DEVELOPMENTAL CHANGES IN CONCEPTUAL AND COLOR CLUSTERING IN YOUNG CHILDREN

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Two experiments were performed to examine the developmental changes in clustering criteria, using preschool children as subjects. The subjects were required to memorize the materials which were selected so as to be classifiable on the basis of conceptual categories or color categories. The results of Experiment I indicated that conceptual clustering increased with age while color clustering tended to decrease with age. The results of Experiment II, however, indicated that both conceptual and color clustering increased with age when the subjects were induced to employ categorizing strategy. These results were discussed in terms of three variables: spontaneous use of categorizing strategy, effective use of categorizing strategy, and developmental changes in clustering criteria.

A number of studies have demonstrated that when subjects are presented with a randomized list of words from several different categories (e.g., animal, fruit), the subjects tend to recall consecutively the words that belong to the same category. This phenomenon is referred to as clustering. Using such a procedure, investigators have generally found an increase in the amount of clustering with age (Mandler & Stephens, 1967; Rossi, 1964; Vaughan, 1968). Such results have led to the general conclusion that young children are deficient in their ability to organize stimulus input. However, it could be argued that the clustering criteria change with age and that the apparent improvement in clustering with age is simply a reflection of the children's acquisition of more adult-like way of categorizing. Evidence from a variety of sources suggests that the bases for cognitive organization change with age. For example, the bases for matching stimuli (e.g., Odom, 1972; Odom & Guzman, 1972) and the bases for sorting stimuli (e.g., Kagan, Moss, & Siegel, 1963; Liberty & Ornstein, 1973) have been reported to change with age. A fairly consistent developmental change observed in these studies is a change from categories based on perceptual features of stimuli to categories based on conceptual features of stimuli. Theoretical positions (Bruner, 1966; Inhelder & Piaget, 1964) also suggest that the general dimensions along which age-related changes in representation occur may be conceptualized as perceptual on the one hand, and conceptual on the other hand. The
initial stages in the construction of a stable representation of the environment may thus be characterized by the dominance of perceptual features such as color and form. Only with growing symbolic and language skills do children begin to focus on conceptual features of the environment. Thus, it seems reasonable to hypothesize that the relative dominance of either one of these two dimensions would be reflected in clustering performance in free recall.

Using pictures classifiable on the basis of either conceptual categories or color categories, Bousfield, Esterson, and Whitmarsh (1958) tested the hypothesis that an interaction between clustering criteria and age should be obtained with younger children clustering more on the basis of color categories and older children clustering more on the basis of conceptual categories. However, they failed to find the developmental changes in clustering criteria. One possible reason for their obtaining negative results is that they employed third and fourth grade children as subjects. There remains a possibility that most pronounced developmental changes in clustering criteria might occur by the third grade level, the starting level in their study. The purpose of Experiment I was, therefore, to examine the developmental changes in clustering criteria by using preschool children as subjects.

**Experiment I**

**Method**

**Subjects.** The subjects were 64 preschool children divided into four groups with mean CAs of 3: 9, 4: 7, 5: 8, and 6: 7.

**Materials.** Sixteen pictures of familiar objects were used as stimuli. These pictures were selected so as to be classifiable in conceptual categories (animal, vehicle, food, and clothing) and also in color categories (red, green, white, and yellow), and were colored with the same pigment for all pictures in the same color category.

**Procedure.** The experiment was performed individually with each subject. All subjects were given three free recall trials on the set of 16 pictures. The subject was told that the experimenter was going to show him some pictures, one at a time, and that he was to look at the pictures and try to remember as many as he could. The pictures were presented one by one for 3 s each in a random order. The subject was asked to name each picture. When, on occasion, a subject was unable to identify a picture or labeled a picture with a name other than that intended by the experimenter, the experimenter provided the correct label. After 16 pictures were presented, the subject was asked to recall the pictures in any order in a 1-min recall period. Recall was made orally and was recorded in writing by experimenter. This procedure was repeated until the subject completed a total of three trials.

**Results**

**Organization.** The adjusted ratio of clustering (ARC) score introduced by Roenker, Thompson, and Brown (1971) was used as measure of clustering, in which chance clustering is set at zero and perfect clustering at one. Two ARC

![Fig. 1. Mean ARC scores for color and conceptual clustering as a function of age.](image-url)
scores were obtained for each subject: One for conceptual clustering and the other for color clustering. Since no significant difference was found as a function of trials, ARC scores for three trials were combined. Means of the two ARC scores as a function of age are shown separately in Fig. 1. A two-way analysis of variance of the ARC score yielded significant main effect of Clustering Criteria and significant Age × Clustering Criteria interaction ($F = 10.73$, $df = 1/60$, $p < .01$; $F = 3.41$, $df = 3/60$, $p < .05$, respectively). However, main effect of Age was not statistically significant. Thus, ARC score for conceptual clustering was higher than ARC score for color clustering. The interaction of Age × Clustering Criteria reflects the tendency for older children to organize materials based on conceptual categories rather than based on color categories as compared with younger children. Analysis of variance performed on ARC score for conceptual clustering revealed significant main effects of Age ($F = 2.90$, $df = 3/60$, $p < .05$). Analysis of variance performed on ARC score for color clustering also yielded marginally significant effects of Age ($F = 2.24$, $df = 3/60$, $p < .10$).

Recall. Mean number of words recalled as a function of age is shown in Fig. 2. As is evident from the figure, mean number of words recalled increased as a function of age ($F = 7.30$, $df = 3/60$, $p < .01$).

Discussion

The results indicated that conceptual clustering increased with age whereas color clustering tended to decrease with age. These results support the hypothesis that the younger children cluster with different criteria from those used by older children and that the apparent improvement with age simply reflects the children's acquisition of more adult-like ways of categorizing (Gerjuoy & Spitz, 1966; Nelson, 1969). It should be noted, however, that the results obtained in Experiment I do not rule out the hypothesis that the younger children's low level of clustering is due to inability to use categorizing strategy spontaneously. It has been found that children as young as 3 years of age organize their recall, and their recall and its organization increase when blocked lists of category items are presented. (Mori & Miyazaki, 1975; Rossi & Rossi, 1965). One of the methods to evaluate these alternative hypotheses is to employ the condition that the subjects are induced to use categorizing strategy. If the same trends were replicated under such a constrained condition, the increase in clustering with age can not be attributed to the development in spontaneous use of categorizing strategy. The purpose of Experiment II was, therefore, to investigate the developmental changes in clustering criteria under the condition that the subjects were induced to organize, being required to sort the pictures on the basis of color categories or conceptual categories, and being provided with the names of color categories or those of conceptual categories as retrieval cues.

![Fig. 2. Mean number of words recalled as a function of age.](image-url)
EXPERIMENT II

Method

Subjects. The subjects were preschool children divided into 3 groups with mean CAs of 3:7, 4:7, 5:7. Each of these age groups was further divided into two subgroups of 14 subjects each: a conceptual category group and a color category group.

Materials. The stimulus materials were the same as those used in Experiment I.

Procedure. The experiment was performed individually with each subject. The subject was shown the pictures successively one by one for 3 s each in a random order. After the full set of items was placed on the table in a random arrangement, the subject was instructed to sort the pictures into categories and memorize them. The subjects in the conceptual category condition were required to sort pictures on the basis of conceptual categories, while the subjects in the color category condition on the basis of color categories. The subject was allowed 3 min for sorting and memorizing the pictures. Immediately following the acquisition period, a 1-min recall test was administered to each subject. The subjects in the conceptual category condition were provided with the names of conceptual categories as retrieval cues, while the subjects in the color category condition the names of color categories.

Results

Organization. ARC score was used as measure of clustering. For each condition, two ARC scores were calculated on the basis of conceptual categories (conceptual clustering) and color categories (color clustering). Figure 3 shows mean ARC scores as a function of age and experimental condition. The crucial data to note in Fig. 3 is that both color clustering for color category condition and conceptual clustering for conceptual category condition increased with age and that conceptual clustering was higher than color clustering in all age levels. A two-way analysis of variance for these data revealed significant main effects for two factors: Ages ($F=20.39, df=2/78, p<.01$) and Experimental Conditions ($F=34.02, df=1/78, p<.01$). The interaction of Ages x Experimental Conditions, however, was not statistically significant ($F<1$).
Recall. Figure 4 presents mean number of words recalled as a function of age and experimental group. An analysis of variance yielded significant main effects of Ages ($F=26.44$, $df=2/78$, $p<.01$) and Experimental Conditions ($F=28.50$, $df=1/78$, $p<.01$), indicating increased recall with age and higher level of recall with conceptual category condition.

Discussion

The purpose of Experiment II was to investigate whether increase in clustering with age is due to the changes in clustering criteria or development in spontaneous use of categorizing strategy. The results indicated that both conceptual clustering and color clustering increased with age, but interaction of Ages x Experimental Conditions was not statistically significant. If the increase in clustering is due to the criteria changes, Ages x Experimental Conditions interaction should be obtained. Also, the finding that the conceptual clustering for conceptual category condition was higher than the color clustering for color category condition in all age levels is inconsistent with the criteria change interpretation. Furthermore, it should be noted that both conceptual clustering and color clustering were higher in Experiment II than in Experiment I. These results suggest that young children could not use the categorizing strategy spontaneously. The results of Experiment II, therefore, do not support the interpretation which attributes the increase in clustering with age: (1) spontaneous use of categorizing strategy, (2) effective use of categorizing strategy, and (3) criteria changes in clustering. Developmental studies of organization would be improved if the relationships between these factors were elucidated.

In summary, the present study suggested that the following factors should be taken into consideration in order to explain the increase in clustering with age: (1) spontaneous use of categorizing strategy, (2) effective use of categorizing strategy, and (3) criteria changes in clustering. Developmental studies of organization would be improved if the relationships between these factors were elucidated.

References


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