A TEST OF ATTENTION THEORY WITHIN THE TACTUAL-KINESTHETIC MODALITY

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CHAPTER I

INTRODUCTION

Most research in discrimination learning has involved the visual and auditory modalities. Relatively few experiments have investigated the tactual-kinesthetic mode of perceiving information. A theory of discrimination learning has been developed by Zeaman and House (1963). The specific purpose of this study is to look at the generality of the Attention Theory of Zeaman and House (1963) to determine if it is applicable within the haptic-somatic sensory modality.

The theory of Zeaman and House is a chaining model consisting of two separate responses: an observing or mediating response and an instrumental response. The observing response is an orienting or attention response made to a dimension which is defined as a broad class of stimuli (e.g., form or texture). The instrumental response is an overt motor response made to a specific cue or group of cues within the observed dimension (e.g., triangle, square, felt or corduroy). The probability of paying attention or observing the relevant dimension (Po) may be at any level when the discrimination task is first presented. Factors affecting this could be the characteristics of the stimulus arrays or a particular preference for the dimensions presented by a subject. However, the initial probability of making the correct instrumental response (Pr) is fifty percent as the experimenter selects the cue to be reinforced. Both probabilities should increase through direct reinforcement when a response is to a positive cue. Also both (Po) and (Pr) can be reinforced indirectly when responses are made to negative cues. Neither (Po) nor (Pr) can be measured directly, since they are combined in the response measure taken. However, the use of reversal (R), intradimensional (ID), and extradimensional (ED) shifts can be used as aids in evaluating these response probabilities.

In a reversal shift, the relevant dimension is maintained on the shift with only the cues reversed in regard to the reinforcement contingencies. The term relevant dimension refers to the class of stimuli which is paired with reinforcement. There is initially a high probability of having a correct observing response and a low probability of producing the right instrumental response. There is a positive mediating or observing response transfer and a negative instrumental transfer in a reversal shift. The growth of the probability of making a correct response starts at a low level, increases to one-half, and ends in an ogival curve. The portion of the curve located at chance is referred to as the reversal midplateau and is thought to indicate the point at which old observing responses are discarded. This reversal midplateau is a consequence of the theory of Zeaman and House (1963) and has been observed in visual studies.

In an experiment using the tactual modality, initial acquisition might occur with either form or texture as the relevant dimension. If a triangle is the correct cue during training, then on the reversal shift, the incorrect cue present during training (e.g., square) would be correct upon execution of the transfer operation. Form is the relevant dimension and texture would remain irrelevant throughout both the training and testing phases.

In an intradimensional shift, the dimension that is relevant on training is again relevant on transfer. However, different specific cues from both the relevant and irrelevant dimensions are selected. Since the dimension reinforced on transfer is the same dimension that was rewarded in initial training, a positive observing response transfer is postulated. The instrumental response probability is expected to be one-half as new specific stimuli are used and the selection of the reinforced cues is made by the experimenter. For instance, if texture is the relevant dimension, and felt is the correct cue and corduroy the incorrect cue during training, then on the intradimensional shift, rough sandpaper might be the correct cue, and the incorrect cue might be smooth sandpaper.

The dimension that was relevant during original learning becomes an irrelevant dimension during an extradimensional shift. Thus, the dimension that was irrelevant during original learning is relevant during the shift. A negative transfer of observing response is postulated. As in the intradimensional shift the instrumental response is at chance level since the specific stimuli used as cues are again new to the subjects and the specific cue reinforced is chosen by the experimenter.

A measure of the observing or mediating response is possible by comparing performance between the intradimensional and extradimensional shifts. This measure is possible since the intradimensional shift has a positive transfer effect on the relevant observing response and the extradimentional shift has a negative transfer effect. Both rates of the instrumental response are initially at chance level after a shift occurs. A measure of the transfer of the

the instrumental response is also possible by comparing the reversal and intradimensional shifts. The observing response for both of these shift conditions transfers positively; the two shifts differ in that a chance level of the instrumental response is seen in an intradimensional shift and there is a low probability of making a correct instrumental response in a reversal shift. The theory predicts that intradimensional, reversal and extradimensional shifts fall into the order as listed here in degree of difficulty. This has been the general conclusion from studies in visual discrimination by Zeaman and House (1963).

Brown (1966) is the only one to have previously tested this theory of Zeaman and House with the use of tactual discrimination tasks. She found a significant difference between the ID and ED shifts at the .01 level, but not between the R and ID shifts. Also she found no evidence for a reversal midplateau. Thus, she obtained evidence for the observing response portion of the theory, but not for the instrumental portion of it. She also found that form is a much more potent dimension than the texture dimension, when retarded children serve as subjects.

Although Brown's findings were similar to those of Zeaman and House for visual discrimination tasks, further investigation of this problem should be undertaken since

Brown used retarded children who varied widely in both mental and chronological age. The comparison of the performance of normal kindergarten children with the retarded subjects in Brown's study might be interesting. Also the homogeneity of the kindergarten group would possibly lead to a more meaningful statistical analysis.

Also, the stimulus objects used in her study restricted the subject's active manipulation and exploration of the stimulus dimensions as well as the differences within a particular dimension. By using stimuli which can be picked up and examined, unrestricted access to the stimuli can be provided. Also, another factor which was not considered in the Brown experiment is that of the effect of familiarization versus no familiarization with experimental stimuli prior to the training portion of the problem.

Normal kindergarten students might be used as subjects; the comparison of the two groups' performance could be interesting and the homogeneity of the kindergarten group might lend itself more readily to a meaningful statistical analysis.

STATEMENT OF THE PROBLEM

The purpose of this study is to conduct tactual-kinesthetic discrimination experiments to further investigate the applicability of Attention Theory within the tactual-kinesthetic modality. Specifically the author proposes to:

1. Determine the differences in acquisition and shift performance between R, ID, and ED transfer situations and compare the results to visual studies and those of Brown (1966).
2. Find out if subjects have a preference for either form or texture within the tactual modality, and also compare the preferences of normal children with those of retarded children.
3. Determine if familiarization with experimental stimuli prior to the main portion of the experiment will have an effect upon the results.
4. Find out if the theory of Zeaman and House (1963) is indeed operative in the tactual modality.

REVIEW OF LITERATURE

Gibson has suggested that we can receive stimulus information without being aware of the channel of perception. For example, the blind person does not realize that auditory echo detection is responsible for his awareness of objects. Although Gibson feels that detection can occur without an active awareness, he does not mean that perception occurs without a source of information. Stimulus characteristics can be easily measured in the laboratory, but the quantity and the kind of stimulus information received is not so easily determined. Since the characteristics of the stimuli that a person attends to are determined by their qualitative and quantitative composition, this becomes an important consideration for attention theory.

An indentation in the tissue can act as a stimulus. However, a temporary indentation or deformation is not, according to Gibson, sufficient to describe the word "touch". Movements of the joints contribute to tactual sensitivity, with the distance traversed being the important factor (Gibson, 1966). Cutaneous kinesthesis refers to the pick up of movement relative to the skin. This information combined with the input directly to the skin yields information about the physical characteristics of the stimulus. It is called by Gibson active or dynamic touch. Generally it refers to the exploratory manipulation tactually of an object. Passive touch is referred to when an object is placed upon the skin, as with the many two-point discrimination studies that have been made.

Gibson believes that the perceptual capacity of the hand goes unnoticed because of its usual connection with motor activity. Touch also conveys meaning spatially. For instance, if the outline of a letter or number is lightly traced on the palm of the hand, it is readily identified.

Properties of objects that make them tactually distinguishable from other objects are comprised of several dimensions. These principally are: geometric shape, size, texture, mass, rigidity-plasticity and temperature. Also, time is important (Buddenbrock, 1958) as the speed with which the hand is passed over a surface affects the judgment of its texture. Stevens and Harris (1951) and Eckman, Hosman and Lindstrom (1965) have found that judgmental values of smoothness are approximately the reciprocals of the values for roughness. Most subjects preferred to touch smooth surfaces over rough ones. These studies were considered when the stimuli used in this experiment were designed. For example, two grits of sandpaper might be selected so that their differences are large enough to facilitate reliable tactual discrimination. Also shapes could be used that are different enough to provide reliable cues as to their design. Bradley (1958), in an experiment concerned with the use of cylindrical knobs for coded control surfaces, found when diameters differed by at least one-half inch, when thickness differed by at least three-eights of an inch and when smooth, fluted or knurled surfaces were used, errors of recognition were made only one percent of the time. Distinctive features of each shape were the main determiners of differences.

The forms and textures to be used in the present experiment were designed with the intent that each would offer obvious differences or distinctive features to the subject. Several experiments in the tactual modality have concluded that those stimuli which do have definite distinctive features are easiest to recognize. Culbert and Stellwagen (1963) in an experiment to determine the relative discriminability of 40 varying textures, using a paired comparison technique, found 11 patterns discriminable enough to be useful in the design of maps and training devices for the blind. The most discriminable textures contained obvious differences such as rows of elevated dots and dashes or rows of textured material at right angles to each other. Jenkins (Blum, 1952) attempted to determine the shape for control knobs which would facilitate accurate recognition by aircrew members. Subjects who were pilots felt a standard knob for one second. Then they tried to find the test knob which was similar to it. Errors and hesitations, which are undesirable in the cockpit, were analysed. Eight "distinctive knobs" were recommended for use on aircraft.

There are a number of studies which are relevant to the familiarization effects which will be tested in the present investigation. Pick, Pick and Thomas (1966) believe that discrimination learning involves the learning of dimensions of difference. They investigated cross-modal transfer between the visual and tactual modalities with first grade children. Their results indicated that if tactual training preceeds visual testing, savings were possible. However, those subjects who received the visual training first did not benefit from it when tested in the tactual modality. Loeb (1965) in an experiment comparing tactual and visual discrimination abilities found vision to be more effective than touch when evaluated separately.

When vision and touch were evaluated jointly, the sequence of visual-tactual was superior to a sequence of tactual-visual. Also, he concluded that as the discrimination task became more difficult, the visual-tactual sequence superiority became more obvious. Loeb presents some interesting hypotheses about why vision is superior to touch. One of these is that because of the faster scanning possible with vision, the increased number of repetitions may increase learning. Another possibility he offers which seems feasible is that simultaneous stimulation which is possible with vision, enables the person using the visual modality to learn the critical features faster.

In addition to the pretraining both visually and tactually, the subjects in this study who did receive pretraining were encouraged to use verbal labels for the various forms and textures. Related research concerning the value of verbal labeling was performed by Eckstrand and Morgan (1965). They explored the effect of naming versus non-naming of tactual control surfaces. A tactual-name group was trained by associating the name with the feel of the knob, while a tactual group only felt the knob during training. A control group had no training. The test of learning involved the tactual discrimination of four similar but different knobs. All groups improved with practice. The tactual-name group did much better than the tactual group and the tactual group did better than the control group. Blank and Bridger (1964), using nursery school children, found that Cross-modal Equivalence, which requires recognition of the same object in different sense modalities depended upon age and that verbalization had no effect. The design involved placing a standard object in the subject's hands (behind his back); then the experimenter displayed visually two objects, one of which was similar to the standard.

Gollin (1960) in a developmental comparision study of adults and children, found that adults were definitely superior in tactually recognizing forms (constructed of raised tacks) from a standard. This difference was especially noticeable when interferents such as tacks not contributing to any particular pattern were present. The adults benefited more from training than the children.

Several studies compare the ability of normal and retarded persons in tactual discrimination tasks. Hermelin and O'Connor (1961) found that retardates did better than normal persons in the tactual modality than in the visual modality. Medinnus and Johnson (1966) tried to check these results. They used twenty retarded and twenty normal children on a successive discrimination task involving nonsenseshaped blocks. Subjects were given ten seconds to tactually explore each block during the training portion; in the test portion of the experiment they were asked if they had felt each block previously. The results were not statistically significant. In an experiment such as this, memory is required as it may help subjects look for differences. This is the opinion of Pick (1965). In a similar study, requiring successive presentations, with first grade children, Pick found that both distinctive features and prototype or schema formation occurred. In the same experiment, Pick used simultaneous tactual discrimination tasks and learned that the subjects were responding to distinctive features alone. Pick says in these types of experiments, the function of practice is to give the subject time to determine which of the many possible stimulus variables are necessary or critical.

CHAPTER II

METHOD

Subjects and Design

A total of 78 kindergarten children from the Jefferson School, Stillwater, Oklahoma, were run in the experiment. Of these, 18 were dropped because of failure to reach a criterion which will be described presently. The teachers provided information concerning the slow learning ability of five other potential subjects who were eliminated from the experiment. Several in this category were allowed to play the game for a short while and win some candy with the intent of letting them participate. This provided a check on the judgment of the teacher. None of the Ss had previous visual or tactual discrimination experience. The mean CA was 5-10 and it ranged from 5-5 to 6-4. This represented a fairly homogeneous group chronologically. Brown's (1966) Ss had a mean CA of 14-10 and the range was from 9-5 to 24-5.

The factors investigated represented the following independent variables: a) STIMULUS DIMENSION-Form and

Texture, b) PRETRAINING-Familiarization and Nonfamiliarization, and c) SHIFT CONDITION-Reversal, Intradimensional and Extradimensional. A 2x2x3 factorial design was used with five Ss in each cell.

Apparatus

A Wisconsin General Test Apparatus (W.G.T.A.) similar to the one used by Brown (1966) was used. It consisted of a movable front panel with two five inch openings which were 12 inches apart into which S inserted his hands for simultaneous sampling of the stimuli. The openings were covered with cloth to prevent S from viewing the interior. The sixteen stimuli were made of hardboard, shaped into four basic forms, and were covered with four textures. The forms were circle, square, rectangle and triangle. The four textures were rough sand-paper, smooth sand-paper, felt and ribbed corduroy. The stimuli were located in two bowls, each of which was mounted upon a piece of masonite which slid in a track. Rewards of M&M candy were placed in a well under the bowl containing the reinforced stimulus object. The well was uncovered by S pushing the masonite with the attached bowl toward E. A one-way vision screen was located between S and E, which restricted the Ss forward view.

The verbal response latencies of the Ss receiving familiarization training were timed with the use of a Grason-Stadler Voice Operated Relay (Model E7300A-1). The timer, which was started manually and stopped verbally, was a Marietta 14-15D .01 Second Timer.

PROCEDURE

Pretraining

Ss selected for familiarization training were trained to visually and tactually recognize the stimuli they would experience in the main portion of the experiment. First they were visually shown the individual stimuli and their responses were timed using the voice operated relay. It was activated simultaneously with the presentation of the stimuli. Each form and each texture was randomly presented visually to each *S*. All reaction times were recorded. In most instances, *Ss* spoke loudly enough to actuate the voice operated relay. If an *S* did not know a verbal label for a particular stimulus, he was given the name for it during the visual portion of the familiarization training. Then the three visual familiarization trials were presented. Following the visual pretraining, three tactual recognition trials were presented during which tactual latencies were recorded. *Ss* used only the right hand in this phase to tactually explore stimuli located in the right bowl of the W.G.T.A.

The second phase of the tactual familiarization training consisted of presenting stimuli simultaneously in both bowls with only one identification task to make as one of the dimensions was constant in both positions. The purpose of this phase was to establish with a degree of certainty that the physical differences of the stimuli could be discriminated. The reversal group received four trials and the intradimensional and extradimensional groups received eight trials of the sequences listed in Table 1.

Rapport was gained initially by asking Ss if they liked candy and if they wanted to play the "candy game". All Ss, whether they received familiarization training or not, were given the following instructions. The S was told to put his hands through the holes and E guided his fingers to the location of the foodwells which were uncovered. An M&M candy was placed in one of the foodwells and the S was told to feel for the candy in the foodwell. Next, a junk object was placed in one of the bowls. S was told he would feel an object inside a bowl and to push the bowl containing the object toward E and to pick up the candy. After this, an additional junk object was placed in the other bowl and S was reminded that what he touched would tell him where to find the candy. On the next trial, the

TABLE I

THE SECOND PHASE OF THE PRESENTATION SEQUENCE DURING TACTUAL FAMILIARIZATION PRETRAINING

Reversal

Trials	Left	Right
1	Sc	Sf
2	Tf	Tc
3	Sc	Tc
4	Tf	Sf

ID and ED

Trials	Left	Right
1	Sc	Sf
2	Tf	Tc
3	Sc	Tc
4	Tf	Sf
5	Rrs	Rss
6	Css	Crs

TABLE I (Continued)

Trials	Left	Right
7	Rss	Css
8	Crs	Rrs

Symbol Code

Form	Texture
S-Square	f-felt
T-Triangle	c-corduroy
C-Circle	rs-rough sandpaper
R-Rectangle	ss-smooth sandpaper

objects were reversed and S was again reminded to remember what he touched as that is how he would find the candy. S was also encouraged to explore thoroughly the characteristics of the stimulus objects. Then E proceeded with the acquisition portion of the experiement using stimuli which were to be discriminated.

Training

A pair of forms and textures was selected at random to be used as discriminanda for the form relevant and the texture relevant training conditions respectively. A triangle was selected as the cue to be reinforced for those Ss in the form relevant training condition. A square was selected as the non-reinforced cue when form was relevant. The two textures in the irrelevant dimension were felt and corduroy. Those Ss in the texture relevant group were reinforced for the cue of felt and non-reinforced for the corduroy cue. Square and triangle were the stimuli in the irrelevant dimension. Positioning of the reinforced cues and positioning of the irrelevant dimension stimuli were determined by the Gellerman series as corrected by Fellows (1967). The same random order of presentation with the same Gellerman-Fellows series was presented to each subject.

This follows a procedure used by Evans (1967). The order of presentation and the positioning of stimuli is given in Appendix A. The criterion during the training phase was 20 correct responses in a block of 25 trials.

Testing

After Ss reached criterion they were immediately transferred to either a reversal (R), intradimensional (ID), or extradimensional (ED) shift. Testing like training was completed in one session. The stimuli used and the reinforcement contingencies in each of these shifts were determined randomly within the restrictions imposed by the transfer condition. Appendix A indicates the particular stimuli and the reinforcements for each shift. Each subject was given only 25 trials during transfer. This procedure was used for the sake of expediency in view of the difficulty in attaining 20 correct responses during 25 trials, particularly in the case of the extradimensional shift which involves substantial negative transfer.

CHAPTER III

RESULTS AND DISCUSSION

Pretraining

The thirty Ss that received familiarization pretraining did learn to tactually identify the experimental stimuli, particularly form, with response latencies that approach the visual identification latencies. These latencies are recorded in Table II. The hypothesis that the slower tactual than visual identification times is a result of the generally accepted superiority of visual discrimination over tactual discrimination could not be adequately evaluated in this study because each S's identification reaction times were first taken visually and then tactually. However, as these tactual recognition times were fairly close to the visual recognition times, the E, as far as this experiment is concerned, did not consider any differences to have a major effect upon later portions of the study. Furthermore, since the effect of this familiarization pretraining was evaluated under original learning and transfer results, an analysis of the pretraining data was unnecessary.

TABLE II

MEANS FOR VISUAL AND TACTUAL LATENCIES TAKEN DURING FAMILIARIZATION PRETRAINING

(Pretraining for 1st and 3rd Trial)

Modality	Trials	Form	Texture
Visual	1st	1.89	2.52
	3rd	1.85	1.91
Tactual	1st	2.35	2.62
	3rd	1.82	2.24

Original Learning

The acquisition functions were similar to those obtained in other tactual studies (Brown, 1966) and to visual studies (Zeaman and House, 1963). The response measure for this analysis was the number of errors to criterion. This lack of significance is not surprising since any S who made six or more errors in a block of 25 trials was not used in the analysis. Mean errors for the form relevant group and texture relevant group respectively were 3.13 and 3.23. Mean errors for those not receiving familiarization training and for those who did are 3.36 and 3.00 respectively. No main effects or interactions were significant in the analysis. The results of the 2x2 factorial analysis of variance for dimension and training are located in Table III. Appendix B contains data used in the analysis of variance. Figure 1 presents the original learning curves for the Ss in the form and texture relevant learning conditions. Also the familiarization and nonfamiliarization conditions are included in Figure 1.

Brown (1966) found a large significant difference between the form and texture dimension on original acquisition. Her average form relevant S made 5.5 errors and the

TABLE III

2 X 2 FACTORIAL ANALYSIS OF VARIANCE
FOR DIMENSION AND TRAINING
IN ORIGINAL TRAINING

(Prior to Shift)

Source	d.f.	S.S.	M.S.	F
D	1	0.150	0.150	*
T	1	2.017	2.017	*
D X T	1	3.750	3.750	*
Within	56	187.066	3.340	
Total	59	192.983		

* None significant

D-Form and Texture

T-Nonfamiliarization and Familiarization

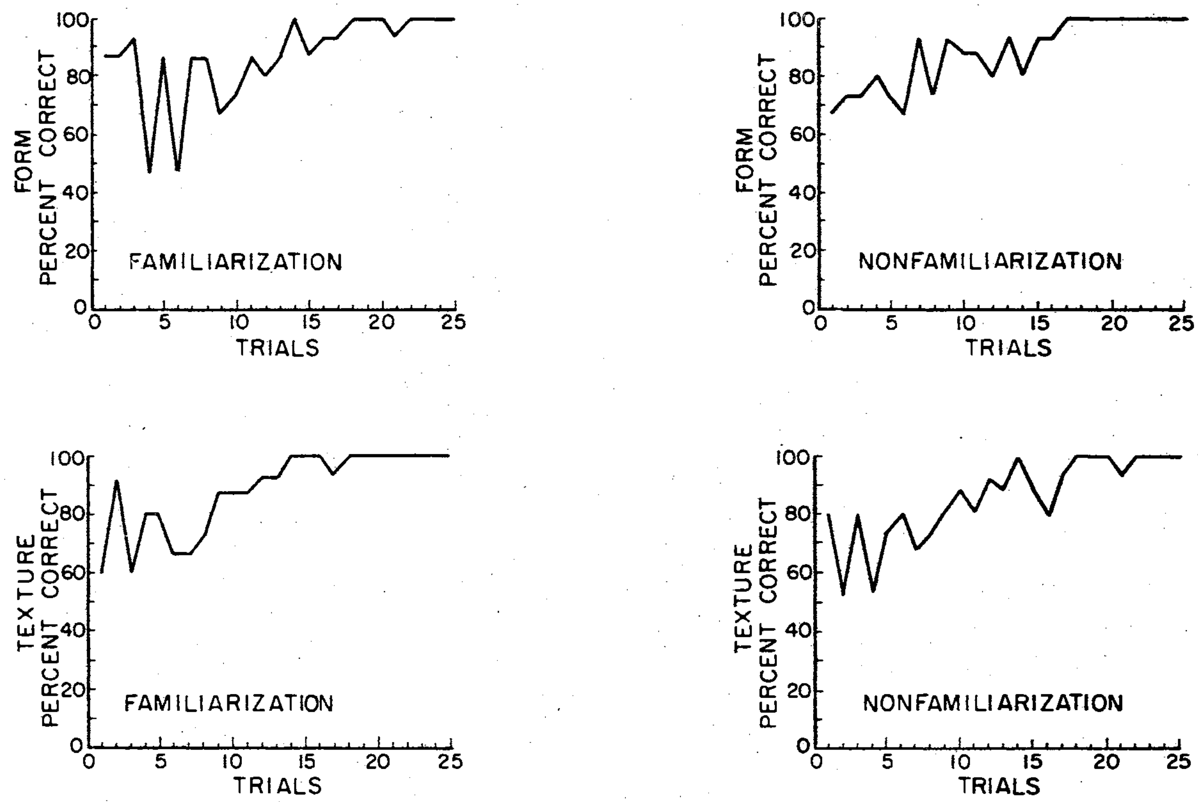

Figure 1. Original Learning Curves for Form and Texture With and Without Familiarization

average texture relevant S made 17.1 errors. Also with retarded children Brown needed more than one training session, since only 15 Ss in the form relevant group and only 9 Ss in the texture relevant group reached criterion on the first day of training. Brown's Ss generally required 25 more trials to criterion with texture than with form. Although statistical differences were not obtained in the present study, the direction of the differences is not inconsistent with Brown's findings. The wide difference in ease of initial acquisition between Ss in Brown's study and Ss in this study could be interpreted to imply that normals do not have the difficulty learning texture that is apparent with retardates. Another possible difference between this experiment and that of Brown which could have affected the relative performance of Ss is that in this experiment active manipulation of the stimuli was possible. The stimuli in Brown's study were fastened down and Ss could not pick them up for unrestricted tactual exploration.

In regard to the effect of familiarization, statistical differences were not apparent in the analysis of variance, possibly because those Ss who did not receive familiarization pretraining were more likely to be eliminated from the experiment. This would result from the stringent requirement that each S had to reach criterion in one session.

Of the 18 Ss that did not qualify for the experiment, the data sheets available indicate that ten did not receive familiarization pretraining and that two did receive it. The number of Ss that did not qualify was equally divided in regard to the relevant training dimension under both familiarization and nonfamiliarization conditions. A statistical analysis of these data is not possible, however, since six of the data sheets were misplaced.

In an effort to learn more about the possible effect of familiarization pretraining, an analysis of variance was run using the trial of last error during original learning as the response measure. For the Ss that did not receive familiarization pretraining, the mean trial of last error was 7.93 and 9.93, respectively, for the form and texture relevant groups. Although the differences were not significant, the form relevant group had an earlier trial of last error. Again the direction of these results is not inconsistent with Brown's (1966) study. The reverse of this was true for those Ss in the present study who received familiarization pretraining, as the mean trial of last error was 10.8 for the form relevant group and 6.93 for the texture relevant group. Possibly an effect of the familiarization pretraining is that it directs S's attention to a dimension that he would not otherwise observe. This may result in a novelty effect which is highly attention producing. The difference between means was unstable but suggestive ($t = 2.857$, df 58, $p < .10$). Data used in this analysis is in Appendix C.

Transfer Results

A 2x2x3 factorial analysis was used to assess differences among errors within a block of 25 trials on the three shift conditions. The factors were dimension (form and texture), extent of pretraining (familiarization or nonfamiliarization), and type of transfer (R, ID or ED). This analysis (Table IV) shows a very significant main effect for type of transfer ($F = 14.02$, df 2/48, $p < .005$). There were no other significant main effects or interactions. Appendix C contains data used in this analysis of variance.

Duncan's New Multiple Range Test (Table V) indicated, after mean errors for shift groups were combined across dimensions and training factors, that there was a significant difference between the ID and ED shifts ($LSR = 2.858$, df 48, $p < .01$), the R and ID shifts ($LSR = 2.858$, df 48, $p < .01$), and between the R and ED shifts ($LSR = 2.257$, df 48, $p < .05$). The predictions that ID, R and ED shifts fall into the listed order of difficulty is supported by the mean errors on shift (2.40, 6.95 and 9.55). The significance at the .01 level of differences between both the ID and ED shifts and the R and ID shifts gives support for the theory of Zeaman and House in the tactual modality.

TABLE IV

2 X 2 X 3 FACTORIAL ANALYSIS OF VARIANCE FOR DIMENSION, TRAINING AND SHIFT

Source	d.f.	M.S.	F.
D	1	8.07	0.432
S	2	261.95	14.02 **
T	1	5.40	0.289
D X S	2	21.62	1.102
D X T	1	19.26	1.031
S X T	2	3.95	0.211
D X T X S	2	0.82	0.043
Error	48	18.68	

** .005

D = Dimension (Form and Texture)

S = Shift (R, ID, and ED)

T = Training (Familiarization and Nonfamiliarization)

TABLE V

ANALYSIS OF TOTAL ERRORS FOR R, ID AND ED TRANSFER GROUPS WITH DUNCAN'S NEW MULTIPLE RANGE TEST

(Mean errors for shift groups are combined across dimensions and training factors)

Reversal (s_1)	Intradimensional (s_2)	Extradimensional (s_3)
6.95	2.40	9.55

1% Multiple-Range Test

Value of p	2	3
SSR	3.796	3.962
Rp = LSR	2.858	2.983

S3-S1 = 2.60 < 2.983; not significant
S3-S2 = 7.15 > 2.858; significant
S2-S1 = 4.55 > 2.858; significant

5% Multiple-Range Test

Value of p	2	3
SSR	2.848	2.998
Rp = LSR	2.159	2.257

S3-S1 = 2.60 > 2.257; significant

Brown (1966) had found a significant difference between the ID and ED shifts, which supports the observing or mediating portion of the theory, but she did not find a significant difference between the R and ID shifts, which indirectly would give support to the instrumental portion of the theory.

Figure 2 presents the performance of the shift conditions when the percent of correct responses are combined across dimensions and training factors. Postulated factors which can affect these curves are: (n) the number of dimensions competing for attention, the probability of Ss paying attention to the relevant dimension, the rate at which Po (observing resonse) and Pr (instrumental response) change, and θ, which is a growth parameter.

The ID shift is clearly the easiest shift to make, as the former relevant dimension remains relevant. The only problem then is for S to learn the correct instrumental response. This response is made to a cue selected by E which is different from former cues, but still remaining within the same general dimension. These predictions are confirmed in that the ID shift had the fewest mean errors; also Figure 2 shows that the ID shift groups' performance clearly reflects the relative ease of making this transfer as compared to the transfer of the R and ED shifts.

The reversal functions fell into an intermediate

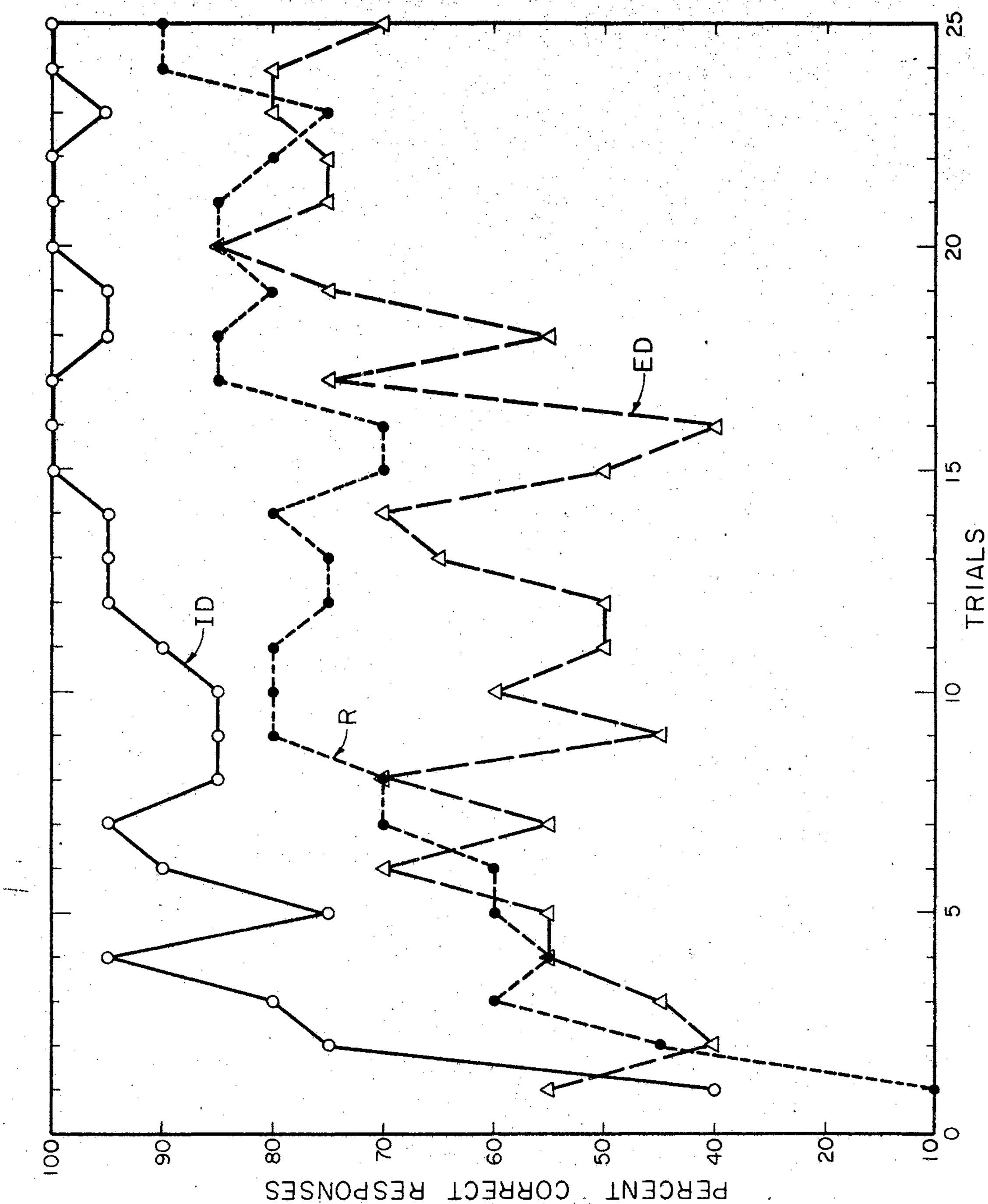

Figure 2. R, ID, and ED Shift Learning Curves Combined Across Dimensions and Training Factors

position between the ID and ED curves, as predicted by the theory. The R shift should normally generate a high Po and a low Pr, since the same dimension is relevant on transfer facilitating the high Po and the Pr is the reciprocal of the pre-shift instrumental response rate. Figure 3 was plotted for the reversal shift condition with the first ten responses combined across dimension and training factors. The purpose of this was to see if there is evidence for the reversal midplateau. There is a rise from 20% correct responses on trial one to 60% correct responses on the third trial. From trial three to trial six, there is an apparent leveling effect of the data. Then from trial six, there is a gradual increase until the 80% level is reached on trials nine and ten. These data, of course, do not provide strong evidence for a reversal midplateau. However, the data in general resembles that reported by Zeaman and House (1963, p. 190), with visual reversal functions.

Figure 2 indicates that the large negative transfer associated with an ED shift was effective as the ED curve reflects the lowest percent of correct responses of any of the shifts. A negative transfer of Po is as expected in an ED shift. Pr is predicted to be at the chance level as E selects the relevant cue to be reinforced. Due to the

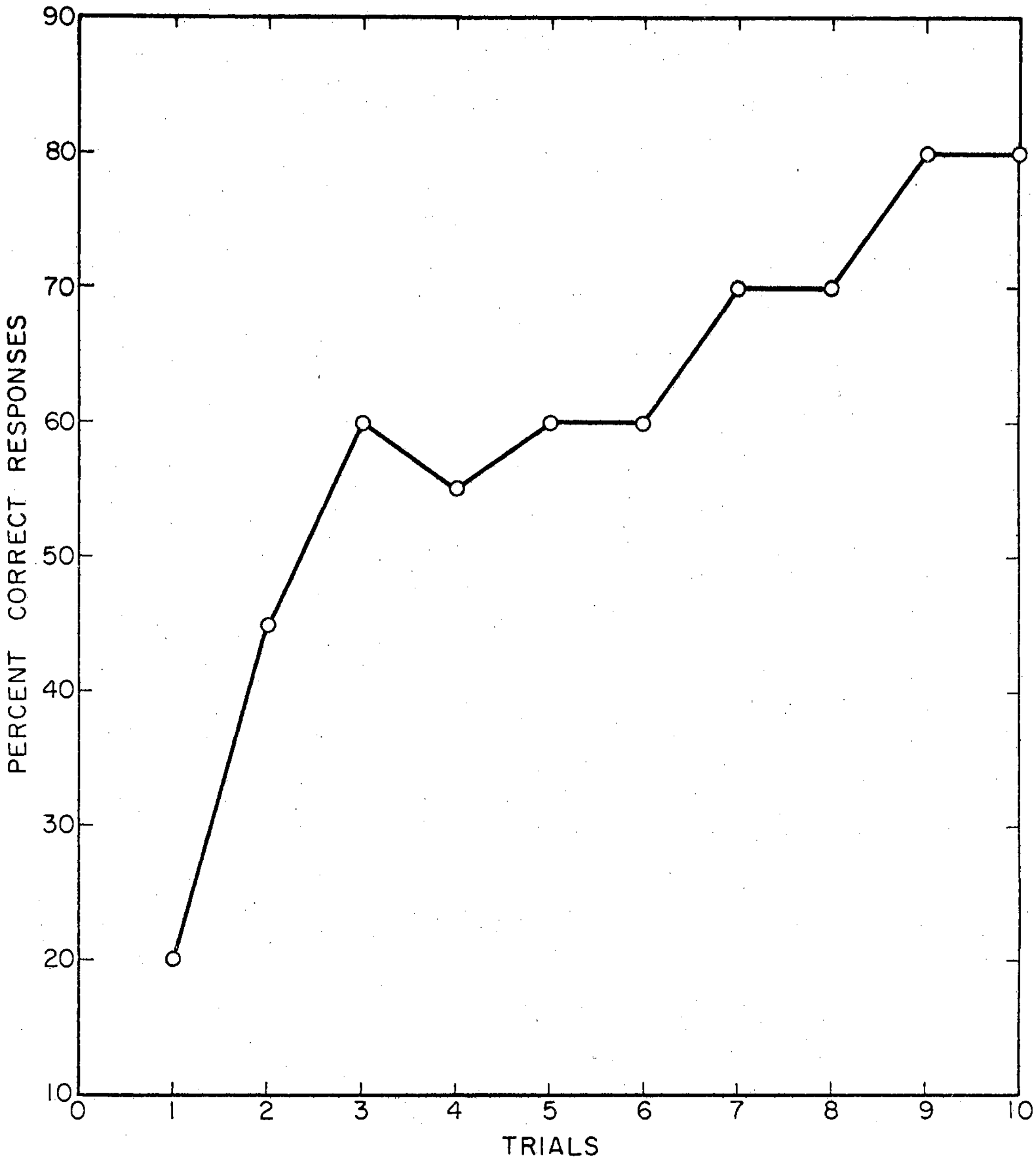

Figure 3. R Learning Curve for First Ten Trials Combined Across Dimensions and Training Factors

response measure being the number of errors in a block of only twenty-five trials and the strong negative transfer of this shift, it is obvious that asymptotes were not reached.

The hypothesis that form and texture are definite dimensions within the tactual modality is supported by the positive and negative transfer effects under the various shift conditions. These findings in regard to shift performance give further evidence that the Attention Theory of Zeaman and House is applicable within the tactual modality.

CHAPTER IV

SUMMARY AND CONCLUSIONS

This study investigated the effects of the following three factors on the acquisition and transfer performance of sixty normal kindergarten children: dimension (form versus texture), training (familiarization versus nonfamiliarization), and shift (reversal, intradimensional and extradimensional).

The results were generally those expected of Attention Theory in regard to the type of shift. The main effect for shift was significant beyond the .005 level. Also significant differences were evident at the .01 level between both the ID and ED shifts and the R and ID shifts. These differences give strong support to Zeaman and House's (1963) theory both in regard to the observing and the instrumental responses.

There is strong support substantiating Brown's (1966) finding that form and texture are definite dimensions in the tactual-kinesthetic modality. However, form and texture are not significantly different in regard to the number of errors required to reach criterion on original learning. This should be regarded as a tentative conclusion due to the availability of Ss. If those Ss who did not qualify under the original learning criterion had been retested, perhaps differences would have been apparent between the learning of the form and texture dimensions. The method of subject selection may have, by eliminating the slow learners, obscured the results that might otherwise have been obtained.

The hypothesis that familiarization training would have a significant effect was unsubstantiated when an error measure was used. When the trial of last error was analysed in regard to original learning, there was weak evidence for some possible effect of the familiarization pretraining.

In conclusion, then, this study provides additional support for the generality of the Attention Theory of Zeaman and House in the tactual-kinesthetic modality.

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APPENDIX A

SCHEDULE OF REINFORCED CUES AND THEIR PRESENTATION POSITIONS

		R-Form	R-Text	ID-Form	ID-Text	ED-Form	ED-Text
	Tng	Test	Test	Test	Test	Test	Test
1.	Sc $\overset{++}{\text{Tf}}$	$\overset{+}{\text{Sf}}$ Tc	$\overset{+}{\text{Tc}}$ Sf	Rrs $\overset{+}{\text{Css}}$	Rss $\overset{+}{\text{Crs}}$	$\overset{+}{\text{Crs}}$ Rss	$\overset{+}{\text{Crs}}$ Rss
2.	Tc Sf	Tf Sc	Tf Sc	Rss Crs	Css Rrs	Rrs Css	Css Rrs
3.	Sf Tc	Sc Tf	Sc Tf	Css Rrs	Crs Rss	Rss Crs	Rss Crs
4.	Sc Tf	Sf Tc	Tc Sf	Crs Rss	Rrs Css	Css Rrs	Rrs Css
5.	Tc Sf	Tf Sc	Tf Sc	Crs Rss	Rrs Css	Css Rrs	Rrs Css
6.	Tc Sf	Tf Sc	Tf Sc	Rrs Css	Rss Crs	Crs Rss	Crs Rss
7.	Tf Sc	Tc Sf	Sf Tc	Rss Crs	Css Rrs	Rrs Css	Css Rrs
8.	Sf Tc	Sc Tf	Sc Tf	Rss Crs	Css Rrs	Rrs Css	Css Rrs
9.	Sc Tf	Sf Tc	Tc Sf	Css Rrs	Crs Rss	Rss Crs	Rss Crs
10.	Sf Tc	Sc Tf	Sc Tf	Crs Rss	Rrs Css	Css Rrs	Rrs Css
11.	Tf Sc	Tc Sf	Sf Tc	Rrs Css	Rss Crs	Crs Rss	Crs Rss
12.	Tf Sc	Tc Sf	Sf Tc	Crs Rss	Crs Rss	Rss Crs	Rss Crs
13.	Sc Tf	Sf Tc	Tc Sf	Css Rrs	Crs Rss	Rss Crs	Rss Css
14.	Sc Tf	Sf Tc	Tc Sf	Rrs Css	Rss Crs	Crs Rss	Crs Rss
15.	Tf Sc	Tc Sf	Sf Tc	Crs Rss	Rrs Css	Css Rrs	Rrs Css
16.	Tc Sf	Tf Sc	Tf Sc	Css Rrs	Crs Rss	Rss Crs	Rss Crs

APPENDIX A (Continued)

	Tng	R-Form Test	R-Text Test	ID-Form Test	ID-Text Test	ED-Form Test	ED-Text Test
17.	Tc Sf	Tf Sc	Tf Sc	Rss Crs	Css Rrs	Rrs Css	Css Rrs
18.	Sc Tf	Sf Tc	Tc Sf	Rss Crs	Css Rrs	Rrs Css	Css Rrs
19.	Sf Tc	Sc Tf	Sc Tf	Rrs Css	Rss Crs	Crs Rss	Crs Rss
20.	Sf Tc	Sc Tf	Sc Tf	Crs Rss	Rrs Css	Css Rrs	Rrs Css
21.	Tc Sf	Tf Sc	Tf Sc	Crs Rss	Rrs Css	Css Rrs	Rrs Css
22.	Tf Sc	Tc Sf	Sf Tc	Css Rrs	Crs Rss	Rss Crs	Rss Crs
23.	Sf Tc	Sc Tf	Sc Tf	Rss Crs	Css Rrs	Rrs Css	Css Rrs
24.	Tf Sc	Sc Tf	Sc Tf	Rrs Css	Rss Crs	Crs Rss	Crs Rss
25.	Sc Tf	Sf Tc	Tc Sf	Rrs Css	Rss Crs	Crs Rss	Crs Rss

Cue reinforced dependent upon relevant condition - +
Form - Square (S), Triangle (T), Circle (C), Rectangle (R)
Texture - Felt (f), Corduroy (c), Rough Sandpaper (rs), Smooth Sandpaper (ss)

(Reinforced cues indicated on trial one remain relevant throughout all trials; first cue indicates left position and second cue the right position.)

APPENDIX B

ERRORS IN ORIGINAL LEARNING WITHIN A BLOCK OF 25 TRIALS

	Nonfamiliarization			Familiarization		
	R	ID	ED	R	ID	ED
	1	2	1	4	5	1
	5	2	3	1	1	5
Form	5	3	3	5	4	2
	5	4	2	5	2	0
	0	5	5	5	5	3
	5	4	5	5	1	0
	1	4	1	5	0	3
Texture	4	5	5	5	3	5
	1	0	5	2	4	1
	5	5	5	4	3	1

APPENDIX C

TRIAL OF LAST ERROR IN ORIGINAL LEARNING

	Nonfamiliarization			Familiarization		
	R	ID	ED	R	ID	ED
Form	1	2	5	17	15	6
	15	8	9	1	9	3
	14	16	4	9	16	21
	10	7	3	15	7	0
	0	11	14	11	12	10
Texture	16	6	16	11	1	0
	2	11	1	11	0	1
	6	11	15	8	9	17
	4	0	12	7	12	1
	21	17	11	10	8	8

APPENDIX D

ERRORS ON SHIFT WITHIN A BLOCK OF 25 TRIALS

	Nonfamiliarization			Familiarization		
	R	ID	ED	R	ID	ED
	10	2	6	12	0	5
	8	0	16	2	1	13
Form	6	0	12	3	1	10
	9	6	11	9	0	10
	0	6	12	10	4	16
	13	5	11	15	1	4
	1	1	4	6	1	16
Texture	5	3	9	17	8	2
	2	1	1	1	2	11
	9	2	9	1	4	13

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