Cross-sex and cross-educational level performance in a color-word interference task

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It has been found in previous studies that Ss can read words faster than colors, and that they can read only stimuli consisting of either words or colors faster than their mixture in a color-word interference task. Such studies have concerned themselves with Ss of roughly the same age, and sex performances have been rarely considered. The present research attempts to find out the difference in performance between: (1) females and males of specific age groups; (2) females and males of certain educational levels; (3) females and males across three different age and educational levels; and (4) trends in the male and female performance levels. Results indicated that there were significant differences between all elementary and high school Ss and between the elementary and college Ss. It was also found that although the females did show a constant trend of better performance than the males, the differences were not significant at the .05 level.

Stroop (1935) was one of the first to find that in a serial verbal performance task the interference for the Ss was minimal with nonsense syllables, but maximal with the color-word interference task.

Rand, Wapner, Werner, & MacFarland (1963) concerned themselves with several types of deviant verbal responses on the color-word test. They found that inappropriate color responses, contaminated responses (such as bren, gred, etc.), and omissions were found to decrease with age. Nonlinguistic utterances, such as "ah" and "uh," were found to increase with age.

Klein varied the relationship between colors and words in his research of 1964. Words were printed either red, green, blue, or yellow, and different sets of words were used: nonsense syllables, rare English words, common words, color-names related to the colors actually employed, and the color-names which were presented in incongruous combinations. He found that color-naming time increased from set to set in the order given, and that the interference was found to be minimal with nonsense syllables and maximal with the incongruous combinations.

Schiller (1966) used color-names like "sky" printed in yellow, "grass" printed in blue, and "blood" printed in black. Therefore, the usual color of the object or word was not presented, but a different color in its place. Older Ss performed better than the younger.

Stein & Langer (1966) tried to relate cognitive interference on a color-phonetic symbol test with personality characteristics and adjustment of Ss. There was an association between test performance and certain aspects of personality and adjustment.

Dalrymple-Alford (1968) and Dalrymple-Alford & Budayr (1966) have investigated various aspects of the color-word performance task. Among their results, they have found that interlingual interference affects performance, that various forms of distractions during the task tend to lower results, and that Ss seem to become frustrated as the difficulty of the color-word stimuli increases.

The present paper considers the performance of Ss on a color-word interference task cross-sex and cross-educational levels. It attempted to find out if there were sex, age, and educational differences to a complex color-word task.

SUBJECTS

On the elementary level, 100 students (50 females and 50 males) from the Ben Franklin Grade School, Moline, Ill., served as Ss. They were randomly selected from the sixth grade. Their ages were from 11 to 13 years.

On the high school level, 100 students (50 females and 50 males) randomly selected from the sophomore level at the Moline Senior High School, Moline, Ill., served as Ss. Ages of these Ss ranged from 14 to 16 years.

On the college level, 100 students (50 females and 50 males) randomly selected from the freshman level at North Park College, Chicago, Ill., served as Ss. These individuals ranged in age from 17 to 20 years.

MATERIALS

Sixty color-words were printed in black lettering on a 24 x 30 in. posterboard chart. These 60 color-words, appearing in random order, were red, green, blue, yellow, brown, and black. These were all words which were later used as the standard stimuli, although in their final form they were colored. This chart was used to find out if the Ss could read. It was used for no other purpose.

A second posterboard, 24 x 30 in., contained 60 colored question marks of the colors given above. These were randomly ordered. This chart was used only to find out if the Ss could name the correct color, or if they were color-blind.

The third posterboard, 24 x 30 in., contained the 60 color-words used as the stimulus in the experiment. Each word was the name of a color, but the color of each word was different from the name. Thus, the word "red" was printed in the color green; the word "green" was printed in the colors red, blue, or yellow. Ss had to name correctly the colors and ignore the word names.

PROCEDURE

Each of the Ss in each group was tested individually. An office or other small room, which was well lighted and relatively free of noise of other distractions, was found in each school and used for testing purposes.

The S sat at a desk facing the researcher, who was seated on the opposite end. He was allowed to sit comfortably and rest his arms on the desk top. The chart with the 60 color-words in black lettering was first shown to the individual. All of the Ss were able to adequately read the words.

Each S was then asked to read the second chart containing the colored question marks to check him for color-blindness. Three Ss in the entire group of individuals from all age and grade levels were found to be color-blind and were replaced with other Ss who were not so affected.

After having indicated that he could read the words and could note the correct colors, the S was then shown the third chart. The following directions were given:

> You are to name the color of these words, and not the name of the word. Read each color across the lines from left to right. Continue to say the color of each line of words until you finish the whole chart. Read and say the color as fast as you can. If you make a mistake, go back and correct it. Any questions? . . . Are you ready? . . . Begin!

As soon as the S began to read and say the first word, a stopwatch was begun in order to check his time. The watch was stopped as

Table 1
Mean Time in Seconds for Reading the Entire Word List

Ss	Mean
All Elementary School	81.7
Female Elementary	77.6
Male Elementary	87.3
All High School	59.8
Female High School	57.3
Male High School	62.2
All College	55.6
Female College	53.7
Male College	58.6
All Female Ss	61.3
All Male Ss	68.6

Table 2
t-Test Results of Significance Between Females and Males at Each Educational Level and the Significance of All Ss Tested at Each Level with Those of the Other Levels

Females and Males	t	Educational Levels	t
Elementary	1.23, $p > .05$	Elementary and High School	6.08, $p < .05$
High School	1.27, $p > .05$	Elementary and College	6.72, $p < .05$
College	1.06, $p > .05$	High School and College	1.67, $p > .05$
All Levels	.96, $p > .05$		

Table 3
Correlation Coefficient Results Between Females and Males at Each Educational Level and Between All Ss Tested at Each Level with Those of the Other Levels

Females and Males	r	Educational Levels	r
Elementary	−.24	Elementary and High School	.76
High School	−.04	Elementary and College	.23
College	−.50	High School and College	.26
All Levels	−.06		

soon as the S finished saying the last color. His name, time, sex, age, and grade were written on his response card.

At the completion of the task for the Ss at each school, the data from the cards were transferred on to a master data sheet. These sheets were used to compute the results of the research.

RESULTS

The mean time recorded for all of the three groups of Ss is indicated in Table 1. The elementary school Ss, as a group, had the longest mean time to read all of the color-words when compared with the other two groups. The time was 81.7 sec. Male elementary school Ss took the longest time (87.3 sec) of any individual sex group; the females at this level had the second longest recording time of any group at 77.6 sec, and had the longest time for any group of females.

All of the high school Ss had a mean recorded time of 59.8 sec which ranked them second, behind the mean for all of the college Ss, who scored a mean of 55.6 sec, of the three groups. Females scored a mean of 57.3 sec, which was slightly faster than the males at 62.2 sec.

The mean for all college Ss was 55.6 sec, the fastest of the total S means. Females were again faster than the males, 53.7 sec as compared with 58.6 sec.

Looking cross-sex index at only the female Ss, a mean of 61.3 sec was found; for males, the mean was 68.6 sec.

A t test was run to find out if the mean scores of the females and males of each age group were significantly different. Table 2 indicates that, in all three educational groups, the female and male means were not statistically significant at the .05 level. A comparison of all females, as a group, and all males, as a group, did not reveal a statistically significant finding at the .05 level.

Table 2 also shows the results of a t test run on the entire number of Ss at one educational level against the entire group from another level. In the table, it can be seen that there was a significant difference between both the elementary and high school Ss ($t = 6.08$, $p < .05$), and the elementary and college youth ($t = 6.72$, $p < .05$). No significant difference at the .05 level was found between the high school and college Ss.

The correlation between elementary school females and males was −.24; between high school females and males it was −.04; and between college females and males it was −.50. When all female scores were correlated with all male scores, the resulting correlation coefficient was −.06 (see Table 3).

The correlation between the elementary and high school Ss was found to be .76; between elementary and college youth it was .23; and between the high school and college Ss the correlation was .26.

CONCLUSIONS AND DISCUSSION

Results for the color-word interference task suggest that performance improves with both age and educational level, as well as with sex.

Comparing the overall mean scores for the elementary, high school, and college Ss, the data have shown that there is a decrease in performance from 81.7 to 59.8 to 55.6 sec for the entire color-word chart. Looking at the results for the females of each group (77.6, 57.3, 53.7), and those of the males (87.3, 62.2, 58.6), we find a similar trend in improved performance.

Elementary school youngsters had the highest mean score, 81.7. This might have resulted from their "slowness" of reading and verbalizing the color, when compared to the high school and college Ss. At least part of this score can be attributed to their laughing, or becoming more easily frustrated than the other two groups. Finally, this group of Ss was not as serious minded about the task as were the other groups; therefore, they might not have tried to do their best.

College Ss, at the other extreme, were the "quickest" in reading and verbalizing the color, became less frustrated at the task, and were the most serious minded in their approach to the research. Each of these might have led to their superior performance.

Females at all age and educational levels might have performed better because of their seemingly more vigilant behavior when compared with the males. Females seemed more "set" for the next word and for the next line on the chart than the males.

It might also be suggested that high-anxiety females perform better on such a task than high-anxiety males. The role anxiety does play in learning and performance has been important in many studies cited in the literature.

Although the t tests at each level, as well as those at all levels for females and males, are not significant at the .05 level of significance, the data, nevertheless, support the superior performance of the female members.

The data show that between the elementary and high school Ss and between the elementary and college Ss there are significant differences, but that between the high school and college Ss there are not. These results suggest that interference is greatest during the elementary years, and, although there is still some interference after 15 or 16 years of age, it is relatively stabilized and seems to show little change.

Elementary youth might also do poorly because, at their age level, the two competing stimuli, words and color, are more of "equal" strength when compared with the other Ss. Each might have the same probability of evoking a response. Performance at this level could be said to reflect undifferentiated tendencies. The child in the lower levels might still be struggling to read the word; therefore, the color is not as salient for him. In the upper levels, the Ss are generally better readers; the two responses, word and color, become more differentiated, and it becomes possible to produce the correct response on the first try with greater speed and less effort.

The correlations for elementary, high school, and all Ss are slightly negative, almost nil. A correlation of −.50 for the college females and males does show a relatively strong negative association. Females do perform better, while males perform worse. At the college level, the differences, due to sex, whatever they might be with regard to perceptual skills, are most highly developed; therefore, the relationships tend to be the most salient.

There is an association between the scores of the Ss from the elementary and high school levels. The data support the general range of responses for all of the members of these groups. Although their mean scores differ, the trend in S response is similar. It might be that the form of the distractions and their number are the same for these groups and not the same for the college group. Younger students might be more easily distracted qualitatively, as well as quantitatively, than older ones.

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Semantic factors in conservation of weight[1]

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The performance of first- and second-grade Ss was analyzed on eight connotative-denotative discrimination problems and seven conservation-of-weight problems, each of which represented physical dimensions that are highly correlated on the semantic differential potency factor. The results indicated that Ss who made correct denotative discriminations performed significantly better on the conservation of weight problems than Ss who were unable to discriminate connotative from denotative meaning. The ability to make correct denotative discriminations is acquired prior to weight conservation and is perhaps a necessary, but not sufficient, condition for conservation of weight.

When a first grader is asked to report what differences exist between two objects that differ only in size, he may say that the larger of the two objects is not only larger, but that it is actually heavier and stronger than the smaller object even when he has contrary evidence about the weight and strength of the two objects (Ervin-Tripp & Foster, 1960). The child apparently accepts the fact that "larger," for example, *connotes* "heavy" and "strong" as indicating that "larger" *denotes* "heavy" and "strong" as well. Of course, it is not unreasonable that the child should confuse connotative and denotative meaning in this instance, since more often than not size, weight, and strength are positively correlated in the child's experience.

In addition to failing to discriminate connotative and denotative meaning, the young child also fails to conserve or maintain the constancy of, for example, an object's weight when the object's shape, texture, or temperature is changed (Murray & Johnson, 1968).

The present investigation explored the relation between these two kinds of children's failures, namely, the failure to discriminate connotative and denotative meaning, and the failure to conserve weight, by analyzing first and second graders' performance on eight connotative-denotative discrimination problems and seven conservation of weight problems, all of which were based on physical dimensions that were highly loaded on Osgood's semantic differential potency factor.

SUBJECTS

Subjects were 27 first graders (15 boys and 12 girls) with a mean age of 6.96 years (S.D. = .57 years), and 30 second graders (17 boys and 13 girls) with a mean age of 7.92 years (S.D. = .44 years).

PROCEDURE

The connotative-denotative discrimination test consisted of eight problems in which two objects differed in size (large-small), weight (heavy-light), texture (rough-smooth), shape (thick-thin, wide-narrow, or long-short), strength (strong-weak), or hardness (hard-soft). The physical dimensions of the stimulus pair for each problem were (1) size: a large block (1½ x 1½ x ¾ in.) and a small block (¾ x ¾ x ½ in.); (2) thickness: a thick block (1¼ x 1¾ x ½ in.) and a thin block (1¼ x 1¾ x 1/3 in.); (3) width: a wide block (1¾ x 1 x ¾ in.) and a narrow block (1¾ x ½ x ¾ in.); (4) length: a long block (3½ x ¾ x ½ in.) and a short block (1¾ x ¾ x ½ in.); (5) weight: a heavy block (1 oz) and a light block (½ oz) both 1¾ x ¾ x ¾ in.; (6) texture: a rough block and a smooth block (both 1¾ x ¾ x ¾ in.); (7) strength: a "strong" dry sponge and a "weak" damp sponge (both 1½ x 1½ x ½ in.); (8) hardness: a hard ball of clay and a soft ball of clay (both 1½ in. diam). Ss, individually, were presented with a pair of these objects that differed on one dimension (e.g., size: one large and one small block) and were asked to say how the objects differed on that dimension. Ss, then, were asked if the objects differed on each of the other dimensions of thickness, width, length, weight, texture, strength, and hardness as well. For example, subjects were specifically asked, "Is one bigger and one smaller or are they both the same size?" and then, "Which one is bigger (or smaller)?" The same question form then was used to ask about the same objects for the following pairs of words: "wider, narrower; longer, shorter; thicker, thinner; heavier, lighter; rougher, smoother; stronger, weaker; harder, softer" in random order for each S.

In the seven conservation of weight problems, after each S agreed two clay balls were equal in weight, one of the two identical clay balls was transformed in size [(1) by adding a piece of clay], in shape [(2) by flattening it into a pancake, (3) by rolling it into a sausage, or (4) by pressing it into a wheel], in texture [(5) by roughing the surface with a table fork], or in strength [by having the S imagine that the ball was (6) heated in the oven, or (7) frozen in a refrigerator]. After each transformation, Ss were asked, "Is one heavier and one lighter, or are they both the same weight?" and if Ss said the balls had different weights, they were asked, "Which one is heavier (or, one-half the time, lighter)?"

RESULTS

Subjects who made four or more correct conservation responses to the seven conservation of weight problems (one size, three shape, one texture, two strength problems) were scored as conservers, and Ss who made three or fewer correct responses were scored as nonconservers. There were, by this criterion, 9 conservers and 18 nonconservers in the first grade and 18 conservers and 12 nonconservers in the second grade. The difference in these proportions of conservers and nonconservers between the two grades was significant by a Fisher Test ($p = .0398$).

A Cochran Q analysis at each grade level of the difference between the proportion of conservers and nonconservers on each of the conservation problems showed significant differences between the proportions of conservers and nonconservers across the problems for both the first-grade Ss ($Q = 76.54$, $p < .001$) and the second grade