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DIMENSION PREFERENCE AND COMPONENT SELECTION: ALTERNATIVE MEASURES OF CHILDREN'S ATTENTION TO STIMULUS COMPONENTS

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Abstract

As children grow older they show an increasing preference for classifying objects on the basis of shape rather than color. To clarify the nature of this "dimension preference," children of ages 3½ to 6½ years were given a method of triads test of dimension preferences, followed (after a week's delay) by a component selection task (see Hale & Morgan, 1973).

The most notable results were these: (a) as expected, children below and above the median age differed in frequency of shape preference, (b) for children below the median age, higher component selection test scores were observed for the preferred dimension, although all scores were considerably above chance level and (c) no age difference was found in the relative magnitudes of the component selection scores. The results suggest that a "preference" for a particular dimension does not necessarily indicate a high degree of selective attention to that dimension. Also, the age difference in children's dimension preferences may be attributable to factors unrelated to selective attention.

DIMENSION PREFERENCE AND COMPONENT SELECTION: ALTERNATIVE MEASURES OF CHILDREN'S ATTENTION TO STIMULUS COMPONENTS[1]

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The question of whether children prefer to classify objects on the basis of shape or on the basis of color has been studied extensively with the "method-of-triads dimension preference test" (e.g., Brian & Goodenough, 1929; Corah, 1966; Harris, Schaller & Mitler, 1970; Suchman & Trabasso, 1966a). In this procedure, a child is shown three stimuli, two of which are identical in shape and two of which are identical in color, and is asked to indicate the two that are "the same" or "alike." The tendency for children to classify objects on the basis of shape rather than color in this task has been found to increase between about 3 and 9 years of age (see studies cited above). The method often has been cited as an index of attention (e.g., Brown, 1970; Corah, 1964; Seitz & Weir, 1971; Suchman & Trabasso, 1966b), and the developmental shift in response has been mentioned along with other evidence as suggesting a major change in children's cognition around age 5 or 6 (White, 1965).

While the reliability of this shift toward greater "preference" for shape is unquestionable, the effect may provide only limited information for understanding the development of attention in children. More important than the question "Which stimulus feature is dominant?" is the question "To what degree do children attend to each component of multi-faceted stimuli?" Since the dimension preference task forces a choice between two stimulus features as a basis for classifying stimuli, it cannot detect whether a child attends highly selectively to that stimulus component or whether his attention is nearly equally divided between features. A measure that is believed to address this issue more effectively is the component selection task described by Hale and Morgan (1973; see also Hale & Taweel, in press). In this task, a child learns the spatial positions of several stimuli that differ on two redundant dimensions--e.g., shape and color. His ability subsequently to identify the position of each shape and color reflects the degree of attention directed to each of these dimensions during learning. Thus, the measure not only indicates which of two dimensions is dominant but also reflects the degree to which one component can be considered dominant over the other (given the specific set of stimuli used).

To clarify the nature of the developmental shift in children's dimension preferences, the present study administered a component selection problem as well as a dimension preference task to children of 3½ to 6½ years of age. Two basic types of information were desired. First, examination of the scores separately for each preference group would determine whether children exercise a high degree of selective attention to their preferred dimension and would also determine whether this tendency is more characteristic of shape- than color-preference subjects. Second, comparison of the younger and older children's performance would indicate whether children exercise selective attention to their preferred dimension at all age levels or whether the degree of selectivity changes with age as well as the specific dimension chosen.

Method

Subjects

The total sample consisted of 74 children, 39 boys and 35 girls, ranging in age from 3.6 to 6.4 years. Dimension preference data were obtained for the 74 children (three other children in the available sample were eliminated for failure to follow instructions); only 58 of these subjects received the component selection task, as two of the children failed to follow instructions for this task and the remainder were unavailable for the second session. The larger proportion of the sample was white; 36% of the children below the median age of 4.8 years and 30% above the median age were black. The total sample was drawn from day care centers in a middle class area of Somerset County, New Jersey and a lower middle class section of Plainfield, New Jersey.

Dimension Preference Task

Materials. The stimuli were colored shapes approximately 7½ cm square, placed in triads on black sheets of paper with roughly 4 cm between stimuli. The shapes were square, circle, and triangle, and the colors were orange, yellow, and blue. Nine triads were constructed, and in each triad one pair of the stimuli were identical in shape but different in color, while another pair (including one stimulus from the first pair) were identical in color but different in shape. Each of the nine possible combinations of two shapes and two colors was represented. Across triads, the stimuli that matched on shape occurred equally often on the bottom, left and right sides of the triangular array; a similar constraint applied to color.

Procedure. The children were tested individually by a female experimenter (L. L.). All subjects received the dimension preference task first, with the component selection problem given seven to ten days later. For the dimension preference task the subject was seated at a table opposite the experimenter. Each of the nine triads was presented with the instruction, "Point to the two that are the same." In order to be classified as a shape (color) preference subject, the child had to match the stimuli on the basis of shape (color) at least six times. Those subjects who failed to do so were classified as inconsistent. The children seemed to have little difficulty in understanding the task, as all but 3 out of 77 children were able to follow the instructions.

Component Selection Task

Materials. The three basic stimuli in this task were composed of the colors and shapes used in the dimension preference test. The two dimensions were redundant, so that each of the shapes was associated with a different color (e.g., blue square, yellow triangle, orange circle). These stimuli were mounted individually on black cards, each 9 cm wide x 13 cm high. Also used in the task were white shapes on black cards and colored cards. The task was administered with the use of a plexiglas screen (11 cm high x 56 cm long) against which the cards could be rested.

Procedure. The subject was seated at a table across from the experimenter with the plexiglas screen before him. The task consisted of two parts, a learning phase and a test phase. At the beginning of the learning phase, three "display cards" containing the three basic stimuli were resting against the screen in a row, with the card backs facing the subject. These cards were turned around and the row exposed to the subject for five seconds, while the child was instructed to remember where each one was located. The display cards were then turned back around, and "cue cards," each identical to one of the display cards, were held above the center of the screen one by one.

As each cue was presented, the subject was asked to point to the display card that was just like that being shown. After the subject had made his choice each time, the experimenter indicated the correct answer by turning the correct display card and showing it briefly above its place on the screen. There were six cue cards arranged in two trials, a trial containing each of the three stimuli. Since two trials were given to all subjects, the current procedure differed from that used by Hale and Morgan (1973), in which subjects were trained to a criterion on the learning phase.

The test phase followed immediately upon completion of the two learning trials. The display cards remained in place against the screen, facing away from the subject and no further feedback was given. Six "test cards" were presented, each of which contained a white shape or a color, and the subject was required to indicate the display card with the same shape or color as on the test card. Each color and shape was presented, with the two components systematically intermixed across test trials. The number of correct responses was determined for each component separately, yielding a "shape score" and a "color score."

These test scores form the basis for inferring selectivity of attention. It is assumed that the amount of information retained about each of the two stimulus dimensions separately reflects the degree of attention focused on each component during learning. Thus if a subject obtains a high shape score and a relatively low color score, he has attended selectively to the first component. However, to the extent that he recalls information about both components, his attention has been less selective, as he has attended to both components in identifying the stimuli.

Results

Data for the dimension preference task alone were examined initially. The numbers of shape and color preference subjects were, respectively, 14 and 22 below the median age of 4.8 and 31 and 5 above the median age; two subjects below the median age were classified as inconsistent. (The younger shape and color preference subjects were distributed throughout the range from 3.6 to 4.8 years of age, so that the mean ages of these two groups--4.2 and 4.0 years, respectively--were not significantly different.) The difference between age groups in relative frequency of shape preference and color preference subjects was highly significant ($\chi^2(1) = 17.13$, $p < .001$), demonstrating the predicted shift toward greater preference for shape. A total of 13 out of 38 children below the median age responded to a single dimension on all nine triads, in contrast with 28 of 36 above the median age ($\chi^2(1) = 14.19$, $p < .001$).

Scores for the component selection task are presented in Table 1. For the younger subjects, the data are presented separately by dimension preference; one of the two inconsistent subjects was available for the component selection task but was excluded in order to simplify the analysis. As there were only four color-preference subjects in the older group, the data are presented for the preference groups combined, for comparison with the combined younger groups. (For the 26 older shape-preference subjects alone, the mean shape and color scores were 2.54 and 2.27; the numbers corresponding to the rows in the table marked S>C, S=C, S<C were, respectively, 10, 10 and 6.)

A particularly striking aspect of the data in Table 1 is that the shape scores were higher than the color scores for the young shape preference subjects, while the reverse was true for the young color preference subjects. In an analysis of variance for the younger children, with Preferred Dimension and

Component Score (shape vs. color) as factors, the interaction between these variables was found to be significant ($F(1,26) = 4.86$, $p < .05$) while no other effect reached significance. For both the shape and color preference subjects the mean shape score and the mean color score were significantly above chance (smallest $t(11) = 3.73$, $p < .01$).

Insert Table 1 about here

To examine age differences in the component selection scores, the preference groups were combined and an analysis of variance was performed with Age and Component Score as factors. Only the overall effect of Age was significant ($F(1,56) = 8.59$, $p < .01$), as the shape and color scores were both higher for the older than the younger subjects. It is notable that the shape-color comparison did not interact significantly with Age ($F<1$); thus, the difference between the shape and color scores was of roughly the same magnitude for children below and above the median age of 4.8 years.

Additional analyses of variance were performed comparable to those described above, but with Sex included as a third factor in one set of analyses and Race in another. No main effects or interactions involving either Sex or Race were significant. Data for the learning phase of the task were also examined. The young shape preference subjects had an average of 5.27 items correct (out of 6) in learning, while the young color preference subjects had a significantly lower average of 4.41 correct ($t(26) = 2.13$, $p < .05$). Overall, the younger children averaged 4.75 correct, which did not differ significantly from the average of 5.03 for the older children. For the second learning trial alone, 71% of the younger children and 77% of the older children had three correct responses (and all but one of the remainder had two correct responses), indicating that the children were generally mastering this task by the second trial.

Discussion

The dimension preference data once again demonstrate the reliability of the developmental trend toward a preference for classifying objects on the basis of shape rather than color. Despite the consistency of this finding, however, it is not entirely clear what a dimension "preference" signifies, with respect to measuring selective attention in children. Attentional factors are likely involved to some extent, since children's response to the method of triads test has been shown here and elsewhere to correspond to performance on other attention-related measures (e.g., Brown, 1970; Seitz & Weir, 1971; Suchman & Trabasso, 1966b; Trabasso, Stave, & Eichberg, 1969). In the present study, for example, the children's scores on the component selection test were higher for their preferred than their nonpreferred dimension, suggesting that the two tasks provide somewhat related information regarding dimensional dominance.

Even more striking, however, is the fact that there was by no means a one-to-one correspondence between the children's dimension preferences and the degree of dimensional dominance reflected in the component selection scores. As indicated in the frequencies at the bottom of Table 1, many subjects in both the color preference and shape preference groups obtained equal shape and color scores.[2] The scores for the nonpreferred dimension thus averaged considerably above chance, suggesting that a preference for a particular dimension does not necessarily mean that attention is exclusively directed to that component. Rather, children direct a reasonably high degree of attention to the nonpreferred as well as the preferred dimension when either or both components can be used to identify the stimuli in a learning task.

Thus, a dimension "preference" is clearly not just a simple attentional response. A similar conclusion is indicated in the learning data; shape and color-preference subjects not only differ in the particular stimulus feature on which they match stimuli, but they differ in learning ability as well (see also Brian & Goodenough, 1929; Brown, 1970; Trabasso, Stave, & Eichberg, 1969).

A particularly critical issue concerns the significance of developmental changes in children's dimension preferences. One might infer that children beyond age 5 devote a high degree of selective attention to shape, given the high proportion of these subjects matching stimuli on the basis of this component, and the great consistency with which each subject used shape rather than color as a basis for matching (84% of the older shape preference subjects responded on the basis of this component for all nine triads). The component selection scores, however, suggest that the relative amount of attention directed to these two features actually may not change markedly over this age period. As shown in Table 1, the relative magnitudes of the shape and color scores were roughly the same for younger and older subjects (combined preference groups). That is, although both scores increased with age, reflecting an increase in learning and retention of both types of information, the degree to which one component was dominant over the other did not change appreciably.[3] Apparently, a rather substantial number of subjects over age 5 attend to color as well as shape when these two dimensions are redundant.

The discrepancy in results is, of course, partly due to the use of a classification task in one case and a learning situation in the other, and in this respect neither task can be regarded as a more valid general measure of attention than the other. Yet there are reasons to believe that the component selection data more accurately reflect developmental changes in the way children naturally deploy attention with multi-faceted stimuli. Consider first the nature of the dimension preference response and the older child's approach to the task. When told to indicate the two stimuli that were the same, several of the older subjects asked questions of the type "Do you mean the same color or the same shape?" Then when the instructions were repeated they typically pointed to the two of the same shape. Many older children apparently recognize the possibility of color matching but interpret the instructions to require shape matching. The older child's response is thus determined, to some extent, by the cognitive operations involved in interpreting the task demands, regardless of his natural disposition to attend to one stimulus feature or the other.

In the component selection task, on the other hand, the dimensions are redundant, so that either or both components can be used as a functional cue, and the child is in no way forced to choose between two dimensions. Rather, he is left free to identify the stimuli according to his natural inclination--on the basis of shape, on the basis of color, or on the basis of both components in combination. Age differences observed with this measure, then, are more likely to represent developmental changes in children's typical approach to multidimensional stimuli. That the component scores maintained their same relative magnitudes across age levels suggests that, in fact, the degree to which children attend to shape rather than color may actually remain relatively constant over the period from 4 to 6 years of age.

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Footnotes

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[2]In the shape preference groups, 2 subjects had a score of 3 for both components, 3 subjects had 2 and no subjects had 1; for color preference the comparable frequencies were 1, 7, and 1.

[3]The frequencies for the shape preference subjects alone were 10, 10, and 6; for 9 of the 11 subjects in the row marked S>C the shape score was only one point higher than the color score.

Table 1

Component Selection Test Scores

	Younger Subjects			Older Subjects
	Shape Preference Subjects	Color Preference Subjects	Combined Groups	Combined Groups
Shape Score				
X	2.55	1.82	2.11	2.57
SD	(.52)	(.64)	(.69)	(.63)
Color Score				
X	2.00	2.06	2.04	2.33
SD	(.89)	(.66)	(.74)	(.71)
N[a]	11	17	28	30
S>C[b]	5	2	7	11
S=C	5	9	14	12
S<C	1	6	7	7

[a]Due to attrition these *N*s are smaller than the numbers of subjects given the dimension preference task alone.

[b]Number of subjects for whom the shape score exceeded the color score; analogously, S=C and S<C, respectively, represent the numbers whose shape scores were equal to, or less than, the color score.