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DIFFERENCES IN VARIABILITY OF COLOR OF STIMULI ON THE CHILD'S HABITUATION OF ATTENTION AND ON HIS PERFORMANCE OF A CUE-RELATED TASK

by

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Approved by

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APPROVAL PAGE

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The purpose of this study was to investigate the effects of different color combinations on length of attention, as measured by eye fixation habituation and amount of information gathered from stimuli, as determined by two cue-related tasks. Four treatments represented simulated environments of high saliency, low saliency, combination high and low saliency, and a control group. Subjects were assigned to one of the four groups with equal numbers of each sex and of high and low mental ages as measured by Peabody Picture Vocabulary Test. High mental age was arbitrarily designated as five years, and below that point mental ages were considered low.

Two sessions were held for each of the 96 four- and five-year-old children selected from day care programs and kindergartens in Guilford County, North Carolina. The first session familiarized the child with the experimental setting, and the Peabody Picture Vocabulary Test was administered. During the second session each subject (S) was presented stimuli of one of the four treatments by repeated presentations on a translucent screen, with rear-screen projection.

Criterion for eye fixation habituation was met when the S's initial fixation on the stimuli was broken within one second after presentation in three out of four consecutive presentations. Following habituation, each S was given two cue-related discrimination tasks of matching a stimulus with a standard and assembling a puzzle of the

stimulus standard. In both tasks, the standard was the same shape as the stimulus to which the S had been habituated except for the control group.

A 4 x 2 x 2 factorial analysis of variance was used to analyze each of the five measures: habituation time, correct matching responses, time for matching responses, correct puzzle assemblies, and time for puzzle assemblies. The hypothesis that habituation would be slower to a combination of high and low saliency was not confirmed. The hypothesis that subjects habituated to the combination treatment would score higher was not confirmed, but the hypothesis stating the prediction of more rapid performance in the combination treatment was supported in the measure of time for puzzle assembly. An hypothesis of there being no difference in habituation time, scores, or timing between the low salient and high salient conditions was supported. The hypothesis of there being no sex differences was also supported.

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CHAPTER I

INTRODUCTION

Some educators have indicated that children from disadvantaged homes and communities are deprived of the stimulation needed for developing optimal patterns for learning (Draper, 1970; Dusewicz, 1970; Meuron and Auerswald, 1969; Dunn, 1970). It is also probable that the development of information processing strategies is hindered by overstimulation as well as by understimulation. Whereas the deprived child might develop a strategy based on complacency due to lack of stimulation, the overstimulated child could develop the same low level strategy through overfamiliarization with outstanding features.

Considerable attention has been directed toward unraveling the processes involved in a child's selection of cues for obtaining information. However, the relationship between the length of attention given a stimulus and the acquisition and use of discriminative cues related to that stimulus is unknown.

There are indications from research that suggest that factors related to stimuli play an important role in the child's attending to the stimuli and picking up information from the cues present (Munsinger, 1968; McCall, 1970; Karmel, 1969). Further research has indicated that attention is directed at a stimulus for a longer period of time when that stimulus has certain characteristics which appeal to the subject and relate to his past associations, but which also has enough novelty, complexity, and irregularity to cause the subject to differentiate it from other stimuli (Berlyne, 1960; Munsinger and Kessen, 1966; Piaget, 1952; Hunt, 1961; McCall, 1970).

The development of a strategy for picking up information has been the subject of a proposal by Jeffrey (1968). He theorized that the strategy begins developing in infancy as the child begins attending to cues in his environment. He proposed that the salience of cues related to a stimulus are instrumental in the development of a strategy for picking up and processing information. According to Jeffrey, the role of cue salience is that of an inverted U in that a midpoint of salience is the optimum for information pick up. Less effective in stimulating and holding attention is too little or too much cue saliency.

Jeffrey suggested that the child whose experiences include variability in stimuli will develop a more useful strategy for dealing with information, because he will have a more varied informational background with which to associate new information. The child whose environment has consisted of both high and low salience will develop a pattern of giving attention to both outstanding features and minute details. However, the child whose environment has had less variability either in the form of too much or too little salience will not have the degree of variation in his background to aid in the development of a strategy for processing information.

In accordance with research pointing toward a preference for mid levels of contour (Karmel, 1969), preferences toward semi-complex stimuli (Munsinger and Kessen, 1966), and a balance between novelty and familiarity (Cantor and Cantor, 1966), it seems reasonable to generalize that the child who has the contrast of high and low stimulation in his environment will direct attention to the stimuli for longer periods of time as he would for middle level complexity stimuli.

Pitch discrimination has been suggested as a possible example of a child's being overloaded with too much variability. Jeffrey (1955) suggested that children may not be given adequate opportunities to discriminate the differences in pitches in their environment. Is it possible that children are bombarded with sound, noise, and music to the degree that they inhibit their interest in pitch levels before they have had an opportunity to develop a set for discrimination?

Color discrimination is another area which has been mentioned as a possibility for overstimulation. Jeffrey (1955) found that some children have a difficult task in learning color discrimination. He again suggested that perhaps children have seen so much color that they no longer are attracted to this dimension.

Statement of the Problem

There is a need to determine levels of dimensions which could produce overstimulation or understimulation. There is a need for determining amounts of stimulation for optimum development of selective attention processes and information processing. Related to this area are questions dealing with the irrevocability of the amount of information one can process and with the relationship of attention habits to cognitive capacity.

In developing a method for studying the problem, the following assumptions were stipulated: an environment of too little or too much complexity will exercise little control over attention; the attention which children give stimuli depends greatly on the amount of contrast found in the stimuli; low salient stimuli will not hold attention; high salient stimuli will not hold attention, but the contrast between high and low salience in the stimuli will hold attention for a longer period of time; as a result of directed attention toward the stimuli, the subjects (Ss), theoretically, will gain more information which will be helpful in solving a discrimination task after habituation of attention (cessation of attention) has occurred.

Based on the preceding assumptions, the purpose of the study was to investigate the effects of three types of color combinations on attention. The color combinations would, in effect, be three environmental situations simulated by colored stimuli. Beige and gray stimuli would simulate a dull, low salient environment; red and beige stimuli would be comparable to a mid level of saliency; and red and green stimuli would compare with an overstimulated environment in which there was high salience in all stimulus elements.

Attention, measured by eye fixation, was studied in relation to length of attention to stimuli, ability to solve two discriminative tasks following habituation, and time involved in solving the tasks. Mental age and sex factors were also considered.

Hypotheses

Hypothesis I

Habituation of attention to stimuli with half-high salient and half-low salient cues will be slower than habituation of attention to stimuli with either high or low salient cues.

Hypothesis II

Subjects being habituated to stimuli with half-high salient and half-low salient cues will score significantly higher and perform better on a cue-related task which follows habituation.

Hypothesis III

Subjects being habituated to stimuli with half-high salient and half-low salient cues will perform significantly faster when solving a cue-related task following habituation.

Hypothesis IV

There will be no significant difference between habituation time, scores on the cue-related task, or time spent in the cue-related task between subjects being habituated to high salient cues and those habituated to low salient cues.

Hypothesis V

Subjects with high mental age will habituate slower than subjects with low mental age in all conditions.

Hypothesis VI

There will be no significant differences in sex.

Hypotheses I through V are derived from the work of Jeffrey (1968). Hypothesis VI was derived from McCall (1970) who found sex differences in long term studies of habituation but no differences in short term studies.

Clarification of the Terms Used

Attention refers to the length of time the subject fixates his vision on the stimulus array.

Habituation refers to the phenomenon which appears to be related to learning not to respond. Several physical characteristics are present when a subject is directing his attention to an object. When these physical characteristics have disappeared, habituation of the orienting response is said to have occurred and the subject is no longer directing his attention to the stimuli. Habituation is defined in the study as occurring when the S fails to fixate his eyes on the stimulus array for more than one second in three out of four consecutive presentations of the stimuli. In this research, habituation refers to eye fixation habituation of attention.

Orienting response (OR) refers to the physical characteristics which occur when an organism is directing his attention to a specific stimulus. Some of the responses are decrease in heart rate, changes in EEG pattern, galvanic skin response, and fixation of eyes on the object. It has been suggested that eye fixation is the best index of the OR when visual stimuli are used, therefore, eye fixation is the measure used to assess the OR in the study (McCall, 1970).

High salient cues refer to those cues which are considered outstanding in everyday life. In this study high salient cues are red and green colored stimuli.

Low salient cues refer to those cues which are considered dull in everyday life. In this study, low salient cues are beige and gray colored stimuli.

Half-high and half-low salient cues are found in stimuli containing two red objects and two beige objects. When the word salient is used in this study, it is in reference to color since the shape of all stimuli is held constant.

Mental age (MA) refers to the subjects' mental age score on the Peabody Picture Vocabulary Test.

Limitations of the Study

Geographical Area. The study was limited to Guilford County.

Age of Subjects. The study was limited to children of preschool age (49 to 77 months) who were involved in a day care or kindergarten program in Guilford County.

Race of Subjects. The study was limited to Caucasian and Negro children. The language spoken in each home was English.

The Sample. Subjects were selected from day care and kindergarten programs in Guilford County. Restrictions on sampling were that there be equal numbers of each sex and of each race.

Any conclusions drawn from this study must be limited to four, five, and six year old children who attend day care or kindergarten in Guilford County, North Carolina.

CHAPTER II

REVIEW OF LITERATURE

When considering the problem of stimulus variability and its influence on information processing, several areas of literature are relevant.

Basic to all the research is the field of knowledge regarding the relationship between stimulus related cues and responses of the organism. The relationship has been described using terms such as the orienting response (OR), habituation, stimulus familiarization effect (SFE), and response decrement. An effort will be made to summarize the vague terms used in this literature into a comprehensible body of references.

Another area of literature is related to specific identifiable cues within a stimulus which play a role in the process of selection of attention. Research related to variables such as complexity, familiarity, novelty, preference, and contour will be discussed.

The interaction between cue-related variables and information processing is an area with less reported research but with a great potential for unraveling some of the unknown factors regarding the neurological processes occurring in the cognitive development of the child.

Habituation

The primary paradigm of the S-R Learning theory is that a stimulus will elicit a response from an organism. To the behaviorist, a response is a response, and the degree of responsiveness is not an element of concern. However, to the cognitive psychologist, the cues within the stimulus, the varying amounts of attention given the stimulus, and the eventual response decrements are vital in understanding processes involved in gaining and using information.

It has been found that physical characteristics change when an organism is directing his attention to a specific stimulus. Some of the responses are: changes in the heart rate, changes in the EEG pattern, galvanic skin changes, and fixation of the eyes on a stimulus object (Thompson and Spencer, 1966). These changes, which occur when an organism is in a high state of attention, have been called the orienting response (OR) (Sokolov, 1963). Sokolov suggested the neurological model as being based on experiences in life being matched with sensory input. When there is a conflict between incoming stimuli and the neurological model, excitation of the neurological system occurs. Simultaneously, the organism becomes physically aroused and mentally alert. Sokolov's model, although theoretical, is in alignment with assumptions from Hebb's cell assembly theory (1949), Berlyne's (1958) conflict and arousal theory, and Piaget (1952) and Hunt's (1961) problem of the match.

A phenomenon directly related to the OR is habituation of the characteristics of the response. Habituation has been defined as a response decrement resulting from repeated stimulation (Harris, 1943). After a period of time the OR completely disappears, and the S̲ ceases attending to a stimulus when that stimulus has been presented to him repeatedly. The length of time necessary for habituation to occur varies according to salience of stimuli (Jeffrey, 1968), and the rate of presentation time (Vicinanza, 1969). The parameters of the habituation process are not clearly defined in the literature. However, Thompson and Spencer (1966) have outlined the major characteristics with which most research is compatible. The characteristics of habituation are: 1. repeated applications of a stimulus which elicits a given response will result in decreased responses; 2. when the stimulus is withheld, the response makes a spontaneous recovery; 3. when a series of habituation training and recovery is given, habituation becomes more rapid; 4. the more rapid the presentation, the more rapid the habituation; 5. weaker stimuli produce more rapid habituation; 6. effects of habituation training may proceed beyond the zero point; 7. stimulus generalization occurs in habituation; 8. presentation of a different stimulus results in recovery of the habituated response; and 9. with repeated applications of dishabituation stimuli, habituation of the dishabituation occurs.

An effort has been made in the literature to differentiate between sensory adaptation and habituation. Sensory adaptation is manifested by effector fatigue, in which case, the stimulus has no influence as long as it is directed toward the "tired" sensory receptor. Habituation may be distinguished from adaptation through application of the nine characteristics of habituation (Thompson and Spencer, 1966).

Stein (1966) has presented a model of habituation in which he outlined the mechanisms by which the brain deals with novel and familiar stimuli. He suggested that there are two antagonistic neural systems which are sequentially activated by the initial presentation of a stimulus. The first system is the excitatory system (OR), and the second system is the inhibitory system (habituation). The excitatory system is activated by novel stimuli, and the inhibitory system is activated by the prolongation of the excitatory system. The sensitivity of the excitatory mechanism decreases after arousal; therefore, habituation occurs more rapidly with fast presentations of stimuli. The activity of the inhibitory system is conditioned. On the second presentation of stimuli, the excitatory and the inhibitory systems are activated simultaneously. The excitatory system is activated by the stimulus, and the inhibitory system is activated by anticipation through conditioning. With each new presentation, both systems are activated at the same time with the excitatory system growing weaker after each arousal, until it is completely diminished, at which time the response is said to be habituated. This model assumes the use of classical conditioning in the structural causality of habituation. Even though there is no research to substantiate this theoretical model, the theory is not in conflict with the characteristics of habituation.

Another term found often in habituation literature is stimulus familiarization effect (SFE). Cantor and Cantor (1966) found the effect when familiarizing Ss with stimuli through repeated presentations. The SFE was described similarly to the habituation of the OR in that Ss showed preferences for novel stimuli after having been familiarized with a specific stimulus. Interest in and reaction to the familiarized stimulus were substantially lower than to novel stimuli. Cantor (1969) would not accept SFE and OR habituation as synonomous, but he stated that he was aware of no explanation of the SFE having more potential than that of habituation theory.

This review has centered upon literature which defines habituation in relation to the cessation of attention. It should be noted that the term habituation has been used in physiological and neurological research and has been shown to occur in reflexes, skin shocks, and other physiological measures (Thompson and Spencer, 1966). This review, however, is only of material related to the habituation of the OR.

Stimulus Influence on Attention

Despite the lack of clearly defined research or theory on the mechanisms of the OR and habituation, several stimulus variables have been studied, and findings were substantiated in interactions between the stimulus cues and the responses of the organism. Researchers have been concerned with the variables of familiarity, novelty, complexity, contour and contrast, color, motion, preference, and noticeability.

Novelty and familiarity have been identified as variables in attracting and holding attention. For the optimum amount of attention, there must be a balance in the stimulus between what is new and what is familiar. Piaget (1952) indicated that a child "looks neither at what is too familiar, because he is in a way surfeited with it, nor at that which is too new, because this does not correspond to anything in his schemata . . . (p. 68)." Hunt (1961) continued and stated that a child's interest in novelty is determined by the "degree to which he has been forced to accommodate to a variety of stimuli during his first six to eight months of life (p. 143)." It seems that Piaget and Hunt are suggesting that attention-holding potential is found in an interaction between the cues in the stimuli and the experiences of the child. For many years, researchers assumed that children enjoyed familiar items (Jeffrey, 1969), but apparently too much familiarization will produce something similar to the habituation effect. Cantor and Cantor (1965) familiarized preschool children with a stimulus and then administered a discriminative reaction time task in which button pressing was elicited by either a familiar or a novel stimulus. Reaction time was significantly faster to a novel stimulus than to the stimulus with which the S had been familiarized. Familiarization was accomplished through 40 presentations of a stimulus. Usual habituation time is between 10 and 30 presentations (McCall, 1970). With the exception of one study, all of Cantor's work was done with visual stimuli. Cantor's work substantiates the suggestion that familiarization may have a detrimental effect on attention-holding potential within a stimulus. Sokolov's neuronal model correlates well with Cantor's research also. When familiarization occurs, there will be no conflict between the neurological image and the information input, thus causing no excitation of the neural system (1963).

Odom (1964) contributed in the same area by studying stimulus satiation and deprivation. His work was done in both visual and auditory modalities. He used 64 eight- to 11-year-old children in four treatment groups. Treatments were satiation in color and tones, auditory satiation, visual satiation, and deprivation of both auditory and visual. Pretraining sessions were held in which the Ss received ten minutes of satiation or deprivation depending on the assigned treatment. No measure of habituation was made, but it was assumed that with two to four presentations per minute, habituation would occur within the pretraining period. Following the pretraining period, Ss were asked to turn a disk. Turning in one direction reinforced the S with colors on a screen; turning in the other direction resulted in the presentation of auditory tones. Each S was given seven minutes in which to manipulate the disk. Analysis was made of amount of color or tones selected across conditions and sex. Results indicated that deprivation of stimulation in one sense increased the reinforcement value of stimulation to that modality, and that satiation in one sense decreased the apparent reinforcement value of stimulation on that sense modality.

The research reported indicates that familiarity with stimuli is influential in the development of a lack of attention given to those stimuli. It must be pointed out that one of the characteristics of habituation is recovery of attention when the stimulus is withheld. Pancratz and Cohen (1970) studied recovery of habituation in infants and found differentiation made between novel and familiar stimuli when the stimuli were presented within 15 seconds after habituation, but no differentiation when a period of five minutes elapsed. Vicinanza (1969) found similar results with kindergarten children when studying recency and varying amounts of suditory habituation on visual stimuli. He concluded that increases in the amount of auditory habituation caused increases in preferences for visual stimuli, and that the longer the delay between habituation and presentation of visual stimuli, the less visual stimuli were preferred. It seems reasonable to assume that novelty and familiarity of stimuli play influential roles in attracting and holding attention. Piaget's statement of the need for a balance between novelty and familiarity appears to be upheld with the reported research.

Complexity as a stimulus variable has been studied considerably, although consistent conclusions have not been made. Berlyne (1958) initiated an increased amount of attention toward stimulus complexity when he found a positive relationship between complexity and attention. Attention was measured in the length of time the S viewed stimuli of his choice which were either defined as simple or complex. Complexity was defined in terms of irregularity of shape, amount of material, and heterogeneity of elements in each stimulus. Even though Berlyne's work has been supported (Willis and Bornbush, 1968) and refuted (Spitz and Hoats, 1963), the most severe failing in research in the area of stimulus complexity has been in a lack of a consistent operational definition of complexity.

Attneave (1957) attempted to provide a definition of complexity, and it has been used by a number of researchers. Using his definition, stimulus shapes are plotted by connecting points which are randomly chosen. Complexity of the stimulus varies along a continuum of simple to complex as the number of points, often called turns, in the shape increases. Studies of preference for specific numbers of turns in the shape have tried to identify the degree of complexity (i.e., number of points in the shape) which is preferred by Ss of differing ages. Munsinger and Kessen (1964) found preferences in children and adults to be near 10 turns. From stimuli varying in points from five to 36, Munsinger and Kessen (1966) substantiated the earlier findings of 10 turns to be preferred. From the preference found in the range of stimuli in Munsinger and Kessen's (1964, 1966) studies and substantiation by Thomas (1966), Berlyne's (1960) contention that complexity and preference have an inverted U function relationship appears to be somewhat supported. Again, in complexity of stimuli, as in novelty and familiarity of stimuli, it seems that a midpoint of stimulation will produce better results in attracting and holding attention.

A mathematical model defining complexity was recently introduced by Vitz and Todd (1971). In this model, the perception of simple geometric figures--line, angle, and area--are the three stimulus elements. A sampling process occurs when an organism looks at a figure. The process begins with lines and ends with areas. Probabilities in the sampling process are formulated in proportion to the magnitude contributed by that element. All elements of a given class are sampled before going on to a different class. After a fixed number of trials, the sampling stops even if all of the classes have not been sampled. Complexity is defined as the total number of trials to sample the elements in a class corrected by a measure of redundancy. The degree of symmetry reflects the degree of redundancy. It seems that this study is a mathematical way of reiterating what has already been indicated in the previous research (Cantor and Cantor, 1966; Jeffrey, 1968). An S will attend to an element of greatest magnitude and will continue sampling elements of that class until habituation occurs, at which time he will sample from other classes. The degree of symmetry would correspond to familiarization and would lessen the degree of complexity of a stimulus. If used in psychological studies, this model of complexity would probably aid tremendously in aligning the terms used in complexity literature.

Another stimulus variable which has been studied has been contour. McCall (1970) studied the attention an infant gives to stimuli varying in contour and contrast. Through manipulation of contour length and number of sides in random shapes, he studied the control of the stimuli over the attention of the infants and found contour and contrast to be important factors in attention. McCall and Melson (1969) defined complexity as the amount of asymmetry and irregularity of an arrangement of black squares on white background. The complexity was held constant, and the amount of contour was manipulated by enlarging or reducing the size of the squares. Results indicated that, to some degree, the greater the contour (contrast between black and white), the greater the attention given the stimulus. Karmel (1969) studied contour by using stimuli composed of black lines on white squares and proposed that the relationship between contour and attention is an inverted U shape function.

The presentation of color into a non-color stimulus array has been found to increase the OR as measured by visual fixation, smiling and pointing. Dodd and Lewis (1969)studied preschool children by presenting visual stimuli by rear-screen projection without color and then adding color to the stimuli. The researchers assumed that the dimension of color added complexity to the stimuli and concluded that the OR was significantly greater when color was added. A second set of stimuli in the same study failed to reach significance, but did indicate that when an array of straight lines is presented to Ss followed by an array of contour lines, the OR increases upon presentation of the contour lines. Control groups were used with both sets of stimuli in which color and contour lines were shown first, with the subtraction of color and the straightening of lines occurring. The OR increases were substantially less when the changes were made in the control groups.

Motion is another variable which has been found to be salient in most organisms (Jeffrey, 1969) and is apparently related to a finding by Gibson (1958) in which rats could identify cut out stimuli but not stimuli painted on flat surfaces. It was assumed that cut out objects would have a depth and a possibility of motion which flat stimuli would not have.

Another stimulus dimension which is probably relevant in attracting attention is noticeability. Clayton, Merryman, and Leonard (1969) studied noticeability by using the following dimensions: color, shape, number, position, size, and brightness. When measuring salience by the number of Ss noticing a particular dimension first, color was the most substantially used cue, followed by shape, number, position, size and brightness. When errors based on a concept identification task were computed positional cues gave the least number of errors followed by brightness, color, shape, size, and number. The authors indicate that there is probably a difference in the processes of noticing a cue and in using it for a concept identification task. Further research is apparently needed in this area to determine to what degree noticed information is processed.

Information Processing and Attention

In considering the body of literature related to strategies of information processing, a review of the area on selective attention which was made by Maccoby (1969) is of primary interest. Maccoby reported that from photographs of eye scanning, adults have greater eye movements. Children's eye movements are less frequent, with more fixations, and with line movements which are straighter than those of adults (Zaporozhets, 1965). It seems that the ability to divide attention and to attend to more messages in the stimuli comes with age. Maccoby suggested that children's information processing system is not deficient but is not employed efficiently. She says that the chunking process has not been refined. The chunking to which she refers is apparently from Miller's (1956) magic seven plus or minus two, in which he indicated that information is processed by channeling chunks of information and that there is an upper limit on the amount of information one can process. Maccoby continued to say that channel capacity is not only a function of age but is determined to some degree by the amount of irrelevant information which an organism can tolerate without having information pick-up adversely affected. Channel capacity is probably a developmental characteristic in that Witkin (1950), in studying recognition of embedded figures, also found definite improvement in disembedding with age. Piaget has written of the young child's inability to see the part-whole relationship (1952). If a child sees a picture of a man with a potato head and carrot arms and legs, he will immediately recognize the potatoes and carrots but fail to see the whole figure. Piaget has given the name "centering" to the inability to perceive the whole relationship. As a developmental process, a shift toward decentering is made and the child will eventually be able to recognize parts and wholes.

Further research (Munsinger, 1968) found that children could not use color and shape cues at the same time to solve a problem. Four classes of stimuli were presented to college students and to elementary school children. The stimuli were in shapes of five, 10, 20, and 40 random turns and each shape was always presented in the same color. From pretests without color, it was found that color did not help children categorize each stimulus according to its number of turns. College students were able to use the correlated cues. Munsinger indicated a possibility of cognitive overloading for the children in the use of the correlated cues.

Munsinger and Kassen's (1964, 1966) studies indicated that adults and children prefer shapes with 10 turns as opposed to other turns within a range from five to 36. These studies are contradictory to a concept of channel capacity being wholly a function of age. If preference is an indication of channel capacity, it may be assumed that the upper limit in processing shapes is probably about 10 turns, and more than 10 turns results in overloading cognitive capacity and the inability to process the information.

In line with this assumption is Jeffrey's (1968) theory of serial habituation. Serial habituation is a strategy for dealing with information which is not a function of age, but which develops in relation to the child's experiences and environment. The development of the strategy begins in infancy as the child begins attending to cues in his environment. While attention is projected on an object, the OR occurs. When the child has habituated his attention to the object, the OR disappears. In every stimulus there are many cues such as color, shape, position, number, and innumerable other cues. Jeffrey proposed that as the child develops a method for processing information, he attends to each cue in the stimulus in a hierarchical ordering according to the ability of each cue to elicit the OR. As the child becomes more practiced in eliciting information from the cues, he is able to process information from each cue in a stimulus in a serial manner of attending, picking up information, and habituating to that cue. The child who develops a serial strategy is able to process the information more rapidly but still gains accurate information. Some type of strategy is developed by each person in learning to deal with his perceptions and sensory experiences, however, Jeffrey proposed that the child whose experiences include many cues with varying ability to catch and hold attention will develop a more useful strategy. Jeffrey suggested that an environment with a saturation of highly salient cues will not lead to a serial strategy but more likely to a pattern of attending only to outstanding cues. He advocated a combination of high and low salience cues in the environment for a child.

This theory is in agreement with most of the research reported in this review, in that the research related to stimulus variability factors strongly suggests an inverted U function as the relationship between attention and the factors. Of the factors discussed, there is conformity in that the optimum condition for holding attention is a midpoint between two extremes. There is also some evidence that cognitive overloading is possible (Munsinger, 1968) and some speculation that it may be detrimental to the development of a strategy for information processing (Jeffrey, 1968, 1969).

CHAPTER III

PROCEDURES FOR THE STUDY

Method

The design (see Figure 1) for this research is a 4 x 2 x 2 factorial design which investigated the effects of the following variables on habituation of attention and on performance of a cue-related task following habituation:

1. Simulated environmental conditions of
   a. Low salience
   b. High salience
   c. Half-high and half-low salience
   d. Control
2. Sex
3. Mental age

Subjects

The total number of Ss was 96. There were 24 white females ranging in chronological age (CA) from 49 months to 77 months with a mean CA of 63 months. Mental ages (MA), as measured by the Peabody Picture Vocabulary Test, ranged from 36 months to 114 months with a mean MA of 54 months. Twenty-four black females ranged in CA from 53 to 75 months; mean CA was 60 months. Mental ages ranged from 40 to 87 months with a mean of 52 months. Twenty-four white males ranged chronologically from 49 to 77 months with a mean of 60 months. Mental ages ranged from 35 to 99 months with a mean of 57 months. Concluding the number of Ss were 24 black males ranging chronologically from 52 to 74 months; mean of 62 months. Mental ages ranged from 36 to 87 months, averaging 52 months.

Figure 1. Factorial Design for Study

	High Salient (Red-Green)		Mid-Salient (Red-Beige)		Low Salient (Beige-Gray)		Control Sticks	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
High Mental Age	n=6	n=6	n=6	n=6	n=6	n=6	n=6	n=6
Low Mental Age	n=6	n=6	n=6	n=6	n=6	n=6	n=6	n=6

The Ss were drawn from children in the following day care centers and kindergartens in Guilford County:

United Day Care Center

Green Street Baptist Church Children's Center

Developmental Day Care Centers

First Wesleyan Church Day Care Center

Christ of the King Catholic Church Kindergarten

The only restrictions in the sample selection were equal numbers of each sex and each race and that half of the Ss in each race and each sex have a mental age equal to or greater than five years.

Apparatus

Rear-screen projection was used to habituate (as measured by eye fixation) the attention of each S. A folding screen consisting of three separate parts, two of which fit together around an acrylic translucent screen, was placed six feet in front of each S. The screen is two feet by three feet and was positioned slightly above the center of the middle section of the apparatus. A viewing hole located left of the screen enabled the experimenter (E) to observe S's visual fixation (see Figure 2).

Projection of stimuli was accomplished with a Kodak Carousel 860 projector with an automatic timer which was positioned on a table four feet behind the screen.

Stimuli

Stimuli for the high salient cue condition were slides on which there was an array of four random 10 turn shapes of one shape in two positions in two high salient colors of red and green (see Figure 3). Low salient stimuli were slides with the same shape and positions except in low salient colors of beige and gray (see Figure 4). The condition having half-high and half-low salient cues in the stimuli used the same shape and positions but in colors of red and beige (see Figure 5). The control group was set up to determine differences in the effects of

Figure 2. Apparatus for Rear Screen Projection

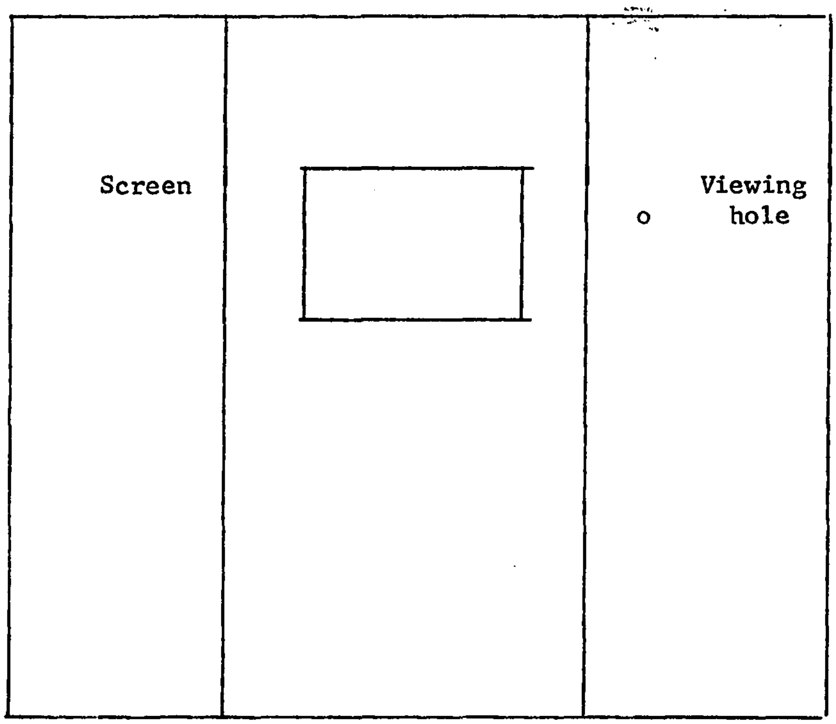


Figure 3. Array of Stimuli for Slide Showing High Salient Colors

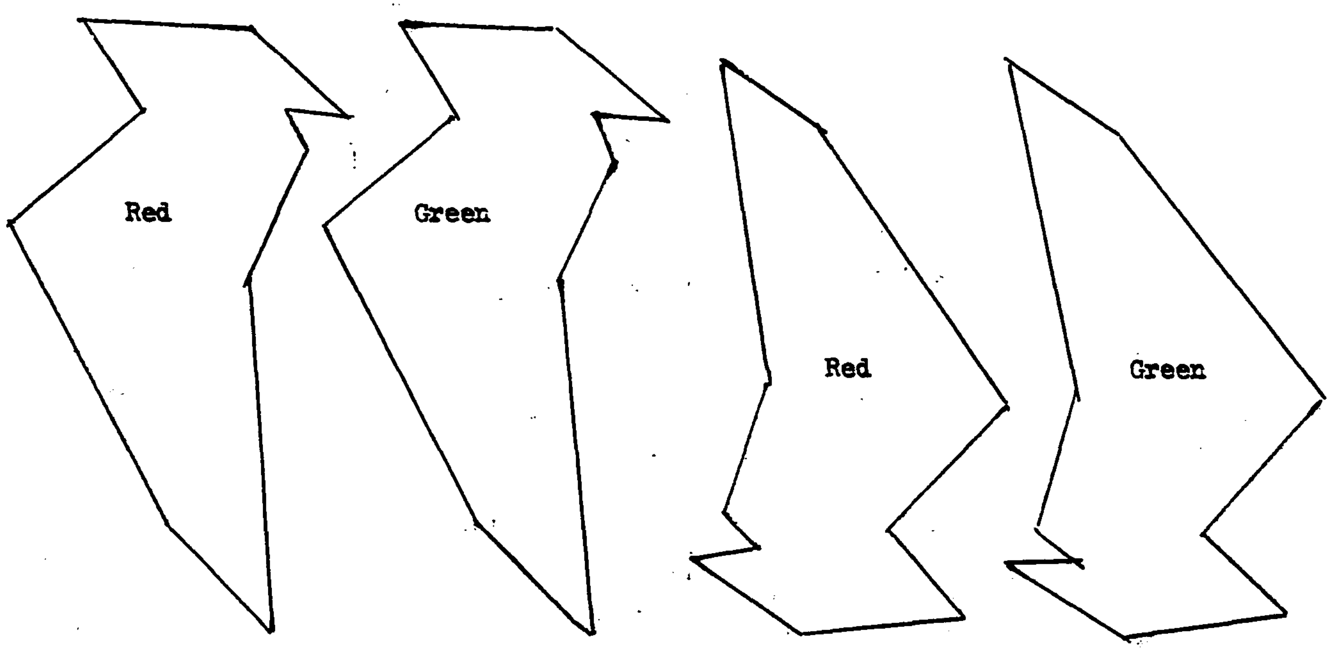


Figure 4. Array of Stimuli for Slide Showing Low Salient Colors

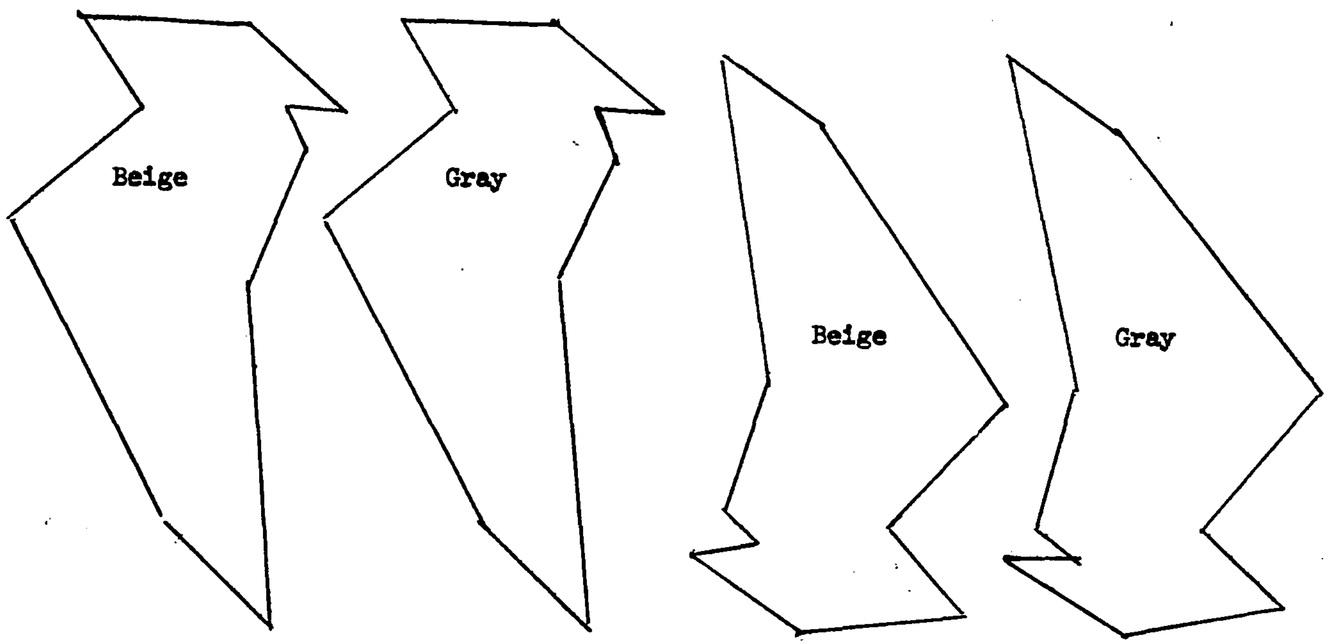
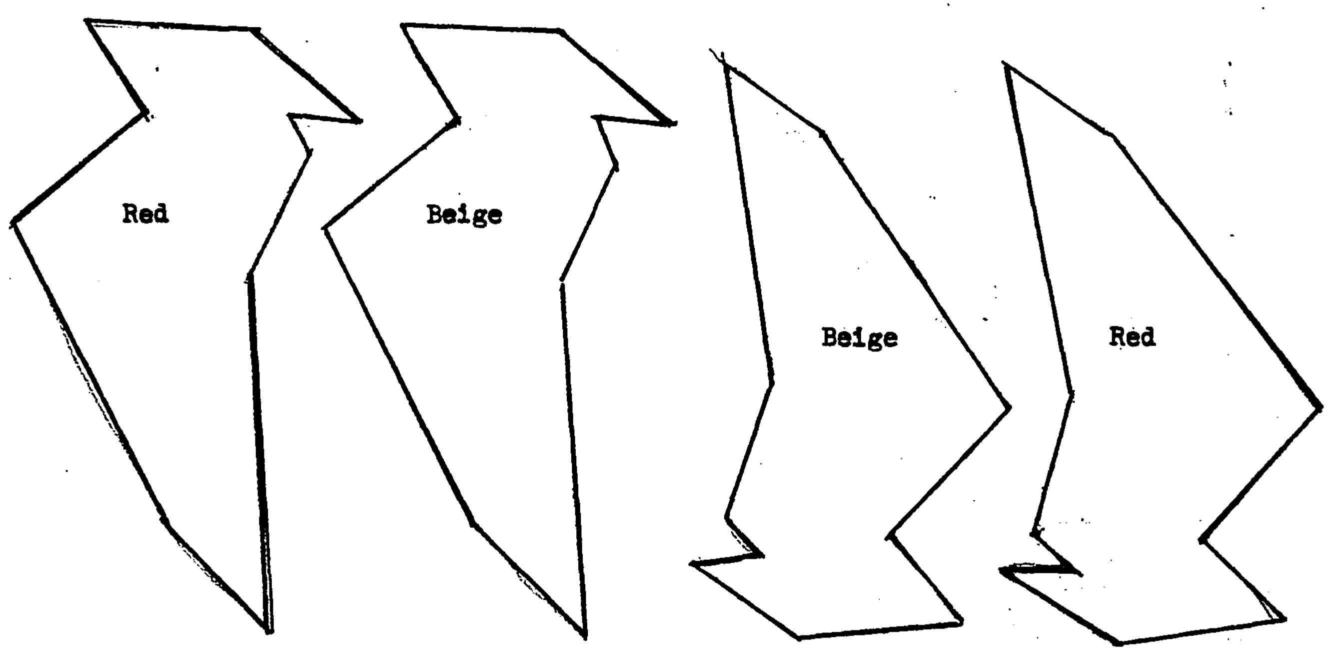


Figure 5. Array of Stimuli for Slide Showing High and Low Salient Colors



having been habituated to the stimuli and then presented a related task in contrast to a group which had been habituated in the same manner to irrelevant stimuli (stick figures) (see Figure 6) and given the same cue-related tasks as the experimental groups were given.

Cue-related Tasks

The first task consisted of a ring bound notebook on which the first 16 pages had four standard stimuli as had been used in the slides for habituation. Four positions were shown on each page. The positions were: right side up and right side out, right side out and upside down, wrong side out and right side up, wrong side out and upside down. Four colors used were: gray, green, red, and beige. A single color was used on each page. Position and color were rotated to offset any positional or color effects. A standard stimulus for each page was constructed corresponding in size, color, and one position. Positions of standards were rotated to guard against effects of positional preferences (see Figure 7).

The second task was an object assembly task in which the object was again the standard stimulus. One object of one of the four colors was cut and mounted on a 2½ x 3½ card in one of the four positions. Another standard stimulus of the same color was cut into two or three sections and resembled a puzzle. There were eight puzzles varying in color and position (see Figure 8).

Figure 6. Stimuli for Control Group

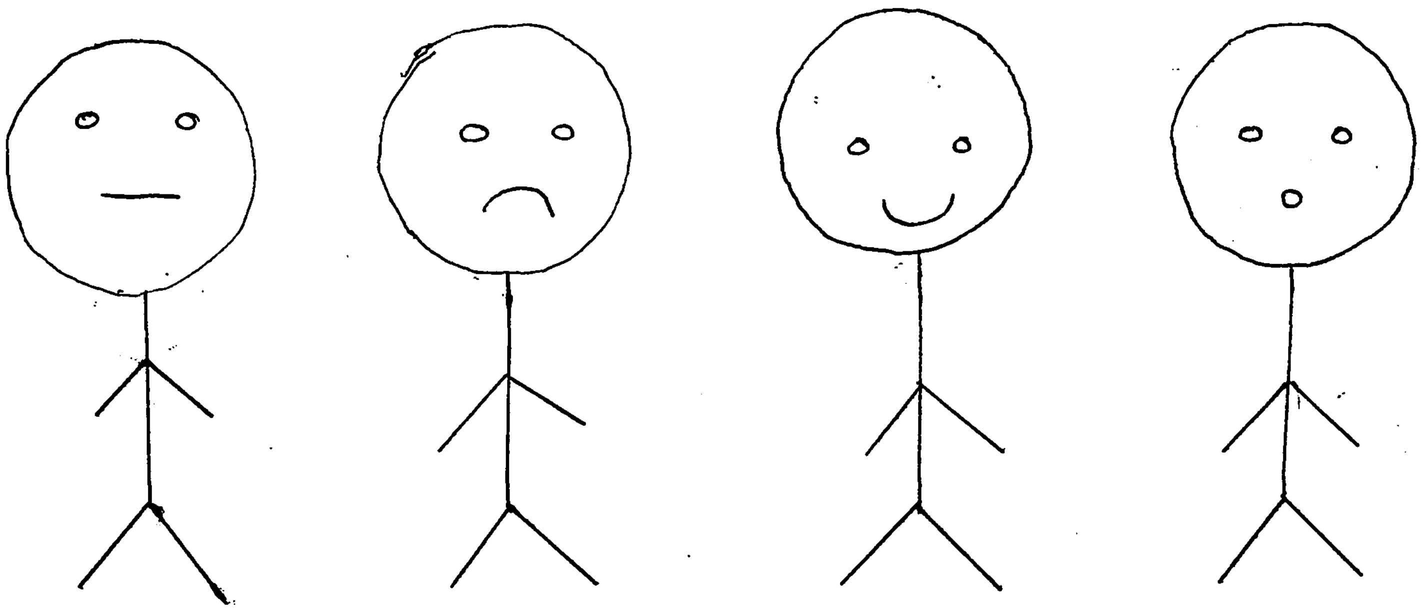


Figure 7. Matching Stimuli Task

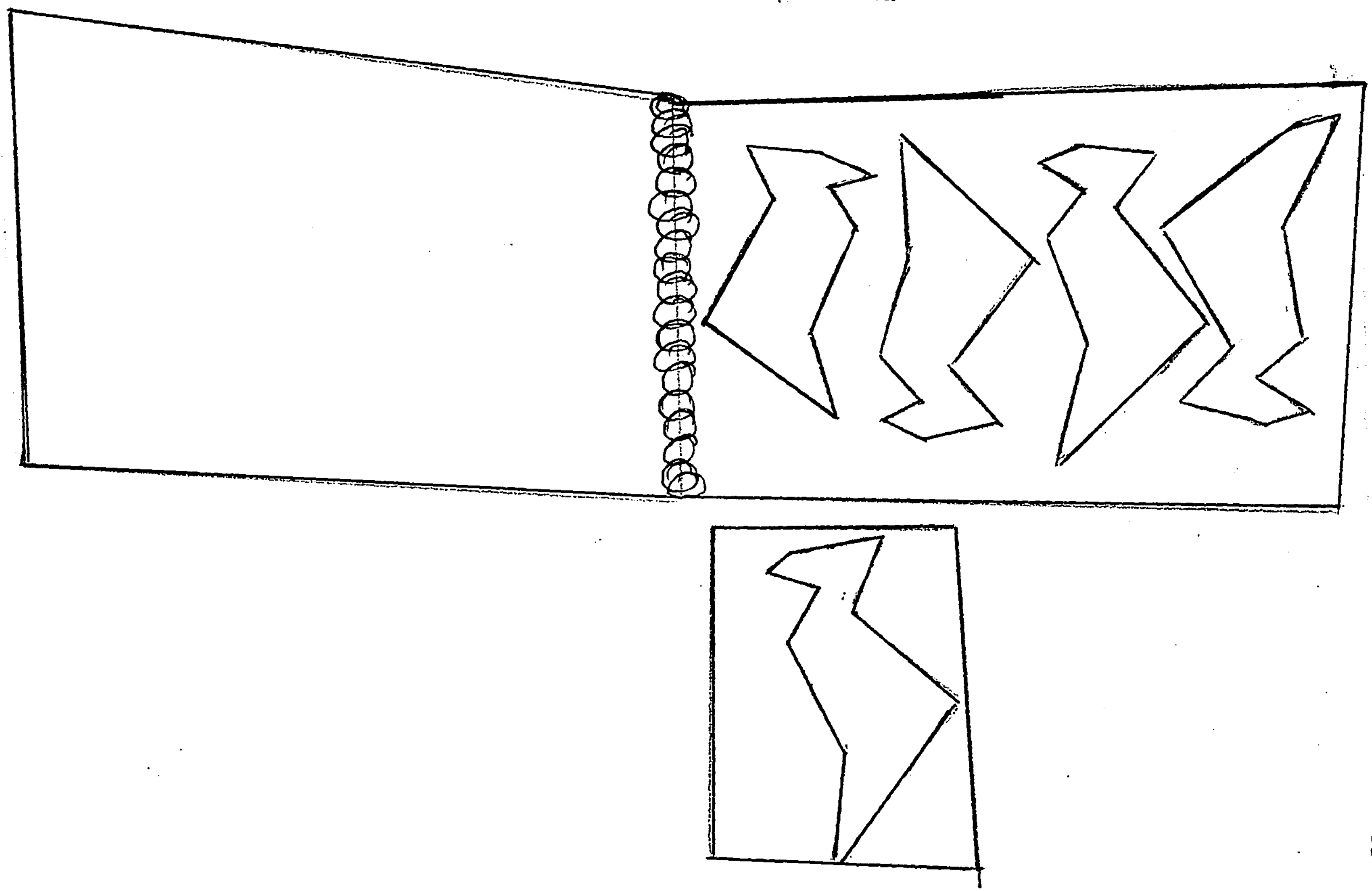
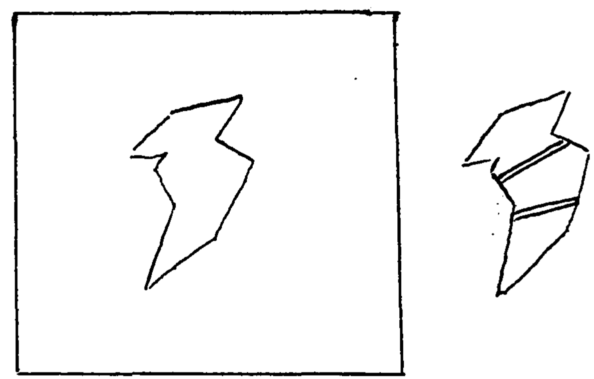


Figure 8. Object Assembly Task



Procedure

Each S was tested individually in a spare room located on the site of the day care center or kindergarten. Each testing room was as bare as possible of all stimuli other than the experimental apparatus.

Each E was seen by the E for two sessions. In the first session the S was introduced to the E, asked his age, asked if he had brothers and sisters, and asked if he liked to look at pictures. The Peabody Picture Vocabulary Test (PPVT) was then administered to the S to gain a measure of mental age. After the PPVT was administered, according to directions in the manual, each S was instructed to return to his group of children and promised more games during the next visit by the E. During this session, it was assumed that the child would become familiarized with the experimental room and the existing apparatus.

During a second session, usually the next day, the S was again asked to go to the experimental room for more games. Upon entrance to the room, each S was greeted by name and asked if he enjoyed watching television. Then E proceeded by stating:

> "I have something like a television set. There is a machine behind the screen which will make pictures come on the screen. I'd like for you to see the pictures. If you will sit in this chair (six feet in front of screen) I will go behind the screen and turn on the machine. I'll have to stay behind the screen to make the machine work. When you finish looking at these pictures, we'll play another game."

E moved to back of screen and asked S if he were ready. Upon his answer E turned switch on projector and turned on the stop watch with the first presentation. The projector automatically changed presentations every five seconds. The E observed S from a viewing hole on the left side of the screen to the E. Criterion for habituation was met when S looked away from screen within one second after initial fixation on screen in three out of four consecutive presentations.

When S was habituated to stimulus array, E stopped the stop watch, turned off the projector, recorded the habituation time and exited from behind the screen. The E asked the S if he had finished looking at the pictures. Responses were 100% affirmative. The E then suggested that they play some more games.

E and S moved to a table on which the matching task was displayed. Directions given to the S were as follows:

> "I have a book with some pictures in it. On each page there are four pictures. I also have some cards with pictures on them. I'd like for you to look at the pictures on this page (notebook is open and objects displayed) and find one of the pictures which is exactly like the picture of a card I have. Find one of those pictures (E pointed to objects) which is exactly like this one (E displayed card with standard)."

As E displayed standard card, E also started timing with a stop watch. When S responded by pointing, E stopped the stop watch and recorded the time and whether or not the response was correct on a prepared score sheet (see Figure 9). One score sheet was prepared for each treatment by race and sex. There were 16 items in the matching task.

After the matching task was completed, E told the S that there was one more game which they could play. E asked S if he enjoyed working puzzles. Directions were given for this task as follow:

> "I have some puzzles which we can work. I also have cards with pictures on them just like each puzzle. (E laid the card standard on the table and took the parts to the puzzle from

> an envelope and displayed them on the table beside the standard.) Watch while I put together this puzzle and then I will tear it apart and you can put it together. See how the puzzle looks just exactly like the picture on the card? I am going to tear it apart and you put it back together and make it look just exactly like the picture on the card."

E started timing when S began manipulating parts and stopped timing when S removed hands and stopped working with puzzle. E recorded time to assemble parts and whether or not the assembly was correct.

There were eight puzzles for each S to complete and scoring was made on the prepared score sheet (see Figure 9).

Each S was told that he had played all of the games which E had brought and that E had enjoyed playing the games with him.

At the beginning of the study Ss were tested with one S being assigned to each one of the conditions and on a continuing rotating basis in order to control for time effects. Later in the experiment, occasionally two or more Ss had to be run consecutively in the same condition due to restrictions on having equal proportions of sex, race, and high and low mental ages in each condition. Time effects were probably minimal since most testing was done between 9:00 and 11:00 a.m.

Figure 9. Score Sheet for Cue-related Tasks

	Condition	Mental Age	Number	Sex	Race	Habituation Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1	2	3	4	5	6	7	8
							Matching Task																Object Assembly							
1																														
2																														
3																														
4																														
5																														
6																														

CHAPTER IV

RESULTS AND DISCUSSION

Analyses of variance were made to determine the major effects of habituation time, matching time, correct matching responses, puzzle time, and correct puzzle responses across treatments, sex, and mental age. Major effects of treatment, sex, and mental age as well as interactions among all the variables were studied.

There were no significant differences found in habituation time due to treatment. Hypothesis I, that habituation of attention to stimuli with a mid level of saliency would be slower than habituation of attention to either high or low salient cues, was not confirmed. However, the means of habituation time by treatment do fall in the predicted direction. As had been predicted, the red-beige condition (half high, half low saliency) did habituate slower than the other groups although the data were not near significance (Table 1).

TABLE 1

Habituation Time by Treatment

Treatment	Habituation Time
Beige-Gray	105.9 seconds
Red-Beige	111.4 "
Red-Green	98.8 "
Sticks (control)	108.0 "

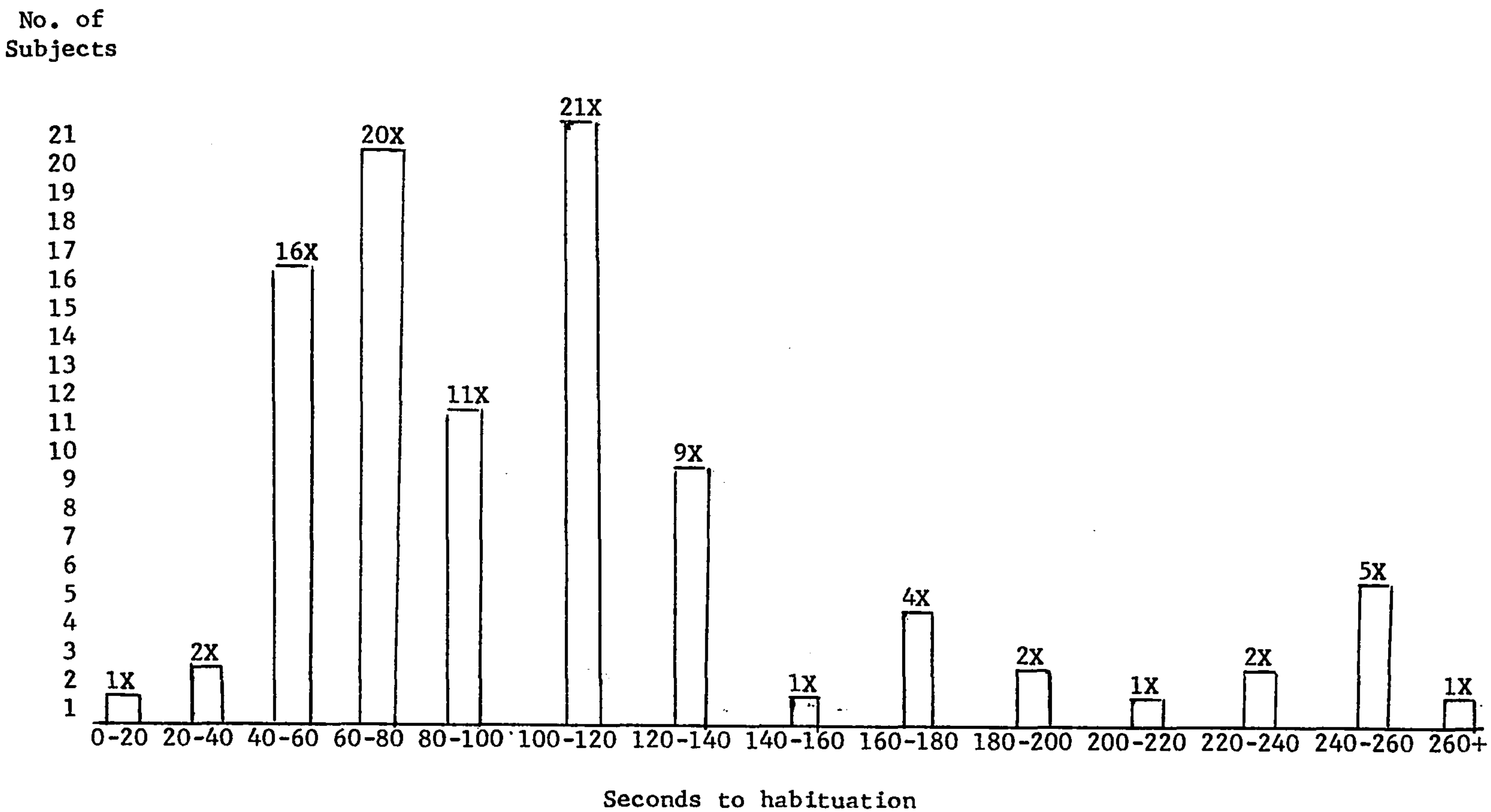
Since the real substance of this research was based on there being a difference in habituation time depending on condition of stimulated environment, careful thought was given to possible fallacies in the research or external causes which could have contributed to this result.

Figure 10 indicates that there was not a normal distribution of habituation time by Ss. One could possibly attribute lack of significance to the 16 Ss who were especially difficult to habituate. Probably future research should set limits for habituation time and use the limits as a restriction for S sampling.

Another possible explanation for these results is in the criterion for habituation. Initial fixation was the measure observed. Later fixations were not recorded in any manner. If an S removed his fixation within one second after the presentation for three out of four consecutive presentations, habituation was said to have occurred. Information was not recorded regarding second or third fixations. Research using a hidden camera in which all fixations could be studied would be helpful in understanding the phenomenon of habituation. Another possible explanation is that with enlargement of Ss in each cell a normal distribution could occur and the predictions could have been supported.

Hypothesis II was not significantly supported by the data, however, they do fall in the predicted direction. It was predicted that the red-beige group would score higher on the cue-related tasks. Means are given in Table 2 showing that the red-beige treatment group

Figure 10. Distribution by Habituation Time



did perform better with more correct matching responses but not significantly better. In correct puzzle responses, the red-beige group had fewer correct responses than the low salient group (beige-gray).

TABLE 2

Correct Responses by Treatment

Treatment	Matching*	Puzzle**
Beige-Gray	7.04	3.54
Red-Beige	9.04	3.50
Red-Green	8.79	3.45
Sticks	7.50	3.16

*$p. < .1071$
**$p. < .88$

In the correct puzzle responses there were three significant interactions which probably affected the data. There was an interaction between sex and mental age on puzzle responses ($p. < .04$). Treatment by mental age had significant differences on puzzle responses ($p. < .01$), and a main effect of mental age was found on puzzle responses ($p. < .0001$). It seems logical that the higher the mental age, the more correct responses would be made in puzzle assembly. The interaction of puzzle time with sex indicating girls having significantly higher scores than boys may reflect practice effects coming from our society. Girls probably are encouraged to assemble puzzles more than boys, thus giving girls an edge over the boys on this task. The interactions on this task, which were not present with the other tasks, probably affected the results.

Hypothesis III was supported with the time involved in puzzle assembly, but not with time involved in the matching task. Table 3 gives the means for puzzle assembly time by treatment.

TABLE 3

Means for Puzzle Time by Treatment

Treatment	Time*
Beige-Gray	35 seconds
Red-Beige	29 "
Red-Green	36 "
Sticks	46 "

*p. $<$ .03

In the puzzle time variable, the red-beige group completed the tasks in significantly less time than the other groups. The score for the control group (sticks) indicates decisively that the treatment did have an effect on the task.

The same hypothesis was not supported with matching time. There was a significant interaction between sex and mental age with females with high mental ages matching in significantly less time. This interaction probably decreased the effect of treatments in this variable.

Hypothesis IV was supported in that there were no significant differences between Ss in the beige-gray group (low salience) and the red-green group (high salience). In the variable of puzzle time which was the only variable with a significant difference due to treatment, the mean time for beige-gray was 35 seconds and red-green was 36 seconds. With the other variables in which significance was not met, but the data were similar to predictions, there were few differences in the low and high salient groups. The implications behind this finding are monumental for education, in that there is substantiation of no difference in time performance of a puzzle in a dull color and a bright color. Generalizing, one might indicate the possibility of there being no difference in some tasks in a dull environment and a highly stimulated environment.

Hypothesis V was not substantiated in this research indicating that habituation time is not a measure of mental age as has been hinted (McCall, 1970). Significant differences in mental age were found in matching correct responses ($p. < .0001$), puzzle time ($p. < .01$), and puzzle correct responses ($p. < .0001$). These results would have been expected. Many researchers probably would not have been surprised if a high mental age were found to be associated with fast habituation. McCall (1970) stated " . . . it is not yet known whether rapid habituation means rapid learning or very limited learning about that stimulus (p. 44)." Possibly habituation is related more to chronological than to mental age. It seems logical that neuro-physiological maturation could be associated with the phenomenon and would be evident more in chronological age than in mental age.

Hypothesis VI was substantiated with each variable except the correct responses in puzzle assembly in which females scored significantly higher than males ($p. < .04$). This result was attributed to practice effects.

The results of this study have not laid a firm foundation for further research in this area, but have been indicative of clues toward better theories of the relationship between attention and stimulus variables.

The significant finding of treatment differences in one variable is strengthening to the theory of differences due to saliency and contrast, and the substantiation of the hypothesis of no difference in low and high saliency on a task performance could have far reaching implications.

CHAPTER V

SUMMARY AND CONCLUSIONS

As a result of the writer's observing bombardment and overstimulation in everyday life, in toys, in media, and in classrooms in our educational system, this research was conceived.

It appeared that there was too much competition for the attention of young minds; too little time to observe, absorb, differentiate and discover. Examples are abundant: involved parents trying to provide stimulation through objects and experiences, public advertisement trying to sell products by being the loudest, brightest or largest, children's programs on television trying to attract the child's attention through known methods for attraction and education competing with everything else, trying to pack as much variety and stimulation into a day as is possible. The goals are not detrimental, but the processes going on within a child, who reacts and responds with enthusiasm that adults cannot remember, are not clearly defined.

Does the child have a mechanism for "tuning out" what he has already assimilated? Does he have a mechanism for "circuit breaking" when the cognitive input becomes more than his channel capacity? Research indicates that both of these questions are probably true (Piaget, 1952; Cantor and Cantor, 1955; McCall, 1970; and Munsinger and Kessen, 1966).

The responsibility on the educator therefore is to determine levels at which information processing ceases due to over-assimilation or overloading of cognitive capacity. Guidelines need to be recognized regarding levels of stimulation for optimum learning environments. Research should be planned to determine optimum levels of stimulation for different dimensions. It is probable that an optimal level for one dimension would not be optimal for another dimension. Long range planning should be made with an outline of sequential experimentation.

Jeffrey (1968) theorized that the pattern for process development begins soon after birth. As a child assimilates the cues from a stimulus, he begins processing new information. This process would be similar to Piaget's (1952) seeking of equilibrium, a contrast between novel and familiar (Hunt, 1961). Stretching one's imagination, habituation could be a form of assimilation in which the information involved is processed and deeply imbedded within a behavior pattern. Following this line of thought, the more highly developed mental capacity would logically habituate more rapidly, because the assimilation would occur more rapidly. Researchers should delve into the relationship between habituation and assimilation. If they are related, speed of habituation may be a key to intelligence testing. The research reported in this dissertation did not find habituation and mental age to be related, however, the theory is based on the development of information processing, and the research was done on preschool children whose patterns of processing have already developed. It seems possible that the real issue may be clouded by the fact that the information processing strategies of these Ss have already been influenced by their environments, and their habituation speed is a reflection of individual strategies regardless of mental age. Some Ss who have developed a pattern of observing and comparing may take longer to habituate because they are taking in more information, possibly information that the tasks in this research study did not survey. Perhaps the rapid habituater is accustomed to attending only to highly salient cues. If this S were placed in the experimental group with low salient stimuli, he would probably habituate extremely fast. In order to further investigate the relationship between habituation time and saliency, younger children should be used. McCall (1970) has used infants in most of his research. He indicated that attention may be an avenue to the study of cognitive development. The research presented here was done with children whose patterns are probably set. The gap is clear and indicates a need for study of the child from six months to two or three years of age. It is possible that there is a critical period during which the child is especially susceptible to stimulation from the environment in directing him toward a strategy for gathering information. Sensitive periods have been noted in the development of socialization, language development, and other areas of growth, and it is conceivable that in developing a strategy for information processing, a sensitive period may also exist. Research should be generated to determine the boundaries of such a period, if it exists.

Another question relating to the development of a strategy is the irrevocability of a learning pattern. This research has indicated that in at least one type of experience the environment significantly interacted with the demonstration of a cognitive-oriented task. This effect suggests that the environment may override a strategy. Before further work is done in the area, strategies of information processing should be identified and defined. Descriptions of cognitive procedures should be recorded for different patterns of selective attention and information pick up. Longitudinal studies detailing eye movements, physiological changes, expressions of language and behavior patterns would probably be a beginning for this research.

In conclusion, the research reported here has indicated that four- and five-year-old children, in the sample reported, have probably already established patterns for attending to stimuli and with the exception of the speed in assembling a puzzle, the saliency of the stimuli did not cause any significant differences. The most penetrating questions left unanswered are:

1. Would the results have been the same if children of two and three years of age had been used?
2. Would the results have been the same if a normal distribution of habituation time had occurred?
3. What caused the distribution by habituation to be skewed?

The optimism for future research lies in answering the questions which have been asked and in determining levels of stimulation which will optimally attract and hold attention while children pick up information.

BIBLIOGRAPHY

Attneave, R. Physical determinants of judged complexity of shapes. Journal of Experimental Psychology, 1957, 53. 221-227.

Berlyne, D. E. The influence of complexity and novelty in visual figures on orienting responses. Journal of Experimental Psychology, 1958, 55, 289-295.

Berlyne, D. E. Conflict, arousal, and curiosity. New York: McGraw-Hill, 1960.

Cantor, G. N. Effects of stimulus familiarization on child behavior. Minnesota Symposia on Child Psychology. Hill, J. P., (Ed.) Minneapolis, Minnesota: University of Minnesota Press, 1969, 3, 3-29.

Cantor, G. N. Discriminative reaction time in children as related to amount of stimulus familiarization. Journal of Experimental Child Psychology, 1966, 4, 150-157.

Cantor, G. N., and Cantor, J. H. Discriminative reaction time performance in preschool children as related to stimulus familiarization. Journal of Experimental Child Psychology, 1965, 2, 1-9.

Clayton, K. N., Merryman, C. T., and Leonard, T. B., III. Rate of concept identification and the noticeability of the relevant dimension. Psychonomic Science, 1969, 15(2), 109-110.

DeMeuron, M., and Auerswald, E. H. Cognition and social adaptation. American Journal of Orthopsychiatry, 1969, 39(1), 57-67.

Dodd, C., and Lewis, M. The magnitude of the orienting response in children as a function of changes in color and contour. Journal of Experimental Child Psychology, 1969, 8, 296-305.

Draper, I. H. The slum child: to have any value learning must be on a personal basis. Clearing House, 1970, 45(1), 48-50.

Dunn, C. J. An analysis of the personal characteristics of deprived youth in a school desegregation institute. The Journal of Negro Education, 1970, 39, 289-295.

Dusewicz, R. A. Early childhood education for disadvantaged two-year-olds. Psychological Reports, 1970, 26(3), 954.

Gibson, E. J., Walk, R. D., Pick, H. L., Jr., and Tighe, T. J. The effect of prolonged exposure to visual patterns on learning to discriminate similar and different patterns. Journal of Comparative and Physiological Psychology, 1958, 51, 585-595.

Gibson, J. J. The senses considered as perceptual systems. Boston: Houghton-Mifflin, 1966.

Haith, M. M. Response of the human newborn to movement. Journal of Experimental Child Psychology. 1966, 3, 225-234.

Hebb, D. O. The organization of behavior. New York: Wiley, 1949.

Hunt, J. McV. Intelligence and experience. New York: The Ronald Press, 1961.

Jeffrey, W. E. The orienting reflex and attention in cognitive development. Psychological Review, 1968, 75(4), 323-334.

Jeffrey, W. E. Early stimulation and cognitive development. Minnesota Symposia on Child Psychology. Hill, J. P., (Ed.), Minneapolis, Minnesota: University of Minnesota Press, 1969, 3, 46-67.

Karmel, B. Z. The effect of age, complexity and amount of contour on pattern preferences in human infants. Journal of Experimental Child Psychology, 1969, 7, 339-354.

Lee, L. C. Concept utilization in preschool children. Child Development, 1965, 36, 221-227.

Maccoby, E. E. The development of stimulus selection. Minnesota Symposia on Child Psychology, 3, Hill, J. P., (Ed), Minneapolis, Minnesota: University of Minnesota Press, 1969.

McCall, F. C., and Melson, W. H. Attention in infants as a function of magnitude of discrepancy and habituation rate. Psychonomic Science. 1969, 17, 317-319.

McCall, R. B. Attention in the infant: avenue to the study of cognitive development. Paper presented at the conference, Early Childhood: the development of self-regulatory mechanisms. Pennsylvania State University, College Park, Pennsylvania, January 12-15, 1970.

Miller, G. A. The magical number seven, plus or minus two: some limits on our capacity for processing information. Psychological Review. 1956, 63, 81-97.

Munsinger, H. Developing sensitivity to correlated cues. Psychonomic Science, 1968, 10(4), 149-150.

Munsinger, H., and Kessen, W. Stimulus variability and cognitive change, Psychological Review, 1966, 73(2), 164-178.

Munsinger, H., Kessen, W., and Kessen, M. L. Age and uncertainty: developmental variations in preference for variability. Journal of Experimental Child Psychology, 1964, 1, 1-15.

Odom, R. D. Effects of auditory and visual stimulus deprivation and satiation on children's performance in an operant task. Journal of Experimental Child Psychology, 1964, 1, 16-25.

Pancratz, C. N., and Cohen, L. B. Recovery of habituation in infants. Journal of Experimental Child Psychology, 1970, 9, 208-216.

Piaget, J. The origins of intelligence in children. New York: International Universities Press, 1952.

Sokolov, E. N. Perception and the conditioned reflex. New York: Macmillan, 1963.

Spitz, H. and Hoats, M. Experiments on perceptual curiosity behavior in mental retardates. American Journal of Mental Deficiency, 1963, 68, 386-394.

Stein, L. Habituation and stimulus novelty: a model based on classical conditioning. Psychological Review, 1966, 73(4), 352-356.

Thomas, H. Preference for random shapes: ages six through nineteen years, Child Development, 1966, 37, 843-859.

Thompson, R. F., and Spencer, W. A. Habituation: a model phenomenon for the study of neuronal substrates of behavior. Psychological Review, 1966, 73(1), 16-43.

Vicinanza, P. J. The effects of recency and varied amounts of auditory habituation on the novel stimulus selection behavior of lower and middle class kindergarten children. Dissertation Abstracts, 1969, No. 70-16, 835.

Willis, E. J., and Dornbush, R. L. Preference for visual complexity, Childhood Development, 1963, 39, 639-645.