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ABSTRACT

The human infant is now considered capable of active informational interaction with the environment. This study tested certain hypotheses concerning the nature of that interaction. These hypotheses, developed partly from Piaget's work, are (1) that repeated visual encounters with a stimulus pattern leads first to attentional preference for that pattern, before leading to preference for an unfamiliar pattern and (2) that patterns responsive to an infant's own acts will acquire an extra attractiveness. Study subjects, 15 infants, approximately 1 month old, had 2 patterns (colorful mobiles of yarn, match boxes or paper umbrellas) introduced above their cribs when they were 4-5 weeks of age. One of these patterns was stable and one was set up to be responsive to the infants' movements, but variation in size and mobility of cribs in the various homes made data relating to the second hypothesis invalid. After the infants had had 4 weeks of familiarization with the patterns, observers tested them twice for attentional preference, with a third, unfamiliar pattern added above the crib. Another period of 4 weeks was followed by a final test. Results indicated initial attentional preference for familiar patterns, followed by preference for unfamiliar patterns after the additional period. (MH)

ATTENTIONAL PREFERENCE AND EXPERIENCE: II. AN EXPLORATORY LONGITUDINAL STUDY OF THE EFFECTS OF VISUAL FAMILIARITY AND RESPONSIVENESS[1,2]

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In recent years, the human infant has come increasingly to be viewed as capable of active informational interaction with the environment. From birth on, the infant not only attends to sights and sounds, but he attends to them selectively, indicating an ability to discriminate inputs along several dimensions (3). If specific interactions with the environment are to be considered important, however, it must be shown that such experiences have a lasting effect on the infant's reactions to the same inputs at some later time. Discrimination of the repeatedly-encountered aspects of the environment from the totality of perceived stimulation may be among the earliest outcomes of perceptual interaction with the environment.

Drawing on several lines of evidence including Piaget's (10) observations of his own children, Hunt (6, 7, 8) has inferred that, under at least certain conditions, repeated perceptual encounters with objects, persons, and places appear to lead to attentional preference for what has become familiar before they lead to such preference for what is unfamiliar or novel. This exploratory study was designed chiefly to test the hypothesis that patterns intermittently encountered over a period of time through vision elicit attentional preference before such preference shifts to unfamiliar patterns. This hypothesis corresponds in certain ways to Hebb's conception of the relation of pleasure to memory where he says that "one would find behavior dominated always by the thought process that is not fully organized -- one that is achieving a new organization or one in which synaptic decay makes it necessary that organization be reachieved" (5, p. 229). In other words, attentional preference presumably goes to objects and patterns which have been perceived just often enough to develop central processes which permit tentative recognition.

This exploratory study concerns also a second hypothesis which has also been suggested in part by Piaget's (10) observation of the delight infants appear to show in the perceptual events which their intentional efforts bring forth, and in part by the fact that objects for which individuals expend effort acquire interest and value (4). According to this hypothesis, patterns which become responsive to an infant's own acts should thereby acquire attractiveness and elicit attentional preference over both patterns which have acquired more recognitive familiarity and also patterns which are unfamiliar or novel.

METHOD

The strategy of this exploratory study consisted in placing two patterns over the cribs of young infants for them to look at and become familiar with. These patterns were installed when the infants were approximately one month old, for a period of four to five weeks. This first period of familiarization was followed by two testings 48 hours apart, and then by another period of four weeks of familiarization, and finally, a third testing. One of the stimulus patterns was attached to a chemistry stand placed alongside the crib so that it was stable and quite unresponsive to any of the infant's movements. The other stimulus pattern was attached directly to the crib and was expected to respond to the infant's kicks and body movements by swaying. The anticipated attentional preference for the responsive-familiar pattern over the stable-familiar pattern and the attentional preference for both the familiar patterns over the unfamiliar one, at least at first, were expected to manifest themselves by longer looking times during the tests of attentional preference, by more smiling, and by more vocalizing toward the preferred patterns.

Subjects

The subjects for this study were obtained in response to a letter sent to those parents whose names appeared in the birth notices of the local newspaper. All of the infants who served as subjects were full-term babies with no known abnormalities or impairments. Over half of them came from student and faculty families. A total of 22 infants appeared in the course of the study, but 4 were dropped for continuous side preference (looking only at one side, irrespective of the pattern), and 3 eliminated themselves by leaving town prior to the completion of the study. This report is based, therefore, on data from 15 infants, 7 boys and 8 girls.

Apparatus

Three different stimulus patterns were constructed for the infants to look at. The base of each was either an equilateral triangle with five-inch sides or a circle five inches in diameter cut from masonite and painted yellow or red. Thus, the stimulus patterns differed in both the color and the shape of these bases and in the nature of the dangles hung from these bases.

The yarn patterns consisted of three tassels made from yarn of various colors. The center of each tassel was of bright-colored yarn (yellow, red, green) while the outside ring was of neutral-colored yarn (gray, tan, or grayish-blue). The three tassles were attached at equal intervals to the edge of the base by three-inch strings.

The box patterns consisted of three match boxes covered with colorful wrapping paper and attached at equal intervals to the edge of the base by three-inch strings. Each box presented a rectangular shape in colored wrappings.

The umbrella patterns consisted of three open, paper umbrellas (yellow, green, and purple) with small flowers painted without prominence on two of them. These were attached to the edge of the base by three-inch strings. These umbrellas presented a series of colored circular displays to the infants.

The base of each of the stimulus patterns was attached to a horizontal pole by means of a loop at the center. The horizontal pole was secured by a right-angle clamp to a vertical pole either coming from a stand resting on the floor or attached to the side of the infant's crib. This arrangement permitted both vertical and horizontal adjustment, making it possible to display the stimulus patterns about 12 inches from the infants' eyes and about 10 inches from each other in spite of variations in the infants' cribs.

These three kinds of stimulus patterns were intended to be roughly matched for brightness, complexity, and attractiveness to the infants. Since such matching could not be perfect, however, the placement of the three types of patterns was counterbalanced. Each served equally often as the familiar-responsive, as the familiar-stationary, and as the unfamiliar one. For each infant, two of the three patterns were familiar, while the third was novel.

Procedure

The study was conducted in the homes of the infants. Most of the infants were between four and five weeks of age when the two stimulus patterns were placed over their cribs. It was assumed that the infants would look at and become familiar with these patterns as they lay awake in their cribs. To insure that all spent at least some time looking at them, each mother was requested to find two 15-minute periods each day when her infant was awake and satisfied and could be placed in the crib specifically to look at the patterns. No other attempt was made to control the exposure of the patterns or the treatment of the infants in their homes. No mother, however, reported difficulty in establishing such "viewing times" after the infant was over six weeks of age.

The tests of attentional preference came in three sessions following the periods of exposure to the patterns. The infants were tested in their own cribs by a single observer. The observer stood at the foot of the crib in a position which permitted a clear view of the direction of an infant's gaze and eye movements. The sweep second-hand of a stopwatch was used to time the infants' fixations. These were recorded manually. The only check on reliability was made by repeating a portion of the observation at the end of a session if an infant was still cooperative. This testing procedure demanded too much of the experimenter, but even so, the agreement between two such records was close. The ages of the infants at the time the stimulus patterns were placed over their cribs and at the time of each test session is given in Table 1.

The initial test of attentional preference concerned first an infant's preference for one of the two familiar patterns. This was assessed while each infant was in his crib with both familiar patterns attached for viewing by obtaining a record of the time he looked at each of them until a total of five minutes of looking had accumulated. Following this, the preferred-familiar pattern was then paired with the unfamiliar one and the record of each infant's looking was obtained until four minutes of looking time had accumulated. After the first two minutes of looking time, the two patterns were reversed in position in order to control for side-preference. A similar four-minute looking record was then obtained for the unpreferred-familiar pattern paired with the unfamiliar one.

The second test came after the two familiar patterns had been removed for a period of 48 hours in order to eliminate any effects of satiation from continuous viewing. The testing procedure during the second test was similar to the first, but the pairings of the two familiar patterns, first the preferred one and then the unpreferred one, with the unfamiliar one came before the five-minute pairing of the two familiar patterns. For the latter test, the infants were in their cribs with the familiar patterns in their accustomed places for viewing.

At the end of the second test of attentional preference, the same two patterns were again placed over each infant's crib and a third test of attentional preference was scheduled following another four weeks of exposure to them. The mean age of the infants at the time of the third test was 3 months and 6 days. The procedure of this third testing followed that of the first except that the two patterns were removed for 24 hours prior to the testing. Following this third testing session, the study was terminated.

Test sessions were arranged at times when each infant would normally be awake, comfortable, and free from bodily needs. When an infant was unable to complete the tests in any session, which required about 20 to 30 minutes of cooperation, that session was rescheduled for the nearest time that the infant could again be expected to cooperate.

RESULTS

The first hypothesis that repeated visual encounters with a stimulus pattern leads first to attentional preference for that pattern, before leading to preference for an unfamiliar pattern, is supported by the results as will be seen shortly. The second hypothesis that patterns responsive to an infant's own acts will acquire extra attractiveness gets no support. The times of looking at the familiar patterns while paired with a novel one was subjected to a repeated-measures analysis of variance with the responsive versus stationary condition of the familiar pattern and the successive tests as treatments (12). The condition of the familiar pattern (responsive versus stationary) failed to influence significantly the time it was looked at while it was paired with an unfamiliar pattern. Thus, the times during which the infants looked at their two familiar patterns while they were paired with an unfamiliar one

could well be combined. The sessions did have a significant effect upon the times of looking at the familiar pattern ($F = 4.62$; df 2, 28; $p < .025$), inasmuch as the infants looked less at their familiar patterns during the third test session than they did during the first two. This latter finding indicates that a process is going on, and that the additional perceptual contact with these patterns during the second four weeks of familiarization led in the third test to less of looking at the familiar patterns and more of looking at the unfamiliar one.

Since each of these tests of attentional preference consisted of a total of 4 minutes of looking at one or the other of the paired patterns, the time of looking at the familiar pattern is the complement of the time of looking at the novel one. Since there are two familiar patterns the looking-time for which can be combined because the responsive versus stationary condition has no effect, a total of 8 minutes of looking is involved. If an infant had no attentional preference, he could be expected to look at each pattern 50% of the time, or 240 seconds out of the 8 minutes of looking time. Table 2 gives the mean times of looking at the various patterns while in their unfamiliar role.

During the first test, made when the infants might well have been satiated with their familiar patterns, the 15 infants in this sample directed their gaze at the unfamiliar pattern a mean of 194.6 seconds, or 40.5% of the looking time. This duration of looking at the unfamiliar pattern is significantly less then 240 seconds, using a one-tailed test ($t = 1.773$, df 14, $p < .05$). In this first test, however, attentional preference for the familiar was substantially less than unanimous. While a majority of 9 infants looked longer at the familiar patterns than at the unfamiliar one, 6 looked longer at the unfamiliar one. If one considers only the preferred familiar pattern in this test, 11 looked longer at it, while 3 looked longer at the unfamiliar one, and 1 showed no preference ($z = 1.78$, $p < .05$, one-tailed, testing for the difference between two proportions).

During the second test, after the familiar patterns had been removed from exposure for a period of 48 hours to eliminate any influence of satiation, the 15 infants looked at the unfamiliar pattern for a mean time of 190.3 seconds or 39.6% of the total 8 minutes of looking time. Moreover, 11 rather than 9 looked longer at the familiar patterns, and only 4 looked longer at the unfamiliar one ($z = 1.78$, $p < .05$, one-tailed). Despite the fact that the mean time of looking at the unfamiliar pattern in this second test is slightly less than that of the first, the difference between the mean of 190.3 seconds and the 240 seconds comprising 50% of the total looking time falls somewhat short of statistical significance ($t = 1.732$, df 14, for $p = .05$, $t = 1.771$).

In the third test when the two familiar patterns had been exposed for an average of 67 days and the infants averaged 3 months and 6 days of age, attentional preference for the familiar patterns had shifted in favor of the unfamiliar pattern. The 15 infants looked at the unfamiliar pattern

for a mean of 255.0 seconds or 53.1% of their looking time. Moreover, only 6 infants looked longer at the familiar patterns, while 8 looked longer at the unfamiliar one, and 1 showed no attentional preference. Thus, these shifts in preference from the two initial tests to the third as well as the repeated-measures analysis of variance indicate that a process is going on which leads from a tendency to prefer familiar patterns toward a tendency to prefer novel ones.

Table 2 also indicates considerable variation in the attractiveness of the various patterns. The yarn pattern appears to be most attractive, the box pattern next, and the umbrella pattern third. In order to examine the statistical significance of the effect of the stimulus patterns on looking time, the total times of looking at the novel pattern (pooled for pairings with the two familiar patterns) were subjected to a two-factor, repeated-measures analysis of variance with the three stimulus patterns (yarn, boxes, umbrellas) and the three test sessions as treatments. The effect of pattern was found to be very highly significant ($F = 13.09$; df 2, 12; $p < .001$). The effect of the successive testings is again significant ($F = 4.66$; df 2, 24; $p < .025$), inasmuch as the infants looked longer at the novel pattern during the third session than during either of the previous two, irrespective of the pattern. The interaction of patterns with sessions, however, was not significant ($F < 1$).

Although the second hypothesis that the responsive-familiar pattern would be preferred over the stationary one failed to get support in the results already mentioned, it should be noted that this hypothesis failed to get an adequate test in this study. The test was inadequate because of the variation in the cribs, the choice of which was left to the parents. Some of the cribs were so large and rigid that a small infant kicking and shaking himself produced no perceptible movement in the stimulus pattern attached to it. On the other hand, a few of the infants slept in cradles so bouncy that even their slightest movement swayed the pattern attached to the cradle. Since the patterns attached to these cradles swayed nearly all the time, the infants had no basis for recognizing a contingency between their own movements and the swaying of the patterns. In several cases where the cribs were moderately mobile, however, the infants did indeed develop what one might call a "relationship" with the responsive pattern. A baby's kicking would set the pattern in motion, and he watched the motion with such signs of delight as cooing and laughing until the movement almost stopped. He would then look intently as if concentrating on something difficult and kick again. As the pattern resumed swaying the signs of delight would reappear. These infants repeated such interactions with their patterns for periods of considerable length. All of the infants who developed such a relationship preferred the responsive pattern to the stationary one. Such cases were too few, however, for statistical tests.

When the time of looking at the pattern intended to be responsive, during the two five-minute tests, was subjected to a repeated-measure analysis of variance with type of pattern (yarn, boxes, umbrellas) and

sessions as the two main effects, neither proved to be significant, although the factor of pattern approached significance ($F = 3.86$, df 12, for $p = .05$, $F = 3.88$). Largely because those infants who had developed a relationship with their responsive pattern kicked repeatedly and looked almost continuously at their swaying, responsive pattern during these five-minute tests of attentional preference, the duration that the group as a whole looked at the pattern intended to be responsive averaged longer than the time they looked at the stationary one. In the first test, the infants looked at the pattern intended to be responsive for a mean of 199.3 seconds, or 66.64% of the five minutes of looking time. During the second session, they looked at it a mean of 195.3 seconds or 65.1% of the looking time. In the third test, they looked somewhat less at the responsive pattern -- a mean of 173.6 seconds or 57.8% of the looking time. Of the 15 infants in the sample, 11, 10, and 9 infants looked longer at the pattern intended to be responsive than at the stable pattern during the first, the second, and the third tests respectively. Despite the high average of the times of looking at the responsive pattern, so great is the variance in the individual looking times that these means are not significantly greater than 150 seconds (50% of the five minutes of total looking time). The variance is so great because those infants who learned to produce swaying did so during the tests. While they looked almost continually at their swaying pattern, others who had not learned to sway the pattern intended to be responsive looked at it relatively little during these tests.

DISCUSSION

In general, the results of this study are consonant with the first hypothesis that repeated visual encounters with an object or pattern lead first to attentional preference for that object over another which is unfamiliar, before such encounters lead to attentional preference for an unfamiliar one. The fact that only 11 of the 15 infants looked longer at the familiar pattern than at the unfamiliar one, even during the second of the first two tests when the exposed patterns had been removed for 48 hours to eliminate satiation, however, gives one pause. Looking time, moreover, is but a single measure of attentional preference. If these exploratory findings concerning this first hypothesis are valid, however, they carry certain implications.

First, the attentional preference for the familiar pattern appeared substantially earlier than expected on the basis of Piaget's (10) observations of the onset of intentional behavior in his own children. Moreover, this preference began to wane in favor of attentional preference for the unfamiliar in the course of this study long before the age at which Piaget's children reached the latter portion of sensorimotor Stage IV when the onset of interest in novelty first appeared.

Whether this change of attentional preference for the familiar one to preference for the novel one represents a general developmental stage is an unsettled issue. The fact that the shift occurred so rapidly for

the patterns used in this study, which were all of a general kind, suggests that such a shift in preference may, under certain still unspecifiable circumstances, be a function of an infant's perceptual interactions with relatively specific kinds of patterns of receptor input. The impression of a general, maturational stage of interest in novelty may possibly be an artifact of infants typically encountering a fairly large number of objects, patterns, persons, and places within their living situations at about the same rate. A series of perceptual interactions with any kind of pattern of input may well lead to a phase of attentional preference for it over unfamiliar ones as the central processes required for recognition are developing, and additional perceptual interactions may lead preference to shift to unfamiliar variants.

The number and duration of the interactions required for attentional preference for the familiar and then for the shift to attentional preference for the novel may vary considerably with several factors. Intricate and complex patterns very likely require more perceptual encounters for the development, first of those central-process codings which permit recognition and lead to the preference for the familiar, and, then, to that habituation which, as Hebb (5, p. 229) has suggested would lead to that loss of interest in the repeatedly encountered and to attentional preference for what is unfamiliar or novel within the domain of the pattern concerned. It is also likely that the number and duration of perceptual encounters required to achieve these changes in attentional preference will depend in part on the number of patterns which the individual has already learned to recognize. Such a principle corresponds to Piaget's aphorism that "the more objects the child sees the more new ones he wishes to see" (10, p. 277), if this aphorism is true.

Yet, as Hunt (7, 8) has suggested, a transition to a stage-like, generalized interest in the novel may possibly occur through experience relatively independent of maturation. Learning to recognize through repeated perceptual encounters a substantial number and variety of objects, persons, patterns, and situations may well lead to a kind of generalized expectation that "things should be recognizable." Such a generalized interest in the novel need in no way interfere, however, with an earlier development of attentional preference first for the familiar and then for what is unfamiliar for specific kinds of patterns.

Second, this finding of attentional preference for familiar patterns seems, at least at first glance, to be at variance with the results of other studies in which the experience of infants with specific patterns of stimulation have been manipulated. Both Fantz (2) and Saayman, et al. (11) have reported repeated perceptual encounters with given patterns to result in lengthened fixation times for the unfamiliar patterns paired with them. These experiments, however, involved almost continuous exposure of the infants to the familiar pattern during a single, relatively brief test-session. Such nearly continuous exposure to a pattern might well set up pattern satiation without developing those central processes upon which recognition depends, at least in the very young. Such considerations suggest that a distinction should be made between satiation,

for more or less continuous perceptual contact, and habituation, for repeated perceptual encounters over an extended period of time (see 8). On the basis of such a distinction, we expected substantially longer looking at the familiar patterns in the second test-session, following removal of the exposed patterns for 48 hours, than in the first test. Actually it increased the time of looking at the familiar pattern by only 4.3 seconds on the average (see Table 2 for the obverse of this statement). By no stretch of the imagination could this be considered to be a significant change. While the finding of attentional preference for the familiar pattern develops before attentional preference for the novel in this study supports this distinction between satiation and habituation, the evidence obtained by removing the exposed patterns to eliminate any effects of perceptual satiation in the second test session hardly supports it.

The evidence from this experiment is quite inconclusive for the second hypothesis that the responsive pattern should be preferred over a stationary one. While all infants who learned to sway their responsive patterns by kicking and shaking themselves preferred that pattern over the stationary one in the first two tests, even the meaning of this preference is unclear. These five-minute preference tests were conducted in the cribs with the patterns attached in their accustomed fashion. Those infants who had developed a relationship with their mobile patterns typically kicked and shook themselves to keep these patterns in motion during the tests. Thus, they were presented in these tests with a moving pattern and a stationary one. Inasmuch as Ames and Silfen (1) have reported attentional preference for a moving pattern over a stationary one, it is unclear whether the attentional preference manifested in these infants in favor of the responsive pattern is a matter of its responsiveness or a matter of its movement during the tests. In addition, although the familiar patterns intended to be responsive attracted somewhat more looking on the average than did those stationary, this difference was not statistically significant.

The fact that some of our infants actually did develop a "relationship" with their responsive stimulus pattern is of interest from the standpoints of both experimental students of behavior and those who wish to foster psychological development in infants.

In terms of the concepts of behavior theory, developing the intentional actions we term a "relationship" with a responsive pattern may also be conceived as a special case of operant learning wherein the infant comes, over time with successive reinforcement from seeing the responsive pattern sway as he kicks and shakes himself, to increase the frequency of this kicking and shaking. Since operant responses have seldom been reported in infants so young (9), the development of such behavior even in only a few of the infants in this sample as early as two months of age is worth noting. Investigators of infant behavior should find this useful. By choosing acts for which infants show high readiness and by arranging circumstances so that the occurrence of such actions will elicit some

change in perceptual input, something to see or something to hear, investigators should find operant behavior or the noting of action-effect contingencies readily available for investigation in very young infants.

The apparent delight manifested by the infants in this experiment when the mobile swayed in response to their kicking and shaking can well suggest to those interested in fostering infant psychological development that making such arrangements may well serve both to promote development and to increase the joy of the infants while their early development is being promoted. On the other hand, a good thing can readily be overdone, and commercial application of such findings without proper scientific evaluation is likely to overdo them.

Finally, the increase in the frequency with which infants in this experiment shifted their glance from one pattern to the other in the third test over the frequency of the first two deserves comment. This frequency of glance shifting is easy to measure. It looks like a useful measure of visual exploration, and it would be interesting to determine to what degree such an index of visual exploration could be modified by an infant's history of visual experience.

FOOTNOTES

1. An earlier version of this paper was presented by Uzgiris at the meeting of the Society for Research in Child Development, Minneapolis, Minnesota, March, 1965.

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3. Now at Clark University.

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Table 1

Age of Infants in Months and Days at the Time Patterns were Placed and at Each Test Session

Ss	Sex	Age of Infant When Patterns Placed	Age of Infant at the time of: First Test	Second Test	Third Test
D. J.	M	1 (4)	2 (6)	2 (10)	3 (17)
D. R.	M	1 (5)	2 (7)	2 (9)	3 (13)
M. C.	F	0 (27)	2 (8)	2 (10)	3 (8)
J. B.	F	1 (5)	2 (14)	2 (16)	3 (12)
H. G.	M	0 (26)	2 (10)	2 (13)	3 (12)
K. R.	F	0 (26)	2 (1)	2 (3)	3 (3)
D. D'A.	M	0 (23)	2 (5)	2 (7)	3 (5)
J. Ba.	M	0 (26)	2 (9)	2 (12)	3 (0)
D. K.	F	1 (2)	2 (4)	2 (6)	3 (10)
K. K.	F	1 (7)	2 (2)	2 (4)	3 (6)
K. G.	M	1 (5)	2 (9)	2 (11)	3 (1)
N. D.	F	1 (5)	2 (8)	2 (10)	3 (0)
M. L.	F	1 (5)	2 (7)	2 (9)	3 (1)
C. J.	F	0 (14)	2 (5)	2 (8)	3 (2)
E. L.	M	0 (23)	2 (0)	2 (3)	3 (2)
	Mean Age	0 (29)	2 (6)	2 (8)	3 (6)

Table 2

Mean Times of Looking at the Unfamiliar Pattern in Seconds During 8 Mintues of Looking (Novel Paired with Familiar-Responsive and Familiar-Stationary

	Observation Sessions		
Novel Pattern	First	Second	Third
Yarn	247.2	280.4	305.2
Boxes	255.8	200.2	280.2
Umbrellas	80.8	90.4	179.8
Overall	194.6	190.3	255.0