Intralist similarity, order of presentation and color in children's paired-associate learning

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Analyses of acquisition trials showed that second graders' learning was more rapid with low than with high intralist similarity and with serial than with scrambled presentation, but the provision of color cues had no significant effect. Removal of the color cues, however, had an adverse effect upon subsequent performance.

On the basis of existing studies there is reason to expect children's paired-associate learning to be enhanced by the addition of color cues to the list. Facilitation could be due to increased opportunities for cue selection (Underwood, Ham, & Ekstrand, 1962), mediation (Jenkins & Bailey, 1964), differentiation (Saltz, 1963), increased motivation (Jones, 1965), or some combination of two or more of these factors. Yet, when elementary pupils were asked to learn a geometric form-trigram list with and without color cues, the addition of color had no significant effect upon performance (Otto, in press, a). However, when the list was changed to pairs comprising a word-like stimulus and a spoken response, color did enhance learning (Otto, in press, b). Furthermore, there was evidence in the latter study that serial order of presentation per se had been used as a cue, whereas this had not been so in previous studies (Otto, 1961; Otto, in press, a) with similar subjects.

An explanation for the apparently conflicting results can be suggested. First, perhaps color becomes a useful cue only when intralist similarity is fairly high; stimulus similarity was low in the form-trigram list, where each stimulus was a distinctive geometric form, but relatively high when word-like stimuli were used. With increased stimulus similarity the need for further stimulus differentiation or outright cue selection (i.e., substitution of the color for the primary stimulus) would increase. Second, Samuels & Jeffrey (1966) have shown that when intralist similarity is high, serial order of presentation is superior to scrambled, but when intralist similarity is low, the order of presentation is unimportant. The suggestion is that the consistency of serial presentation makes it easier for subjects to discriminate between items and that learning is thereby enhanced even when the items are scrambled after a number of trials. The use and non-use of serial order as a cue in the studies cited above can be explained in these terms.

The present study was done to examine the relative roles of and possible interactions among intralist

similarity, order of presentation, and color in children's paired-associate learning.

Method

Two basic lists were prepared. The high similarity list comprised six whimsical, word-like stimuli that were made up from three Greek letters arranged in every possible three letter combination. The low similarity list also comprised six stimuli, but they were made up from 18 Greek letters, none of which occurred more than once. Some liberties were taken with certain Greek letters to avoid duplication of Roman letters with which the Ss were familiar. Orally presented English words—ask, ear, few, had, men, and sea—served as responses. The stimulus words were printed on 3 x 5 in. cards in 1 in. characters, either in black or in six distinctive colors—green, light blue, brown, orange, red, and purple.

The Ss were 144 second graders, equal numbers of boys and girls selected at random from two schools. Ninety-six of the Ss were assigned to the eight basic groups, six boys and six girls to each group, included in the 2 (high and low intralist similarity) by 2 (serial and scrambled presentation) by 2 (colored or noncolored stimuli) design schematically represented in Table 1. The remaining Ss were assigned to four groups and exposed to selected pre-criterion learning conditions (see Table 1, groups in brackets) in order to permit additional post-criterion cue shifts; data from these groups were not considered in the acquisition trials analyses.

Each S was shown the appropriate list of six "words," told the response to be associated with each stimulus, asked to repeat each response, and then told that on subsequent trials he was to attempt

Table 1.

Schema of the Basic Design and Post Criterion Learning Conditions

Pre-Criterion		Post-Criterion	
High Similarity (Hi)	Serial (Ser)	No color (Nc)	Nc Scr Nc Scr [C Scr] [Nc Ser]
		Color (C)	Nc Ser
	Scramble (Scr)	No color (Nc)	Nc Scr Nc Scr Nc Scr [C Scr] [Nc Ser]
		Color (C)	Nc Scr
Low Similarity (Lo)	Serial (Ser)	No color (Nc)	Nc Scr Nc Scr Nc Scr [C Scr] [Nc Ser]
		Color (C)	Nc Scr
	Scramble (Scr)	No color (Nc)	Nc Scr Nc Scr Nc Scr [C Scr] [Nc Ser]
		Color (C)	Nc Scr

to give the response before it was given by E. Stimulus cards were presented manually. An approximate 4-sec interval before E gave the response was followed by another 4-sec interval until the next card was presented. The cards were shuffled between trials for the scrambled presentations. The criterion was two correct consecutive anticipations of the entire list or 15 trials. A single post-criterion trial was given immediately. The nature of the list (stimuli colored or noncolored) and the order of presentation were systematically varied on the post-criterion trial (see Table 1) in order to obtain data relevant to the importance of order of presentation and color as cues.

Results and Discussion

Separate analyses of variance of correct responses on Trials 3, 6, 9, 12, and 15 were run. The notion was that perhaps there would be some differences in results across pre-criterion trials, but each analysis yielded similar results, i.e., significant Intralist Similarity and Order of Presentation effects, a non-significant Color effect, and a single significant interaction, Intralist Similarity by Order of Presentation. Specifically, these results are exemplified by the Trial 15 analysis, where the Intralist Similarity effect ($F=25.49$, $df=1/88$, $p<.001$), the Order of Presentation effect ($F=59.39$, $df=1/88$, $p<.001$), and the Intralist Similarity by Order of Presentation interaction ($F=22.88$, $df=1/88$, $p<.001$) were significant. Comparisons of means show that there were more correct responses with the low similarity list ($M=5.73$) than with the high similarity list ($M=4.94$) and more correct responses with serial ($M=5.94$) than with scrambled ($M=4.73$) presentation. The means in Table 2 clarify the nature of the interaction. The Ss who learned the High Similarity Scrambled list differed from all other Ss, but there were no other between-group differences, according to the Scheffe post hoc test. Analyses of trials through criterion and of total correct responses through Trial 15 also yielded similar results. Thus, serial order of presentation enhanced learning but color did not, even when there was high intralist similarity.

Comparisons of pre- and post-criterion perfor-

Table 2. Mean Numbers of Correct Responses on Trial 15 for High and Low Similarity Tests with Serial and Scrambled Presentation

Group	Mean
Low Similarity Serial	5.96
High Similarity Serial	5.92
Low Similarity Scrambled	5.50
High Similarity Scrambled	3.96

Table 3. Mean Responses Correct and t-Test Results for All Groups on Trial 15 Pre-Criterion and Trial 1 Post-Criterion

Pre- and Post-Condition	Pre-Mean	Post-Mean	t-Value
Hi Nc Ser - Hi Nc Scr	5.83	2.75	7.39**
Hi C Ser - Hi Nc Scr	6.00	2.75	8.74**
Hi C Ser - Hi C Scr	6.00	3.33	4.69**
Hi C Ser - Hi Nc Ser	6.00	4.75	3.05*
Hi Nc Scr - Hi Nc Ser	3.75	3.08	2.36*
Hi C Scr - Hi Nc Scr	4.17	2.67	3.59**
Lo Nc Ser - Lo Nc Scr	5.92	4.58	4.71**
Lo C Ser - Lo Nc Scr	6.00	4.67	3.74**
Lo C Ser - Lo C Scr	6.00	5.33	3.55**
Lo C Ser - Lo Nc Ser	5.83	5.00	3.46**
Lo Nc Scr - Lo Nc Ser	5.25	5.08	.53
Lo C Scr - Lo Nc Scr	5.75	4.83	3.20**

* $p < .05$, ** $p < .01$

mance are shown in Table 3. In each instance there were fewer cues—i.e., color, order, or both eliminated—on the post-criterion trial. It is no surprise that there was no change when Low Similarity/No Color/Scrambled was changed to Serial; but the change when High Similarity/No Color/Scrambled was changed to Serial is a bit awkward. Perhaps it is simply a symptom of too many t tests. Nevertheless, the essential point seems clear: In every instance the removal of cues resulted in poorer performance, and this was true even when color was the only cue removed. Color may be a less potent cue than serial order, at least among second graders, but there does appear to be some value.

Apparently the cue value of color—again, at the second grade level—is rather fragile and apt to be superseded by more potent cues. The immediate implication seems to be that color cues are better than no cues. The study should be replicated with children from other grades.

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