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FIXATION OF THE STANDARD AND NOVELTY PREFERENCE IN SIX-MONTH-OLD WELL—AND MALNOURISHED INFANTS

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The majority of the world's population has suffered a period of malnutrition in childhood (Jelliffe, 1966). Children who have been severely malnourished early in life perform more poorly than their well-nourished peers on assessments of intellectual development (for reviews of this research see Birch, 1972; Pollitt & Thompson, 1977; and Brožek, 1978). The interpretation of these results is disputed. It is unclear how much these early deficits were caused by malnutrition per se or by other factors associated with malnutrition (Warren, 1973). In addition, it is unclear whether these deficits persist into adulthood (Stein, Susser, Saenger, & Marolla, 1972).

Most researchers have used traditional infant scales or IQ tests in order to assess the intellectual development of the malnourished child. Relatively little is known concerning specific capabilities which may be affected by malnutrition. Fantz and his collegues have compared the preferences of normal and high risk infants for visual stimuli differing on a number of dimensions (Fantz, Fagan, & Miranda, 1975). Institutionalized infants (Fantz & Nevis, 1967), Down's Syndrome infants (Miranda & Fantz, 1974), and premature infants (Fantz & Fagan, 1975) all differ from normal infants in the age that they begin consistently to prefer certain visual stimuli to others. One of these differences concerns a preference for novel stimuli.

The present study attempted to determine whether there are differences between well- and malnourished infants in the extent to which they prefer novel stimuli. One potential problem in interpretation is the likelihood that malnourished infants are relatively unresponsive to external stimuli. Lester (1975) has reported that 14-

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month-old male malnourished infants failed to "orient" to pure tones as indexed by cardiac deceleration, whereas well-nourished controls did. Lester's results add confirmation to clinical observations that the malnourished infant is relatively unresponsive to certain external stimuli. Consequently, in order to compare the preferences of well- and malnourished infants for novel stimuli, it is necessary to equate the extent to which the infants have processed the familiar stimuli. It is unclear how to define an equal amount of visual processing in infancy (see Cohen & Gelber, 1975, for a discussion of this problem). We have used one definition which proved to be useful.

EXPERIMENT 1

Subjects

The subjects for this experiment were obtained from government-sponsored well-baby clinics in Guatemala City, Guatemala. All the families using these clinics come from impoverished regions of the city. Although comparisons are inappropriate, these families would be classified in the lowest social class in Western cultures. All of the infants in the sample were born at Hospital Roosevelt, the large government-sponsored hospital in Guatemala City. All of the infants weighed greater than 2.5 kg at birth and had no history of significant health problems in the pre-, peri-, and post-natal periods (defined as serious enough to require a clinic visit or hospitalization). Malnutrition was defined by retardation in weight for age according to Gomez's classification (Gómez, Galván, Frank, Cravioto, Chávez, & Vaśquez, 1956). All infants who were from 5½ to 6½ months of age and were defined by Gomez's classification as second or third degree malnourished (75% or less of the expected weight for age) were included in the sample. The mean age of the 16 subjects in the sample was 5.9 months ($SD = .4$) and their mean weight was 5.03 kg ($SD = .68$ kg). Half of the subjects were males; the other half were females.

Apparatus and stimuli

A visual preference apparatus was used to present the stimuli. It consisted of a three-sided box with a base but no top. The interior of the box was painted flat grey. The side bounded by the other two served as the presentation stage. The stimuli were presented through a 70 x 50 cm aperture in the presentation stage. The stimuli consisted of pairs of non-glossy black-and-white photographs of human faces placed side by side on the white cardboard background. The faces measured 20 cm from the tip of the chin to the top of the head. Forty centimeters separated the center of the two photographs. Midway between the photographs was an observation peephole, 7.5 mm in diameter. The experimenter sat on one side of the presenta-

tion stage and looked through the peephole to observe the eyes of the infant who was seated on the other side of presentation stage. When seated, the infant was facing the presentation stage and his eyes were about 64 cm from the peephole.

Each subject was presented one standard stimulus followed by one test stimulus. The standard stimulus consisted of two identical photographs placed side by side. The test stimulus also consisted of two photographs: one was identical to the photographs in the standard stimulus; the other was novel. One of the photographs used in the present study was the face of a Guatemalan man; the other was the face of a Guatemalan woman. The 16 subjects were randomly placed by sex into one of four groups, two with the photograph of the man as the standard stimulus and two with the photograph of the woman as the standard stimulus. The novel photograph was located on the left for two groups of subjects, one with the woman as the standard and one with the man as the standard. It was located on the right for the other two groups of subjects.

Procedure

Transportation for the mother and her infant was furnished to the Institute of Nutrition for Central America and Panama where the testing was conducted. Prior to testing, the infant was weighed, and the mother was questioned concerning the infant's health status. Sick infants at the time of testing were excluded from the experiment. The experiment was then explained to the mother, and the mother and her infant were led into the experimental room.

The subject was placed in the visual preference apparatus, and the mother was seated nearby out of view. The experimenter listened to a tape recorder through an earphone. Taped instructions specified when and how long the standard and the test stimuli should be presented. The standard stimulus was presented for 60 seconds. The experimenter recorded the subject's visual fixations for each of the two photographs on separate channels of an event marker. After a 60-second interval, the occluding panel was again slid into place. During the 10-second interval, the standard stimulus was replaced by the test stimulus. The test stimulus was presented for 10 seconds and the infant's fixations of the novel and familiar photographs were recorded on separate channels of the event recorder. The experimenter did not know on which of the two sides the novel stimulus was presented.

Inter-observer reliability was assessed on 16 normal infants (mean age =5.7 months, $SD = .3$). A second experimenter recorded the infant's fixations through a second peephole 30 cm above the first peephole. Because of their proximity, the second experimenter had to tilt her head in order to look through the peephole. Preference for the novel photograph was measured by subtracting the time

fixating the familiar photograph from the time fixating the novel photograph during the test phase. The two experimenters reliably coded the infants' total fixation of the standard photographs ($r = .91$) and preference for the novel photograph ($r = .95$).

Results

A one-sample *t*-test was computed to determine if the malnourished infants fixated the novel photograph longer than the familiar photograph during the test (mean preference for the novel = .01 secs, $SD = 4.81$ for males and .28 sec, $SD = 4.32$ for females). It was nonsignificant. In contrast, Lasky, Klein, and Martinez (1974) have reported that well-nourished six-month-old infants from the same population as the malnourished sample reliably preferred the novel photograph with stimuli and presentation times identical to those used in the present study. Lasky et al. also used Gómez's classification to define nutritional status in their sample (90% or more of the expected weight for age).

This study suggests that malnourished infants differ relative to well-nourished infants in the effect of familiarity on their fixation preferences. The malnourished infants looked less, although not significantly so, than the well-nourished infants ($\overline{X} = 28$, $SD = 18$ for the malnourished infants, and $\overline{X} = 32$, $SD = 14$ for the well-nourished infants). Thus, malnourished infants may be unable to form representations of stimuli in memory, they may do so relatively slowly, and/or they may merely fixate stimuli less frequently than well-nourished infants. Experiment 2 was conducted in order to differentiate these alternative interpretations.

EXPERIMENT 2

Subjects

Subjects were obtained from the same well-baby clinics using the same criterion for nutritional status as in the previous experiment. There were 32 well-nourished and 32 malnourished infants (16 males and 16 females in each group). The well-nourished infants had a mean age of 5.9 months ($SD = .3$) and a mean weight of 6.97 kg ($SD = .70$). The malnourished infants' mean age was 6.0 months ($SD = .3$), and their mean weight was 5.13 kg ($SD = .61$).

Procedure

The apparatus, stimuli, and the counter-balancing of stimuli were the same as those used in Experiment 1. The only procedural difference concerned the presentation of the standard. The presentation of the standard stimuli depended on the amount of time the subjects fixated the standard photographs. The visual fixations of the subjects were recorded as in Experiment 1 on an event recorder. In addition,

a second experimenter observed the event recorder and used a timer to record the accumulated fixation time for both photographs of the standard stimulus. The second experimenter signalled to the first experimenter via an earphone when to replace the standard stimulus with the test stimulus. The subjects were presented the standard stimulus for approximately 30 seconds of fixation time (the mean fixation as later measured from the event marker was 31.5 seconds, $SD = 2.8$ for the well-nourished sample and 30.8 seconds, $SD = 1.9$ for the malnourished sample). The fixation time for the present experiment was selected after reviewing. the relationship between fixation time and preference for the novel photograph in a study by Lasky (1979) using the same stimuli, apparatus, and procedure as used in the present. Lasky presented stimuli to well-nourished Guatemalan infants for 15, 30, or 50 seconds of fixation. Only the 30- and 50-second fixation groups significantly preferred the novel stimulus, and they did not differ in their preference behavior.

Results

The mean preference times for the novel photograph and the proportion of time fixating the standard are presented in Table 1. Both malnourished and well-nourished infants significantly preferred

TABLE 1

Preference for the Novel Photograph and Proportion of Time Fixating the Standard in Experiment 2

Nutritional Status	Sex	Preference for the novel photograph (secs) $\bar{X}$	*SD*	Proportion of time fixating the standard $\bar{X}$	*SD*
Well-nourished	Males ($n=16$)	2.85**	3.70	.67	.23
	Females ($n=16$)	2.83**	2.49	.63	.19
	Total ($n=32$)	2.84**	3.10	.65	.21
Mal-nourished	Males ($n=16$)	1.01	4.06	.56	.15
	Females ($n=16$)	2.39*	3.91	.56	.18
	Total ($n=32$)	1.70*	3.98	.56	.17

*$p < .05$ (fixation of the novel-fixation of the familiar $\neq 0$)
**$p < .01$

the novel photograph. The malnourished males were the only nutritional status x sex group that did not significantly prefer the novel stimulus. A 2 (nutritional status) x 2 (sex) x 2 (standard) x 2 (position) analysis of variance was computed. None of the main effects or interactions proved significant.

A 2 (nutritional status) x 2 (sex) x 2 (standard) analysis of variance was computed to determine if well- and malnourished infants differed with respect to the proportion of time they fixated the standard. None of the main effects or interactions proved significant. The nutritional status main effect approached significance ($F = 3.60$, $df = 1/56$; $p = .06$).

GENERAL DISCUSSION

The present study investigated the effect of familiarity on fixation preferences in well- and malnourished infants. In Experiment 1 malnourished infants failed to demonstrate any effect of familiarity in a situation in which well-nourished infants had demonstrated a strong effect. Experiment 2 demonstrated that given sufficient exposure to a stimulus, malnourished infants did fixate a novel stimulus significantly longer than a familiar one. This statement is less clear for male than for female malnourished infants. Malnourished male infants did not differ statistically from their well-nourished peers in their preference for the novel stimulus in Experiment 2. As a group, however, they failed to demonstrate a statistically consistent preference for the novel stimulus. With a larger sample size the issue of sex differences could be resolved. Sex differences concerning the effect of environmental factors on intellectual performance have been noted by Bayley and Schaefer (1964). Bayley and Schaefer argue that males are more affected by environmental factors than females although data bearing on this issue are mixed (Maccoby, 1966). Barnes and his colleagues (Barnes, Cunnold, Zimmerman, Simmons, MacLeod, & Krook, 1966) observed nutritional effects on the behavior of male rats but not female rats. The possibility that malnutrition may affect the behavior of male infants but not female infants is not without precedent.

Although malnourished and well-nourished infants may not differ qualitatively in their ability to become familiarized with a stimulus and prefer a novel one of comparable complexity, they may differ quantitatively. Quantitative differences in processing efficiency in malnourished infants can be investigated by using a greater range of exposures to the familiar stimulus. Work by Friedman (1972) and Milewski and Siqueland (1975) suggests that the very young infant does prefer a novel stimulus given sufficient exposure to the familiar stimulus. Previous negative reports (Bronson, 1974; Fantz, 1964; Jeffrey & Cohen, 1971; Kagan, 1970) probably failed to present the familiar stimulus sufficiently long. Thus, the newborn's deficit seems

to be quantitative and not qualitative as had been concluded. A similar error of interpretation could have been made concerning Experiment 1 of the present study if Experiment 2 had not been conducted.

Fantz, Fagan, and Miranda (1975) have demonstrated the utility of assessing visual preferences, including a preference for the novel, in Down's Syndrome, premature infants, and normal infants. By varying the age, exposure to the familiar stimuli, and type of stimuli, Fantz and his colleagues have demonstrated differences in infants of different developmental levels and/or intellectual potential. As yet there is little data which relates early assessments of a preference for novel stimuli and intellectual performance in later childhood and adulthood. Work by Fantz and his colleagues suggests that a preference for the novel may have utility as an assessment of early cognitive ability.

Although differences between well- and malnourished infants in the proportion of time fixating the standard were only marginally significant, they are worth commenting on. First, proportion of time fixating the standard represent an important variable. It measures, in part, the extent that infants visually explore their environments. Given the clinical symptoms of malnutrition, it is likely that malnourished infants may be less visually responsive to their environments. Second, differences in preference for novel stimuli as a function of malnutrition, age, or other status variables can only be unambiguously interpreted if fixation of the standard is considered. If comparison groups differ in the extent that they visually explore their environments, methods presenting stimuli for a constant time interval will be inadequate to make definitive statements concerning processing time.

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