durations; the data have been collapsed across weeks in the figures which follow. The eyes closed data shown in Figure 3, indicate a further mother--stranger difference ($t = 2.73$, $p < .01$). (Closing eyes is not a completely satisfactory category of behaviour since it occurs for two if not three reasons: with fussing; with fatigue; and possibly as a means of regulating sensory input. The latter is suggested by instances of eyes closing during a stimulus presentation and opening again to the blinking lights.)

Figure 4 shows the results for looking away, that is, a frank turning of head at least 45 degrees from midline. Although there is not very much of this rather extreme behaviour, the "mismatched" conditions evoke it more. The configuration of means is the same within mother and stranger conditions, although the stranger evokes significantly more (Mf + MfMv vs Sf + SfSv: $t = 2.80$, $p < .01$). Data for the two faces combined is shown in Figure 5. $T$-tests indicate differences significant at the 5% level for "mismatched" vs "matched" face-voice pairs ($t = 2.05$) and between "mismatched" combinations vs the no voice conditions ($t = 1.81$).

## DISCUSSION

Now let's consider how these findings relate to the predictions. The overriding effect was not face plus voice vs face without voice but mother's face vs stranger's face. There was clear-cut differentiation of the familiar face from strange face in the predicted direction of more attention to the familiar face. Clearly infants are capable of discriminating between two female faces, on some basis, within the first 7 weeks of life.

Mother-stranger differentiation is thus found at an earlier age than has been reported previously. The most frequently reported evidence for stranger discrimination has been in terms of negative response to stranger, e.g., absence or increased latency of smiling; crying; turning away; etc. These responses have been found in infants of 3 to 4 months of age, and to an extent described as fear by 6 to 8 months of age (e.g., Ambrose, 1963; Tennes & Lampl, 1964; Schaffer, 1966; and Morgan & Ricciuti, 1969). Measuring cardiac rate, Banks and Wolfson (1967) found differential response to mother vs stranger, both of whom were speaking, in infants who were only 6 to 8 weeks of age. The responses measured are clearly critical to the question of discrimination at different ages.

Now let's turn to the primary hypothesis that there would be "preference" for face-voice pairs. Within the conditions of this study, faces were more salient than voices in determining visual regard. However, for each face individually, the addition of voice did increase attention. The effect of more attention to face plus voice is not simply one of quantity of stimulation: more stimulation yields more attention, since mother's face without voice was looked at longer than stranger's face with a voice. Thus the data are best understood in terms of greater attention to the more familiar conditions.

The third prediction of less direct regard of "mismatched" face-voice combinations, if supported, would be the strongest evidence for development of complex expectations very early in life. This would require recognition of mother's face and voice, association of the two, and the ability to discriminate in two modalities simultaneously. With respect to present analyses of direct and peripheral regard, the two most frequently occurring behaviours, faces received differential response; voices did not. However, more frank turning away in the "mismatched" conditions does indicate discrimination of voices and face-voice association and lends support to the prediction that "mismatched" conditions would produce more aversive ocular response.

The ocular behaviour reported suggests an active perceptual process. Differences in attention time derive from differential amounts of turning the eyes or head from direct fixation, since the infant is facing directly forward at the beginning of each trial and timing does not begin until the infant has looked at the stimulus. Thus less looking at stranger suggests negative response to the unfamiliar face. Similarly, the lesser attention to the stationary, silent face, within both face conditions, is consistent with ocular withdrawal from a very unusual set of circumstances. The greater amount of turning right away from the stimulus in the "mismatched" face-voice conditions suggests an avoidance response to incongruity.

An index of mother-stranger discrimination frequently reported for older infants has been negative response of various kinds, often referred to as fear. The ocular responses found here suggest relative withdrawal from strange or incongruous experience and are possibly an early manifestation of the same underlying process.

Data from two previous studies (Carpenter, et al., 1970; Carpenter, 1972) have bearing on the interpretation of present findings. In the earlier studies, mother was differentiated from three different artificial faces, but always in the direction of less attention to mother. Since mother presently evoked more attention than a stranger and formerly less than artificial faces, the discriminations cannot be accounted for by a simple novelty effect. Rather sensory input would seem to undergo multiple categorization which mediates attention.

Whatever the processes underlying the data turn out to be, it would be difficult at this time to account for the present findings in terms other than very early learning.

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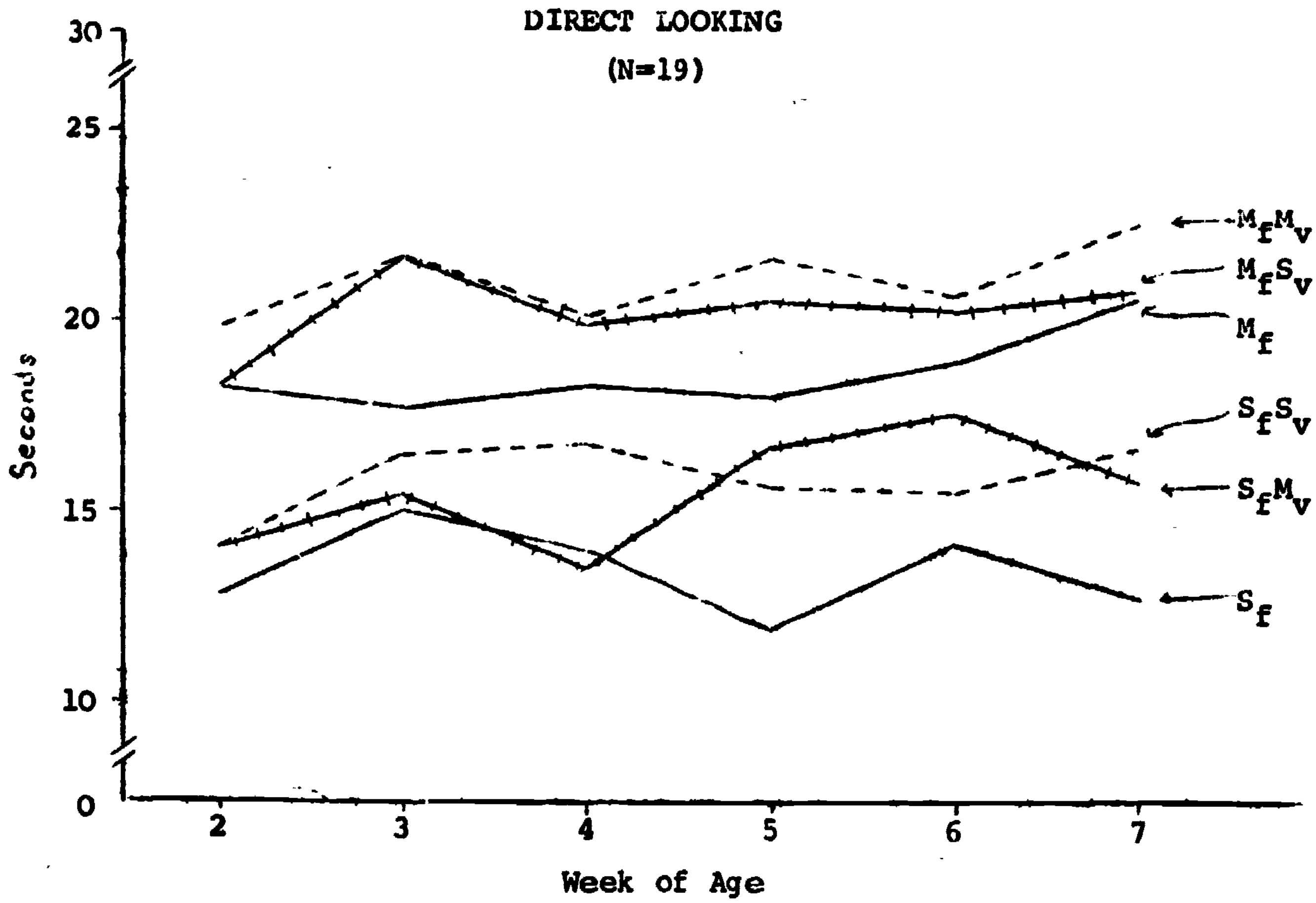


Figure 1

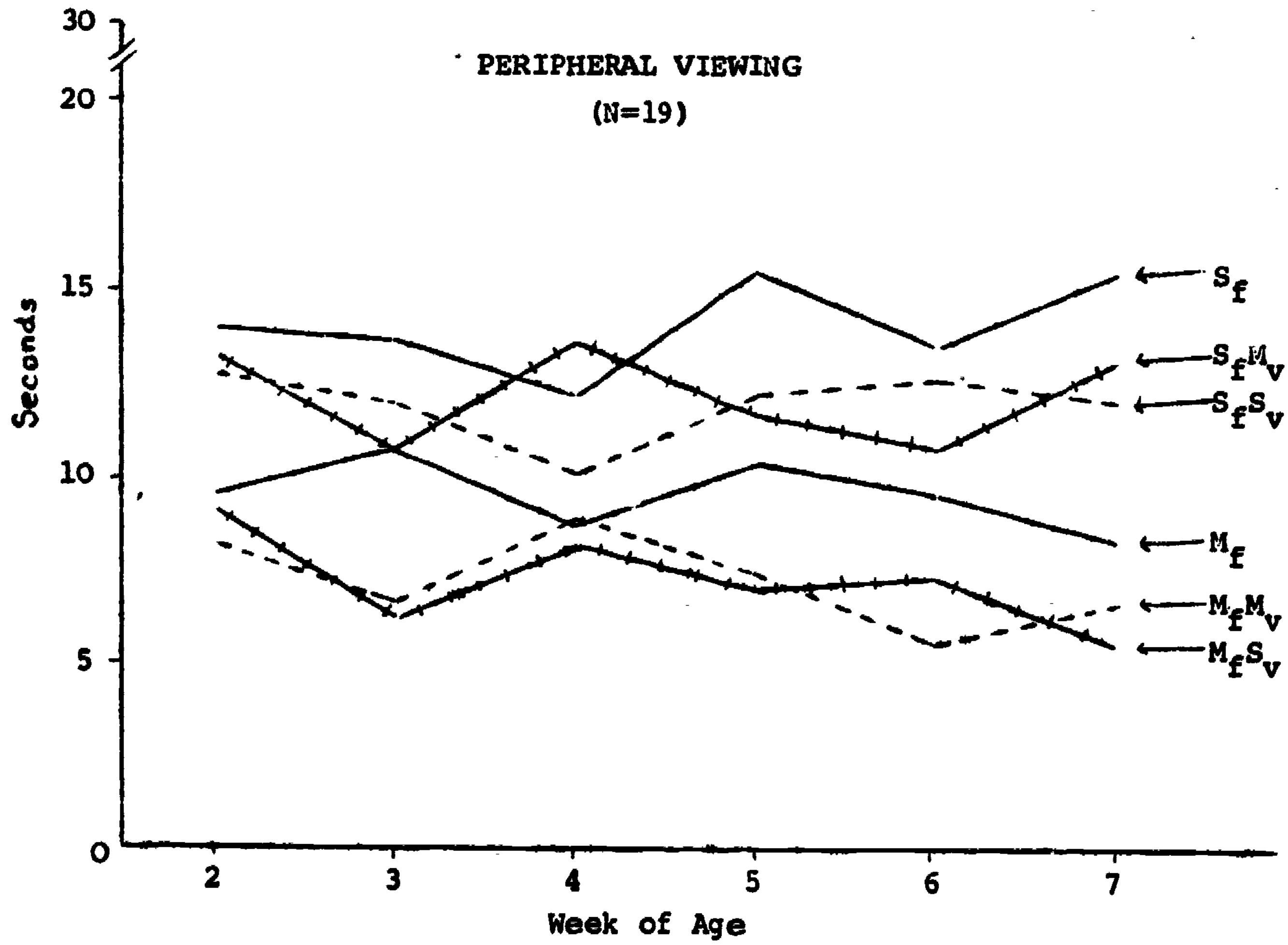


Figure 2

EYES CLOSED

(N=19)

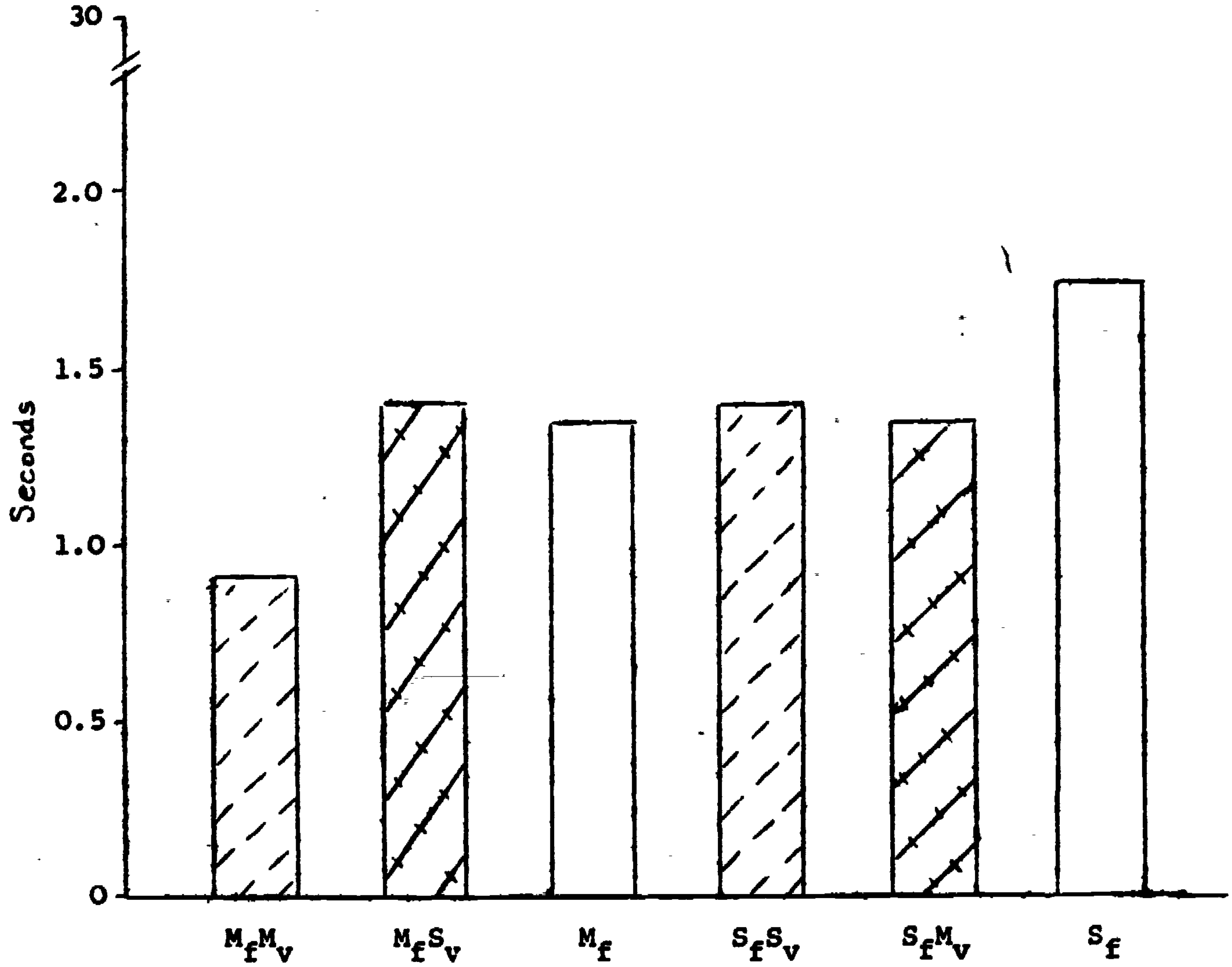


Figure 3

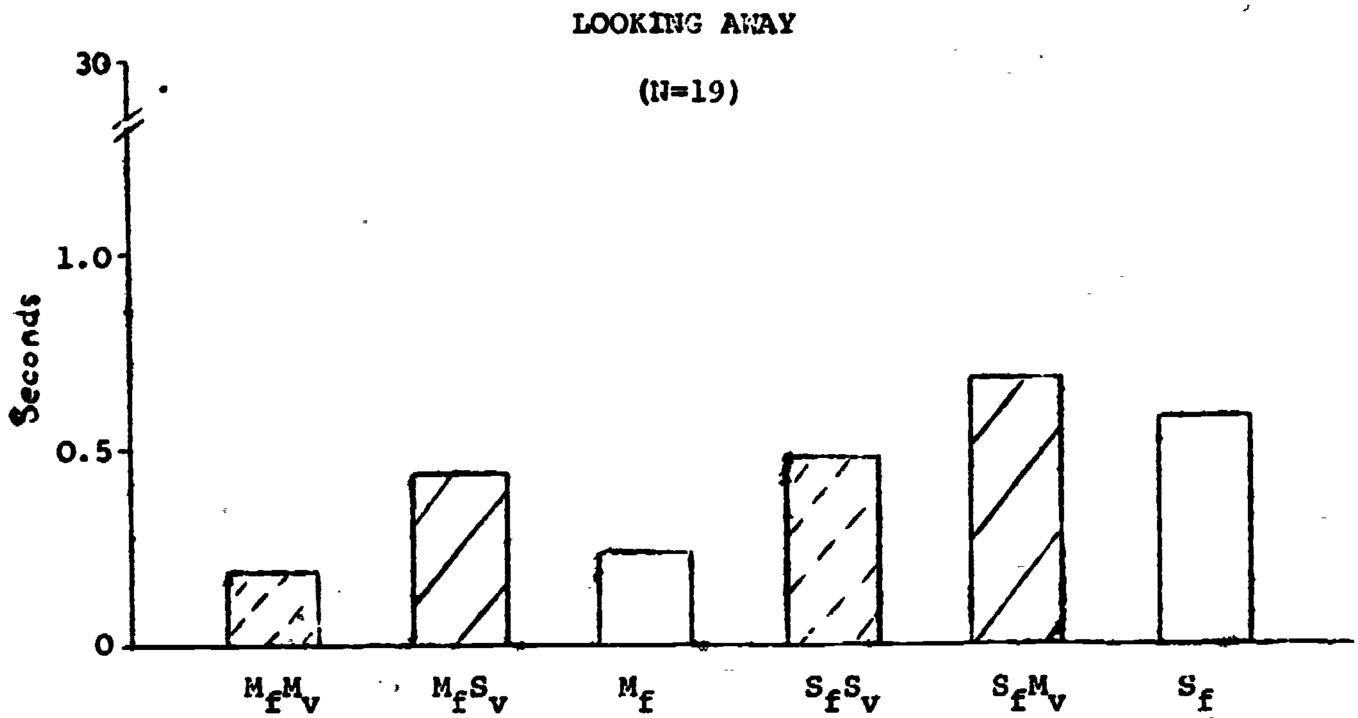


Figure 4

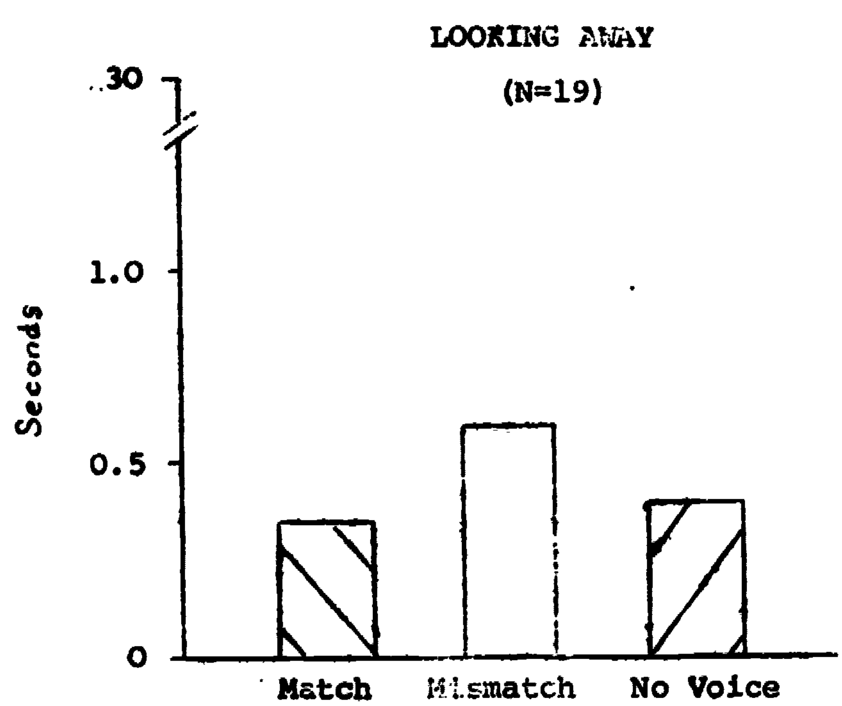


Figure 5