for very short lengths the illusion is reduced. (An obvious instance is the zero illusion when the inducing lines have zero length.) In the case of a single slanted line, perceived orientation is independent of the line length for lengths greater than about 1 deg of visual angle (Bouma & Andriessen, 1968).

The difficulty encountered by the centration theory in specifying the features of the stimuli which are responsible for controlling the S's attention illustrates the major weakness of the theory. Piaget (1969) does not elaborate on the possible "systematic reasons" for one region of a stimulus figure to receive more centration than another. As Over (1968) notes, the centration theory specifies attentional processes in terms of their consequences rather than in terms of their initiating conditions.

There is some evidence, however, that the centers of acute angles do act as a stimulus to fixation. Kaufman & Richards (1969) found a definite tendency for Ss to fixate the center of acute angles in relation to a 90-deg angle, especially for angles of 20 deg. Although the center of fixation may not always correspond to the focus of attention (Pritchard, 1958), the conventional view is that the perception determines the eye movement (Yarbus, 1967). It is likely that the scanning operations of the eye are related to central attentional processes and that the latter contribute to the perceptual distortion of acute angles.

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Word sorting and free recall*

GEORGE W. McCONKIE and BRUCE R. DUNN
Department of Education, Cornell University, Ithaca, N.Y. 14850

Using Mandler's word sorting task, the effect of a possible experimental artifact which might account for the relation between the number of categories used and recall was investigated. When Ss sort into more piles, more cards are exposed to view, giving Ss the opportunity to scan more words. If scanning is analogous to repetition of the individual words, increased recall could be due to increased exposure to the words rather than to the use of more categories. No difference in the category-recall function was obtained between Ss who were and who were not allowed to see the top cards in the piles. These results suggest that repetition per se is not the cause of increased recall with more categories.

Recently, Mandler (1967, 1968; Mandler & Pearlstone, 1966) introduced a new method for exploring the relationship between Ss' organization of a set of words and the number of those words they can then recall. Typically, S is required to sort cards, each bearing a single word, into piles (categories) of related items. He is allowed to sort the words into two to seven piles, using any category system he wishes other than such arbitrary criteria as the number of letters, initial letters of the words, etc. Successive trials are given until he reaches some criterion of consistency in his sorting. Experiments utilizing this task have consistently found strong positive linear relationships between the number of piles used in sorting (NC, or number of categories) and the number of words recalled (R).

Mandler's research appears to support the position that the way a person organizes information in learning influences his ability to recall it later. It also provides a method for further analysis of this relationship. However, it is important to make sure that the relationship obtained between

NC and R is, in fact, caused by the effect of organization on recall and not due to some artifact of the experimental task. Mandler has examined several of these possible alternative explanations. He reports that Ss sorting into different numbers of piles do not differ in the number of trials or in sorting time required to reach criterion in the task and that the relationship is still obtained when number of trials and time are held statistically constant. He also obtains the relation between NC and R when Ss are assigned randomly the number of categories they are to use in sorting, thus excluding the possibility that individual differences produce this relation. In fact, a later study (Mandler, 1968) found the same relation in data obtained by repeated testing of individual Ss, varying the number of categories they were asked to use on different lists.

The present study was designed primarily to determine if another aspect of the sorting task, the number of words exposed to S at any one time during sorting, could account for the NC-R relationship. It also provides further data on the relation of sorting time to NC and R. In carrying out the sorting task, cards are placed face up on the piles. As S decides where to

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Fig. 1. Mean recall as a function of sorting condition.

place each card, he likely scans the top card of each pile before him. Ss using more piles in sorting will tend to see each word more times during the task. If seeing a word can be viewed as a repetition of that word, then the total amount of learning produced would increase with the number of piles used in the sorting task. This could account for the relationship between NC and R, without resorting to a hypothesized relationship between organization and memory. The present study tests this alternative explanation of Mandler's results by having some Ss turn their cards upside down when they place them on the piles. In this way, an S is able to see only the word he is sorting at any one time. If the relationship between NC and R were obtained in this facedown sorting condition, the repetition explanation would be discounted.

METHOD

Sixty nouns were selected at random from a list of words having a frequency of occurrence in written English of 50 to 100 per million (Thorndike & Lorge, 1944). Each word was typed on a separate 3 x 5 in. card, thus producing the card deck to be sorted.

Half the Ss (Group FU) were instructed to place the cards face up in the sorting task, as Mandler has done in his studies. The remaining Ss (Group FD) were instructed to place the cards face down on the piles so that once a word was sorted it could no longer be seen. Within each group, an equal number of Ss was instructed to sort into two, four, and six piles. This resulted in a 2 by 3 experimental design. Sixty Ss participated, all students in an introductory psychology class at Cornell University. Thus, there were 10 Ss in each of the six experimental conditions.

The procedure was similar to that

used by Mandler (1968). Each S was given the cards and instructed to sort them into a particular number of piles of meaningfully related words. He was told not to sort on the basis of such physical features as the first letter or the number of letters in a word and was not allowed to move a card once placed or to shuffle back through cards already sorted. After each sorting trial, he was given a new pack of cards arranged in a different order and asked to sort them again. He was instructed that these sorting trials would continue until he placed all but two of the cards into the same piles he had on the immediately preceding trial and was informed that he would be asked to recall the words after reaching this criterion. In the recall test, the S was asked to write down as many of the words as he could in any order he wished. Ss were encouraged to continue recalling until they reported that they could recall no more.

RESULTS AND DISCUSSION

The average number of words recalled correctly in each condition is shown in Fig. 1. A two-way analysis of variance indicates that the only significant effect resulted from the number of piles used in sorting [$F(2,54) = 10.73$, $p < .001$]. Neither the sorting condition effect [$F(1,54) = .56$] nor the Sorting Condition by Number of Categories interaction [$F(2,54) = .99$] approached significance.

A similar analysis of variance was employed to test differences among the conditions in the number of trials required to reach the sorting criterion. Both main effects were significant, sorting condition [$F(1,54) = 7.22$, $p < .01$] and number of categories [$F(2,54) = 7.53$, $p < .01$]. The interaction was not significant [$F(2,54) = 1.79$]. Thus, the FD

condition required more trials than the FU condition (4.1 trials vs 3.2 trials) and the two-pile conditions required fewer trials than the four- or six-pile conditions (2.80, 4.35, and 3.90 trials, respectively). Data on actual time required to reach sorting criterion showed much the same pattern and are not reported here.

The results of these analyses clearly indicate that the relationship between NC and R obtained by Mandler does not result from Ss' seeing the words more frequently when more piles are used in sorting. This relationship was found under both the face-down and face-up conditions. It is of interest that although the face-down condition required more trials to reach criterion, it did not differ from the face-up condition in number of words recalled. A similar result was reported by Mandler & Pearlstone (1966) in a study in which some Ss learned to sort the cards into exactly the same piles used by other Ss, who were allowed to sort freely. The constrained Ss required about twice as many trials to reach criterion as did those allowed to sort freely, yet once having reached criterion both groups recalled the same number of words.

There is one respect in which our results differ from those reported by Mandler. Although Mandler consistently reports finding that number of piles used in sorting does not affect the number of trials required to reach criterion in sorting, we did obtain a significant difference. Partial correlations were computed between NC and R, holding number of trials to criterion constant statistically. For the face-up condition, this correlation was $r = .59$ [$t(27 \text{ df}) = 3.74$, $p < .001$], and for the face-down condition it was $r = .43$ [$t(27 \text{ df}) = 2.35$, $p < .05$]. Correlations with sorting time (rather than trials to criterion) partialled out were quite similar. Thus, although the number of trials needed to reach criterion varied with the number of piles used in sorting, there was still a relationship between NC and R when this factor was statistically controlled.

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