RESPONSES OF HUMAN INFANTS TO NOVEL STIMULI

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By

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This thesis is concerned with the responses of human infants to novel visual stimuli. Novelty is defined in terms of a time dimension so that a stimulus which is presented to the subject for a period of time (familiarization period) is said to be novel relative to a stimulus which has not been so presented. Experiments demonstrated that infants will fixate a novel stimulus longer than they fixate a familiar stimulus. This effect was shown to be greater when familiar and novel stimuli differ from each other in two dimensions than when they differ in only one dimension. The decline in responsiveness to stimuli presented for a familiarization period was shown to be a linear function of time.

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CHAPTER ONE

INTRODUCTION

Experimental research on young infants is considerably limited because of the inability to control the experimental situation. In the typical animal experiment the animal is brought under the control of the experimenter by some such operation as food or water deprivation, or by the application of electric shock. In the adult human experiment the subject performs the response which is made explicit in the instructions which he receives. When, however, one places a well-fed two month old infant in an experimental situation, there is very little to guarantee the cooperation of the subject in the experiment.

One of the solutions which investigators have put forward to solve this problem is the use of the method of spontaneous visual preferences. Staples in 1932 used this method to test infants of two months and over for the ability to discriminate between colours. Recently, Fantz (1958, 1961) has made more widespread use of the method in order to determine the discriminative abilities of infants ranging in age from five days to several months. The method is simply to record the length of the spontaneous visual fixations of

various kinds of stimulus patterns and objects. If the infant looks consistently longer at one kind of pattern rather than at another, it can be said to "prefer" that pattern and hence discriminate between the two patterns.

The use of this method immediately raises another question. One asks why it is that the infant is expected to look consistently at a pattern at all, and, if this is indeed shown to be the case, one must ask again what it is about the patterns used which evokes a visual "preference", so that the infant will consistently look longer at one kind of pattern rather than at another.

An answer to this question is suggested by the following considerations: psychologists have recently begun to devote an increasing amount of research to the investigation of behaviour which is concerned with the exploration and manipulation of external stimuli when such behaviour is not instigated by any motive other than its own occurrence. Included within this broad classification of exploratory, manipulatory and investigatory behaviours are the reactions of organisms to unfamiliar stimuli. As a result of research conducted in this area, it seems to be generally agreed that unfamiliarity as a property of a stimulus evokes investigatory responses in infra-human organisms.

It is, therefore, possible that one of the determinants of visual attention which would bring about a "preference" in young infants is the novelty of the stimulus presented to the infant. The research with which this thesis is concerned was conducted primarily with the aim of investigating this possibility. A further and related aim was to determine whether the method of visual preference could be extended as a means of exploring the discriminative abilities of young infants. It is clear that an organism will only respond to changes in its environment if its nervous system is capable of making the discrimination which is necessary to detect the change. As such, this experiment was also intended to contribute something to our knowledge of perceptual development.

CHAPTER TWO

HISTORICAL REVIEW

Animals respond selectively to the stimuli which impinge upon them from their environment. It is meaningful therefore to ask what it is about certain stimuli which enables them to take control of behaviour. One stimulus property which has received increasing attention from psychologists over recent years is the quality of novelty.

If novel stimuli affect organisms in a relatively uniform manner, then they must have something in common which other stimuli do not have. While stimuli are normally categorized in terms of their common physical properties, which in turn produce a common behavioural effect, novel stimuli are not necessarily distinguishable in terms of physical properties. The property of novelty can apply to a multitude of stimuli. Novelty is meaningfully specified only in terms of a time continuum along which an object which was once novel becomes familiar. The longer an object has been experienced, the less novel and consequently the more familiar it becomes. Stimuli of diverse kinds are said to be novel if they fall at one end of the time continuum.

However, it is not entirely correct to imply that the only important dimension is that of time. Another variable which has been shown to be of importance in this connection and which is related to novelty, at least in short-term situations, is the property of complexity. The more components an object possesses the more complex it is said to be.

In addition, the phenomenon of stimulus generalization must be considered. Complete novelty is rare. Ordinarily novel and familiar stimuli can be conceptualized as being a certain distance apart on a generalization gradient, even in the simple case in which they differ along only one dimension. The magnitude of this distance certainly constitutes part of the measure of novelty.

Although this delineation of novelty becomes fairly involved, it is not difficult to establish laboratory operations to manipulate the novelty variable by controlling the time of presentation of stimuli. A considerable amount of work has been done on infra-human organisms in which research workers have studied changing responsiveness to stimuli as a function of time.

Three major concepts can be distinguished in the literature which deals with the reactions of animals to novel stimulation. Glanzer (1958) has identified these as

exploratory drive, stimulus satiation and curiosity. Since the central aims of this thesis are not concerned with the determination of the relative explanatory values of these concepts, they will merely be briefly outlined, in order to permit a more thorough investigation of the common behavioural phenomena with which they deal.

The concept of an exploratory drive, although it has often been invoked as an explanation (e.g. Montgomery 1952,1953), has not been greatly elaborated. The theory states merely that a drive is elicited by external stimuli which are novel, and that this drive declines as the stimuli become familiar. The concept appears to have been established to fill in the void which resulted from experiments which demonstrated the existence of exploratory behaviour which was not necessarily determined by the homeostatic drives such as hunger or thirst.

A second concept mentioned by Glanzer concerns what Glanzer (1953) has called stimulus satiation. He uses a formulation which is similar to that of Berlyne (1950) to explain the well-known phenomenon of spontaneous alternation of rats on successive trials in a T maze or a Y maze when either arm of the maze will provide the same reward. Glanzer postulates that satiation to a stimulus object develops as long as the organism is stimulated by that object,

thereby reducing the organism's tendency to respond to the object. As the development of this satiation is thought to be an increasing linear function of time, it also follows that when the organism ceases to perceive the stimulus object, the quantity of satiation to that object declines as a function of time. Glanzer also argues that the effect of satiation generalizes to objects which are similar to the original stimulus.

The main characteristic which distinguishes the exploratory drive formulation from the stimulus satiation formulation is that the concept of exploratory drive stresses arousal of responsiveness to novel stimulation while the stimulus satiation concept deals with decreasing responsiveness to stimuli which have been previously experienced. The distinction is, therefore, one of emphasis.

Berlyne (1950) has proposed a formal theory of curiosity couched in Hullian terms to deal with exploratory behaviour elicited by novel stimulation. This formulation appears to be the most comprehensive as it is able to deal with both the arousal and the decline of responsiveness to novelty. The form of this theory is somewhat as follows: novel stimulation produces a response which in turn leads to a drive stimulus called curiosity. The animal then responds by increasing stimulation due to the novel stimulus: it explores the curiosity arousing stimulus. As exploration

proceeds, curiosity diminishes, but may again be aroused after a further lapse of time during which there has been no stimulation from the stimulus in question. As such spells recur there will be less exploration, and extinction of the exploratory response occurs. This explanation of exploratory behaviour is readily seen to be derived from Hull's theory of extinction. It attempts to explain how the animals learn not to respond to situations which have become familiar, by using the concepts of reactive inhibition (Ir) to account for short term decrements in the exploration of the curiosity arousing stimulus, and conditioned inhibition (sIr) to explain the more permanent cessation of exploration of familiar objects.

The accumulation of empirical evidence concerning the behavioural effects of novelty has been promoted by deductions from these formulations. Glanzer (1958) pointed out that much of the research conducted in this area could have been derived from any one of these formulations and that they are, therefore, remarkably similar. The present author favours Berlyne's formulation for its comprehensive exposition of the problem of novelty, but the aim of this thesis is neither to defend nor to debate the pro's and con's of an approach which makes use of intervening variables such as those employed by Berlyne. Tests of deductions which might differentiate the theories are not pertinent to

the aims of this thesis, and, therefore, they will not be considered in this review. Instead, emphasis will be placed on the common effects of novelty at the behavioural level. When considered at this level all three concepts can be seen to contain statements from which similar predictions may be derived. The following review of the literature is organized, therefore, according to generalizations which arise from experimentation conducted in all three of these conceptual frameworks.

Only experiments which have studied some aspect of orienting or exploratory responses following the presentation of novel stimuli have been included. In these experiments the general procedure has been to take an initial measure of responsiveness to a novel stimulus and then to compare it to a measure of responsiveness when the novelty of the object has declined as a result of its continued exposure to the animal.

Novelty Stimulates Exploration

As long ago as 1925 Dashiell made the observation that white rats which were placed in a new enclosure, or which were returned to a nest box which had just been renovated, would pay no attention to food although they had not been fed for 24 hours. Instead, they explored the

environment as if the new surroundings had operated as a stimulus. Dashiell described an apparatus to measure exploratory behaviour by scoring the number of maze segments which were crossed by the animal.

In contrast to the earlier work which attempted to ascertain whether intrinsic exploratory tendencies existed in their own right (e.g. Nissen 1930), more systematic studies of exploratory behaviour do not appear in the literature until the 1950's. Berlyne (1960) remarks that these studies have been predominantly concerned with detecting the factors which determine the amount of exploration an animal will emit.

Berlyne (1955) questioned the assumption that the area covered by rats running in a maze can be used as a clear index of exploration, and proposed that some form of behaviour more certainly associated with exploration be studied. Approaching and sniffing objects were, therefore, used as indexes in his investigations using rats as subjects. In an experiment to study the effect of novelty on investigatory responses, Berlyne (1950) permitted rats to explore three identical objects for five minutes. When, five minutes after the exploration period had terminated, the rats once again were given the opportunity to explore the same stimuli, they explored them for a significantly shorter period of time.

When one of the objects was replaced by a dissimilar and novel stimulus, the animals explored this stimulus more than they did the two identical and familiar stimuli.

Berlyne (1955) placed each of three groups of rats in a box for 10 minutes on three successive days. For the first group the box contained a wooden cube, while the two other groups were put in an empty box. On the fourth day the three groups of rats were placed in an exploration box for a trial of three minutes. The wooden cube was present in the exploration box for the first and second groups, providing the first group with the presence of a familiar stimulus, and the second with the presence of a novel stimulus. The third group found the box empty. There were significant differences between the group with the novel object and the group with no object at all, but the exploration of the group with the familiar object was not significantly different from either of these groups, the amount of exploration being midway between the two. It was, therefore, not possible to conclude that the greater amount of exploration of the group with the completely novel stimulus was due to the fact that the stimulus was novel.

Berlyne and Slater (1957) made the prediction that rats will learn to go to an arm of a Y maze which leads to novel stimuli rather than to the arm which leads to stimuli which have been encountered within the last few minutes.

This prediction was not confirmed, as rats showed no significant preference for either arm of the maze. However, the rats did spend significantly more time exploring the novel visual figures than the familiar ones.

Kivy, Earl and Walker (1956) used a T maze which had glass partitions inserted at the entrances of the goal arms so that they could be seen by the animal but not entered. The animal was allowed to run from the start box to the choice point while the glass partitions were in place and both alleys were always the same colour, both black for some animals and both white for others. Rats were exposed to this situation for periods of 1, 15 or 30 minutes. Animals were then tested when the colour of one of the arms had been changed and the glass partitions had been removed. For the 15 and 30 minute groups there was a significant tendency to approach the colour which had been changed.

Dember (1956) performed a similar experiment in which he tested the hypothesis that a change in one of the stimulus arms might evoke curiosity because of the novelty introduced by this change. Thus he predicted that the animal would enter the arm that had been changed when rats had been pre-exposed to a black arm and a white arm of the maze, and were then exposed to arms which were made either both black or both white. The pre-exposure period was

15 minutes. The animal made the predicted choice when the glass partitions were removed. Dember pointed out that an explanation in terms of novelty would account for these results.

Welker (1956a) conducted an experiment using young chimpanzees as subjects to investigate the effect of novel stimuli on behaviour. Various pairs of objects were offered to the animalson a presentation board and a record of the manipulations and orientations of the animals towards the stimulus objects was kept. Each stimulus situation was presented to the animals in a series of 6 minute sessions until the animals' responsiveness reached a criterion of satiation. The author reports that no attempt was made to schedule equal intervals between the successive sessions. After satiation a new situation was offered to the animals. When the total responsiveness of the animals in a session which introduced a novel set of objects was compared to the total responsiveness of the animals to the familiar objects in the preceding session, all animals showed a significant increase in responsiveness to the novel situation.

An interesting aspect of the results of this experiment was an increase in responsiveness to the same situation shown when the first minute of a new session was compared to the last minute in the preceding session. This increase in

responsiveness to the same objects demonstrated an increase in novelty after an intersession interval, and as such is representative of the spontaneous recovery of exploration after the dissipation of reactive inhibition (Ir) as made explicit in Berlyne's (1950) theory.

Exploration of Novel Stimuli Declines as a Function of Time in the Presence of the Stimuli

This section is concerned with experiments which have reported a temporal change in responsiveness to novel stimulation: If response measures are taken while the animal is in the presence of novel stimuli it is generally reported that the animal's responsiveness declines over time. Some exceptions to this generalization have been reported, however (Welker 1956a,1956b; Menzel, Davenport and Rogers 1961). These exceptions, which appear to be related to the age of the animal, will be reported at the end of this section.

Berlyne (1955) studied the exploration of rats when they were placed in an empty box, both during the course of one session and also when they were placed in the box on three successive days for periods of 10 minutes. The results showed a sharp drop in exploration from the first to the second day, but no drop from the second to the third day.

There was a steep decline of exploration during each day's session.

Welker's (1956a) experiment also traced the effect of the decline of novelty. There was a decline in the amount of manipulation during the course of the session and, although the amount of responsiveness went up again on the next session, there was also a session-to-session decline.

Age differences have been reported to have an effect on the rate at which chimpanzees become satiated to novel stimuli. Welker noted in his experiment (1956a) that the three younger chimpanzees were more responsive than the three older chimpanzees throughout all the sessions and to all situations. They also showed a slower satiation rate.

Another age difference was reported by Welker (1956c). Younger chimpanzees at first reacted to objects only by head and eye orientation. When the objects were presented repeatedly, however, the animals began to manipulate them. On the other hand, older animals manipulated the objects when they were first presented, and showed less orientation unaccompanied by manipulation. They initially contacted the objects more frequently and also reached a criterion of familiarity much more rapidly. Welker suggests

that this may be due to the older animals having had more experience with objects in general. Possibly the younger animals had to overcome an initial fear of the strange objects, and began to explore them only when fear had become allayed by habituation.

This proposition was supported by observations of Menzel, Davenport and Rogers (1961) using young chimpanzees as subjects. The animals were 25 and 27 months of age when the research began. The animals had been reared in isolation and were thus even more than normally inexperienced with regard to generalized contact with novel objects. Eight test objects which were novel in contrast to a familiarized standard object were presented. The contact scores of each subject increased daily for each novel object. The results agreed with those of Welker on young animals aged six months to three years, while they are in direct contrast with Welker's data concerning older chimpanzees of five years and older (1956c).

The More Different the Novel and the Familiar Objects Are in Their Stimulus Properties, the Greater is the Novelty Effect

Welker (1956a) found that chimpanzees showed significant stimulus preferences for objects which were more

heterogeneous, larger, brighter and more movable. In a second experiment by Welker (1956b) this finding was confirmed using stimuli which were more carefully controlled to represent an increase in complexity from one situation to another. Stimulus objects were ten wooden blocks, which were presented in three situations: in the first situation the blocks did not differ from each other at all, and were alike in size, shape and colour. In the second situation they were painted in six different colours, resulting in a mottled pattern. Although the blocks differed from those used in situation 1, the author does not say, nor is it possible to tell from his diagrams, whether the chimpanzees could discriminate differences among the blocks in the second situation. In the third situation, although the blocks did not differ in size from the first two situations, the set was more heterogeneous since the blocks differed from each other in colour and form. The procedure was similar to that adopted in the previous study by Welker (1956a), described on page 13. Sessions were 10 minutes long. It was again found that introduction of a novel stimulus situation brought about an increase of responding with the greatest increase in total responsiveness for each animal being brought about by the presentation of situation 3, the most complex situation. The animals also spent more time

responding to objects in the third situation than they did in the second situation, and more time responding to objects in the second situation than they did in the first situation. When the situation was more complex chimpanzees exhibited greater variability of behaviour. In the third situation the animals touched the objects more frequently and also shifted from object to object more frequently than they did in situation 1.

Welker put forward the theory that a more heterogeneous situation elicits responses to each of its different aspects and thus there are a greater number of shifts from aspect to aspect. Complexity of the stimulus situation was shown to be important, and related to short term novelty as, "a shift in response from one stimulus to another represents a short term satiation to the current stimulus with subsequent approach to another stimulus which at the moment is more novel". (Welker 1956b, page 184)

It should be pointed out that there appears to be an important defect in the design of this experiment. The author nowhere reports that the stimulus situations were presented in a systematic fashion so as to control for the separate effects of the two factors which are varied in this study: complexity and novelty. It appears that the situations were presented consecutively in order of increasing

complexity. If this is the case it is clear that the increase in responsiveness which is reported when new situations were first presented could be accounted for by the greater complexity of the new situation, or by the fact that the stimuli were novel, or by a combination of both these factors acting together.

However, an experiment by Menzel, Davenport and Rogers (1961) employed test objects differing in more and more attributes (size, colour, form or combinations thereof) from a standard object which had been left in the home cage for 22 hours a day for two weeks prior to testing. The subjects were two young chimpanzees. Objects which differed in larger numbers of attributes from the standard object elicited greater amounts of contact. The standard object was handled least, presumably due to its familiarity. It will be recalled that this experiment was conducted on young animals. Further research would be required, therefore, before the conclusions could be generalized to older animals.

The above experiments were concerned with stimuli which differed in complexity with regard to number of components varied. The following two experiments deal with situations in which values along the dimension of one stimulus component are varied.

In a study which employed three mazes identical except for brightness, Montgomery (1953) tested the hypothesis that the decline in exploratory behaviour brought about by continuous exposure to a situation will generalize to similar situations, and that the magnitude of this decrement would decrease as the similarity of the situations decreased. Three mazes were used, one being painted black, another white and the third grey. Rats successively explored situations which differed in brightness. The results showed that the number of units which were traversed in one maze depended on the similarity to the maze explored five minutes previously. The more similar the mazes, the less was the amount of exploration of the second maze.

Dember and Millbrook (1956) conducted an experiment in which rats were given a choice between a change and a greater change. First they were exposed to the two arms of a Y maze, one arm of which was grey while the other arm was either white or black. On the choice trial rats found two arms which were equal in brightness, but both were different in brightness from the values used in the previous trial. Thus each arm was changed but one was changed more than the other. For example, on the first trial one arm was grey and the other white, while on the test trial, both arms were black. The greater change was, therefore, from

white to black; the lesser change from grey to black. Significantly more rats chose the arm representing the greater change.

Response to Novel Stimuli Provides Evidence of Discrimination

If an animal is capable of making a differential response to two different stimuli then it follows that the animal is able to discriminate between the two stimuli. From this point of view, every experiment demonstrating a differential response made to a novel stimulus as opposed to a familiar stimulus is a demonstration of discrimination.

There is at least one experiment which was designed explicitly to use response to novelty as evidence of discrimination. Thompson and Solomon (1954) attempted to avoid the confounding which arises due to the use of reinforcement as an incentive for discrimination. This confounding occurs when, in addition to learning to perceive the difference between two or more visual forms, the animal has to learn to associate rewards or punishments with particular forms. A situation was set up to determine whether rats could discriminate between two-dimensional black and white patterns which they had not experienced before. Two groups of animals were presented with a striated pattern for 10 minutes, and

the time spent exploring these patterns was recorded. When one of the groups was then presented with a different pattern consisting of an isosceles triangle and the other was again presented with the striated pattern, the former group showed significantly more exploratory behaviour. This was taken as evidence that the rat has the capacity to discriminate between two-dimensional patterns which have not been paired with extrinsic rewards.

This experiment has further methodological value: In experiments which merely record spontaneous fixation as an index of the animal's ability to discriminate between stimuli, one is able to conclude that the animal is discriminating only if it does in fact show a "preference". On the other hand, if no preference is shown, it is not permissible to conclude that the animal is not able to make the discrimination.

By utilizing the effect of novelty, as in the Thompson and Solomon experiment, it is possible, in effect, to exercise greater control over the behaviour of the animal. The animal is not merely placed in a situation to which it is allowed to respond spontaneously: some measure of control is exercised by the operation which makes one of the patterns familiar, thus enhancing the probability of a greater response to the more novel stimulus, if the animal can indeed make the discrimination.

Aims of the Present Experiment

The primary aim of the experiment is to determine whether human infants will respond differentially to novel and familiar stimuli. The preceding review of the literature indicates that a differential response to novel and familiar stimuli is fairly well established with regard to infra-human species, but there is a complete lack of controlled experimentation on human infants. Therefore, the generalizations which have been reviewed in this chapter have been examined using human infants as subjects. Each of the generalizations which have been presented provides an hypothesis:

1) Novelty stimulates exploration. A stimulus which is relatively novel evokes more visual fixation than one which has been experienced for some time.

2) Exploration of novel stimuli declines as a function of time in the presence of the stimuli.

3) The more different the novel and the familiar objects are in their stimulus properties, the greater is the novelty effect. Specifically, stimuli which differ from each other in two dimensions will produce a greater novelty effect than stimuli which differ with respect to only one dimension.

4) Response to novel stimuli provides evidence of discrimination. A differential response to novel stimuli would

imply the ability of infants in the age range tested to discriminate between the two-dimensional patterns employed.

Finally, in order to extend the generalizability of the conclusions reached in the above three experiments, a fourth experiment was run. In this experiment the general procedure differed from the procedure adopted in the other three experiments in that the stimuli which were familiarized were initially non-preferred. This was intended to test the hypothesis that,

5) The results do not differ from results obtained when a preferred stimulus is familiarized.

The rationale of the procedure which was adopted to test these predictions was as follows: The stimuli chosen were a cross and a circle. These forms have been shown by Fantz (1958) to evoke no consistent visual preferences in groups of infants within this age range. If an initial measure of the preference of each subject for the cross or the circle is taken when the two stimuli are presented simultaneously, and the preferred stimulus alone is then presented to the infant for a period of time, it should become familiar and consequently evoke less visual fixation. When the two stimuli are again presented simultaneously, the initially non-preferred stimulus should evoke the greatest amount of visual fixation as it will now be more novel than

the other stimulus. Hence, the infant should display a change in preference, fixating the stimulus which has become novel relative to the stimulus which was initially preferred.

By employing two groups, one group which initially prefers the cross, and one group which prefers the circle, the change in preference should occur in both groups after familiarization. This would, therefore, provide a control for stimulus factors other than the novelty variable.

Four experiments were run. For the first experiment a cross and a circle were employed as stimuli. Both of these were red in colour, and, therefore, differed only in form. For the second experiment form was held constant by employing two circles as stimuli, but these differed in colour, one being painted black and the other red. This experiment was designed to test whether a differential response would occur to colour alone.

In the third experiment, a red cross and a black circle were chosen as stimuli. Thus each stimulus pattern varied from the other in two respects: form and colour. This experiment attempted to determine the validity of the third generalization contained in the third section of this chapter. As the novel stimuli differed from each other with regard to two components, the novelty effect was expected to be greater in this experiment than in the other

two.

In the fourth experiment, as has already been pointed out, the subjects were familiarized on the stimulus which was non-preferred in the intial trials. The stimuli used in this experiment were the same as those used in Experiment 3.

CHAPTER THREE

GENERAL PROCEDURE AND APPARATUS

The general procedure and apparatus were identical for the three experiments to be reported. These are described below. Another section at the end of this chapter deals with a test on the reliability of the observations made by the experimenters.

Subjects

Infants were obtained by sending to parents in the Hamilton area postcards which offered $2 for participation in the experiment. The only basis of subject selection was age. Infants were discarded only if they did not complete the experimental session because of fussing and crying.

Apparatus

The apparatus consisted of a wooden chamber 28" x 27½" x 23" which enclosed a mobile crib 29½" long and 16" wide. Both the crib and chamber were mounted on a steel framework on wheels. One side of the chamber was open so that the crib could be rolled underneath it on a straight track along the midline of the box. The base of the crib

was uniformly concave along its length and prevented gross head or body movements. A soft pillow placed in the crib served as a mattress.

The child's field of vision was restricted to the inside of the chamber or to the blank cream-coloured wall exposed by the open end of the box. The inside of the chamber was painted a uniform grey in colour. A centre portion of the ceiling 28½" long and 12¼" wide was hinged. Two metal card holders were attached to this section of the ceiling to the right and left of a ¼" peephole in its centre and 18" above the supine infant's eyes. The centres of the holders were 19 3/8" apart. The cardboard stimulus cards were 11½" x 8¾" and slid into the holders. Illumination was provided from below the infant's field of view by two 60 watt bulbs attached to the steel framework to the left and the right of the infant's head. A white blind attached 4½" below the ceiling of the chamber could be drawn horizontally across the chamber from bottom to top of the infant's field of vision. The blind contained a 4" square hole directly above the infant's head.

Responses were recorded on a Rustrak model 92, 4-channel event recorder moving at the speed of 1.2 mm per sec. Two channels of the recorder were activated independently by two buttons attached to the outside of the apparatus.

Procedure

All infants were placed face up in the crib by their mothers, who remained in the room but out of the infant's field of vision. The crib was then rolled under the chamber so that the infant's head was directly below the point at which the stimulus patterns were to appear. The blind was already drawn and the stimulus patterns were not visible to the infant.

One experimenter (E_1) stood behind the apparatus at the head of the infant and observed the infant through the peephole in the centre of the test chamber ceiling. When the infant looked up at the centre hole in the blind, the blind was released, and a second experimenter (E_2) started the stop watch and recorder for a 30 second trial. The stimulus patterns reflected on the cornea of the infant's eyes. When the eyes were directed towards a stimulus pattern, the image of that pattern overlapped the pupil as viewed through the observation hole. This overlap of reflected image and pupil was the criterion of fixation. While observing the infant through the peephole E_1 recorded the amount of time that each stimulus was fixated by pressing the button that corresponded to the stimulus that was being fixated. Each presentation was of 30 seconds duration.

The pair of stimuli was presented for two initial

trials of 30 seconds each, each stimulus being presented once on the left and once on the right to control for any possible side preferences. At the end of each 30 second trial E_1 drew the blind and E_2 removed the two stimulus cards from the metal card holders. Care was taken to ensure that E_1 did not see the stimulus cards.

Subjects were divided into two equal groups according to which stimulus pattern they preferred on the two initial trials. For each group one stimulus was presented simultaneously in both of the stimulus positions for a familiarization period of 4½ minutes. Immediately after this period, another two trials presenting the initial pair of stimuli were run.

The side on which each stimulus appeared in the first trial of both the pre-familiarization and post-familiarization trials which followed the 4½ minute period was varied systematically, so that all possible arrangements of presentation for the two pairs of trials were used.

Analysis

The amount of time spent looking at each of the stimulus patterns was used as the dependent measure. A three-way analysis of variance was performed on the looking time data.

The data for the familiarization period were divided

into four equal intervals. The total time spent looking at the stimuli for each interval was subjected to a linear trend analysis.

Inter-observer Reliability

A separate study was run to determine the reliability of the measures recorded by the experimenters.

Subjects

The subjects were ten physically normal infants ranging in age from 11 to 15 weeks at the time of testing.

Apparatus

The apparatus used in this study was the same as that used in all the other experiments except that the centre portion of the chamber ceiling was replaced by another section which contained a window 11/16" wide and 10" long. The window was covered by a piece of wire gauze which fitted flush with the surface of the chamber ceiling.

Stimuli

The stimuli used in this study were similar to the formalized faces which have been described by Fantz (1961). In addition to the normally arranged face and face with the scrambled features, there was a stimulus card which had all

the features of the others but these were arranged symmetrically in a non-face pattern. The faces consisted in black outline features pasted onto a pink, oval-shaped background. The dimensions of the faces were 7½" measured vertically, and a maximum of 5" measured horizontally across. Each card was presented against an outline equated in form and area to the other faces but which contained none of the facial features except for a black "hairline" which extended about 1/3 of the way down the face.

Procedure

The basic procedure was the same as that described in the other experiments. There were six trials of 30 seconds each, the three stimulus arrangements being presented once with the control outline on the left and once with the control presented on the right. The order of presentation was randomized for each subject. The lights in the experimental room were switched off during the testing so that the infant was unable to see through the gauze-covered window. E_1 and E_2 stood side by side at the head of the infant, while a third experimenter started the stop watch and recorder for each 30 second trial when the blind was released.

An additional two buttons enabled E_2 to activate the remaining two channels on the event recorder simultaneously

with E_1. The amount of time spent looking at each of the stimulus patterns was recorded by E_1 and E_2 on the 4-channel recorder. The records made by the two observers appeared side by side on the same record sheet and, had agreement been perfect they would have been identical. An agreement score was calculated by counting the number of seconds per 30 second trial during which the observers agreed, i.e. all time except time during which one E recorded the infant as looking at one of the patterns while the other E recorded the infant either as looking at the other pattern or as not looking at either pattern. The scores were totalled over 60 trials (six trials for each of the ten subjects), and converted to a percentage of total stimulus presentation time.

Results

The percentage scores showed that the two observers agreed 94% of the time.

Discussion

As observations made by each observer were not made from a central position as they were in the experiments to be reported, but were rather made from a position slightly to one side above the infant's head, each observer was working under disadvantageous conditions and one would expect observations made under the normal conditions to be even more accurate than those obtained in the reliability study.

CHAPTER FOUR

RESULTS

Four experiments were run to determine whether a change in preference occurs as a result of familiarization. The apparatus and general procedure for all experiments were those described in the last chapter. The four experiments differed as follows with regard to the kind of stimuli used:

In Experiment 1 the two stimuli differed only in form. They were a cross and a circle, both red in colour, and equated for area.

In Experiment 2 the two stimuli differed only in colour. They were a red and a black circle, of identical size.

In Experiment 3 the two stimuli differed in both form and colour. They were a red cross and a black circle. As both form and colour were varied, the stimulus patterns were more complex than in the preceding two experiments.

In Experiment 4 the two stimuli were the same as those used in Experiment 3, but subjects were familiarized on the initially non-preferred stimuli.

EXPERIMENT 1

Subjects

The subjects were fourteen infants ranging in age from 12-15 weeks at the time of testing.

Stimuli

The stimuli were a cross and a circle equated in area. The circle was 2½" in diameter, while the cross measured 6" along either axis, and 2" across each arm. The stimuli were painted red against a white cardboard background.

Procedure

Subjects were divided into two groups on the basis of the preference shown in the first two pre-familiarization trials. Those who preferred the cross were presented with the cross for the familiarization period of 4½ minutes, while those who preferred the circle were presented with the circle for the same length of time. The final two (post-familiarization) trials were run immediately after the end of the familiarization period.

Analysis

A three-way analysis of variance was performed on the looking time data for both pairs of trials: this was a Groups (familiarized on cross vs familiarized on circle)

x Stimuli (familiarized vs non-familiarized) x Trials (pre- and post-familiarization) analysis. There were repeated measures on the last two factors.

The data for the familiarization period were treated as follows: The time period was divided into four equal intervals, and the total time spent looking at the stimulus cards was measured for each subject. The total time for both groups over intervals was subjected to a test for linear trend. A further test was carried out on the differences between the linear components of the group trends.

Results

Table I shows the mean time spent looking at the familiarized and non-familiarized stimuli by both groups for both pairs of trials.

Insert Table I about here

The results of an analysis of variance of the looking time data are shown in Table II.

Insert Table II about here

There was no significant difference between the

group familiarized on the cross and the group familiarized on the circle. The interaction between Stimuli and Trials was significant ($p<.01$). Table III shows the nature of the Stimuli x Trials interaction.

Insert Table III about here

The finding that the total time on the familiarized stimulus is greater than the non-familiarized stimulus ($p<.05$) is not surprising since subjects were familiarized on stimuli which they initially preferred. The pre-and post-familiarization trials difference is entirely due to the decrease in time spent looking at the familiarized stimulus. There is virtually no difference between the time spent looking at the non-familiarized stimulus before and after familiarization.

Table IV shows the amount of time spent looking at the familiarized stimulus for both groups during the familiarization period.

Insert Table IV about here

The results of an analysis for trend are shown in

Table V.

Insert Table V about here

There is a significant decline in looking time during the familiarization period. There is no significant difference in this linear trend between the group familiarized on the cross and the group familiarized on the circle.

Discussion

Experiment 1 shows that under the conditions of this experiment--i.e. where stimuli vary only in one dimension, form, and not in colour or area--presenting the initially preferred stimulus of a pair for a familiarization period brings about a decline in the time spent looking at that stimulus. The time spent looking at the non-familiarized stimulus does not change appreciably. Therefore, the change in stimulus preference is not accounted for by a change in the amount of fixation of the initially non-preferred, non-familiarized stimulus, but by a decrease in fixation of the initially preferred familiarized stimulus.

The results also show that there is a decline in the time spent looking at the stimulus during the familiarization period. This decline is a linear function of time.

TABLE I

Mean number of seconds per trial spent looking at the familiarized and non-familiarized stimuli by both groups for both pairs of trials.

GROUPS	STIMULI			
	Familiarized		Non-familiarized	
	Trials		Trials	
	Pre-fam.	Post-fam.	Pre-fam.	Post-fam.
Familiarized on cross	16.14	7.14	10.0	10.28
Familiarized on circle	19.14	3.92	7.64	7.29

TABLE II

Summary of analysis of variance of time spent looking at the familiarized and non-familiarized stimuli by both groups for both pairs of trails.

Source	Sum of Squares	df	Mean Square	F	p
Between Subjects	551.8	13			
Groups	27.1	1	27.1	0.62	N.S.
Subj within groups	524.7	12	43.7	-	
Within Subjects	1699.5	42			
Stimuli	108.6	1	108.6	7.34	<.025
Groups x Stimuli	23.2	1	23.2	1.56	N.S.
Stimuli x Subjects within groups	178.0	12	14.8	-	
Trials	516.0	1	516.0	36.6	<.001
Groups x Trials	41.2	1	41.2	2.92	N.S.
Trials x Subjects within groups	169.1	12	14.1	-	
Stimuli x Trials	510.1	1	510.1	48.58	<.001
Groups x Stimuli x Trials	27.1	1	27.1	2.58	N.S.
Stimuli x Trials x subj within groups	126.2	12	10.5	-	

TABLE III

Mean number of seconds per trial spent looking at the familiarized and non-familiarized stimuli on pre-and post-familiarization trials.

STIMULI	TRIALS	
	Pre-familiarization	Post-familiarization
Familiarized Stimulus	17.65	5.53
Non-familiarized Stimulus	8.82	8.79

TABLE IV

Amount of time spent looking at the familiarized stimulus for both groups during familiarization.

GROUPS	INTERVALS 1	2	3	4	Total
Familiarized on cross	154.5	104.5	79.0	65.0	403.0
Familiarized on circle	108.5	101.5	72.5	79.0	361.5
Total	263.0	206.0	151.5	144.0	764.5

TABLE V

Linear trend analysis showing decline in time spent looking at the familiarized stimulus during the 4½ minute period.

Source	Sum of Squares	df	Mean Square	F	p
Intervals	604.76	1	604.76	21.44	<.001
Groups x Intervals	111.3	1	111.3	3.95	N.S.
Error	338.5	12	28.21	-	

EXPERIMENT 2

Subjects

The subjects were fourteen infants ranging in age from 12-15 weeks at the time of testing.

Stimuli

The stimuli were two circles equated in area, both 2½" in diameter and both painted on a white cardboard background. One circle was red and the other was black.

Procedure

Subjects were divided into two groups on the basis of preference shown in the pre-familiarization trials. Those who preferred the black circle were presented with the black circle in both positions for the familiarization period of 4½ minutes, while those who preferred the red circle were presented with the red circle for the same length of time. The final two (post-familiarization) trials were run immediately after the end of the familiarization period.

Analysis

A three-way analysis of variance was performed on the looking time data for both pairs of trials: this was a Groups (familiarized on black circle vs familiarized on

red circle) x Stimuli (familiarized vs non-familiarized) x Trials (pre- and post-familiarization) analysis. There were repeated measures on the last two factors.

The data for the familiarized period were treated as follows: The time period was divided into four equal intervals, and the total time spent looking at the two identical stimulus cards was measured for each subject. The total time for both groups over intervals was subjected to a test for linear trend. A further test was carried out on the differences between the linear components of the group trends.

Results

Table VI shows the mean time spent looking at the familiarized and non-familiarized stimuli by both groups for both pairs of trials.

Insert Table VI about here

The results of an analysis of variance of the looking time data are shown in Table VII.

Insert Table VII about here

There was no significant difference between the group familiarized on the black circle and the group familiarized on the red circle, nor was there a significant difference between familiarized and non-familiarized stimuli. The interaction between Stimuli and Trials was significant ($p < .005$). Table VIII shows the nature of the Stimuli x Trials interaction.

Insert Table VIII about here

The decline in looking time from pre- to post-familiarization trials is again almost entirely due to the decrease in time spent looking at the familiarized stimulus. The time spent looking at the non-familiarized stimulus dropped only very slightly.

Table IX shows the amount of time spent looking at the familiarized stimulus for both groups during the familiarization period.

Insert Table IX about here

The results of an analysis for trend are shown in Table X.

Insert Table X about here

The test for linear trend is not significant ($p < .1$).

Discussion

Experiment 2 shows that under the conditions of this experiment--i.e. where stimuli vary only in one dimension, colour, and not in form or area--presenting the initially preferred stimulus of a pair for a familiarization period brings about a decline in the time spent looking at that stimulus. Again, the time spent looking at the non-familiarized stimulus does not change appreciably. Therefore, the change in stimulus preference, as in Experiment 1, is not accounted for by a change in the amount of fixation of the initially non-preferred, non-familiarized stimulus, but by a decrease in fixation of the initially preferred familiarized stimulus.

TABLE VI

Mean number of seconds per trial spent looking at the familiarized and non-familiarized stimuli by both groups for both pairs of trials.

	STIMULI			
	Familiarized Trials		Non-familiarized Trials	
GROUPS	Pre-fam.	Post-fam.	Pre-fam.	Post-fam.
Familiarized on black circle	12.71	3.86	7.29	7.36
Familiarized on red circle	14.86	7.57	11.0	8.0

TABLE VII

Summary of analysis of variance of time spent looking at the familiarized and non-familiarized stimuli by both groups for both pairs of trials.

Source	Sum of Squares	df	Mean Square	F	p
Between Subjects	1120.08	13			
Groups	91.29	1	91.29	1.06	N.S.
Subj within groups	1028.79	12	85.73	-	
Within Subjects	1107.31	42			
Stimuli	25.11	1	25.11	2.37	N.S.
Groups x Stimuli	1.97	1	1.97	0.185	N.S.
Stimuli x Subjects within groups	127.35	12	10.61	-	
Trials	318.25	1	318.25	11.02	$<.01$
Groups x Trials	1.97	1	1.97	0.068	N.S.
Trials x Subj within groups	346.47	12	28.87	-	
Stimuli x Trials	152.8	1	152.8	16.01	$<.005$
Groups x Stimuli x Trials	18.86	1	18.86	1.97	N.S.
Stimuli x Trials x Subj within groups	114.53	12	9.54	-	

TABLE VIII

Mean number of seconds per trial spent looking at the familiarized and non-familiarized stimuli one pre- and post-familiarization trials.

		TRIALS	
		Pre-familiarization	Post-familiarization
STIMULI	Familiarized Stimulus	13.79	5.72
	Non-familiarized Stimulus	9.15	7.68

TABLE IX

Amount of time spent looking at the familiarized stimulus for both groups during familiarization.

GROUPS	INTERVALS				
	1	2	3	4	Total
Familiarized on black circle	89.5	80.5	61.0	62.0	293.0
Familiarized on red circle	99.0	68.5	60.5	67.5	295.5
Total	188.5	149.0	121.5	129.5	588.5

TABLE X

Linear trend analysis showing decline in time spent looking at the familiarized stimulus during the 4½ minute period.

Source	Sum of Squares	df	Mean Square	F	p
Intervals	149.36	1	149.36	3.19	N.S.
Groups x Intervals	0	1	0	-	
Error	561.23	12	46.77	-	

EXPERIMENT 3

This experiment was intended to broaden the generality of the findings of the first two experiments. This was done by varying the stimuli in two dimensions: form and colour. It is hypothesized that there will be a greater response to novel stimuli which differ along more than one dimension.

Subjects

The subjects were fourteen infants ranging in age from 6-16 weeks at the time of testing.

Stimuli

The stimuli were a red cross and a black circle equated in area. The circle was 2½" in diameter, while the cross measured 6" along either axis, and 2" across each arm. The stimuli were painted against a white cardboard background.

Procedure

Two groups of seven subjects each were formed on the basis of the preference shown in the pre-familiarization trials. For the first group, those who preferred the black circle were presented with the black circle, in both positions for the familiarization period of 4½ minutes, while in the second group, those who preferred the red cross

were presented with the red cross for the same length of time.

Analysis

A three-way analysis of variance was performed on the looking time data for both pairs of trials. This was a Groups (familiarized on black circle vs familiarized on red cross) x Stimuli (familiarized vs non-familiarized) x Trials (pre-and post-familiarization) analysis. There were repeated measures on the last two factors.

The data for the familiarization period were treated as follows: The time period was divided into four equal intervals, and the total time spent looking at the stimulus cards was measured for each subject. The total time for both groups over intervals was subjected to a test for linear trend. A further test was carried out on the differences between the linear components of the group trends.

Results

Table XI shows the mean time spent looking at the familiarized and non-familiarized stimuli by the three groups for both pairs of trials.

Insert Table XI about here

The results of an analysis of variance of the looking time data are shown in Table XII.

Insert Table XII about here

There was no significant difference between the three groups, nor was there a difference between familiarized and non-familiarized stimuli. The interaction between Stimuli and Trials was significant, ($p < .001$). Table XIII shows the nature of the Stimuli x Trials interaction. There is, as in the previous experiments, a significant decline in looking time from pre- to post-familiarization.

Insert Table XIII about here

However, inspection of Table XIII also shows that the amount of looking time for the non-familiarized stimuli <u>increases</u> in the post-familiarization trials. Both the decrease in looking time at the familiarized stimuli and the increase in looking time at the non-familiarized stimuli are significant ($p < .01$) using a Tukey test (Winer 1962, pp. 87).

Table XIV shows the amount of time spent looking at the familiarized stimulus for both groups during the

familiarization period.

Insert Table XIV about here

The results of an analysis for linear trend are shown in Table XV. There is a significant decline in looking time during this familiarization period ($p < .025$).

Insert Table XV about here

There are no significant differences between the two groups with regard to this decline.

Discussion

Experiment 3 shows that under conditions of this experiment--i.e. where stimuli vary in two dimensions, form and colour--presenting the initially preferred stimulus of a pair for a familiarization period brings about a decline in the time spent looking at that stimulus. This result agrees with those of the first two experiments.

However, there is in addition a significant increase in the time spent looking at the non-familiarized stimulus for this experiment. This was not found to be the case in

the other two experiments which varied only one stimulus dimension. The change in stimulus preference is, therefore, accounted for by a decrease in time spent looking at the familiarized stimulus as well as by an increase in time spent looking at the non-familiarized stimulus.

The results also show that there is a decline in the time spent looking at the stimulus during the familiarization period. As has already been shown in Experiment 1, this decline is a linear function of time.

TABLE XI

Mean number of seconds per trial spent looking at the familiarized and non-familiarized stimuli by both groups for both pairs of trials.

GROUPS	STIMULI			
	Familiarized		Non-familiarized	
	Trials		Trials	
	Pre-fam.	Post-fam.	Pre-fam.	Post-fam.
Familiarized on cross	24.0	8.57	12.79	25.43
Familiarized on circle	23.64	7.79	11.28	16.5

TABLE XII

Summary of analysis of variance of time spent looking at the familiarized and non-familiarized stimuli by both groups for both pairs of trials.

Source	Sum of Squares	df	Mean Square	F	p
Between Subjects	1170.63	13			
Groups	117.2	1	117.2	1.34	N.S.
Subj within groups	1053.43	12	87.79	-	
Within Subjects	4351.87	42			
Stimuli	3.5	1	3.5	0.41	N.S.
Groups x Stimuli	75.41	1	75.41	0.88	N.S.
Stimuli x subj within groups	1031.21	12	85.93	-	
Trials	157.79	1	157.79	6.84	<.025
Groups x Trials	53.97	1	53.97	2.34	N.S.
Trials x Subj within groups	276.86	12	23.07	-	
Stimuli x Trials	2113.14	1	2113.14	42.47	<.001
Groups x Stimuli x Trials	42.92	1	42.92	0.86	N.S.
Stimuli x Trials x Subj within groups	597.07	12	49.76	-	

TABLE XIII

Mean number of seconds per trial spent looking at the familiarized and non-familiarized stimuli on pre- and post-familiarization trials.

		TRIALS	
		Pre-familiarization	Post-familiarization
STIMULI	Familiarized Stimulus	23.82	8.18
	Non-familiarized Stimulus	12.04	20.97

TABLE XIV

Amount of time spent looking at the familiarized stimulus for the three groups during familiarization.

GROUPS	INTERVALS 1	2	3	4	Total
Familiarized on cross	182.5	160.5	160.0	153.0	656.0
Familiarized on circle	214.5	109.5	135.5	119.5	579.0
Total	397.0	270.0	295.5	272.5	1235.0

TABLE XV

Linear trend analysis showing decline in time spent looking at the familiarized stimulus during the 4½ minute period.

Source	S	Sum of Squares	df	Mean Square	F	p
Intervals		432.51	1	432.51	7.71	<.025
Groups x Intervals		103.22	1	103.22	1.84	N.S.
Error		673.18	12	56.1	-	

EXPERIMENT 4

The hypothesis tested in this experiment followed from the conclusions established in the previous three experiments. The subjects in this study, in contrast to the other two studies, were familiarized on the stimulus which they did not prefer in the pre-familiarization trials. The prediction was made that this group would not deviate from the results of groups familiarized on preferred stimuli. The confirmation of this hypothesis would broaden the generality of the previous experimental findings.

Subjects

The subjects were fourteen infants ranging in age from 12-14 weeks at the time of testing.

Stimuli

The stimuli were a red cross and a black circle equated in area. The circle was 2½" in diameter, while the cross measured 6" along either axis, and 2" across each arm. The stimuli were painted against a white cardboard background.

Procedure

Two groups of seven subjects each were formed on the basis of the preference shown in the pre-familiarization trials. For the first group, those who preferred the black

circle were presented with the red cross in both positions for the familiarization period of 4½ minutes, while in the second group, those who preferred the red cross were presented with the black circle for the same length of time.

Analysis

A three-way analysis of variance was performed on the looking time data for both pairs of trials. This was a Groups (familiarized on red cross vs familiarized on black circle) x Stimuli (familiarized vs non-familiarized) x Trials (pre- and post-familiarization) analysis. There were repeated measures on the last two factors.

The data for the familiarization period were treated as follows: The time period was divided into four equal intervals, and the total time spent looking at the stimulus cards was measured for each subject. The total time for both groups over intervals was subjected to a test for linear trend. A further test was carried out on the differences between the linear components of the group trends.

Results

Table XVI shows the mean time spent looking at the familiarized and non-familiarized stimuli by the three groups for both pairs of trials.

Insert Table XVI about here

Table XVII shows the results of an analysis of variance of the looking time data.

Insert Table XVII about here

The only significant difference was between the familiarized and non-familiarized stimuli. This result is explained by the fact that the familiarized stimuli were non-preferred in the first place.

Table XVIII shows the amount of time spent looking at the familiarized stimulus for both groups during the familiarization period.

Insert Table XVIII about here

The results of an analysis for linear trend are shown in Table XIX.

Insert Table XIX about here

There is a significant decline in looking time during this familiarization period ($p < .025$). There are no significant

differences between the two groups with regard to this decline.

Discussion

The results of this experiment do not fulfill the prediction that the same results will be obtained with non-preferred stimuli as with preferred stimuli. Looking time at the familiarized stimulus was not significantly less in the post-familiarization trials.

It is difficult to reconcile this finding with the findings of the earlier experiments. That a significant linear trend was obtained for the data on the familiarization trials indicates that the familiarized stimulus did, in fact, become familiar and thus lose their novelty. One would, therefore, predict a significant drop in looking time at the familiarized stimulus in the post-familiarization trials.

One tentative explanation which suggests itself is that the use of a non-preferred stimulus during the familiarization period had the effect of so lowering the general tonus of the subjects' interest, that the non-familiarized stimulus was unable to increase looking time in the post-familiarization trials. In other words, the decrement in responsiveness to the familiarized stimulus became generalized to the whole situation, so that even the introduction of a novel stimulus was not sufficient to

stimulate a significant increase in attentiveness to any single aspect of the situation, even when a change was introduced. This explanation implies that in the other experiments the familiarized stimulus was able to maintain a certain minimal amount of interest, which was not present in Experiment 4 when a non-preferred stimulus was employed during the familiarization trials.

TABLE XVI

Mean number of seconds per trial spent looking at the familiarized and non-familiarized stimuli by both groups for both pairs of trials.

	STIMULI			
	Familiarized		Non-familiarized	
	Trials		Trials	
	Pre-fam.	Post-fam.	Pre-fam.	Post-fam.
Familiarized on cross	11.21	6.79	16.71	18.14
Familiarized on circle	6.14	4.07	14.86	13.43

TABLE XVII

Summary of analysis of variance of time spent looking at the familiarized and non-familiarized stimuli by the two groups for both pairs of trials.

Source	Sum of Squares	df	Mean Square	F	p
Between Subjects	1273.33	13			
Groups	180.36	1	180.36	1.98	N.S.
Subj within groups	1092.97	12	91.08	-	
Within Subjects	2328.56	42			
Stimuli	1067.51	1	1067.51	28.77	<.001
Subjects x Stimuli	1.29	1	1.29	0.035	N.S.
Stimuli x Subjects within groups	445.14	12	37.1	-	
Trials	36.97	1	36.97	1.31	N.S.
Groups x Trials	.22	1	.22	0.0078	N.S.
Trials x Subjects within groups	169.1	12	14.1	-	
Stimuli x Trials	36.96	1	36.96	1.17	N.S.
Groups x Stimuli x Trials	23.79	1	23.79	0.75	N.S.
Stimuli x Trials x subj within groups	378.93	12	31.58	-	

TABLE XVIII

Amount of time spent looking at the familiarized stimulus for both groups during familiarization.

GROUPS	INTERVALS 1	2	3	4	Total
Familiarized on cross	120.0	127.0	89.0	80.0	416.0
Familiarized on circle	129.5	99.0	80.5	47.5	356.5
Total	249.5	226.0	169.5	127.5	772.5

TABLE XIX

Linear trend analysis showing decline in time spent looking at the familiarized stimulus during the 4½ minute period.

Source	Sum of Squares	df	Mean Square	F	p
Intervals	699.31	1	699.31	8.36	<.025
Groups x Intervals	40.51	1	40.51	0.48	
Error	1003.45	12	83.62	-	

CHAPTER FIVE

SUMMARY AND CONCLUSIONS

In this chapter the hypotheses put forward and tested in earlier chapters will be discussed in the light of the experimental results. This discussion will make use of the conceptual framework concerning the functions of varied experience in the behaviour of animals which has been developed by Fiske and Maddi (1961). This theoretical formulation is outlined briefly in the following paragraphs, and our experimental findings are then evaluated.

Present day psychology appears to incline towards the view of the organism as requiring an optimal amount of stimulation in order that it may function efficiently. The notion of arousal level has been outlined in a paper by Hebb (1955) which is a definitive exposition of a recent formulation of the conceptual nervous system. It is this conception which has been developed by Fiske and Maddi in the light of accumulating empirical evidence. Their formulation is in terms of a number of propositions. Those propositions which are of importance for this discussion will be reported here.

The conceptual nervous system of Fiske and Maddi is similar to that of Hebb. They use the term "impact" to refer to that property of a stimulus which affects activation level, while the term "activation level" refers to a degree of excitation taking place in some postulated brain centre, possibly the reticular formation. The authors consider that the organism seeks to maintain its level of activation at a normative value, much as the biological drives are thought to function according to a principle of homeostasis.

Level of activation does vary, however. It varies over a given period of time with the total impact of stimulation. One of the important sources of variation for the purposes of this discussion is the amount of variation in the stimulation to which the organism is subjected. An important assumption is that the impact of a stimulus derives very largely from the extent to which it is different from stimulation which preceded it:

> The last aspect of variation is the degree to which the given stimulus departs from the pattern or regularity of thepreceding sequence of stimuli. If such pattern exists, and is recognised in some sense by the organism, an expectancy develops. Hence, the degree of departure of the given stimulus from the pattern built up by prior stimulation may be called the unexpectedness of that stimulus. We presume that there is a direct relationship between degree of unexpectedness and impact. Thus, the appearance of a circle where a square was expected has more

> impact than does the appearance of a rectangle. (Fiske and Maddi, 1961, pp 25)

As will be seen, this paragraph has some important implications for the results obtained in Experiment 3.

A further relevant proposition is concerned with activation level and performance. Again, in agreement with the Hebbian formulation relating performance to level of activation in terms of an inverted U-shaped function, Fiske and Maddi point out that it is postulated that the best performance is obtained when activation is at an optimal level. At the lower end of the curve, when activation is low, the organism may not function efficiently due to inattention, lack of concentration, drowsiness and so on. At the other extreme poor performance would result from too high a level of activation so that there would be a loss of control over the correct response. This concept of activation traversing a continuum is of importance for the evaluation of the results of Experiment 4.

Bearing these considerations in mind, let us now turn to our specific experimental hypotheses:

Novelty Stimulates Exploration

The experimental results clearly verify this hypothesis. A novel stimulus, as defined by the operations employed in our experimental procedure, is explored more

than a stimulus which is familiar. In each experiment, the non-familiarized stimulus is looked at more in the post-familiarization trials than is the familiarized stimulus.

Exploration of Novel Stimuli Declines as a Function of Time in the Presence of the Stimuli

For three out of the four experiments this prediction is confirmed. For all experiments except Experiment 2, the decline in looking time for the familiarized stimulus is a linear function of time. In Experiment 2, although the decline in time spent looking at the familiarized stimulus does not show a significant linear trend, the totals for the first three intervals are in the hypothesized direction. The lack of significance seems attributable to a slight increase in the fourth interval.

The general finding is in agreement with Glanzer's (1953) postulate which runs as follows:

> "Each moment an organism perceives a stimulus-object or stimulus-objects, A, there develops a quantity of stimulus satiation to A.
>
> i. The same amount of stimulus satiation develops in each successive moment. The total amount developed is therefore, an increasing linear function of time."
>
> (Glanzer, 1953, pp 260)

Glanzer does not report this particular corollary of his postulate as being directly verified experimentally, and neither has it, to the author's knowledge, been verifield by any other experimenter. Although Glanzer is presumably dealing with a hypothetical neural quantity, these experiments which measure a behavioural response over time yield results which would follow logically from Glanzer's stimulus satiation formulation. As stimulus satiation reduces the organism's tendency to make any response to A, deductively, the amount of time spent responding to A should decline as a decreasing negative function of time. Although nothing is gained for the purposes of this thesis by espousing the stimulus satiation position, the results of the experiments reported do confirm this explicit statement which Glanzer has made concerning the nature of the decline of responsiveness to a stimulus over time.

We conclude that it is because of this familiarization that the stimuli are looked at less when paired with a relatively novel stimulus in the post-familiarization trials. In terms of the Fiske and Maddi formulation we would say that the familiarized stimulus has lost some of its impact during familiarization.

The More Different the Novel and the Familiar Objects are in their Stimulus Properties, the Greater is the Novelty Effect

In the first two experiments, where the stimuli used differ from each other only in one dimension, form or colour respectively, time spent looking at the familiarised stimulus decreases. However, looking time remains practically unaltered for the non-familiarized stimulus. This stimulus is looked at neither more nor less in the post-familiarization trials than in the pre-familiarization trials.

In the third experiment, where the stimuli differ from each other in both form and colour, the results show that, in agreement with the first two experiments, the non-familiarized stimulus is looked at longer in the post-familiarization trials than is the familiarized stimulus. But in addition, the time spent looking at the non-familiarized stimulus is significantly greater after familiarization than it was before familiarization. A Median test (Siegel 1956, pp 111) was performed to test the significance of the difference between Experiments 1 and 2 combined, and Experiment 3. A difference score on time spent looking at the non-familiarized stimuli before and after familiarization was computed for subjects in Experiments 1 and 2. These scores were compared to scores

similarly computed for subjects in Experiment 3. Thus there were seven subjects from Experiment 1 with scores on a non-familiarized red cross, and seven subjects from Experiment 2 with scores on a non-familiarized red circle. There were comparable scores for the fourteen subjects in Experiment 3. The difference between the two groups of fourteen each was significantly well below the .001 level of confidence ($X^2 = 70$, $df = 1$), thus indicating a real and substantial difference in dependent measures for the two classes of stimuli employed. We see thus, that when the stimuli differ from one another in two respects, form and colour, a stronger novelty effect is present than when stimuli differ on only one of the dimensions. This stronger effect consists of increased looking at the non-familiarized stimulus as well as decreased looking at the familiarized stimulus.

It should be pointed out that this result is suggested by the research reviewed in Chapter 2, although the precise experimental operations employed in this experiment to vary the novelty of the stimuli have not been used by other experimenters.

In order to ensure that the experimental design controlled for variables other than novelty, it was necessary to take an initial measure of the subject's response to both

stimuli. Because both stimuli were presented for two initial trials, neither stimulus can be called completely novel. To ensure the relative novelty of one stimulus, however, the other was presented for the 4½ minute familiarization period. It is during this period that a decline in looking time at the stimulus cards occurs. From this we conclude that a stimulus which is familiar evokes less fixation than it did when initially experienced. We assume further that the familiarized stimulus as well as its setting, the inside of the experimental apparatus, have become literally less stimulating for the infant than they were when initially introduced, and it is for this reason that interest in them declines. It is into this less stimulating environment that a change is introduced when the non-familiarized stimulus is again presented.

Let us briefly consider what may possibly ensue when this event takes place: The infant for a longer period of time has been fixating a certain stimulus, which has steadily been losing its interest value over time; the impact of the familiarized stimulus declines as long as it is in the presence of the infant, as one of the important sources of impact is derived from the moment of onset of a stimulus which is as yet unfamiliar. We further assume that the infant's immediate environment, unchanging and

static, similarly loses its impact. As activation level is dependent, among other things, upon changing exteroceptive input, and as the visual environment is relatively unchanging, activation level, and consequently performance, the response of looking also declines.

In addition, the long period of familiarization may be considered to constitute an unchanging sequence over time: consequently, in terms of the Fiske and Maddi formulation, the infant can be said to develop an "expectation" which is proportional to this high degree of "patterning" of its immediate past experience during the familiarization period. It is, therefore, conceivable that when the non-familiarized stimulus is introduced into an environment which has lost much of its capacity to stimulate the interest of the infant, the accompanying change raises the activation level of the subject. This is what we mean when we say that a novel stimulus stimulates exploration. The non-familiarized stimulus has now acquired the capacity to arouse attention because it is placed against a background of familiarity. Fiske and Maddi express these ideas as follows: "In general, the greater the order or regularity in the preceding sequence, the greater the unexpectedness and impact when the given stimulus departs from that order. Stated in other words, the stronger the expectation that a given

stimulus will appear, the greater the effect of some other stimulus." (Fiske and Maddi, 1961, pp 26)

We, therefore, propose that two contradictory processes are at work. On the one hand familiarization lowers the impact of the familiarized stimulus, thus reducing the infant's tendency to respond to that stimulus, while at the same time an expectation of that stimulus is also developed. On the other hand, these two factors combine to give the unfamiliarized stimulus greater impact when it is presented thus once again heightening activation level, and reinstating the response of fixation in favour of the unfamiliarized stimulus, the stimulus providing the greater impact.

What then explains the difference between Experiments 1 and 2 on the one hand and Experiment 3 on the other? As we have already noted in the review of the history, rats in Montgomery's (1953) experiment explored mazes which were similar to mazes which they had previously explored, less than they did when the mazes were less similar than those previously explored. This finding could be interpreted by assuming that the dissimilar mazes were more novel than the mazes which more closely resembled the familiar maze. Again, in terms of Fiske and Maddi's conceptual framework, we have seen that variation in stimulation, especially when

this is unexpected, is an important source of impact. Hence, for rats in Montgomery's experiment, the dissimilar mazes were more novel, and thus they had more impact, representing as they did, a greater variation in stimulation than did the similar mazes. We assume that the decrement in impact and thus in exploration was generalized from the familiar maze to the maze which most resembled it. There was less generalization to the dissimilar maze, which, therefore, had greater impact, thus raising activation level. Consequently, exploration in this situation was greater.

Similarly, in this research, there are more discriminable differences between the two stimuli employed in the third experiment. The unfamiliarized stimulus in the third experiment is, therefore, more novel in the post-familiarization trials than it was in the other two experiments, and it can thus be said to have greater impact. Consequently, the response it evokes is of a greater magnitude under these conditions. Restated, this means that the impact of the unfamiliarized stimulus is greater in the third experiment because it departs from expectation much more than do the non-familiarized stimuli in Experiments 1 and 2. The decline in fixation due to the familiarization of the stimulus itself as well as of the whole experimental situation is, therefore, countered by a rise in activation level due to the presentation of the unfamiliarized stimulus.

Fixation of the non-familiarized stimulus is, therefore, greater than fixation of the familiarized stimulus, while in Experiment 3 activation level and, therefore, performance are so increased by the unexpectedness of the non-familiarized stimulus, that fixation of the non-familiarized stimulus exceeds the amount it was fixated in the pre-familiarization trials.

We, therefore, put forward the proposition that the amount of exploration is proportional to the degree of novelty: the more novel the stimulus as defined by the number of ways in which it differs from the familiar stimulus, the greater the degree of exploration. In this way, therefore, we can say that the enhanced response to the non-familiarized stimulus is due to its greater degree of novelty. This enhanced response to a novel stimulus introduced to the infants after a period of 4½ minutes does not occur in the first two experiments, although the non-familiarized stimulus is fixated more than the familiarized stimulus in these experiments, because the novel stimuli resemble the familiarized stimulus in one attribute, either colour or form.

Results Obtained by Familiarizing a Non-preferred Stimulus Agree with the Results Obtained When a Stimulus Which is Initially Preferred is Familiarized

Experiment 4 does not confirm this prediction.

Although a significant linear trend was found during the familiarization period, indicating that the novelty of the familiarized stimulus was lost during this period, the non-preferred stimulus was not looked at significantly less in the post-familiarization trials.

As has already been pointed out in the discussion of Experiment 4, it is difficult to reconcile this finding with the results obtained for the other three experiments. An explanation already put forward in the discussion of Experiment 4, but now refined in terms of the Fiske and Maddi formulation, could be suggested as follows:

A certain level of activation is required in order that a task be efficiently performed. A necessary condition for this successful performance is that the impact of the task upon the organism be sufficient to maintain the necessary activation level. An example which is often quoted in this connection is that of the radar operator watching a screen. Because of the monotony of the task there is always the danger that the operator's performance may so decline over time that when some object does appear upon the screen, the operator may not be alert enough to detect it. In Experiment 4 this element of interest may have been precisely what was lacking during the familiarization period. As the familiarized stimulus was initially non-preferred we can

assume that its impact upon the subject was low to begin with. When it was presented during the familiarization period, we have evidence that even more of its impact was lost.

The effect of this could conceivably have been to lower the activation level of the subject with respect to the experimental situation so that its responsiveness to this situation so declined that even the introduction of the non-familiarized stimulus was not sufficient to restore any selective interest to any part of the situation.

Stated in different terms, we could say that the loss of interest brought about by familiarization of a non-preferred stimulus was generalized to the whole experimental situation. Evidence that generalization of response decrement does occur in this situation has been discussed in the preceding section of this chapter, where the differences between Experiments 1, 2 and 3 are considered. It is possible that something similar occurred in Experiment 4.

Response to Novel Stimuli Provides Evidence of Discrimination

If a response occurs differentially to novel and familiar stimuli the above proposition must logically be considered verified. In all the experiments reported there

was a differential response to the novel stimulus--i.e. there was a change in preference from one stimulus to another after familiarization. The experiment by Thompson and Solomon (1954) reported on page 21 adopted this method in order to investigate the discriminatory abilities of rats. The research reported here has one methodological advantage over the Thompson and Solomon experiment: in our experiments an initial measure was taken of the infant's preference for the stimuli used, and then a change in preference was effected by familiarizing one of the stimuli. A control group was also run, in effect, by familiarizing equal numbers of subjects on both of the stimuli used.

In the Thompson and Solomon experiment, none of these controls were exercised, so that when rats explored a second and novel stimulus more than a control group explored a familiar stimulus, the effect could have been due to either the novelty of the new stimulus, or to the fact that the new stimulus was more complex than the familiar stimulus or to virtually any one of many possibilities. Although the data from the Thompson and Solomon experiment can be interpreted as providing evidence for discrimination, it is difficult to conclude that the <u>stimulus property</u> which evoked the differential response of heightened exploration of the newly introduced stimulus was <u>novelty</u> alone.

As already pointed out, Fantz (1958) has found no difference in preference for either of the forms employed in our experiments. Furthermore, no difficulty was experienced in finding equal numbers of subjects who preferred the cross and the circle, thus indicating that there is no intrinsic property of either stimulus which makes it more attention provoking than the other. Arguing from the results of initial visual fixation preference alone, one would conclude that there is no evidence that infants can discriminate between a black cross and a red circle. The use of the familiarization method shows clearly that they can make the discrimination. By this operation it is possible to bring the organism under the control of the experimenter, thus "forcing" it to make the required response without the use of external incentives. Since some of the possible external incentives are commonly objected to on humane grounds, and since, in any case, their use usually necessitates a training period longer than the 4½ minute familiarization period used in this experiment, the latter technique, which utilizes the response to novelty, has much to recommend its wider use in studies of infant perception.

SUMMARY

Four experiments were run to test specific hypotheses concerning responses of human infants to novel visual stimuli. An initial measure of responsiveness was taken when two stimuli were simultaneously presented to the infant and the fixation time for each stimulus was recorded. The stimulus which was fixated longest in two initial trials was then presented to the infant simultaneously in both stimulus positions for a familiarization period of 4½ minutes. Immediately after this period another two trials presenting the initial pair of stimuli were run. These experimental operations served to partially define the novelty of the stimulus. It was predicted that the initially non-preferred stimulus would be preferred in the post-familiarization trials, as the 4½ minute familiarization period served to make it novel relative to the initially preferred familiarized stimulus.

For each experiment fourteen subjects were divided into two equal groups according to the stimulus pattern which they preferred in the two initial trials. Novelty was varied further by the ways in which the stimuli differed

from each other. For the first two experiments the stimuli differed in either form or colour, being a black circle and a red circle in the first experiment, and a red cross and a red circle in the second experiment. In the third experiment the stimuli differed in both form and colour, and were, therefore, considered to be more novel after familiarization, as they differed from each other on two dimensions. This experiment served to test the hypothesis that a greater response would occur to novel stimuli which differed from each other in their properties more than did the novel and familiar stimuli in the first two experiments.

Experimental results indicated that novel stimuli evoke more visual fixation than do familiar stimuli, while the decline of responsiveness to stimuli which are in the presence of the subject for 4½ minutes is a linear function of time. Novel stimuli which differ from familiar stimuli in form and colour evoke a greater response than do stimuli which differ only in one dimension, either form or colour. This was shown both by a decline in fixation for the familiarized stimulus, as well as a significant increase in fixation for the non-familiarized stimulus after the familiarization period.

The generalizability of these conclusions was restricted by the results of the fourth experiment. This experiment used the same stimuli as in the third experiment,

but subjects were familiarized on stimuli which were initially non-preferred. There were no significant post-familiarization differences, although a significant linear decline in responsiveness to stimuli was found during the familiarization period.

The results were discussed in terms of recent conceptions of the nervous system, and it was pointed out that the response to novelty could be employed in order to bring about differential responsiveness to stimuli, thus indicating the ability to discriminate between them.

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APPENDIX A

Raw data for pre- and post-familiarization trials for all four experiments.

EXPERIMENT I

Time spent looking at the familiarized and unfamiliarized stimuli for each subject before and after familiarization.

STIMULI

		Familiarized		Unfamiliarized	
	Subject	Before	After	Before	After
Familiarized on Cross	1	19.0	6.0	17.0	16.5
	2	25.5	4.5	15.0	13.5
	3	11.0	4.5	7.0	13.5
	4	4.5	2.0	4.0	0
	5	16.0	11.5	8.5	9.0
	6	15.0	6.0	11.5	7.0
	7	22.0	15.5	7.0	12.5
Familiarized on Circle	8	18.5	0	10.0	5.5
	9	12.0	4.5	7.0	8.0
	10	23.5	1.5	5.0	2.5
	11	16.5	6.0	11.0	6.5
	12	25.5	8.0	7.0	11.0
	13	15.5	4.0	6.0	9.0
	14	22.5	3.5	7.5	8.5

EXPERIMENT II

Time spent looking at the familiarized and unfamiliarized stimuli for each subject before and after familiarization.

STIMULI

			Familiarized		Unfamiliarized	
		Subject	Before	After	Before	After
Familiarized on	Black Circle	1	11.5	2.5	4.5	3.5
		2	6.5	1.5	1.5	4.0
		3	4.0	2.5	3.5	8.0
		4	8.5	6.0	2.5	10.5
		5	27.0	4.5	21.5	12.0
		6	24.5	7.5	13.0	11.0
		7	7.0	2.5	4.5	2.5
Familiarized on	Red Circle	8	7.0	7.5	6.5	7.0
		9	15.0	6.0	9.5	2.5
		10	22.5	6.5	18.5	12.5
		11	18.0	2.5	2.0	5.5
		12	9.0	8.5	7.0	3.5
		13	16.0	11.5	11.5	9.0
		14	16.5	10.5	22.0	16.0

EXPERIMENT III

Time spent looking at the familiarized and unfamiliarized stimuli for each subject before and after familiarization.

		STIMULI			
		Familiarized		Unfamiliarized	
	Subject	Before	After	Before	After
Familiarized on Cross	1	26	0	19.5	51.0
	2	14	11	7.0	21.0
	3	35.5	20.5	17.0	20.5
	4	14.5	3.5	14.0	26.5
	5	22.5	5.0	9.0	13.0
	6	20.5	4.5	12.5	23.0
	7	35.0	15.5	10.5	23.0
Familiarized on Circle	8	31.5	.5	3.0	8.0
	9	14.0	6.0	13.5	18.0
	10	23.0	2.0	6.5	32.0
	11	23.0	13.0	8.5	12.0
	12	31.5	18.0	17.5	19.0
	13	16.0	2.0	12.5	7.0
	14	26.5	13.0	17.5	19.5

EXPERIMENT IV

Time spent looking at the familiarized and unfamiliarized stimuli for each subject before and after familiarization.

		STIMULI			
		Familiarized		Unfamiliarized	
	Subject	Before	After	Before	After
Familiarized on Cross	1	3.0	4.5	14.0	18.5
	2	11.5	3.5	14.0	38.0
	3	13.0	4.0	19.0	3.5
	4	17.5	19.5	25.0	19.0
	5	6.5	1.0	8.5	2.5
	6	13.5	8.5	18.5	27.0
	7	13.5	6.5	18.0	18.5
Familiarized on Circle	8	4.5	5.0	10.0	14.5
	9	10.0	6.5	22.0	32.5
	10	6.0	1.5	17.0	10.0
	11	7.0	4.5	17.5	15.5
	12	5.5	2.0	5.5	7.0
	13	4.5	3.0	20.5	11.5
	14	5.5	6.0	11.5	3.0

APPENDIX B

Raw data for familiarization period for all four experiments.

EXPERIMENT I

Time spent looking at the familiarized stimulus for each subject for both groups during familiarization.

		INTERVALS			
	Subject	1	2	3	4
Familiarized on Cross	1	19	1.0	6.0	1
	2	21.0	16.0	16.0	14.0
	3	31.0	23.0	19.0	18.0
	4	7.5	10.5	-	1.0
	5	28.0	15.0	11.0	10
	6	22.0	19.0	13.0	7.0
	7	26.0	20.0	14.0	14.0
Familiarized on Circle	8	14.0	18.0	1.0	5.0
	9	3.5	1.5	7.0	15.5
	10	10	3.5	6.0	3.5
	11	8.0	1.5	1.5	5.0
	12	39.0	40	35	22
	13	24	23	12	24
	14	10	14	10	4

EXPERIMENT II

Time spent looking at the familiarized stimulus for each subject for both groups during familiarization.

		INTERVALS			
	Subject	1	2	3	4
Familiarized on Black Circle	1	9	5.5	6.0	2.0
	2	3	4.0	2.5	0.5
	3	13	13.0	11.0	4.0
	4	5	5.0	5.5	5.5
	5	34	42.0	24.0	34.0
	6	20.5	8.0	10.5	9.0
	7	5.0	3.0	1.5	7.0
Familiarized on Red Circle	8	14.5	6.5	10.5	13.0
	9	5.0	5.0	4.0	7.0
	10	30.0	26.5	13.5	-
	11	4.0	-	4.0	5.0
	12	2.5	8.0	4.5	10.0
	13	23.5	14.0	19.5	17.0
	14	19.5	8.5	4.5	15.5

EXPERIMENT III

Time spent looking at the familiarized stimulus for each subject for both groups during familiarization.

		INTERVALS			
	Subject	1	2	3	4
Familiarized on Cross	1	9	21.0	13.0	10.0
	2	47.5	61.0	54.0	56.0
	3	5.0	2.5	2.0	6.0
	4	28.0	4.0	10.0	1.0
	5	22.0	14.0	10.0	14.0
	6	28.0	30.0	25.0	28.0
	7	43.0	28.0	46.0	38.0
Familiarized on Circle	8	60.0	29.0	56.5	47.0
	9	32.0	4.0	2.0	1.0
	10	41.0	36.0	40.5	26.5
	11	9.0	7.0	6.0	12.0
	12	17.0	3.5	-	-
	13	27.0	22.5	23.0	24.5
	14	28.5	7.5	7.5	8.5

EXPERIMENT IV

Time spent looking at the familiarized stimulus for each subject for both groups during familiarization.

			INTERVALS			
		Subject	1	2	3	4
Familiarized on Non-preferred Red Cross		1	6	7	7	8
		2	16	20	13	22
		3	25	27	29	18
		4	37	36	29	22
		5	6	11	3	2
		6	22	15	4	3
		7	8	11	4	5
Familiarized on Non-preferred Black Circle		8	20	23	15	2.5
		9	30.0	19.5	31	16.0
		10	25.0	28.0	18.0	9.0
		11	21.0	9.5	5.5	3.0
		12	8.0	4.0	2.5	4.5
		13	13.5	5.0	2.0	5.0
		14	12.0	10.0	6.5	7.5