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BRIEF REPORT

The Effects of Movement of Internal Features on Infants' Preferences for Face-Like Stimuli

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The role of internal feature movement on 1-, 3- and 5-month-old infants' preferences for schematic face-like patterns was studied using an infant control testing procedure. Internal feature movement had a significant effect on the preferences of the 5-month-old group, but not the younger infants.

face recognition movement internal features infant control

The age at which infants will preferentially attend to schematic face-like patterns has been a matter of some controversy. Although we have recently replicated the evidence in favor of the newborn infant having information about the structure of faces (Johnson, Dziurawiec, Ellis, & Morton, 1991), a more commonly held view is still that it takes several months of experience of faces before infants show a consistent preference for the appropriate arrangement of features of a face (e.g., Gibson, 1969; Haaf, 1977; Maurer, 1985). Evidence in support of this latter position was provided by a frequently cited study by Maurer and Barrera (1981). These authors demonstrated, using an infant control testing procedure, that 1-month-old infants had no preference between intact and scrambled schematic faces, whereas a group of 10-week-old infants looked significantly longer at the intact face.

We now report our attempt to replicate the Maurer and Barrera (1981) study with groups of 1-, 3-, and 5-month-old infants. Only a brief account of this experiment is given because many aspects of the procedure were identical to those used in the original study, and the results obtained were also similar. Infants' preferences for four different stimuli were compared: a schematic face closely resembling that used by Maurer and Barrera (face); a stimulus in which nonfacial features were arranged in the normal locations for the eyes

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and mouth (configuration); a stimulus with face features in inappropriate relative locations (linear); and a stimulus which possessed neither a facial configuration nor intact, correctly oriented facial features (control). The stimuli were projected on slides and were matched for average luminance (6.15–6.60 lux). Our subjects were fourteen 1-month-olds (*M* age = 5.0 weeks; range: 4–6 weeks), fifteen 10-week-olds (*M* age = 10.7 weeks; range: 10–12 weeks), and fifteen 5-month-olds (*M* age = 18.6 weeks; range: 18–20 weeks); all were normal full-term births. There were approximately equal numbers of males and females in each group. In addition, four 1-month-olds, four 10-week-olds, and six 5-month-olds did not complete the experiment due to fussing or drowsiness.

The procedure we followed was very similar to that used by Maurer and Barrera (1981).[1] Briefly, this involved showing one of the four stimuli on the projection screen and terminating the presentation once the infant looked away from the stimulus. This "infant control" procedure has been recommended by Cohen (1976) and Maurer (1985) as being the most sensitive of the standard infant testing procedures. The infants sat on their mothers' lap facing a projection screen. Mothers were instructed to keep their eyes closed. The infants' eyes were around 90 cm from the screen. The experimenter watched a monitor screen showing the infant's face and once the infant was looking in the right direction, the experimenter pressed a button. This advanced the projector to the next slide and started a timer. The experimenter watched the infant on the monitor screen and once he/she thought the infant had looked away from the stimulus, the slide was terminated and the timer stopped. The four stimuli were presented twice, initially in random order and then in the reverse order. The infant's face and the timer were recorded on videotape for the entire duration of the experiment, and the length of time that the infant had looked at each slide was later assessed by a judge blind to the stimulus being shown.

The mean time spent looking at the stimuli for each of the age groups is shown in Table 1. The results we obtained from the younger age groups replicated those of Maurer and Barrera (1981). There were no significant differences among the times spent looking at the four stimuli for the 1-month-olds, $\chi^2(3) = 0.75$, $p > .8$. In contrast, for the 10-week-olds, there was a significant difference in length of looking at the four stimuli, $\chi^2(3) = 10.28$, $p < .02$. The face stimulus was significantly preferred over all of the other stimuli, $p < .05$ (Wilcoxon test). Thus, we were able to replicate the finding that, under certain testing conditions, infants do not show a preference for face patterns until around 10 weeks of age. Initially, this result appears to

[1] Our procedure differed from the original study in a few minor ways unlikely to influence the results. For example, we used a small red flashing light above the screen to attract the infants' attention, and each infant's eye movements were coded from videotapes after the end of the experiment rather than by judges during the running of the experiment.

conflict with evidence indicative of a preference for faces in newborns. For example, several studies have found that newborns will track a face pattern further than "scrambled" face patterns under certain conditions (Goren, Sarty, & Wu, 1975; Johnson et al., 1991; Maurer & Young, 1983). In these experiments with newborns, the neonates tracked each stimulus with their head and eyes as it moved around them. Johnson and Morton (Johnson, 1988; Johnson & Morton, 1991; Morton & Johnson, 1991) have attempted to resolve these bodies of apparently conflicting data by proposing a two-process theory of the development of face preferences. This theory suggests that the tracking of moving faces in early infancy is modulated by a primitive orienting mechanism primarily mediated by subcortical structures. In contrast, the emerging preference for a face-like configuration presented in a static location within the nasal visual field, as investigated in the study just discussed, may be indicative of the maturation of cortical visual structures and their increasing control over the visuomotor preference behavior of the infant (see also Johnson, 1990a, 1990b).

There is, however, one result from the replication attempt that remains to be accounted for. As mentioned earlier, we also tested a group of 5-month-olds. For this group, there was also a significant difference in length of looking time at the four stimuli for the 5-month-olds, $\chi^2(3) = 10.28, p < .02$. However, the face appeared to be looked at for the shortest periods of time (two-tailed Wilcoxon tests disclosed no significant differences between the intact face and the other stimuli).

A number of researchers have argued that the monotone schematic face stimuli often used in face preference tasks are impoverished. That is, these stimuli do not possess many of the stimulus characteristics that real faces do (Maurer, 1985; Sherrod, 1979). If an infant who has had more experience with faces requires a more realistic representation of a face to elicit interest, then the simple monotone schematic face used in the Maurer and Barrera (1981) experiment may be insufficiently realistic to merit attention in older infants. If this interpretation of the 5-month-old result is correct, restoring some of the characteristics of a real face to the simple schematic face should reinstate the preference for the facial arrangement. Among the most prominent characteristics of real faces is movement of the internal features. In the second experiment reported in this article, an infant control procedure was

TABLE 1
Arithmetic Mean Looking Times (Seconds) Toward the Stimuli for the Three Age Groups

	Face	Configuration	Linear	Control
1 month	20.2 (13.7)	20.0 (25.1)	16.4 (11.3)	20.2 (12.7)
10 weeks	22.5 (18.8)	12.1 (10.5)	11.1 (6.3)	8.4 (5.2)
5 months	5.4 (4.3)	7.3 (7.3)	6.3 (3.0)	7.4 (5.7)

Note. Standard deviations appear in parentheses.

used to establish whether movement of the internal features makes the face-like configuration the most attractive for the 5-month-old infants. For comparison with earlier experiments, groups of 1- and 3-month-old infants were also tested.

The subjects were twenty-five 1-month-olds (*M* age = 4.6 weeks; range: 4–6 weeks), twenty-two 3-month-olds (*M* age = 12.2 weeks; range: 12–14 weeks), and eighteen 5-month-olds (*M* age = 18.8 weeks, range: 18–20 weeks), all normal full-term births. There were approximately equal numbers of males and females. Another eight 1-month-olds, seven 3-month-olds, and four 5-month-old infants did not complete the experiment due to fussing or drowsiness. In addition, infants with consistently very short looking times (under 2 s per stimulus) were excluded from the sample (fourteen 3-month-olds and four 5-month-olds).

All stimuli were generated by a BBC microcomputer and presented on a video display unit (VDU). Three different configurations of facial features were used: normal, scrambled, and linear scrambled (Figure 1). For each of the three stimuli, there were two conditions, *moving* and *static*. In the moving condition, the internal features of the face were made to move slightly by making transitions from one static presentation to another. The two frames alternated every second. The replacement was carried out by overwriting each feature (mouth, nose, eyes, brows) in turn, this process taking 180 ms. The effect was one of animation of an otherwise constant stimulus. In the other condition, one of the two static frames for each configuration was used. Half of the infants were exposed to one of these frames, and half to the other. In total, therefore, each child was exposed to six stimuli, three static and three moving. The mean illuminance of these stimuli varied between 1.8 and 2.0 lux. The presentation of each stimulus was preceded by an attractor stimulus which consisted of a line between 2 and 5 cm in length drawn in a random direction from the center of the screen every 500 ms.

The infants sat either on their parents' lap or on the lap of a trained holder facing a VDU which was fitted behind a larger black screen. A video camera was mounted just below the VDU and could not be seen by the infants. Behind the screen the experimenter could view the infant's face on a video monitor. The experimenter controlled the presentation of the next stimulus or attractor by means of a key on the computer.

The general procedure was very similar to that used in the Maurer and Barrera (1981) experiment. After the experimenter had brought the parent and infant into the room and ensured that the infant was sitting upright on the parent's lap, the lights were dimmed. Then the experimenter started the attractor stimulus on the VDU. Once the infant was watching the screen, the experimenter pressed a key which caused the first test stimulus to appear. The stimuli were presented in a random order decided by the computer. The experimenter watched a monitor screen showing the infant's face. When the infant looked away from the screen, the presentation was stopped, and

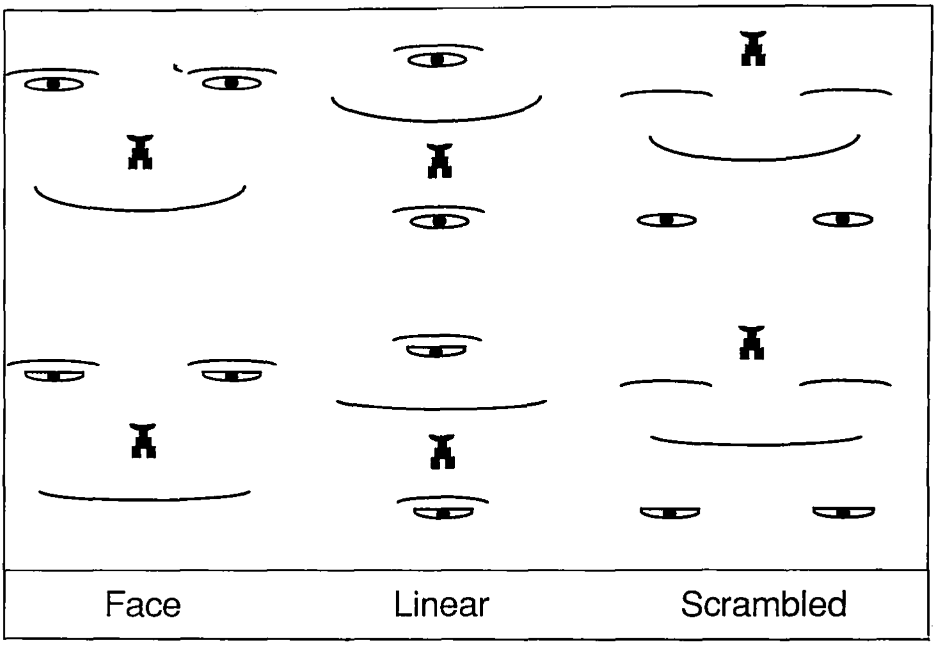

Figure 1. The three stimuli used in both static and moving versions to assess infants' preferences. Half the infants saw the top row as static patterns, and half saw the bottom row as the static patterns. Movement was introduced by switching from a pattern on the top row to its equivalent on the bottom and vice versa. Stimuli are referred to as (from left to right) face, linear, scrambled.

the attractor stimulus was presented. The infant's eye movements were recorded on videotape for the entire experiment, and the length of time that the infant had looked at each stimulus was assessed from this tape by a judge blind to the stimulus being presented.

For each age group, we performed a Friedman analysis of variance to compare the amount of looking towards the six stimuli. In Table 2 (p. 134) we show the arithmetic mean values for the three configurations and two conditions; moving and static, for the three age groups. With 1-month-olds, the analysis revealed no significant effect of stimulus on looking time, $\chi^2(5) = 7.17$, n.s., whereas with 3-month-olds, the analysis did reveal a significant overall effect of stimulus on looking time, $\chi^2(5) = 13.10$, $p < .05$. Because this latter Friedman test was significant, we carried out individual comparisons. Wilcoxon tests revealed a significant preference for the static face over the other static stimuli, $p < .05$ in both cases, and for the moving face over the moving linear scrambled pattern, $p < .01$. No other comparisons reached significance. Although for the five-month-olds, the overall Friedman test did not reach significance, $\chi^2(5) = 9.03$, n.s., planned individual comparisons revealed significant effects for the moving stimuli. The moving face pattern was significantly preferred over both moving scrambled faces, $p < .05$ for both cases. No other comparisons were significant. For all age groups, the overall length of time spent looking at the moving stimuli did not differ from the overall length of time spent looking at the static stimuli.

Although 1- and 5-month-olds show no significant preference for the static intact face over the other static patterns, the 3-month-olds did. Thus, this finding appears to be replicable across different stimulus presentation methods and viewing distances. Even when the internal features are moving, 1-month-olds show no evidence of a preference for a face-like arrangement of facial features in the infant control procedure. This result extends the claim made on the basis of several studies that, using preferential looking and habituation procedures, infants of 1 month of age fail to show a preference for face-like patterns (see Maurer, 1985, for review). In the 3-month-old group, there was a significant overall effect of stimulus. Although this effect was mainly due to the static face being looked at longer than the other static stimuli, the moving face was significantly preferred over one of the two moving scrambled faces. Thus, although face-like configurations are important at this age, internal feature movement is not. Although internal feature movement had no specific effects on the preferences of 1- and 3-month-olds, it did have a significant effect on the 5-month-olds; the moving face pattern was significantly preferred over the other two moving stimuli. This finding is consistent with other recent reports indicating the importance of internal feature movement for infants' recognition of facial expressions (Birigen, 1987) and infants' ability to discriminate between facial or nonfacial movement of abstract patterns (Stucki, Kaufmann-Hayoz, & Kaufmann, 1987).

There remains the possibility that the younger infants show no effect of internal feature movement because they are less sensitive to the movement induced in the stimuli. That is, the younger infants are unable to detect the

TABLE 2
Arithmetic Mean Looking Times Toward the Stimuli (Seconds) for the Three Age Groups

	Face	Scram	Linear
1 month			
Moving	21.6 (16.3)	19.6 (16.9)	18.8 (14.4)
Still	17.6 (17.5)	20.8 (18.9)	13.2 (15.1)
3 months			
Moving	17.7 (17.3)	9.2 (7.6)	16.1 (18.7)
Still	21.1 (22.9)	10.4 (9.6)	11.0 (11.6)
5 months			
Moving	13.9 (12.5)	8.8 (13.7)	8.7 (8.1)
Still	9.2 (5.9)	12.0 (13.4)	8.7 (7.6)

Note. Standard deviations appear in parentheses.

movement in the "moving" stimuli. We regard this explanation as unlikely for at least two reasons. First, even newborn infants are able to detect some differences in relative spatial arrangement of similar-sized schematic face features from a similar viewing distance (Johnson et al., 1991). Second, both of the younger groups of infants showed (nonsignificantly) overall longer mean looking times toward the moving set of stimuli than toward either of the static sets of stimuli, suggesting that they detected the addition of motion. This latter finding is reinforced by the fact that when the data was analyzed using parametric statistics following logarithmic transform both the 1- and 3-month-old groups of infants showed significantly greater looking toward the moving set of stimuli than toward the static set of stimuli. This effect was independent of the significant preference for the face stimulus in the 3-month-old group.

These findings are broadly consistent with the notion that the older an infant gets, the more realistic the schematic representation of a face requires to be in order to elicit preferential attention, and that, by 5 months of age, the cortical representation of "faceness" may require the additional characteristic of internal feature movement.

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