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ABSTRACT

Adolescents defined as educable retarded who have demonstrated their ability to profit from experiences (highscorers and gainers) were hypothesized to perform more adequately than nongainers on the Stroop Color-Word interference task. The tasks were administered on three successive days to each subject in the following order: color, word, color-word-color, and color-word-word. Performances by highscorers and gainers tended to show less interference than nongainers on the color-word-color task. No significant differences in performance were found on the color or word naming cards, indicating that the groups did not differ on simple tasks but on the ability to inhibit a response to a conflictful stimulus and to respond adequately with a minimum of delay. (RJ)

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STUDIES IN LEARNING POTENTIAL

PERFORMANCE ON THE "STROOP COLOR-WORD TEST" AS RELATED
TO LEARNING POTENTIAL STATUS OF EDUCABLE
MENTALLY RETARDED ADOLESCENTS

By

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PERFORMANCE ON "THE STROOP COLOR-WORD TEST" AS RELATED TO
LEARNING POTENTIAL STATUS OF EDUCABLE MENTALLY RETARDED ADOLESCENTS

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Jensen and Rohwer (1966) reviewed the literature on the Stroop Color-Word Test, and concluded that:

The Stroop Color-Word Test, which has now been in existence for 30 years, is of considerable psychological interest for several reasons: (a) it yields highly reliable and stable measures of individual differences on what seem to be three quite simple and basic aspects of human performance; (b) though there are reliable individual differences on each of the three time scores obtained from the Stroop test, the three scores maintain the same rank order of magnitude for all subjects (there was not a single exception among over 400 Ss tested by the writers); (c) the test has been used in a large variety of studies and has shown correlations with a host of other, often more complex, psychological measurements.

They also concluded that:

Stroop scores are not tenuously related to intelligence. There is no reported instance of the Stroop ever having been used with Ss much below the normal range of intelligence, and most studies have used college students.

J. P. Das (1969) did administer the Stroop test to retarded (ranging from 35 to 65 in IQ) and normal IQ children of 10 to 15 years of age. He concluded:

The retardates named colours faster than reading words, and showed relatively less interference than normals in naming the colours of words. In these they functioned like the normal children at a Grade 1 level. The reading speed and interference measures appeared to reflect stable individual differences which might be related to those in learning. (Das, 1969)

Budoff (1969) has argued that psychometrically defined EMRs vary considerably in ability to reason when these Ss are offered the opportunity to demonstrate their facility in profiting from experience (his operational definition of intelligence), as in a learning potential assessment strategy. This assessment permits the child to demonstrate his competence on a series of administrations of a nonverbal reasoning task, in which series, a tutorial session is interpolated which teaches the child principles relevant to solution of the reasoning problems. A series of studies has

shown that children who showed marked competence before (high scorers) or after tuition (gainers), but whose IQs are in the educable retarded range, perform more similarly to educationally handicapped students (IQs > 80), while those who do not improve their performance following tuition (nongainers) function like mentally retarded children (see Budoff, 1968, 1969; Budoff and Pagell, 1968; Budoff and Meskin, 1969). The present study, then, mainly explored whether special class students segregated in classes for the educable mentally retarded (EMR) who differed in learning potential (LP) status would differ in their responses to the Stroop tasks. Pines and Budoff (1969) have shown differences in the ability of high scorers, gainers, and nongainers to cope with a mild frustration stress, the latter group tending to cope least adequately. In similar fashion, it was predicted that among special class adolescents segregated in classes for the EMR, the high scorers and gainers, who were hypothesized to be educationally handicapped, will perform more adequately than the nongainers on the Stroop Color-Word interference task.

Method

The Stroop Test consists of three cards:

1. a Color Card (C) containing 100 patches of three colors (red, blue, and green);
2. a Word Card (W) containing the same three color names;
3. a Color-Word (CW) Card in which the names of the same three colors are printed in an ink of a conflicting color.

The cards are 9 1/4" x 9 1/4" and the items are in a 10 x 10 matrix. The Color Card consists of rectangular patches 5/16" x 2/16". The stimuli are printed on a white background. The order of the items is random. At the top of each card is one row of practice items.

Jensen (1965) has reported marked reductions in time required to complete the Stroop tasks on successive administrations of the tasks (over ten successive days to college students). Examination of his data indicates the most marked reductions occurred during the first three repetitions, after which an asymptomatic level of performance was attained. The Ss in this study were administered the tasks on three successive days to determine the effects of practice, and to allow the Ss to demonstrate a more optimal performance level.

Das (1969) has shown that speed of reading was weaker among retarded children. An additional adjustment in the task is suggested by his results, namely, to have the EMR Ss read the words with the interference of conflicting color (CW_w).

The Stroop tasks, then, were administered on three successive days to each S in the following order:

1. Color Card - speed of reading colors
2. Word Card - speed of reading words in black and white
3. Color-Word Card - (susceptibility to interference factor)
 - a. reading colors with interference of words
 - b. reading words with interference of colors

Sample:

The male and female Ss were segregated in classes for EMRs and ranged in CA from 10 to 16 years, and in Binet IQ from 60 to 80 (see Table 1 for the means and standard deviations for these variables for each learning potential group).

Insert Table 1 about here

All the Ss were resident in a low income housing project and had been administered the Kohs learning potential procedure.

Procedure:

The cards were presented in the following order for each successive administration: color, word, color-word color, color-word, word. As the subject sat comfortably facing the table, the first card was presented and the following instructions given:

Three colors appear on this card: red, blue, and green. What you have to do is name the colors as quickly as possible beginning with the top row, going from left to right. Do you understand? Use the first row as practice.

After S finished the practice row, E repeated:

Now I want you to name all the rest of the colors as quickly as you can.

After finishing with this card, the Word card was presented and the following instructions given:

On this card the same three colors appear, but this time they are printed, and you have to read the words as rapidly as possible. Use the first row for practice.

The third card was the color-word card. This card was presented twice. The first time it was presented as Color-Word color (CW_c) in accordance with the standard administration, and the S was read the following instructions:

On this card I want you to name the color of ink and ignore the printed word. Do you understand? Use the first row for practice.

On the second administration of the Color-Word card (which is not included in the standard Stroop administration), the instructions were as follows:

This time you will have to read the printed word, and ignore the color of the ink. Do you understand? Use the first row for practice.

This procedure was repeated three times. After each performance the S was given his results. In the retests Ss were given their first scores with their second and third scores. This kept them motivated to perform on a basically very boring task. When an

error was made, E tapped the table with a pencil.

The total time taken for each card was recorded beginning with S's first response following the practice row. Time scores for the four cards and Interference Scores ($CW_C - C$ and $CW_W - W$), were obtained for each administration.

Results

The times (in seconds), per card, were analyzed by an unequal N multivariate analysis of variance program that included univariate analyses for each Stroop task score [learning potential status (3 levels), sex (2), and successive days (3)]. CA and IQ were included as covariates, although the pattern of results did not differ on the unadjusted scores, nor for each covariate separately. The two degrees of freedom (df) for learning potential status were analyzed separately. The learning potential hypothesis predicts that high scorers and gainers will perform more adequately, hence, with less interference than the nongainers. The analysis of the linear component tested this hypothesis (1 df). The analysis of the quadratic component (1 df) tested the obverse of this hypothesis, i.e., when high scorers and nongainers are compared with gainers there would be significant differences.

Table 2 is a summary table of univariate F -ratios for the color, word, and color-word color scores. There were no significant effects for the color-word word interference score and these F -ratios have been omitted from the table. Table 3 presents the means of the three learning potential groups by trials for each task.

Insert Tables 2 & 3 about here

Learning Potential Status. The prediction that high scorers' and gainers' performances would show less interference than nongainers' on the color-word color task, tended in the predicted direction and represented the only significant effect for learning potential status main effect for either the linear or quadratic components ($F = 3.07, >.10 p >.05$; see means Table 3). High scorers were less susceptible to interference effects than the nongainers (see Table 3). There were no significant differences in performance on the color or word naming cards, which indicates that the three learning potential groups were not different in performance on these simple tasks, but rather in a personality characteristic, namely, the ability to inhibit response to a conflictful stimulus and to respond adequately with a minimum time delay.

The only other effects involving learning potential status which tended toward significance was the learning potential quadratic x sex interaction for the color-word color interference

($F_{1,19} = 3.96, .10 > p > .05$), color naming ($F_{1,19} = 3.49, .10 > p > .05$), and word naming tasks ($F_{1,19} = 6.14, p < .05$). These means, when plotted, indicated that male gainers needed less time than high scorer or nongainer males, while gainer females required more time than female high scorers or nongainers. The boys tended to perform more rapidly than the girls, pooling over all three trials. (Sex main effect, $F_{1,19} = 3.28, .10 > p > .05$.)

The comparison between the two interference conditions, CW_{color} and CW_{word} , can be seen in the table of means (Table 3). Color-Word_{word} (CW_w), which was added to the standard Stroop Test, yielded no significant effects. The mean differences between the color naming and the color-word color interference are very dramatic, requiring approximately 200% more time when mean time/third trials are compared. By contrast, naming the words on the color-word card required approximately 25% more time, and was not a consistently more difficult task for all Ss over all three trials. It would seem that adolescent special class students can and do read these simple color words with only slightly greater difficulty on the interference card than the non-interference card.

The effect of practice from trial 1 to trial 3 was significant for the color card ($F = 25.02, p < .01$), for the words card ($F = 90.50, p < .01$) and for color word--color comparison ($F = 24.51, p < .01$), but not for color-word_{word}. In all conditions, save the latter task, performance was faster with each succeeding trial in the series. The major improvement was from the first to the second trial (see Table 3 for means).

Discussion

As predicted, then, learning potential status tended to be related to increased ability to cope more rapidly with the interference effects of the Color-Word card, high scorers and gainers tending to cope more satisfactorily than nongainers. Interestingly, there were no differences in performance on the simple tasks of color and word naming, but only on this more demanding interference task. These results are similar to the findings of Pines and Budoff in studies of reaction to frustration on utilizing a behavioral task (1969a), and verbal tasks, such as a questionnaire and sentence completion task (1969b). In these tasks, high scorers and/or gainers indicated more ability to cope with mild stress behaviorally and verbally. This difference suggests that the differences among these groups are not merely cognitive or intellectual but have motivational or personality correlates as well. Harrison and Budoff's (1969) findings that less maladjustment characterizes the responses of high scorers and gainers to a self report scale provides additional support for the clear differences evident between these two groups and the nongainers on these verbal and nonverbal tasks.

Successive trials with these tasks does appear to be a useful

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experimental control though the major improvement in speed of response occurred by the second trial in these data, in contrast to the 3rd day, which Jensen (1965) reported with college students.

This study should be replicated with another sample of special class EMRs and with contrast sample of CA and MA controls, from similar socio-economic backgrounds. In light of our argument that gainers and high scorers are educationally retarded, the controls might usefully include educationally retarded Ss with IQs above 80.

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TABLE 1

Means and Standard Deviations for CA and IQ of the
Special Class Study Sample Subdivided by Learning Potential Status

	<u>High scorers</u>	<u>Gainers</u>	<u>Nongainers</u>
CA (in months)			
Mean	164	162	162
SD	17.97	18.24	21.56
IQ			
Mean	73	72	71
SD	5.47	6.55	5.38

TABLE 2

Summary of F-Ratios for Color-Word and Color-Wordcolor
Interference Scores on Stroop Test, Covaried for CA and IQ
(When not indicated, $F > 1$).

Source	d.f.	F-Ratios		
		Color	Word	Color-Wordcolor Minus Color
<u>Between Ss</u>				
Learning Potential	(2)			
LP _{lin} (HS+G vs NG)	1	--	--	3.07*
LP _{quad} (HS+NG vs G)	1	--	--	--
Sex	1	3.28*	--	--
LP _{lin} x Sex	1	--	--	--
LP _{quad} x Sex	1	3.49*	6.14**	3.96*
Regression	2	1.09	--	--
Error Mean Square	19	592.48	265.49	2564.19
<u>Within Ss</u>				
Testings (T)	2			
Testings _{lin}	1	25.02***	90.50***	24.51***
Testings _{quad}	1	1.36	15.71***	4.67**
LP _{lin} x T _{lin}	1	--	1.60	--
LP _{quad} x T _{lin}	1	--	1.35	--
LP _{lin} x T _{quad}	1	--	--	--
LP _{quad} x T _{quad}	1	--	--	--
Sex x T _{lin}	1	4.65**	10.18***	4.19**
Sex x T _{quad}	1	6.19**	2.32	--
LP _{lin} x Sex x T _{lin}	1	--	2.76	--
LP _{quad} x Sex x T _{lin}	1	1.77	--	--
LP _{lin} x Sex x T _{quad}		--	--	--
LP _{quad} x Sex x T _{quad}		--	--	--
Error Mean Square		74.15	27.64	672.76

* - $.10 > p > .05$

** - $p < .05$, one-tailed test

*** - $p < .01$

TABLE 3

Means on Stroop Subtests by Learning Potential
Status over Three Successive Days

	Color	Word	Color- Word color	Color- Word word
Trial 1				
High scorers	91.7	83	180.8	96.4
Gainers	90.9	81.4	202.8	93
Nongainers	98.4	83.5	221.5	94.6
Trial 2				
High scorers	83.5	72.3	147.7	85.3
Gainers	85.5	70.5	164.2	85.6
Nongainers	87.1	69.4	174.3	84.2
Trial 3				
High scorers	81.5	70.7	141.2	88.2
Gainers	80.1	69.8	158.8	79.3
Nongainers	82.7	66.1	164.7	82.1