Dimensional salience as a function of educational attainment and method of discrimination training¹

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The effects of three methods of selective-attention training with 4-sided forms on the salience of an invagination physical dimension in discrimination judgments with a stimulus domain of 12-sided forms were examined for 6-year-old Ss of low and high educational attainment. The results demonstrated that training procedures involving perceptual demonstration or manipulation increase the invagination dimension salience in the 12-sided stimulus domain more than a verbal training procedure for low educational attainment Ss. Implications for the psychophysical study of relatedness of stimulus domains are discussed.

Gibson (1963) proposed an attentional characteristic in perception that involves a searching for and a selection of specific properties of the stimulus object. Forsyth and Brown (1967) presented a methodology for determining the hierarchy of physical characteristics of a stimulus domain to which Ss selectively attend and reported the differential utility of three physical dimensions of a stimulus domain of four-sided random forms. The present study represents part of a larger project that has three primary objectives: (1) to determine the hierarchies of stimulus characteristics to which individuals attend for a variety of stimulus domains from random forms to faces, (2) to examine how these hierarchies change for different types of individuals as a function of exposure to different environmental conditions, and (3) to study the degree to which training to attend selectively to specific attributes of one stimulus domain affects the dimensions used for discrimination between objects of other stimulus domains. The third objective was the one of specific interest in this study.

The role of motor movement has repeatedly been emphasized in the study of perception and cognition. Held (1965) demonstrated the strength of the effects of self-produced movement on visual perception. Roach and Kephart (1966) suggested that successful development of concepts is based upon the earlier interrelated stages of motor movement and perceptual organization. Similarly,

Trabasso and Bower (1968) postulated a nonlinguistic attentional mediating hypothesis that the development of conceptual proficiency increases with discriminative experience with task-relevant dimensions. The importance of this active perceptual organization for educational attainment has been demonstrated by Gibson (1965) and by Elkind and Deblinger (1969). Thus, the present authors predicted that discrimination training that emphasized metron variability (Garner, 1962) in a specific physical dimension of a stimulus domain of 4-sided forms would result in a greater salience for that dimension in 12-sided form-recognition judgments by low educational attainment first-grade Ss when that training involved concrete or active demonstrations rather than a more abstract verbal description only. No similar increases in dimension salience were expected as a result of increasingly active and concrete training methods for high educational attainment Ss.

METHOD

Subjects

Sixty first-grade children served as Ss in this experiment. Thirty had been classified as high and the other 30 as low in educational attainment.

Materials

Stimuli for discrimination training were selected from a sample of 200 4-sided forms on the basis of the ranking of the forms on an invagination physical dimension that resulted from an R-technique factorization of 80 physical measures (Brown & Owen, 1967). Figure 1 illustrates this physical dimension. The two forms comprising the top pair both rank low on the invagination physical dimension, while the forms in the lower pair rank high and low, respectively, on that same stimulus characteristic. Stimuli for the discrimination-judgment task were selected on the basis of the ranking of the 12-sided forms on invagination, compactness, or x-axis areal asymmetry physical dimensions or factors of 80 measures taken on 200 12-sided random forms (Brown & Owen, 1967). These three

dimensions are demonstrated in the top, middle, and bottom pairs, respectively, in Fig. 2. The stimulus on the right of each pair ranked high on the selected dimension, and the stimulus on the left ranked low. Measures that correlated highly with the invagination factor reflected the degree of acuteness of some of the interior angles for both 4-sided and 12-sided forms.

Two jigsaw puzzles, which consisted of 10 pieces each, were used for instructional and motivational purposes. One puzzle was in the shape of a dog, the other a horse. The ability of children to complete both puzzles successfully, and the reward value of the puzzles, was demonstrated in an earlier study by Forsyth (1968).

Procedure and Design

The Ss were assigned to six groups defined by the factorial combination of the two levels of educational attainment and three discrimination-training procedures. Upon entering the experimental room, each S was told that we wanted to see how

Fig. 1. Example of pairs of four-sided forms used for training procedure.

Fig. 2. Illustrations of the invagination, compactness, and x-axis areal asymmetry in 12-sided forms.

children worked jigsaw puzzles and was asked if he would like to work one. After S had assembled the dog puzzle, the pieces of that puzzle were used to show how some pieces looked alike and others looked different from one another.

Discrimination-training procedure. S was shown two pairs of four-sided forms at a time and was asked to figure out which pair most children would judge as most different. A total of 25 pairings was presented to each S, wherein forms of one pair were alike and forms of the other pair different on the invagination characteristic (see Fig. 1). Under all training procedures, S was told that he was correct if he chose the pair with the greatest invagination difference. Ss in the verbal-training procedure were told that the high-low invagination pair was correct because one "puzzle piece" looked like it had been pushed in with a pencil and the other did not. The second procedure (demonstration) consisted of E making an invagination in Play Doh with a pencil along with the same verbal explanation given to the verbal-procedure Ss. The third procedure (manipulation) was the same as

the second except that S also manipulated the Play Doh with a pencil to make it invaginated. Ss were given the horse puzzle to assemble as promised after the 25th trial and were told that they could put together either the dog or the horse puzzle again after helping us with some new "puzzle pieces."

Discrimination-judgment task. This task involved showing two pairs of 12-sided forms at a time and asking S which pair of "puzzle pieces" he thought was most different. The same 36 trials were presented to all Ss; 12 trials consisted of pairings of high-low invagination pairs with either high-low compactness or x-axis areal asymmetry pairs. Figure 2 presents illustrations of these three dimensions. The remaining 24 buffer trials were comparisons of randomly selected pairs of 12-sided forms.

RESULTS

Table 1 presents the mean number of discrimination judgments on which the high-low invagination pair of forms was selected as most different for each of the experimental groups. The analysis of variance yielded a significant educational attainment main effect ($F = 5.67$, $df = 1/54$, $p < .05$); this reflects the mean high-low invagination pair judgments that were higher for the high educational attainment Ss (7.50) than they were for the low ones in educational attainment (6.28). A significant Educational Attainment by Training Method interaction ($F = 3.29$, $df = 2/54$, $p < .05$) qualifies the educational attainment effect. A test of simple main effects and Newman-Keuls procedure showed a significant effect on differences between training methods for the low educational attainment Ss. Specifically, Ss exposed to the verbal-training procedure gave fewer high-low invagination judgments on the discrimination-judgment task than did Ss exposed to the demonstration or manipulation training procedure. No significant simple main effect was obtained for differences between training conditions for the high educational attainment Ss.

An examination of performance on the training trials with four-sided forms indicated that all Ss consistently chose the high-low invagination pairs over the high-high or low-low invagination pairs during the last eight trials.

DISCUSSION

The similarity in performance by all groups during the last eight trials with the 4-sided forms indicated that differences in the discrimination-judgment task with the 12-sided forms were not a function of differences in perceptual learning (Gibson,

Table 1
Mean Number of Invagination Judgments

	Educational Low	Attainment High	
Verbal	4.50	7.50	6.00
Demonstration	6.83	7.67	7.25
Manipulation	7.50	7.33	7.42
	6.28	7.50	6.89

1965) with the 4-sided forms per se. Rather, the greater salience of the invagination dimension with the demonstration and manipulation compared with the verbal-training procedures for the low educational attainment Ss appeared to result from differences in perceptual transposition. This perceptual transposition is defined as responding to a new stimulus domain with perceptual responses learned under a different set of stimulus conditions or with a different stimulus domain. These results confirm Wohlwill's (1960) proposition that transposition involves "processes of a more complex order."

While no attempt was made to determine the level of logical thought for each S, the data suggest that the degree to which training to attend to specific attributes of one stimulus domain affects the dimensions used for discrimination between objects of other stimulus domains may depend upon the child's transition from a preoperational stage to one of concrete operations (Inhelder & Piaget, 1958). It is important to note here that results obtained with one set of stimulus domains are not necessarily generalizable to other sets. As Sigel (1964) points out, the utilization of concepts depends upon the degree to which stimulus objects possess properties readily accessible to perception in the normal environment. Thus, different results may obtain when examining the effects of training individuals to attend to specific physical dimensions of a stimulus domain of two-dimensional human-face pictures upon the ability to discriminate between three-dimensional representations of human faces. The description of the physical relatedness of stimulus domains and the conditions under which changes in dimensions attended to in one domain affect dimensions attended to in another are variables for future psychophysical research. This initial study suggests, however, that future designs should include psychometric information on a number of individual-difference variables as well as a variety of stimulus domains and training conditions.

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NOTES

1. This research was supported by Research Grant CURF-322 and by a summer fellowship from the University of New Hampshire Research Foundation.

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(Accepted for publication August 25, 1969.)