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Stimulus selection under conditions of free choice by preschool children at baseline and after adaptation

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STIMULUS SELECTION UNDER CONDITIONS OF FREE CHOICE BY PRESCHOOL CHILDREN AT BASELINE AND AFTER ADAPTATION

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CHAPTER ONE

REVIEW OF THE LITERATURE AND

STATEMENT OF THE PROBLEM

The experiments reported in the present paper may be characterized as belonging to the general area of motivation research referred to as stimulus selection behavior. Stimulus selection behavior includes curiosity, exploratory, and manipulatory activities. Generally, the research in the area attempts to determine the relation between changes in the stimulus and changes in the measures of approach behavior in the subject (S). In this research, approach behavior is apparently unrelated to organic need conditions. The experiments presented in this paper were designed to determine a preschool child's stimulus preference as he entered the experimental setting, and whether that preference could be systematically modified by exposure to other stimuli. The major conceptual hypothesis for the experiments was derived from the theory of stimulus change presented by Dember and Earl (1957).

The Theory of Stimulus Change

In the theory of stimulus change posited by Dember and Earl (1957) the responses of an organism to a group of stimuli are assumed to be mediated by psychological attributes.

The attributes are not properties of the physical stimulus events or objects, but are comprised of three different measures of complexity: (a) the complexity of the stimulus, (b) the complexity or capacity for complexity of the organism when it first approaches the stimulus, and (c) the interaction of the stimulus and the organism. These three values of complexity are discussed in more detail.

In determining the complexity value of a stimulus a distinction has frequently been made between temporal or within stimulus change and spatial or between stimulus change.

> While the distinction between the temporal and spatial factors by which behavior is aroused is useful in classifying some of the experimental techniques involved, theoretically it is an unnecessary distinction. In the present context, according to Dember and Earl, the fact that a spatially dishomogenous stimulus has apparently the same effect upon behavior as has a temporal change in stimulation implies some sort of scanning process on the part of an organism; the scanning of a spatially heterogenous stimulus is equivalent to movement by the stimulus, over time, past the "stationary" organism. In this sense spatial heterogeneity has the same effect psychologically as temporal change in stimulation. (Earl, 1957, pp. 8-9.)

The complexity of a stimulus can be determined in two ways: (1) objectively by the experimenter (E) on an a priori basis (20 spots on a card would seem to be more complex than two spots because there is more change), or (2) by having an S rank or scale stimuli according to his own judgment of what is more complex. When the stimulus itself is a goal and not a means to an end, the complexity level of the stimulus is a crucial motivational value of the stimulus. For instance, if a student is actually interested in a subject, mathematics,

rather than a mathematics course's utility in fulfilling a graduation requirement, then the level of the mathematics course is important in establishing and maintaining the student's interest and motivation. If the course's level matches the student's (see below for complexity of the organism) then the student's motivation will be consistently high. But if the course is only a means to the goal (graduation) then the level of the course will not have as much effect on the student's motivation.

According to the theory an individual can also be assigned a complexity value. Dember explains individual complexity as: " . . . for each individual there is some highest level of complexity in the range of objects he might encounter, which he is equipped to deal with comfortably and effectively . . . . Some objects would <u>for him</u> be excessively complex; some would be too simple; some would be just right, as the baby bear's bed was for Goldilocks." (Dember, 1965, p. 420.)

If the organism is affected by the stimulus, that is if the complexity level of the stimulus approximates that of the organism, there is a resultant change in the complexity level of each. Behavior aroused by a change in stimulation will eventually decline in amount if the organism is repeatedly exposed to that specific change. If the stimulation change is maintained but the behavior declines apparently as a function of time, the organism itself must be changing as a function of having sensory contact with the stimulus. He

"outgrows" it as Goldilocks would have outgrown the bed. In the interaction the stimulus loses some of its motivational or complexity value.

The complexity value of a stimulus can be equated with its motivational value. An individual should approach the level of the stimulus that is nearest the individual's own level, and which offers the optimal amount of change or complexity for the individual. That is: for a stimulus to attract an individual it must be at that individual's complexity level; stimuli that are less complex do not arouse or motivate. To sustain approach behavior a stimulus needs to contain some increment of complexity greater than the organism's own complexity level. The stimulus with this increment of complexity is called a pacer stimulus. The pacer stimulus' complexity level is not only more complex than the individual's complexity level, but its complexity lies within an <u>acceptable range</u> of complexity above the complexity level of the individual. If there is no pacer available, approach behavior will not be sustained. If forced to respond, the organism will not exhibit motivated behavior but will respond at random. When a pacer is available, approach behavior is sustained and the organism's complexity level moves upward.

Studies Dealing with Stimulus Change

As Cantor (1963) notes in the review of the literature, relatively little of the research done on stimulus change is done with humans and even less is done with

children. Beauchamp (1965) reviews the human stimulus change literature from his interpretation of the Dember-Earl theory. Leckart and Faw (1969) review the literature on stimulus change and looking time without comment. Very little of the recent research on stimulus selection is designed directly from the Dember-Earl theory. Much of the research can be interpreted to support the theory. (See Appendix XVII.) The Cantors' work on novelty [Cantor & Cantor (1964a), Cantor & Cantor (1964b), Cantor & Cantor (1966), Cantor (1968a), Cantor (1968b)] can be considered to provide support for the Dember-Earl theory. In the Cantors' work children are familiarized with several pictures. Then the S's preference for the familiar pictures or novel pictures is measured. The novel are reliably preferred. Each of the Cantors' studies and the results are not reviewed in the present paper because of the concern with novelty rather than complexity. The three studies reviewed by the present writer are concerned with complexity and were stimulated by the Dember-Earl theory of stimulus change.

May (1963) identified the measurement of complexity with the number of "differently colored rectangles" on a stimulus card. According to the definition, the more rectangles per card the more complex the card; i. e., a card with 20 rectangles was more complex than a card with two rectangles. May used five different numbers of rectangles on a card; 2, 3, 5, 8, 12. The five numbers represented three levels of complexity: low (2, 3), medium (5), and

high (8, 12). The rectangles were arranged in "a semi-random arrangement." No two cards were alike. The 21 preschool Ss were tested individually. All Ss were adapted to the cards of medium complexity. In adaptation each S was given a set of 10 cards; each card had five rectangles on it. The Ss looked at all 10 cards. Presumably looking at the set of 10 cards brought the S's complexity level to the level of the cards. After adaptation five sets were put on a table in front of the S. On the table was the AL set of five rectangles per card, and sets with two rectangles, three rectangles, eight rectangles, and 12 rectangles per card. The Ss were allowed to choose one card at a time from any of the five sets. As predicted, when Ss selected the first card from a set other than the adaptation set, more Ss selected cards which were more complex than the adaptation set ($p = 0.006$, one-tailed sign test). Of those Ss that showed a preference in their total performance, more Ss selected cards from the more complex sets ($p < 0.001$, one-tailed sign test).

The designation of complexity levels seems to have been somewhat arbitrary. It has not been shown that for preschool children five is of medium complexity and eight and 12 are of high complexity. There is some evidence [Kuo & Marshall (1968), Munsinger, Kessen, & Kessen (1964), Munsinger & Wier (1967)] that May's designation of levels is not consistent with other investigators' designations. Munsinger's studies have equated complexity with the number of

turns in a randomly generated figure. For most age groups tested, the figure with 10 turns elicited preference or maximum approach behavior. However, in preschool children the levels of complexity preference were those of "high" complexity (25-40 turns) and the complexity level preferred increased with increased exposure to the figures.

Using May's (1963) general procedure, Sackett (1967) tested four groups of retarded children: 17 cultural familials, 23 mongoloids, 20 post-encephalitics, and 16 with gross brain-damage. The ages of the Ss ranged from 5 to 19 yrs. Their median mental ages were between 2 yrs., 3 mo. and 2 yrs., 11 mo. Instead of adapting all the Ss to medium complexity, Sackett randomly assigned three ALs (high, medium, low) to all Ss. Assignment of different ALs stemmed from the Dember-Earl hypothesis that complexity change is a function of the complexity of the individual as well as of the stimuli. Elaborating on individual complexity, Sackett proposed that the width of the optimal range (the degree of acceptable complexity increase) is a function of the individual's complexity level as he enters the experimental situation. The lower the individual complexity level on a given dimension of complexity, the smaller will be the degree of acceptable complexity increase above the individual's own complexity. Sackett found significant differences in choice behavior between diagnostic groups of Ss and between and within groups as a function of the AL card. In two groups, post-encephalitic and brain-damaged, those Ss adapted

to medium or high complexity chose stimuli less than or equal to their AL in first choice and total choice behavior. Sackett interpreted this as indicating that the ALs were actually out of the child's optimal range for complexity and thus the child's choice "dropped" back to his own level. The other two groups, mongoloid and cultural familial, in first choice behavior, chose cards significantly greater than their AL. The total choice behavior of the latter two groups was a complex interaction of diagnostic group, AL, and choice stimuli.

Kuo and Marshall (1968) tested 39 pairs of hearing and impaired-hearing preschool children. The Ss were matched in age, sex, father's occupational rank (all economic levels were included), and language spoken at home (English or Spanish). There were 18 visual stimuli divided by the Es into six triads of low, medium, and high complexity, as shown in Cantor, Cantor, and Ditrichs (1963). The complexity of the stimulus was determined by the number of stimulus elements. The visual stimuli were presented in viewing boxes designed by Cantor, Cantor, and Ditrichs (1963) or by a slide projector. A triad was presented in the three viewing boxes. When an S looked into the oval window of a box, his forehead pressed against a response panel. Movement of the response panel activated a microswitch which turned on a light in the box so that the pattern was visible, and started an electric clock. Removal of the forehead (and thus the child's attention) turned off the light and stopped the clock. There were 18

tactual stimuli, also in triads of low, medium, and high complexity. A triad was presented to the S in three tactual stimulus boxes set on a child-sized table. The boxes were open in back for observation by E. The front of each box had two curtained holes large enough for S's lower arms. The S could put his hands and arms into the holes and feel each object. None of the tactual stimuli were ever visible to the S. E stood behind the boxes and used a stop watch to time the exploration of each stimulus. "In all analyses, roughly half of both impaired-hearing and hearing groups explored the high complexity stimulus longer than they explored the medium or low complexity stimuli. All χ^2s of these numbers were non-significant" (p. 188). There was no difference in complexity level choices between hearing and impaired-hearing groups.

Statement of the Problem

According to Beauchamp (1965):

> The three general problems usually encountered in some form in any experiment in the stimulus selection research area are: (1) to obtain a measure of the stimulus or stimuli, (2) to obtain a measure of the subject with respect to the stimulus (or stimuli) . . . (3) to make predictions about the relationship between the measures of the response(s). In terms of the Dember-Earl theory, the three general problems are: (1) to obtain measures of the . . . novelty or complexity of the stimuli, (2) to obtain measures of the Ss with respect to their prior experience with stimulus change (complexity of the S), and (3) to make predictions concerning the relationship between the measures of behavior of the S and the measures of stimulus change (p. 22).

In terms of the present study, these three problems will be examined in the remainder of this section.

The present study was concerned with complexity or amount of within stimulus change. The operational definition employed was May's (1963). The complexity of a stimulus was said to increase as the number of rectangles on a card increased.

May's choice of five as a medium level of complexity for preschool children, and his implicit assumption that five spots would be above the majority of the children's own complexity levels was questioned on the basis of Kuo and Marshall's (1968) findings that half the Ss preferred the high complexity stimulus, Munsinger and Wier's (1967) findings of preference for very high complexity in preschoolers, and the writer's intuition. Preschool children may already have a fairly high complexity level because of the toys which are available, especially in higher income groups. According to the Dember-Earl theory, children should approach and select most frequently a level of stimulus complexity which is closest to their own complexity level. If children do have a fairly high complexity level, then they should tend to choose cards of medium or high complexity (as defined by May) when first introduced to the stimuli in the experimental situation. The free choice selection of cards by each S should result in a measure of the S's complexity on the experimental attribute as he enters the experiment.

With complexity defined, a priori, as increasing along the numerical scale, and with approach behavior of an S defined as indicating the S's preference or level of

complexity, a prediction of S's choice behavior can be made from the Dember-Earl theory. If a pacer stimulus is available to S, then commerce with the pacer should allow the S to increase his complexity.

Six experiments are reported in the present paper. In the first three experiments S's complexity level was measured by frequency of free choice behavior. A set of pacer stimuli arbitrarily set as one number higher (having one more rectangle) than the S's complexity level was presented to the S. The S was adapted to the level of the pacer stimulus by looking at 11 cards of the same level (same number of rectangles per card). After adaptation the S was again given free choice of stimuli that included the original level chosen, but did not include the pacer or adaptation level. As indicated previously, a prediction was that most preschool Ss, expecially Ss from higher income families, would have a complexity level higher than five. The prediction from the Dember-Earl theory was that after adaptation the S would choose stimuli more complex than the adaptation stimuli.

As a control for boredom or loss of motivation, Experiment 4 measured first choice behavior instead of modal choice. The S was allowed to only make one choice of the stimuli in Trials 1 and 3. The hypotheses were the same as in the first three experiments.

Experiments 5 and 6 were stimulated by Sackett's concept of optimal range (acceptable complexity increase). If

Sackett's modification of the Dember-Earl theory is valid for normals, the Ss should be able to accept jumps in the objective complexity of the stimuli as the stimuli become more complex. With high original complexity of an S, a jump (more "distance") may be required between an AL and the original complexity level to raise the complexity level of the S. The Ss were exposed either to an AL (pacer) card that contained one more spot than the modal choice on Trial 1 (no-jump) or an AL card that contained three, four, or five more spots than the modal choice on Trial 1 (jump AL). The hypotheses were: (1) given a choice of a low (3, 5) complexity level on Trial 1, exposure to an AL card with one more spot (no-jump) will lead to a more frequent choice of high complexity cards on Trial 3 than exposure to an AL card with three, four, or five more spots (jump AL), and (2) given a modal choice of high complexity (8, 12) on Trial 1, exposure to a jump AL will lead to a more frequent choice of higher complexity cards on Trial 3 than exposure to a no-jump AL. A corollary of the first hypothesis is that for a modal choice of low complexity on Trial 1, a no-jump AL may lead to quantitatively greater choice behavior (as determined by the mean of the total number of spots chosen) on Trial 3 than a jump AL. If the jump AL is out of the optimal range it will not influence the S and he will "drop" back to his own level and progress from there. The no-jump AL should be within optimal range and the S should be able to continue choices from the level of the AL without going back to his original level.

CHAPTER TWO

METHOD AND RESULTS OF EXPERIMENTS

ONE, TWO, THREE, AND FOUR

Experiment One

Method

Subjects. The 19 Ss were preschool children ranging in age from 49 mo. to 60 mo. with a mean of 56.5 mo. Of the 9 boys and 10 girls, five were Black, seven Chicano, and seven White. All were part of a preschool "culture-enrichment-program" for disadvantaged children (similar to Headstart but funded by the State of California). With one exception all Ss present on the days of testing were used. Ss were obtained by E approaching a child and asking if the S wanted to play a game. If S said "No," E asked another child; if "Yes," S was tested and the selection procedure repeated. One child was not tested because he refused all invitations to play and no pressure was applied. Each S acted as his own control for the first and third trials.

Apparatus. Five in. by 8 in. cards with a random arrangement of 1 in. by 3/4 in. colored rectangles (red, blue, and yellow) of scotch plastic tape were used. The color and position of each rectangle on each card was determined with

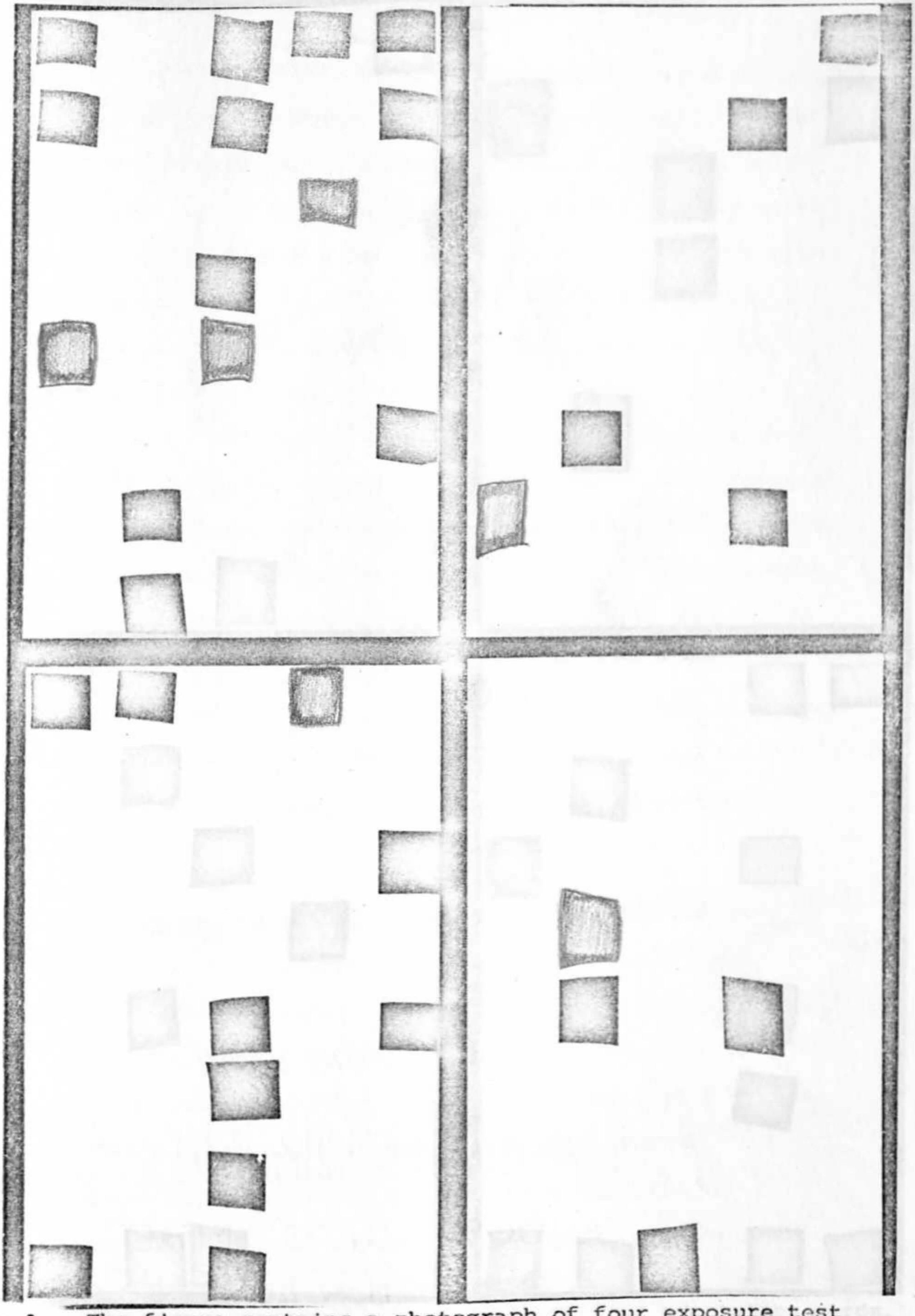

Figure 1. The figure contains a photograph of four exposure test cards. The cards were randomly selected from each set to be representative of the configuration any S saw. There are only four cards instead of the five used in Experiment 1 because of space limitations within the photograph. The dark areas are the rectangles of

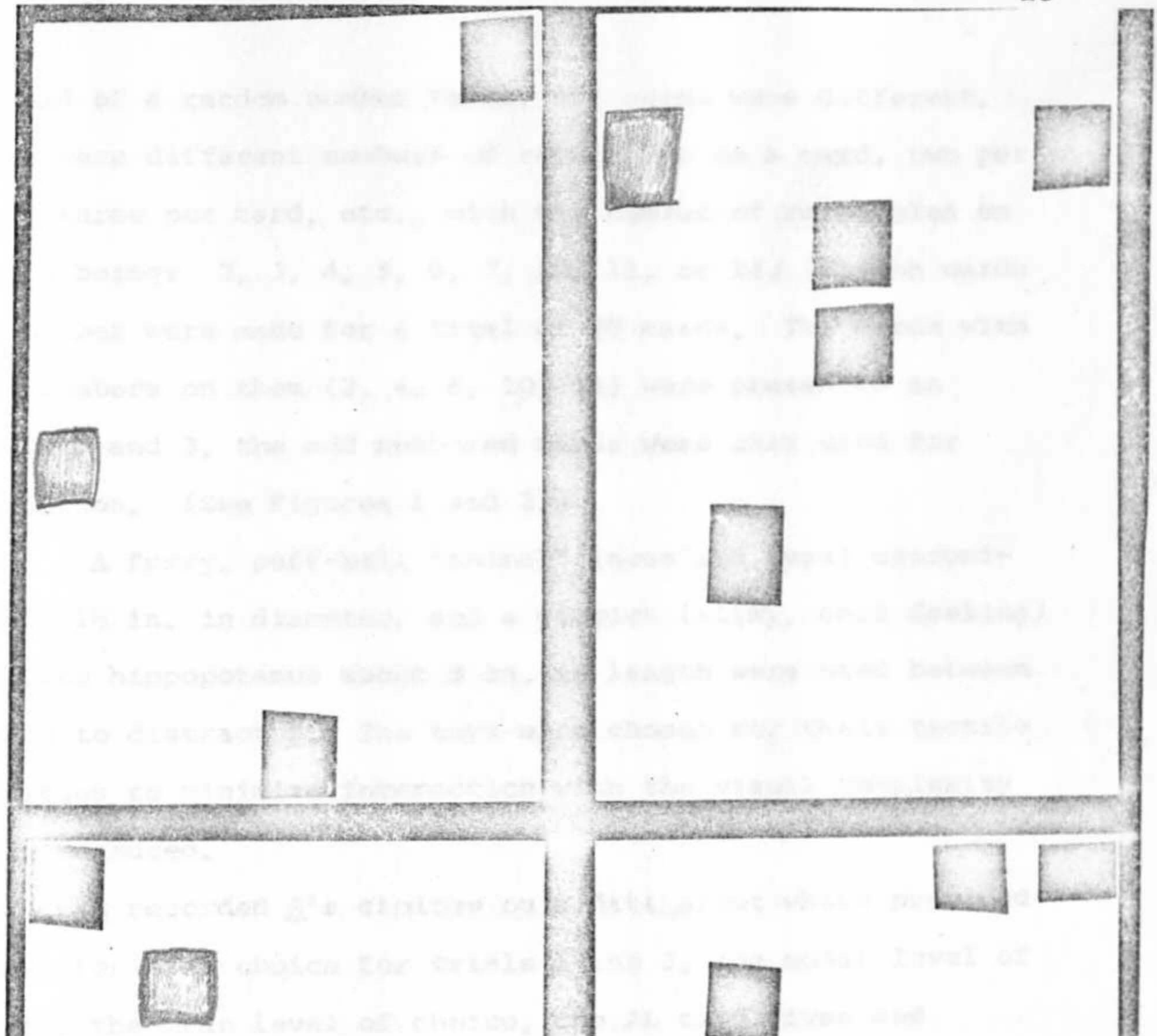

Figure 2. The figure contains a photograph of four adaptation cards. The cards were randomly selected from each set. Each S saw all 11 cards of whatever number he was given. The dark areas are the rectangles of tape.

the aid of a random number table; all cards were different. There were different numbers of rectangles on a card, two per card, three per card, etc., with the number of rectangles on a card being: 2, 3, 4, 5, 6, 7, 10, 11, or 14. Eleven cards per number were made for a total of 99 cards. The cards with even numbers on them (2, 4, 6, 10, 14) were presented in Trials 1 and 3, the odd numbered cards were only used for adaptation. (See Figures 1 and 2.)

A fuzzy, puff-ball "animal" (nose and eyes) approximately 1½ in. in diameter, and a gimmick (slimy, cold feeling) silicone hippopotamus about 3 in. in length were used between trials to distract S. The toys were chosen for their tactile qualities to minimize interaction with the visual complexity being measured.

E recorded S's choices on a data sheet which provided spaces for each choice for Trials 1 and 3, the modal level of choice, the mean level of choice, the AL card given and comments by E.

Procedure. E helped in the classroom and became acquainted with the children for three full school days (4 hrs. a day) before beginning testing. On the testing days E approached a non-busy S during "free-time" (non-structured activity) and asked if S wanted to play a game. If S agreed, E led him to a corner of the room where five sets of even-numbered cards (2, 4, 6, 10, 14) were displayed on a table in random numerical order. The S saw five piles of cards. Each pile had 11 cards, all of which had the same

number of rectangles. Each card's rectangles were in different positions and color combinations. The left-to-right and within set order of the cards was randomized between S's and within S's; on each trial both orders were different. Changing the order of the sets (e.g., from 2, 10, 4, 14, 6 to 4, 14, 6, 2, 10) controlled for position effects, and rearranging (shuffling) the cards within each set controlled for the attractiveness of any random design. S was seated and told that all the "pretty cards" were different and that he (S) could look at any of them that he wanted. He could pick them up one at a time, but to put one down before picking up another. (Having S pick up one card at a time facilitated recording his choices and provided accuracy in determining his focus of attention.) After 2 min., one of the two toys was quickly placed in S's hands with E providing voice effects of the "animal." This terminated Trial 1, the exposure trial. Half the time the fuzzy toy was brought out and half the time the hippopotamus was presented at the end of Trial 1. While S examined the animal, E determined S's modal response by glancing across the data sheet and noting which number of rectangles had been chosen most frequently. After the mode was determined, the AL set of 11 cards which contained one more rectangle than the modal choice set was presented to S. For example, if S had chosen the cards with four rectangles six times and six rectangles three times, the modal response would be four and the AL set would be five. Usually S continued to hold the toy or to "show the cards to the toy"

during the adaptation trial. Showing the toy each card helped insure S's inspection of each card and to eliminate the possibility of the S simply shuffling the cards. While S was looking at the cards of the AL set, E shuffled each set and rearranged, according to a predetermined random sequence, the even-numbered cards on the table (within S randomization of numerical and within set position). At the end of 2 min. or when S finished looking at all the cards, whichever came first, the other animal was quickly brought out by E with E providing voice effects that it was that animal's turn to be held. The first animal was removed at this time. If S was beginning to squirm or express a lack of interest in the cards, the animal "helped" him make his choices in Trial 3, the test trial. Otherwise the animal "took a nap" after a brief inspection by S. At the beginning of the test trial, S was told again that he could look at any of the five sets of cards he wanted and that all the cards were different, but to only pick up one of the cards at a time. If S was reluctant to make choices, prompts such as "Wilbur (one of the animals) likes to look at cards, why don't you show him some"? or "Do you want to look at some more of the spots"? were used. About half of the children used the toy to select the cards or showed the toy the cards they selected, only a few (less than five) Ss required that E suggest they look at more cards. After 2 min., E told S that the time for the game was up and that E would have to stop playing. E thanked S for playing and repeated the selection procedure.

Results

Nineteen children from a class of 21 were tested. The data from one of the children tested was discarded because of lack of response; the child only made three choices in the first trial and one in the third. Out of the remaining 18, one S displayed highly unusual behavior in that he systematically looked at the complete set of two and the complete set of 14, and he made one choice from another set when time was up for the first trial. The unusual S posed two problems; determining AL with a perfectly bimodal sample of two extremes, and accurately testing him on the test trial because there was no card of a higher complexity value for him to choose. The data have been analyzed both with and without the unusual S's scores.

Trial One. The modal response was determined by seeing which number of rectangles had been chosen most frequently. For example, if S had chosen the cards with two rectangles six times and ten rectangles three times, the modal response would be two. The data were divided into two groups of modes, those Ss which had a modal choice of cards with six or more rectangles (6, 10, 14) and those with less than six rectangles (2, 4). In calculating probabilities, the binomial test, with an a priori p (modal choice of six or more) = 0.6 was used. An a priori probability of 0.6 was used because out of five choices, by chance three choices would be six or greater (6, 10, 14). By chance only two choices would be below six (2, 4).

When the modal response was used to determine baseline complexity on Trial 1, nine out of 18 Ss chose cards with six or more rectangles per card (one-tailed binomial $p = 0.86$). When the unusual S was discarded the number of modal choices equal to or higher than six was eight of 17 (one-tailed binomial $p = 0.91$).

Trial Three. The modal response was defined by determining which number of rectangles had been chosen most frequently. The data were divided into two groups; those children with modal choices higher than the AL card, and those children with modal choices lower than the AL card. The binomial test with an *a priori* binomial p (choice higher than AL card) = 0.5 was used. An *a priori* probability of 0.5 was used because if the S were behaving randomly, he would be equally likely to choose cards above or below the AL card. The modal choice of 14 out of 18 Ss was higher than the AL card (one-tailed binomial $p = 0.004$). Discarding the unusual S yielded 15 out of 17 modal choices higher than the AL card (one-tailed binomial $p = 0.001$).

Trial 3 data supports the prediction from the Dember-Earl theory that complexity level could be raised by adaptation to a more complex stimulus. Trial 1 modal results do not support the prediction that preschool children's complexity level is of medium complexity or above.

Experiment Two

Method

As a check for experimenter bias, a replication of the study was completed by three undergraduate girls. The girls did not know the hypotheses or predictions of the experiment. The Ss were preschool children ranging in age from 54 mo. to 70 mo. with a mean of 62.9 mo. The 18 females, 14 males were from preschool programs and nursery schools in middle class neighborhoods in Oroville and Stockton. There were four Black and 27 White Ss. The procedure and apparatus were the same as Experiment 1 except that two extra sets of cards (15 and 16) were made. The cards were made so that any S whose modal response on Trial 1 was 14 would have cards of a higher complexity from which to choose on Trial 3. When an S had a mode of 14, he was given the AL set of 15 and the set of 16 was substituted for the set of two on Trial 3.

Results

Trial One. The modal response was used to determine baseline. For the same reasons noted on page 19, a binomial one-tailed *a priori* probability of 0.6 was used. Of the 31 Ss tested, 17 Ss had a modal choice of cards with six or more rectangles ($p = 0.66$).

Trial Three. The Ss were divided into two groups, those whose modal responses were higher than their AL cards and those whose modal responses were lower than their AL cards. As explained on page 20, a one-tailed binomial test

of *a priori* *p* of 0.5 was used. Ten of the 31 *S*s had modal responses higher than their AL cards ($p = 0.86$).

Trial 1 data do not support the prediction that preschool children have a high complexity level. Trial 3 results do not support the prediction that complexity level can be raised by exposure to a more complex stimulus.

Experiment Three

The undergraduate *E*s also tested another 11 *S*s (six boys, five girls) for baseline only. These *S*s were White middle class children in Stockton. The *S*s ages ranged from 43 mo. to 64 mo. with a mean of 50.5 mo. When the modal response was used, eight out of 11 *S*s had modal choices of six or greater (one-tailed binomial $p = 0.03$). This provides support for the prediction of high complexity choice in preschool children.

Experiment Four

Method

As a control for possible boredom effects due to the 2 min. trials, the first choice was the only measure taken in the present experiment. The *S*s were middle class preschool children ranging in age from 49 mo. to 68 mo. with a mean of 56 mo. The nursery school gave enrollment preferences to single-parent families. Of the 13 children, four were girls. Two Blacks, two Chicanos, and nine Whites were tested. The

procedure and apparatus were the same as Experiment 1 except that instead of 2 min. trials for Trials 1 and 3, the first choice of the S was recorded and the trial then terminated.

Results

Trial One. The first choice was used as the baseline for the S. A binomial one-tailed a priori probability of 0.6 was used. Of the 13 Ss tested, 12 Ss chose cards with six or more rectangles ($p = 0.01$).

Trial Three. The Ss were divided into two groups, those whose first choice on Trial 3 was higher than their AL cards and those whose first choice was lower than their AL cards. As noted previously, a one-tailed binomial test of a priori p of 0.5 was used. One S refused to choose any card on Trial 3. Three Ss of the 12 that chose cards on Trial 3 chose cards higher than the AL ($p = 0.93$).

The prediction of high baseline complexity in pre-school Ss was supported. The prediction of higher complexity choices after exposure to a more complex stimulus was not supported.

CHAPTER THREE

METHOD AND RESULTS OF

EXPERIMENTS FIVE AND SIX

Experiment Five

Method

Subjects. The 34 Ss, from an upper middle class background, were enrolled in a private nursery school. They ranged in age from 52 mo. to 67 mo. with a mean of 61.8 mo. The Ss were predominately White with three Orientals and one Black. The same method of selection was used as in the previous experiments.

Apparatus. Five in. by 8 in. cards with a random arrangement of colored rectangles were used. The numbers of rectangles on the cards were different from the cards used in Experiments 1 through 4. The numbers used were: 3, 4, 5, 6, 7, 8, 12, 13, 16, or 20. There were 11 cards per number for a total of 110 cards. The cards 3, 5, 8, 12 were used for Trial 1, the exposure trial. Cards with 4, 6, 9, 13, and 16 were used on Trial 2, the adaptation trial. In Trial 3, the test trial, the set of cards with 20 was added to the four sets presented in Trial 1.

The toys used in the previous experiments were used

again.

The recording sheet was similar to the type used before with the number of rectangles per card necessarily being changed.

Procedure. The procedure for selection, Trial 1, and determining the modal response was the same as before. After the modal response had been determined, the Ss were randomly assigned an AL set one number higher than the modal response or a "jump AL" 3, 4, or 5 numbers higher than the modal response. For example, when the mode was three, half the Ss received an AL of four and half of six (three greater than the modal choice). When the mode was five, half received an AL of six and half of nine. When the mode was eight, half received nine and half 13. When the mode was 12, a proper progression of 18 would have made the discriminability of 20 questionable, so half received an AL of 13 and half of 16. In Trial 3, the set of 20 was presented with the four sets from Trial 1. The third trial was conducted the same as the third trials in the previous experiments.

Results

The data were divided into two groups, those with a jump AL and those with a no-jump AL (one number higher than the modal response). There were 17 Ss in each group. The Trial 1 data of each group were divided into two groups, those with modal choices of low complexity (3, 5) and those with a modal choice of high complexity (8, 12). At low complexity

a small optimal range was hypothesized. Seven Ss in the no-jump group had modal responses of low complexity on Trial 1. Of these seven Ss, on Trial 3 six Ss most frequently chose cards higher than their AL; one did not. Three Ss in the jump group had modal responses of low complexity on Trial 1. All three Ss' modal choices on Trial 3 were higher than their AL cards. (See Table 1.) The data are in frequency form and meet the assumption of independence, but three of the four expected values are less than five which makes a χ^2 illegitimate (Siegel, 1956). The Fisher's Exact test was performed and a p of 0.7 obtained.

Table 1

Trial 3 Choice Behavior of Ss whose Baseline (Trial 1) was of Low Complexity

	No-Jump Group	Jump Group	Total
Mode > AL	6	3	9
Mode < AL	1	0	1

For high complexity a large optimal range was hypothesized. In the no-jump group, 10 Ss had a modal choice of high complexity on Trial 1. Three of the 10 Ss had a mode higher than their AL on Trial 3, seven had modal responses lower than their AL. In the jump group, 14 Ss' modal responses on Trial 3 were above their ALs. (See Table 2.) A χ^2 would be legitimate for those groups, but since a Fisher's Exact test was used for the low complexity group, it was used here

also. The probability of the obtained matrix of data and all more extreme matrices in the predicted direction was 0.10.

Table 2

Trial 3 Choice Behavior of Ss whose Baseline (Trial 1) was of High Complexity

	No-Jump Group	Jump Group	Total
Mode > AL	3	9	12
Mode < AL	7	5	12

The corollary hypothesis was that for Ss with low complexity modal responses, a no-jump AL would be followed by more choices than a jump AL. In the no-jump group, seven Ss had a low complexity modal response on Trial 1. The mean of the total choice behavior for these seven Ss on Trial 3 was 6.0 choices. In the jump group, three Ss had a low complexity modal response on Trial 1. The mean of the three Ss' choices on Trial 3 was 6.6 choices.

Independently of the pacer distance hypothesis, Trial 1 data were divided into two groups: those Ss with low complexity modes (3) and those Ss with modes of medium or high complexity (5, 8, 12) as defined by May. The binomial test was used in calculating probabilities with an *a priori* *p* (modal choice of five or more) of 0.75. An *a priori* probability of 0.75 was used because out of four choices, by chance three choices would be five or greater (5, 8, 12). By chance only one choice (3) would be below five. Of the 34 Ss, 29

had a modal choice on Trial 1 of five or more (one-tailed binomial $p = 0.05$).

The prediction that a no-jump AL would be more effective than a jump AL for Ss with low complexity choices on Trial 1 was not supported. Tentative support was found for the prediction that Ss with high complexity choices on Trial 1 would be more affected by a jump AL than by a no-jump AL. The corollary hypothesis of a greater increase in choice behavior in low complexity no-jump Ss as compared to low complexity jump Ss was not supported. The hypothesis that preschool children would have a fairly high complexity level on Trial 1 was supported.

Experiment Six

Method

The stimuli did not always seem to hold the interest of the Ss, so a replication of Experiment 5 was done using younger children. The eight girls and seven boys ranged in age from 29 mo. to 69 mo. with a mean of 44.0 mo. The Ss were from a private lower-middle class and middle-middle class nursery school. Thirteen Whites and two Chicanos were tested. The apparatus and procedure were the same as in Experiment 5.

Results

The data were divided into two groups, jump and no-jump ALs. There were seven Ss in the no-jump group and eight Ss in the jump group. The Trial 1 data was divided into two groups, those with low complexity modal choices on

Trial 1 and those with high complexity modal choices. Two of the no-jump Ss had low complexity modes on Trial 1. Both of these Ss chose cards higher than their AL on Trial 3. Four Ss in the jump group had low complexity modes on trial 1. Two of these Ss' modal responses on Trial 3 were higher than their AL and two were lower than their AL. (See Table 3.) Fisher's Exact test yielded a probability of 0.40 for the obtained scores.

Table 3

Trial 3 Choice Behavior of Ss whose Baseline (Trial 1) was of Low Complexity

	No-Jump Group	Jump Group	Total
Mode > AL	2	2	4
Mode < AL	0	2	2

In the no-jump group, five Ss had modal responses of high complexity on Trial 1. Three of the five Ss chose cards higher than their ALs on Trial 3, two chose cards lower than their AL. The jump group had four Ss with modal responses of high complexity on Trial 1. Of the four, one had a modal response higher than the AL on Trial 3, three had modal responses lower than the AL. (See Table 4.) The probability of the obtained matrix and all more extreme matrices is 0.96.

Table 4

Trial 3 Choice Behavior of Ss whose Baseline (Trial 1) was of High Complexity

	No-Jump Group	Jump Group	Total
Mode > AL	3	1	4
Mode < AL	2	3	5

The corollary hypothesis was supported by the data. In the no-jump group, two Ss had low complexity modal responses on Trial 1. The mean of the total choices for these Ss on Trial 3 was 9.5 choices. In the jump group the mean of the four Ss with low complexity modal responses on Trial 1 was 4.75 choices, (t = 9.81, df = 4, $p < .001$).

Trial 1 data were divided into two groups, those Ss with low complexity choices and those Ss with medium or high complexity choices. A binomial one-tailed probability of 0.75 was used. Of the 15 Ss, 12 had modal choices of medium or high complexity on Trial 1 (p = 0.24).

The predictions regarding distance of AL and baseline complexity were not supported. Neither was the baseline hypothesis supported. The corollary hypothesis that for low baseline Ss a no-jump AL would increase choice behavior more than a jump AL was supported.

CHAPTER FOUR

DISCUSSION OF RESULTS

In Chapter One an empirical generalization was constructed from the results of studies concerned with the effect of stimulus change on stimulus selection. The empirical generalization was that, within the limits of the studies reviewed, measures of stimulus selection would monotonically increase as a function of measures of stimulus complexity. The generalization was considered by the writer to be consistent with the theory of stimulus change presented by Dember and Earl (1957) and Earl (1957).

As is true of any theory, certain assumptions must be met when applying the theory. The assumptions can be translated into experimental conditions which must be satisfied by the data. One of the conditions necessary to the application of the theory of stimulus change is that of a "free-choice" situation. In the six experiments in the present paper, three conditions attempted to satisfy this requirement. (1) The S voluntarily "played a game"; the S was not forced to do so by E or the teacher. (2) the S could choose any of the cards he wanted and was free to repeat or change his choice at will. (3) The S was free to cease responding at any time during the experiment. As noted in Chapters Two and Three,

some Ss did exercise this last option.

The Dember-Earl theory specifies a second necessary condition, that the Ss be "non-anxious." In part, steps taken to fulfill condition one also meet this requirement. Ss who are anxious will refuse the E's invitation to play. There was no pressure applied to S to continue playing or to "perform correctly." The Ss were adapted to the E outside the experimental situation, and given a chance to become comfortable with her. Also the teachers and helpers were assured that there was no "wrong" answer and that E was relatively harmless as psychologists go. This helped provide a more relaxed atmosphere for testing.

An ideal application of the theory would have each S scale the stimuli. The S would determine the optimal range for the pacer stimulus, would order the stimuli according to his perception of complexity, and would indicate the distance between each pair of stimuli. As has been noted in Chapter One, the writer arbitrarily set the increment for the pacer stimulus and the distance between the choice stimuli. Thus the ideal was not followed. The ideal procedure was not used for the following reasons. (1) The present paper attempted to replicate and expand upon the previous studies of May (1963), Sackett (1968), and Munsinger (1969). Those studies used arbitrary levels. (2) The age of the Ss, the corresponding short attention span, and uncertainty that each S possessed the conceptual organization necessary for scaling contra-indicated a complete scaling of stimuli. (3) The stimuli used

were very simple in construction and in type of change offered. The amount of exposure required to obtain even a rough or partial scaling would probably have exhausted all the change or complexity available to the S before completion of the scaling. (4) The practical aspects of collecting scaling data on the 123 Ss tested in the six experiments prohibited scaling. In this regard the kind of standardization that could be achieved by using pre-set complexity levels lent itself to mass production; individual scaling did not. An indication of preference for or the efficiency of different sized pacers was sought in Experiments 5 and 6. Experiments 5 and 6 employed jump and no-jump ALs. The studies yielded a slight tendency for size of increment covered by the pacer to be significant only at higher complexity levels.

Scaling to Test Discriminability

None of the six experiments reported in Chapters Two and Three of this paper provided data on individual differences or individual reactions to the stimuli. E's observation of S's reactions to the stimuli and the observations of E's colleagues questioned the assumption that the stimuli were discriminable on the basis of number. To test the distinctiveness or discriminability of the stimuli a scaling study was done. An attempt was not made to encompass all necessary operations of scaling. The study is considered by the writer to be a scaling study because each S judged whether to him the stimuli were the same or different.

Each of 16 Ss was trained in discriminating "same" and "different." The training stimuli were cards covered with ribbon (satin, velvet, gro-grain, felt). After the S could discriminate which cards felt the same and which felt different, he was asked whether any of the experimental stimuli were the same. The stimuli were presented in groups of four. The stimuli (numbers of rectangles) presented in each trial were: Trial 1--2, 3, 4, 5; Trial 2--5, 6, 7, 8; Trial 3--8, 9, 12, 13; Trial 4--13, 15, 16, 20.

Out of the 16 Ss, two did not learn the training discrimination. All of the 14 Ss who learned the discrimination confused at least two cards. No S saw every card as different. No two numbers or cards were seen as the same by all Ss; every set was discriminated by at least five Ss. The numbers most frequently confused were 4-5 (four times), 8-9, 9-12, 13-15 (five times), 12-13 (eight times), and 16-20 (nine times). The specific data for individual Ss is given in Appendix XVI. Since no one set of numbers was completely confused and since the stimuli were physically more similar than in the experiments reported in Chapters Two and Three, the writer feels the assumption of discriminability for the six experiments was justified.

Baseline Complexity in Preschool Children

Data on the complexity preference of preschool children as they entered the experimental situation were recorded in Trial 1 of all experiments. The hypothesis was that preschool children, especially middle and upper class children, have a

fairly high complexity level as they enter the experiment and consequently should most frequently choose stimuli of medium or high complexity (five or more rectangles per card).

Although data were recorded for the Ss in Experiment 6, the contribution of Experiment 6 data to the evaluation of the average preschool child's (4-5yr.) complexity is questionable, since the Ss were younger children (3 yr.). Experiment 1, Trial 1 data did not support the hypothesis (one-tailed binomial $p = .91$). However, the Ss in Experiment 1 were from disadvantaged backgrounds. The hypothesis was not clear in its prediction of the choice behavior of Ss not in the middle or upper class. The baselines of Ss in Experiment 1 were the lowest of Ss in all six experiments.

Of the four studies directly relevant to the hypothesis, three were significant at the 0.05 level. The writer feels that the hypothesis of medium or high complexity was tentatively supported. With tentative support of a high baseline hypothesis, the assumption that May (1963) raised the complexity level of the Ss in his study is highly questionable.

Extraneous Variables

Of the five experiments based on the Dember-Earl theory, support for the prediction of complexity increase through stimulus change was found only in the first experiment. Tentative support might be inferred from the high complexity jump group in Experiment 5. But neither the low complexity

jump group nor either of the no-jump groups supported the prediction. None of the predictions of complexity change were supported in the other experiments. The corollary hypothesis that approach behavior, as measured by total choice behavior, would be more affected in low complexity Ss given a no-jump AL than for low complexity Ss given a jump AL was supported in Experiment 6, but not in Experiment 5. There are two variables which, in the writer's opinion, may account for the results obtained. Steps were taken to attempt to control for these variables, but the present writer does not feel that the controls were entirely successful. The last section is a discussion of these two variables.

The arbitrary definition of complexity as number of rectangles, with the higher number being more complex may be erroneous. This definition does not account for the color or configuration of the rectangles. Nor does the definition account for the possibility of satiation at one "level" of complexity and a desire for change in the density of spots. Frequently an S who had been at a "high complexity" level would choose a "low complexity" card on Trial 3. Not infrequently the jump was from the highest available to two rectangles. A greater amount of numerical change is available in a preference shift from high to low, for instance 12 spots to two spots, than in a predicted shift from high to high, 14 spots to 16 spots. The Ss may not have chosen by complexity levels, but on some other dimension. For example, after observing several high complexity cards (14, 16, 20) the

experimenter found cards with just two spots somewhat relaxing and consequently pleasing. In Experiment 6, the data from younger Ss with low complexity did not support the complexity change prediction, but their total choice behavior was affected by the AL card given. That the approach behavior was affected suggests that the measure of complexity is incorrect. Future studies should attempt to re-define complexity or to measure complexity change.

Experiment 4 was designed to control for a possible boredom effect. The Ss were exposed to the stimuli for at least 6 min. in all of the experiments except Experiment 4. The time variable in terms of total temporal exposure to stimuli was controlled in Experiment 4, since the time for one individual was frequently less than 2 min. The results of Experiment 4 were consistent with the results of Experiments 2, 3, 5, and 6. The six experiments reported in this paper are the only ones in which the Ss made choices of the same stimuli on two separate trials. Perhaps the repeated exposure to the stimuli exhausted the complexity of the stimuli. May (1963) and Sackett (1968) were mainly concerned with first choice, which was Ss first exposure to all stimuli. Dember (1965) cautioned that for the theory to apply, the stimuli must be goals, stimuli interesting on their own, not means stimuli. The stimuli in all of these studies might have been means stimuli rather than goal stimuli. If the stimuli were means stimuli, the Ss were playing the game in order to receive individual adult attention and to meet the strange

"friends" of the E, not to look at the cards.

Either boredom or an incorrect measure of complexity could account for the non-significant predictions of stimulus change in the current set of experiments. The writer feels that, in spite of controls, both were operating.

Concluding Statement

The present paper's empirical generalization of the Dember-Earl theory that stimulus selection should monotonically increase along a numerical measure of complexity was not supported. Attempts were made to control or account for (1) other than numerical differences within the stimuli, (2) a deleterious anxiety state within the Ss, (3) original complexity of the S, (4) size of optimum complexity range, and (5) potentially detracting exposure effects. The hypothesis of high baseline complexity in preschool children gained qualified support. The results of May's experiment which showed a complexity increase by adapting the S to an arbitrary level of the stimuli and then allowing him free choice of stimuli may be confounded with the S's baseline complexity, since middle class preschool children have a high baseline complexity on the type of stimuli used in the present experiments.

For future studies the implications are that the stimuli used should be more intrinsically motivational, more varied in range, and should not have a predetermined measure of complexity. A major consideration of future studies should be whether an arbitrary or objective definition of complexity

can be used in connection with the Dember-Earl theory.

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APPENDIX I

Card Number (Number of Rectangles per Card) in order
Chosen for each S in Experiment 1, Trial 1

Choice Number

Subject	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	14	14	4	4	4	14	14	6																	
2	2	2	2	2	2	2																			
3	10	10	4	10	10	10	4																		
4	14	14	2	2	2	2	2	10																	
5	10	10	10																						
6	14	2	2	6	10	6	2	4	14	2	2	4	4	4	4	14									
7	14	4	6	2	5	2	14	14	6	6															
8	2	2	2	2	2	2	2																		
9	4	4	4	4	4	4	4	14	14	14	14														
10	14	2	6	4	14	14																			
11	2	2	2	2	2	2	2	2	2	10	10	10	10	10											
12	10	10	6	4																					
13	14	2	6	4	10	14	2	6	6	4	10	4	2	2											
14	2	2	2	2	2	2	2	2																	
15	4	6	6	14	2	10	6	4																	
16	10	4	14	6	6	14	14	14	14																
17	14	10	6	14	2	4	4	2	2																
18	2	2	2	2	2	2	2	2	2	2	2	14	14	14	14	14	14	14	14	14	14	14	4		
19	6	6	6	6	Discard																				

APPENDIX II

Card Number (Number of Rectangles per Card) in Order
Chosen for each S in Experiment 1, Trial 3

Subject	Choice Number																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	4	4	4	4	4	4	4	6	6	6															
2	10	10	10	10	10	10																			
3	14	14	14	14	14	14	14	14																	
4	10	10	10	10	10																				
5	14	14	14	14	14																				
6	2	10	10	2	2	6	6	14	14	6	14	2	4												
7	14	6	2	10	14	14	14	14	10	6	14	14	6	2											
8	14	14	14	14	14	14	14	14	10	14	14	14	14												
9	10	10	10	10	10	10	10	10	2	2	2	14	14	14	14										
10	10	10	10	10	14	14	14	14	14	14	14	14	14												
11	10	10	10	10	10	10	10	10	10	10															
12	6	6	6	6	6																				
13	10	2	14		6	4	2	14	10	6	4														
14	4	4	4	4	4																				
15	6	6	6	10	10	10																			
16	14	14	14	14	14																				
17	14	4	4	14	10	2	6																		
18	10	10	10	10	10	10	10	10	10	10	6	6	6	6	6										
19	6	Discard																							

APPENDIX III

Card Number (Number of Rectangles per Card) in Order Chosen for each S in Experiment 2, Trial 1

Subject	Choice Number																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	2	4	4	6	6	6	10	2																	
2	2	2	2	2	4	10	10	10	14	14	14														
3	4	2	6	4	10	2	4	6	4	2															
4	2	4	6	10	14	10	6	2	2	4															
5	4	2	2	6	6	4	10	10	4	6	4														
6	4	2	4	4	6	6	10	6	6	4															
7	4	2	4	4	4	6	10	6	4																
8	2	4	6	10	14	6	10	6	4	2															
9	2	2	4	6	4	10	14	10	4	6															
10	6	6	14	14	10	14	6	4	2	4	6														
11	4	4	2	2	4	6	6	4	4	6															
12	2	4	6	2	4	6	2	4	6	4															
13	2	2	2	4	4	6	6	6	10	10	10	10													
14	6	14	4	10	2	4	14	6	4	10	2	14													
15	10	6	4	6	10	2	2	6	10																
16	10	10	10	10	10	10	6	2	4	6															
17	4	6	10	14	2	4	6	6	4	4															
18	2	2	2	2	2	2	2	2	2	2	2	2													
19	2	4	6	10	14	2	4	6	10	14															
20	4	4	4	6	6	4	2	2	2	2	4	4													
21	4	4	2	2	4	6	10	10	10	14															
22	6	6	6	6	6	6	6	6	6	6															
23	2	4	6	6	4	2	4	6	14	14															
24	2	4	6	10	14	14	10	6	4	2															
25	2	2	2	2	4	6	6	10	6	4															
26	2	4	6	10	14	14	14	10	6	4															
27	2	4	6	6	4	6	10	14	6	4	2														
28	14	10	6	6	10	14	10	6	4	4															
29	4	4	2	4	6	10	10	6	4	4	4														
30	4	4	2	2	6	10	10	6	4	6															
31	2	4	6	4	2	4	6	4	2	4	4	2													
32	6	6	6	10	10	10	14	14	14																

APPENDIX IV

Card Number (Number of Rectangles per Card) in Order Chosen for each S in Experiment 2, Trial 3

Subject	Choice Number 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	4	4	4	4	6	4	4	4	4																
2	2	2	2	2	4	10	10	10	14	14	14														
3	2	2	2	4	4	6	10	10	14	14															
4	6	4	6	4	6	10	2	6	10																
5	6	6	10	6	2	2	4	4	10	6															
6	2	4	4	2	6	6	4	6	10	4															
7	2	2	2	4	10	6		2	4	4															
8	2	2	2	4	6	4	10	6	2																
9	6	10	14	10	2	4	4	6	10	4															
10	2	4	6	6	6	10	6	4	2	10															
11	4	2	2	4	6	6	4	4	6	4															
12	14	10	6	4	2	2	2	2	2	2															
13	10	6	6	6	6	10	10	4	6	10	6														
14	14	2	6	4	10	2	6	14	4	2	10	6													
15	6	6	4	2	2	6	10	6	4	4															
16	14	14	10	6	10	10	6	4	2	4															
17	4	4	6	6	10	14	10	2	4	4															
18	4	4	4	4	6	6	6	6	4	4	4	4													
19	14	10	6	6	10	6	4	4	4	4															
20	6	6	10	10	10	10	6	4	2	2	4														
21	6	6	6	6	6	4	4	6	6	6															
22	2	4	6	6	6	6	4	4	4	6															
23	4	4	6	6	10	14	2	2	6	10															
24	2	4	6	10	14	10	6	4	2	2															
25	6	6	6	4	2	2	4	4	4	6	4														
26	16	16	16	10	6	2	16	14	10	6															
27	4	4	4	6	6	6	4	4	4	4	6														
28	4	2	2	2	6	10	10	6	4	2															
29	4	6	6	6	4	2	14	10	6	4															
30	2	4	6	10	2	4	6	10	6	4															
31	4	4	4	6	10	10	6	4	4	4	4	10													
32	10	10	10	6	6	4	4	2	2	2															

APPENDIX V

Card Number (Number of Rectangles per Card) in Order
Chosen for each S in Experiment 3, Trial 1

Choice Number

Subject	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	14	14	14	14	14	14	14	14	14	14															
2	2	4	4	4	6	4	6	6	2	6															
3	4	2	6	10	14	10																			
4	14	6	4	2	10	4	6	14	2	2															
5	6	4	2	10	14	14	6	4	2																
6	10	6	4	2	14	14	10	6	4	2															
7	6	6	6	4	4	10	6	6	2	2															
8	10	4	14	14	4	14	14	2																	
9	2	4	6	10	14	10	6	4	2	6															
10	4	10	6	6	14	2	6	2	6	6															
11	10	10	10	2	6	6	4	4	2	2	14														
12	2	2	2	2	2	2	4	4	14	14															
13	10	10	10	10	10	14	10	10	2																

APPENDIX VI

Card Number (Number of Rectangles per Card) in Order Chosen for each S in Experiment 4, Trial 1

Subject	I
1	6
2	6
3	14
4	14
5	2
6	14
7	10
8	10
9	6
10	14
11	14
12	6
13	6

APPENDIX VII

Card Number (Number of Rectangles per Card) in Order Chosen for each S in Experiment 4, Trial 3

Subject	III
1	14
2	2
3	14
4	6
5	2
6	4
7	4
8	2
9	6
10	6
11	6
12	2
13	10

APPENDIX VIII

Card Number (Number of Rectangles per Card) in Order Chosen for each S in the No-Jump Group in Experiment 5, Trial 1

Subject	Choice Number 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	5	5	12	5											
2	8	8	8	8	12	8	12	12	12	12					
3	3	3	3	3	3										
4	5	5	5	5	5	5	5	5							
5	5	3	3	3											
6	12	3	3	5	8	8	12	12	5	5	5				
7	8	8	3	3	3	3	12	12	12						
8	3	3	8	12											
9	3	8	3	12	5	12									
10	5	12	12	12											
11	8	8	8	12	5	12	12	3	8	8					
12	12	12	12	12	12										
13	12	3	12	8		5	3	5	3	12	8				
14	8	8	8	12	3										
15	8	3	5	12	12	12	3								
16	8	5	3	12	3	12	12								
17	3	12	12	8	5	12	12	12	5						

APPENDIX IX

Card Number (Number of Rectangles per Card) in Order Chosen for each S in the No-Jump Group in Experiment 5, Trial 3

Subject	Choice Number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	8	3	5	20	20	8	8								
2	3	3	3	3	12	12									
3	20	20	20	20	20	20	20								
4	12	12	12	12	12	12									
5	12	20	3	8	20	20									
6	3	3	8	20	12	8	8								
7	5	20	20	20	20										
8	20	3	3	3											
9	20	20	20	20	20	20	20	20	20						
10	5	5	5												
11	20	3	3	12	3	3	3								
12	3	3	3												
13	8	3	20	12	5	12	12	12	20	20					
14	20	20	12	3	5										
15	12	12	12	12	12	12	12	12	12	12					
16	3	12	20	20	8	20	20								
17	8	3	3	3	3	3									

APPENDIX X

Card Number (Number of Rectangles per Card) in Order Chosen for each S in the Jump Group in Experiment 5, Trial 1

Subject	Choice Number 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	3	12	5	8	12	3	5	8	3	12	12				
2	12	12	12	12	12	12	12								
3	8	3	3	12	5	12	3	8	8	8	8				
4	12	12	12	12	5	5	5	12	5	12					
5	12	12	12	12	12	12	12								
6	8	8	8	8	8	8	3	3	8	3					
7	8	12	12	12	12										
8	12	5	5	5	5	5	12	12	12	12	12				
9	3	8	5	12	12	8	8	3	5	12					
10	3	5	12	8	3	5	12	8	8	3					
11	8	8	8	5	12	5									
12	8	8	8	5	12	12	12	5	3						
13	12	12	3	8	5	12									
14	12	12	12	12	12	12	12	12	12	12					
15	3	3	3	3	3	3									
16	5	3	5	5	5	5	5	5							
17	5	5	5	5	5	5									
18	12	12	3	12	12	12	12								
19	3	3	12	12	12	12	12								

APPENDIX XI

Card Number (Number of Rectangles per Card) in Order Chosen for each S in the Jump Group in Experiment 5, Trial 3

Subject	Choice Number													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	3	8	12	20	5	3	8	12	20	20					
2	20	20	20	20	20	20									
3	20	20	20	12	12	12	20	20	20	20					
4	12	12	5	8	12	5	5	5	5	5					
5	12	20	20	20	20	20	20	8	8						
6	20	20	20	20	20										
7	8	8	20	20	20	20									
8	20	3	20	20	12	12									
9	8	12	3	3	3	20	20								
10	20	20	8	3											
11	20	20	8	12											
12	3	3	3	3	3	3	3	5	3	3					
13	5	12	12	3	5	20									
14	5	5	5	5	5	3	12	12	12	12					
15	12	12	12	12	12	12									
16	20	12	12	12	12										
17	3	3	3	20	20	20	20	20	20						
18	12	12	12												
19	No Choices														

APPENDIX XII

Card Number (Number of Rectangles per Card) in Order Chosen for each S in the No-Jump Group in Experiment 6, Trial 1

Subject	Choice Number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	12	12	12	12	12	12	12	12							
2	8	8	8	8	8	3	3	12							
3	8	3	12	5	8	12	3	12							
4	8	8	8	8											
5	3	3													
6	8	3	3	3	3	3	3	3	3	5					
7	8	8	8												

APPENDIX XIII

Card Number (Number of Rectangles per Card) in Order Chosen for each S in the Jump Group in Experiment 6, Trial 1

Subject	Choice Number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
8	8	3	8	12	5										
9	12	12	12	12	12										
10	12	12	12	12											
11	8	8	8	8	8	8	8	8	8						
12	5	5	3	12	5	8									
13	5	5	3	5											
14	3	12	5	5											
15	3	3	12	8	12	3									

APPENDIX XIV

Card Number (Number of Rectangles per Card) in Order Chosen for each S in the No-Jump Group in Experiment 6, Trial 3

Subject	Choice Number 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	20	20	20	20	20	20	20	20							
2	12	5	5	20	8	3	20	20	20	5					
3	3	20	12	5	8	3	3	5	5						
4	12	3	3	3	3	3	12								
5	5	20	8	3	12	5	12	5							
6	12	12	8	20	20	20	8	3	3	12					
7	20	20													

APPENDIX XV

Card Number (Number of Rectangles per Card) in Order Chosen for each S in the Jump Group in Experiment 6, Trial 3

Subject	Choice Number 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
8	3	20	20	3	12	12	5	3	12	12					
9	20	20	20	20											
10	12	20	12	20	12										
11	5	5	5	5	5	5	5	5	5	5	5	12			
12	8	20	20	5	20										
13	20	3	20	3	12										
14	5	20	8	5											
15	20	20	20	20	20										

APPENDIX XVI

Scaling Data

Stimuli (Number of Rectangles) Judged the Same

S	Trial 1 (2,3,4,5)	Trial 2 (5,6,7,8)	Trial 3 (8,9,12,13)	Trial 4 (13,15,16,20)
1	none	none	8-9, 9-12	13-20
2	3-4	5-8	9-12	16-20
3	none	none	8-12	13-16
4	none	none	8-9, 12-13	15-16-20
5	none	none	none	16-20
6	2-3	5-6-7-8	8-9-12	13-15-16-20
7	none	none	12-13	13-15, 16-20
8	4-5	none	12-13	16-20
9	4-5	5-6	12-13	13-15
10	4-5	6-7-8	8-9-12-13	13-15, 16-20
11	none	none	9-12	none
12	none	5-7	8-9, 12-13	13-15
13	none	6-7	12-13	15-16-20
14	4-5	6-7	12-13	16-20

APPENDIX XVII

Recent Research Supporting Dember-Earl Theory

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