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ABSTRACT

To investigate two measures which have been used to assess children's attention to stimulus dimensions, component selection, and dimension preference, both measures were administered to 38 3 1/2 to 5-year-olds and 20 5- to 6 1/2-year-olds. Seven to ten days after the dimension preference task was given, the component selection measure was administered using the stimuli of the dimension preference task. Results indicate: (1) a developmental increase in the proportion of judgments made on the basis of form rather than color on the dimension preference measure, (2) no significant difference in the performance of the two age groups on the component selection task, and (3) within the younger group, a significant relation between component selection and dimension preference performance, with subjects showing higher component selection scores on their preferred dimension. The effect of experimental context on the child's deployment of attention is discussed. (Author/SET)

DIMENSION PREFERENCE AND COMPONENT SELECTION: A COMPARISON OF ALTERNATIVE METHODS FOR MEASURING CHILDREN'S ATTENTION TO STIMULUS ATTRIBUTES

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Abstract

Two measures which have been used to assess children's attention to stimulus dimensions, component selection and dimension preference, have produced conflicting results with different developmental implications. To investigate this discrepancy both measures were administered to 38 3½- to 5-year-olds and 20 5- to 6½-year-olds. Seven to ten days after the dimension preference task was given the component selection measure was administered using the stimuli of the dimension preference task. Results indicate: (a) a developmental increase in the proportion of judgments made on the basis of form rather than color on the dimension preference measure, (b) no significant difference in the performance of the two age groups on the component selection task, and (c) within the younger group, a significant relation between component selection and dimension preference performance, with subjects showing higher component selection scores on their preferred dimension. The effect of experimental context on the child's deployment of attention is discussed.

An important aspect of children's learning is the manner in which the child attends to the multiple attributes of complex stimuli. Two measures which have been used to investigate this issue, dimension preference (Suchman and Trabasso, 1966), and component selection (Hale and Morgan, in press), have obtained conflicting results with markedly different developmental implications. In the typical dimension preference task, the child is given stimulus objects varying in value on two or more dimensions, such as color and shape, and is required to indicate which ones "go together" or are "the same." The tendency to use form rather than color as a basis for "sameness" judgements has been shown to increase with age between 4 and 8 years (Brian and Goodenough, 1929; Corah, 1964; Suchman and Trabasso, 1966). In the component selection measure a child performs a learning task with stimuli differing on two or more redundant dimensions. Following this phase a test of his memory for information about each of the dimensions reflects the relative degree to which attention was directed to those dimensions during learning. Research conducted with this measure using colored shapes as stimuli (Hale and Morgan, in press) has indicated that between ages four and eight children attend increasingly to color while maintaining a even higher degree of attention to shape, in contrast to the decrease in relative attention to color shown in studies of dimension preference. While each of these tasks is designed to measure the relative amount of attention directed to stimulus dimensions such as shape and color, the conflicting results obtained by these two approaches suggest different interpretations of how the child's attention deployment changes with age.

In an attempt to resolve this conflict the present study compared these two procedures directly. Children were given a dimension preference task using colored shapes and a component selection task using the same stimuli was administered a week later. Children of ages 3½ to 6½ years were divided into two age groups. Developmental differences in performance on both tasks and the relation between performance on the two tasks were examined.

Method

Subjects

The study included a total sample of 78 children, 38 males and 40 females, with 52 children from 3½ to 5 years of age and 26 between 5 and 6½ years of age (mean ages 50.3 and 67.6 months). Dimension preference scores were obtained for [illegible]4 children. Sixty of these subjects received the component selection task, as two of the children were eliminated for failure to follow instructions on the component selection task; the remainder were unavailable for the second session. The larger proportion of the sample was white; 16 of the younger and 7 of the older children 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 25 cm x 35 cm, with roughly 4 cm between stimuli. The shapes used were square, circle, and triangle; the colors were orange, yellow, and blue. There were nine sheets, each containing a triad of three stimuli. In each triad one pair of the stimuli was identical in shape but different in color, while another pair (which included one stimulus from the first pair) was identical in color but different in shape. The positions of these stimulus pairs were systematically varied across trials so that the bottom, left, and right sides of the triad occurred equally often. The order of trials was randomized with the constraint that no particular shape or color combination occurred more than twice in succession.

Procedure. The children were seen individually in the testing room by the same female experimenter. All subjects received the dimension preference task first, with the component selection session given seven to ten days later. After agreeing to participate in the dimension preference task, the subject was seated at a table opposite the experimenter. The child was told there were "some things for you to look at". Each subject received nine trials 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 make at least six "same" responses based on the shape (color) dimension. Those subjects who did not do so were classified as inconsistent. Even the youngest children seemed to have little difficulty in understanding the task; only three subjects (all in the young group) were eliminated from the study for failure to follow instructions in the dimension preference task.

Component Selection Task

Materials. The stimuli were constructed using the same colors and shapes as those in the dimension preference task. Here, each colored shape was mounted individually on a black card 9 cm x 13 cm. The primary stimuli in the task for each subject were three cards selected so that all three colors and shapes were represented, e.g., blue square, yellow triangle, orange circle. Also used in the task were white shapes on black cards and colored cards, all 9 cm x 13 cm. The task was administered with the use of a plexiglas screen (11 cm high x 67 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. At the beginning of the first phase of the task, the learning phase, three "display cards", each containing a colored shape, were resting against the screen with card backs facing the subject. As the display cards were turned around and the row exposed to the subject for five seconds, the child was instructed to look at the cards carefully and remember where each was located. The three display cards were then turned back around and "cue cards", each identical to one of the display cards, were then presented one by one above the center of the screen. As each cue card was presented the subject was asked to point to the display card that was just like the cue card being shown. After each choice the subject was shown the correct answer by the experimenter who turned the correct card and held it briefly above its position in the row. In the learning phase there were six cue cards, two for each of the three stimuli, and these cards were arranged in two trial blocks, a block containing one of each of the three stimuli.

A test phase followed immediately upon completion of the six 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 told to point to the display card which had the same shape (or color) as the card shown. Each color and shape was presented once in the six test trials.

Two distinct sets of stimuli were constructed (designated set A and set B). These differed in the following aspects, which were confounded with each other: (a) the particular shape-color combinations of the display and cue cards, e.g., set A, blue square, yellow triangle, orange circle; set B, yellow square, orange triangle, blue circle; (b) the spatial positions of the display cards; (c) the order of presentation of both cue and test cards. Roughly half of the subjects within each of the dimension preference subgroups (shape and color preference subjects) received set A, the other set B.

The number of correct responses during the test phase was tallied for each component separately, yielding a shape and color score for each subject. These scores form the basis for inferences regarding the operation of selective attention during the component selection task. It is assumed that the amount of information retained about each of the two stimulus dimensions separately (as reflected in the shape and color scores) indicates the degree to which attention has been focused on each component during learning. For example, a subject who obtains a high shape score and a relatively low color score has presumably used information primarily from the first dimension in learning the task, while making little use of the information from the second dimension. The current procedure differed from that used by Hale and Morgan (in press) in that the subjects were not required to learn to criterion prior to the test phase.

Results

The dimension preference data were analyzed with respect to age and unidimensional preference of the subjects. A subject was classified as unidimensional if he matched on the basis of one dimension in at least six of the nine preference trials. Only two of the 74 subjects for whom dimension preference scores were obtained did not meet this criterion (both subjects were in the young group); these two inconsistent subjects were excluded from further analysis. The number of shape and color preference subjects were, respectively, 22 and 24 at age 3½ to 5 and 23 and 3 at age 5 to 6½. To determine whether the proportion of subjects preferring shape over color in the older group was greater than in the younger group, a X^2 analysis was performed. The obtained X^2 of 11.71 (df=1, $p<.01$) was significant, consistent with the results of other studies which have shown an increase with age in the proportion of choices made on the basis of form, e.g., Brian and Goodenough, 1929; Corah, 1964; Suchman and Trabasso, 1966.

The component selection performance of the two age groups was also compared; for this analysis the color and form preference subjects were combined at each age level (see Table 1). To determine whether the relative amounts of shape and

Insert Table 1 about here

color information used in component selection performance differed for the two age groups an unweighted means analysis of variance was performed with age and sex a between-subject factors and shape vs. color score as a within-subject factor. The results were not significant (F (1,54)=1.83, $p>.10$ one tailed test), indicating no difference in the component selection performance of the two age groups. There were no significant sex differences in component selection performance. An additional analysis of variance was performed, analogous to that described above, with race of subject as an independent variable in place of sex. This analysis indicated no race differences in component selection nor any significant interactions involving race.

Due to the fact that performance on dimension preference divided the younger children into nearly equal numbers of shape and color preference subjects it was possible to investigate the relation between component selection and dimension preference tasks for the 3½- to 5-year-olds (see Table 1). An unweighted means analysis of variance was performed on the component selection test scores, with dimension preference and sex as between-subject factors and component score (shape vs. color) as a within-subject factor. The interatcion between dimension preference and component selection score was significant (F (1,34)=3.89, p<.05, 1-tailed test). No main effects reached significance. Thus, both preference groups showed higher component selection test scores on their preferred dimension.

Discussion

Performance on the dimension preference task differed markedly for the two age groups with the older subjects making a significantly greater proportion of their judgments on the basis of form. In contrast, the relative magnitude of shape and color scores on the component selection task remained constant across the two age groups, even though the absolute magnitude of the component selection scores showed an expected but non-significant increase with age. Both tasks have been devised to measure children's attention to stimulus attributes yet they have produced conflicting results with different developmental implications. While the dimension preference data imply a shift toward greater attention to the shapes of objects and lesser attention to their color, the component selection results suggest that the relative degree of attention directed to the two components changes little during the four to six year age range. Clearly, these two measures are tapping somewhat different attentional processes.

The conflicting results obtained with these two measures may be partially attributable to differences in that which is necessary (and that which the child interprets as necessary) for successful performance in two different experimental situations. In component selection, either or both dimensions can be selected for use in a learning task and the task does not demand that the subject consciously select a single dimension. The measure reflects the degree of attention the subject naturally directs to each component as he learns. The demands of dimension preference are quite different. No learning is involved and the child is asked to select a single dimension for use in classifying the stimuli. The inference is made that the subject has attended primarily to the dimension which he has used in making his judgments of "sameness". It is possible that the processes involved in performing the dimension preference task differ for children over and under five years of age. For the younger child, selection of a dimension may be based on the immediate perceptual salience of the stimulus components, while the older child's performance may be increasingly affected by his interpretations of task demands and the plans and strategies he generates in an attempt to perform successfully. Nearly all of the older children in the present study (and presumably in other dimension preference studies as well) had some school experience and thus a history of exposure to situations in which shape defines "thingness", e.g., alphabet learning, and may have interpreted the task as one which required a response to the shape dimension. Dimension preference performance thus may change with age not because of a change in the relative amount of attention a child naturally directs to shape and color dimensions but because the child begins to respond in the manner he thinks the experimenter wants him to.

Anectdotal evidence obtained from the verbal responses of the older children in the present study lend support to this interpretation. In the total sample, 39 of the 74 subjects made all their judgments on the basis of one dimension even though several of the older subjects asked questions of the form, "Do you mean the same color or the same shape?", suggesting that at least some of the older children were not responding spontaneously to differential salience of stimulus components. This evidence also suggests that consistency of response may not be an adequate measure of strength of preference, particularly for older children. Even in cases where both dimensions were verbalized the older subjects still made "sameness" judgments consistently in terms of one dimension. The initial response on the first trial was often used throughout all subsequent trials despite precautions taken by the experimenter to avoid reinforcing any preference response.

While the dimension preference and component selection tasks produced different developmental results, the relation between the two measures for the younger children suggests that, at least for 3½- to 5-year-olds, these two tasks are tapping similar processes. Subjects who "prefer" shape show a pattern of relatively higher shape than color scores on component selection, while those "preferring" color obtained relatively higher color than shape scores. It has been argued that for the older child, the dimension preference response involves a complex decision and is not solely determined by the degree to which the child would naturally direct his attention to each of two components. However, for the younger child, the matching or categorizing of stimuli apparently does reflect, to some degree, the way in which attention is naturally deployed in a learning task. Spontaneous attention to stimulus components is apparently being measured here, with each child differentiating among the stimuli in both tasks in the manner that seems most natural to him. As the child grows older, his preference judgments become less indicative of his spontaneous attention to stimulus components. This interpretation is consonant with the suggestion made by several investigators that children become increasingly active processors of information as they mature. White (1965) has reviewed a large amount of research (including the color to form dimension preference shift) suggesting a major cognitive reorganization at about age five.

Component selection assesses attention in a learning task, and the child's test scores form the basis for inferences about attention to stimulus components. In dimension preference, however, inferences about attention to components of a complex stimulus are based on judgments which are supposed to be an indication of the child's perceptual response to differentially salient stimulus dimensions. The ability to classify stimuli, not learning, is of interest in assessing dimension preference. Attention is often defined as the selection of stimulus attributes which are relevant to the task at hand (Moray, 1970). In evaluating component selection and dimension preference as measures of attention, the phrase "task at hand" is critical, for attention cannot be measured independent of an experimental context. Different contexts, e.g., learning in component selection, classification of stimuli in the dimension preference task, impose different task demands on the subject. In investigating attention as an important aspect of children's learning, component selection appears to be a more valid measure of attention than dimension preference because it attempts to measure the child's disposition to attend to stimulus components within the context of the learning "task at hand".

For the child under about five years, differing task demands do not seem to be well understood and the two measures, despite their different contexts and demands, produce consonant results. The conflicting results obtained from the performance of the older group on the two tasks may be an indication that for the older child, his attempts to adapt successfully to task demands come to have a powerful effect on the manner in which he deploys attention to components of a complex stimulus.

Table 1

Mean Component Selection Scores for Shape and Color Preference Subjects at Each Age Level (Standard Deviations in Parentheses)

	3½-to 5-Year-Olds			5- to 6½-Year-Olds
	Shape Preference Subjects	Color Preference Subjects	Combined Groups	Combined Groups
Shape Score	2.42 (.69)	1.89 (.66)	2.16 (.72)	2.70 (.47)
Color Score	2.04 (.71)	2.11 (.66)	2.08 (.67)	2.40 (.82)
N*	19	19	38	20

*Due to attrition these Ns are smaller than those presented for the dimension preference task. Inconsistent subjects were also omitted from this analysis.

FOOTNOTE

1. This research was conducted while the author was a fellow at the Educational Testing Service, Princeton, New Jersey. The author wishes to thank Dr. Gordon Hale for his assistance throughout the study. My thanks also to the Somerset County Day Care Center and the Plainfield Day Care Center for their cooperation and participation in the study.