

BRIEF REPORT

Recognition of Familiar Faces by Newborns

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Newborns, ranging from 12 to 36 hours of age, produced significantly more sucking responses in order to see an image of their mothers' faces as opposed to an image of strangers' faces using a preferential operant sucking procedure.

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Field, Cohen, Garcia, and Greenberg (1985) presented evidence that infants, ranging in age from 22 to 93 hours, would preferentially fixate their mother's face upon sequential presentation of the mother's face and a stranger's face. Bushnell, Sai, and Mullin (1989) replicated these results, simultaneously presenting the mother's face and the stranger's face with some additional controls, particularly maternal odor.

These results are sufficient to obsolesce most established theories of perceptual development (e.g., Bower, 1989); however, the results are not beyond question. Both sets of investigators used prolonged presentation of real live mothers and strangers. It is possible that changes in expression differentiated the two, or that the mother synchronized changes in her expression with changes in the infant's expression, in order to consciously or unconsciously elicit a first look from the infant and maintain looking as long as possible. The post-hoc control attempted by Bushnell et al. (1989) could not take into account this possibility.

Twelve healthy full-term infants (7 male, 5 female), ranging in age from 12 to 36 hours, completed the procedure. Infants had no history of pregnancy or birthing complications and had Apgar scores of 8 or greater at 1 and 5 min. Boy infants were tested prior to circumcision.

In this study, an image of the mother's face was captured on videotape and then loaded into an Amiga computer. The image was digitized in 16 colors at 640×200 pixels and displayed lifesize on a Sony 19-inch color monitor. Since all of the videotaping involved the mother looking at the video camera with a

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neutral facial expression, there is little possibility of capturing special maternal expressions that a mother would direct towards her infant. Each mother was matched with a stranger from a file held on the hard disk of a computer for hair color, eye color, complexion, and hairstyle, with a match on all four criteria being required for inclusion in the study. The matching was done by eye by an experimenter in the hospital. Each mother-stranger pair in this study was more alike than the pairs used in previous studies (Bushnell et al., 1989; Field et al., 1985). The addition of eye color and hairstyle increases the similarity of the mother-stranger pairs used in this study versus the mother-stranger pairs used in the Bushnell et al. (1989) study.

The infant controlled the presentation of mother or stranger by sucking on a pacifier and had no interaction with either image prior to testing. A complete (increment then decrement) positive pressure suck in the range of -20 cm to $+120$ cm H_2O switched off the background screen (homogeneous blue) and replaced it with Screen 1 (S1). Placement of the mother's face on either S1 or Screen 2 (S2) was random across infants but consistent for a given infant. The randomization was done by computer, so that for any given infant, the experimenter was blind to the order of stimulus presentation. The duration of S1 and S2 was 400 ms. Reinforcement was quasiconjugate (Crook, 1979) in the sense that a second suck during presentation of S1 or S2 terminated that reinforcement and began a new presentation lasting 400 ms unless the clock was reset by another suck. Each suck was reinforced by presentation of S1 for 400 ms until an intersuck interval (ISI) of 1 s or more occurred. A suck occurring 1 s or more after the last suck switched on S2. Subsequent sucks produced S2 until an ISI of 1 s or more occurred, in which case the second suck of the pair produced S1 once more. The infant could thus control what was presented by varying the rate of sucking.¹

Mothers and infants were recruited in a local private hospital. The prevailing standards of pre- and postnatal care were of the highest quality. Informed consent of the mother was first obtained, then the mother was videotaped, her image digitized, and a suitable strange face selected from the file. When both had been loaded into the computer program, the infant was brought into the experimental room. Only fully awake infants were tested. Three infants fell asleep before testing could begin. The infant was held upright facing the monitor, 25 cm from the screen, with "liberated neck" (Amiel-Tison & Grenier, 1986). The theory and practice of the liberated neck is described at great length by these authors; in essence, the head is gently lifted and supported to minimize pressure on the spinal cord. It would appear that a similar procedure was used by Bushnell et al. (1989).

The pacifier was then inserted and held in the infant's mouth by Experi-

¹ A copy of this computer program may be obtained by sending a blank 3½-inch disk to N.J.A. Bower at the Richardson, TX address.

menter 1 (E1). Experimenter 2 (E2) observed the infant to check that the eyes were open and fixed on the screen and monitored the infant during presentation. Neither experimenter could see the screen. When the infant was looking at the screen, E2 pressed the mouse buttons to begin the experiment. The first four sucks produced a bull's-eye pattern lasting 400 ms, after which 300 s of preference presentation began. There was a facility to pause the experiment if the infant grew inattentive, which was used once. During the pause, the infant was repositioned to facilitate looking at the screen. After this, the experiment was begun again to yield 300 s worth of data from an alert, attentive infant.

The mean number of responses for the mother's face was 155.08 ($SD = 33.30$), for the stranger's face, 117 ($SD = 30.38$), $t(11) = 3.39$, $p < .005$. The mean presentation time of the mother's face was 61.25 s, of the stranger's face, 46.50 s. Eleven out of 12 infants sucked more to see an image of the mother's face, $p = .0029$, by the binomial test. These results, thus, replicate the results of Bushnell et al. (1989) and Field et al. (1985).

A previous study by Wolff (1968) measured the mean nonnutritive sucking rate of 4-day-old newborns at 2.13 sucks per s, with high consistency of rate across states of wakefulness. Our findings are comparable, given the introduction of a contingency which gives the newborns the opportunity to modify their sucking patterns in order to see the stimuli.

In the prior studies of Bushnell et al. (1989) and Field et al. (1985), the preference for the mother appeared right away. We assume that there was a similar pre-experiment preference in our subjects; however, the preference did not manifest itself immediately. The minute-by-minute averages of sucking over the course of the 5-min experiment are shown in Table 1 (p. 268). We assume that the delay occurred because the infants had trouble learning how to control the apparatus. In the 11 infants who did show preference for the mother, there came a point during the experiment when the mean number of sucks for the mother exceeded those for the stranger, and stayed above. However, there were significant differences in the time taken for preference to emerge, ranging between 40 s and 280 s after the beginning of the experiment. The hypothesis that the infants did have difficulty in controlling the apparatus may explain the exceptional infant, the one who did not show a preference. In the last 30 s, that infant sucked 37 times for the mother against 4 for the stranger; the overall stranger preference was 2 responses. With a longer experiment, that infant might have shown a preference for the mother. All of the infants in this study looked more at the mother's face once they could control the apparatus. The time to master the apparatus was the main source of individual difference. These issues are more a matter of operant learning than perception. The latter are the concern of this article.

The ability of a newborn to identify a familiar face raises many interesting questions. The ability is clearly learned. Various colleagues have considered

TABLE 1
Mean Number of Sucks as a Function of Face and Time

Face	Time (minutes)				
	0-1	1-2	2-3	3-4	4-5
Mother					
M	25.08	36.92	37.00	28.00	28.08
SD	15.24	14.01	9.69	4.26	9.25
Stranger					
M	28.00	36.00	13.00	20.00	20.00
SD	18.81	13.30	3.34	5.67	5.76

the possibility that the normal bonding routine in which the first face the infant sees is mother's may stamp an image of mother that defines the infant's attachment figure. This idea is akin to theories of imprinting (Lorenz, 1952). In the hospital in which this study was conducted, infants who are born vaginally are routinely placed immediately upon the mother's abdomen and encouraged to nurse, if the mother so desires. The infants remain with their mothers for the next hour and are subsequently taken to the nursery to be weighed and measured. Infants born at this hospital by cesarean section are first shown to the mother, allowing face-to-face contact between mother and infant, and are then taken to the nursery while the mother's surgery is completed; infants are then brought back to the mother. Mothers may call to the nursery to have their infants brought to them whenever the mothers desire.

Two items of information may be relevant to the issue of imprinting. One concerns preference for the father's face. Bonding routines ensure that the father's face is not the first face that the infant sees; however, some fathers are fortunate enough to spend time with their newborn so that the infant can become familiar with them. One mother suggested that we use the father's face rather than hers, because the father had spent more time with the infant than she had. We obtained consent and tested three infants with the fathers' faces versus male strangers' faces. The number of responses elicited by father's face versus male stranger's face was, respectively, 70 versus 60, 75 versus 73, and 95 versus 91. All of the three infants tested showed a father preference. However, the differences are not significant and are much smaller than those seen with mother versus female stranger; there are not enough data to say whether they are significantly smaller.

Performance was not related to infant age. We had and cannot obtain in the future any data on how much face-to-face contact actually occurred between mother-infant pairs. This would require continuous observation of mother and infant. Because this study is concerned with visual recognition of a familiar face, records of the amount of time that the infant spent with the mother at each feeding would be an inaccurate representation of how much

time the infant actually spent with eyes open, fixated on the mother's face. It is doubtful that any hospital would allow such a continuous intrusion of the intimate moments between a mother and her newborn.

The latter results with father-stranger pairs support the idea that the first face is more important than the most familiar face; the mother's face is normally both. We were able to study in part the emergence of preference in one infant. We tested one infant who had gone through the normal hospital bonding routine with his mother after birth and had not been with her again before the first testing session. The first test at 5 hours of age yielded no mother preference. A retest at 12 hours and two feedings later showed a significant mother preference. The number of responses for mother at 5 hours was 73, for the stranger, 78; the corresponding numbers at 12 hours were 90 and 68. The difference is significant, $\chi^2(1, N = 1) = 5.77, p < .025$. However, this single result does not seriously undermine the idea that it is the first face that is significant. It is probable that the infant could not control the display on the first presentation, because learning to control the display was the main source of individual difference. It may require some time postbirth for the powerful newborn learning mechanisms to settle down and operate to full capacity. It will take a great deal of further research to answer that question and the other questions raised by this fascinating newborn ability.

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