ABSTRACT

THE EFFECT OF SEMANTIC RELATEDNESS AND PRACTICE ON THE COLOR-WORD TEST

by Burton L. Alperson

A factorial experiment on 220 subjects determined the contribution of practice and semantic relatedness to the production of interference in the color-word test. Each subject was trained in a paired associate learning task to one of three sets of response terms, representing three levels of relatedness to the color naming task (Direct, Irrelevant, and Looking at the stimulus items). Each subject was also trained to one of three levels of practice (3, 10, or 50 trials). Stimulus items were then used as interfering materials in the color-word test.

Analyses of time scores and errors both suggest that semantic relatedness is a more potent variable in the production of interference than is amount of practice. Amount of interference, in terms of time scores, increased over the course of the experimental interference task. Amount of interference decreased over the course of a standard interference task (one in which the interfering materials were actual color names rather than conditioned nonsense syllables).

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Supplementary analyses failed to support the validity of using tachistoscopic duration thresholds or extraversion scores to predict within subject interference effects.

The results support Klein's theoretical analysis of the interference effect. The results also suggest that improvement of performance on the color-word test represents an increase in ability rather than specific learning effects.

THE EFFECT OF SEMANTIC RELATEDNESS AND PRACTICE ON THE COLOR-WORD TEST

By

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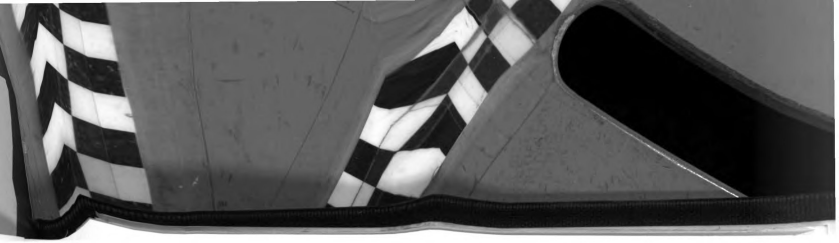
TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES



LIST OF APPENDICES

CHAPTER I

INTRODUCTION

The Stroop color-word phenomenon is generally demonstrated by presenting a subject with three cards in a fixed order. The first of these cards (the W card) consists of a series of color names printed in black ink. S's task is to read these names as fast as possible. This card is usually used as a warm up task; reading times on the W card are rarely analyzed. The second card (the C card) contains a series of patches of colored ink. S's task on this card is to name the colors as fast as possible. The final card (the CW card) consists of color names printed in conflicting colors, e.g., the word "red" might be printed in blue ink, "green" might be printed in red ink, etc. On this card, S must ignore the words and name the ink colors as fast as possible. The CW card seems to be universally more difficult than the C card. The difference between C and CW is usually taken as a measure of interference.

This phenomenon has aroused considerable interest among psychologists. The interference effect is large and stable. Jensen (1965) found no reversals (i.e., CW slower than C) in testing 436 subjects. Bakan and Alperson (1967) found no reversals in testing 125 subjects.

The scores reveal highly reliable individual differences (Jensen, 1965) which have been correlated with a broad range of events (cf. Jensen and Rohwer, 1966). Used as a measure of individual differences, the Stroop effect has successfully predicted retention of anxiety and non-anxiety materials (Ullman and Saltz, 1965), recall of intentionally and incidentally learned concepts (Amster, 1965) and errors on a paragraph reproduction task under two motivational conditions (Lazarus, 1957), to name just a few. Jensen and Rohwer review these and a number of other similar studies in their 1966 review.

In view of the variety of theoretical approaches assumed by investigators who have used the Stroop effect, it is unfortunate that very few studies have been concerned with analyses leading to increased understanding in discussion of the effect, itself. Most investigators have used face validity as the only criterion of the relationship between the Stroop phenomenon and other experimental or theoretical variables (Jensen and Rohwer, 1966). Lazarus (1957), for example, views individual differences as representing a preference for either conceptual or sensori-motor operations. The interference phenomenon is used as an index of "cognitive control." Agnew and Agnew (1963) feel that individual differences represent the ability to maintain "narrowed attention." Schwartz and Shagass (1960) explain the interference effect by the use

of "cognitive rigidity" and Rorschach type "color-shock." Ullman and Saltz (1965) feel that the interference effect is inversely correlated with "cognitive differentiation."

Stroop's original interpretation of the effect (1935a, 1935b) is that many responses are attached to color (e.g., touching, looking, naming, etc.) while only one response (saying) is attached to a word. Word reading, therefore, is a more highly practiced task than color naming (Stroop, 1938). The reading habit is stronger than the color naming habit so word reading interferes with color naming to a much greater extent than color naming interferes with color reading.

Since 1938 relatively few studies have been directly concerned with the Stropp phenomenon, itself. Dalrymple-Alford and Budayr (1966) showed that the serial nature of the task is not a necessary condition for interference. These investigators used a tachistoscope to present individual color-word items to Ss. The stimulus remained in view until S responded with the appropriate color name. They found that it took longer for bilingual (Arabic-English) subjects to name the ink color when the interfering stimulus was an Arabic or English color name than when the interfering stimulus was a nonsense "squiggle." They also found that serial presentation contributes to the interference effect and that variation in the serial order of items can produce variations in interference, when the standard Stroop cards are used.

Klein (1964) manipulated interference by varying the verbal text in which the colors are imbedded. He found increasing amounts of interference as the nature of the verbal text went from nonsense syllables to rare words, to common words, to words that imply color (lemon, grass), to color names different from the ink colors, to color names the same as the ink colors. He also found that allowing Ss to say the word response before naming the color improved performance on the color naming task.

Klein's interpretation of these results is that there are two factors which produce interference. The first is the semantic relationship of the interfering words to the color naming task. The closer the words to color in meaning, the greater the interference. The second component is the "attensity" or attention catching power of the word. His measure of attensity was frequency of occurrence of the word in English. These two components produce a response (saying the word) which competes with the color naming response for a single response channel. Thus, interference is produced and there is an increase in time necessary to name the colors on the CW card in comparison to the C card.

The effect of attensity was later confirmed by Bakan and Alperson (1967). In this study, verbal materials at four levels of pronounceability were used as interfering stimuli. Three groups of subjects were tested with nonsense syllables, each with a different level of pronounceability and two groups of subjects were tested with words,

each with a different level of pronounceability. Two of the groups worked with material equated for pronounceability, but varying in meaningfulness (words and nonsense syllables). There was general support for the hypothesis that amount of interference increases with pronounceability. Of the two conditions equated for pronounceability but varying in meaningfulness (words and syllables), the interference was greater for the more meaningful material. A tachistoscopic measure of the attensity of the stimuli showed a better relationship to interference than the measure of pronounceability.

Schiller (1966) administered a modified form of the Stroop test to students in grades 1, 2, 3, 5, 8 and college freshmen. He found little interference in the first and maximal interference in the second and third grades. Naming colors was faster than reading color names in the first grade. From the second grade on, the reverse was true. Some doubt is cast on the simple differential practice explanation of the interference effect since the difference between C and CW remained constant across all grade levels after the first grade. Reading is increasingly more practiced in comparison to color naming as the child advances in grade level. If differential practice accounts for the Stroop effect, there should be greater interference in the higher grades than in the lower grades.

CHAPTER II

STATEMENT OF THE PROBLEM

Both the Klein and Schiller studies suggest that the simple differential practice explanation of the Stroop effect is insufficient to account for the interference. The implication of the Klein study is that it is not general practice in reading, but rather it is the specific kind of practice which is important in the production of interference. This interpretation is necessary to explain the effects of semantic relatedness in this study.

There are, however, two problems in the interpretation of Klein's data. The first is that different words are used in each class. Although this variable probably accounts for very little variance, there remains a possibility that it does have an effect. It should, therefore, be controlled.

The second problem is a more serious one. It is clear that both practice (if it can safely be assumed that practice is highly correlated with word frequency and tachistoscopic duration threshold) and semantic relatedness influence amount of interference. All of the studies done on this problem (Klein, Schiller and Bakan and Alperson) have confounded these two variables. Words have been selected on

the basis of their relatedness to color naming and this automatically fixes the level of practice for each word. For example, if the word "lemon" is selected as an interfering stimulus because of its relationship with the color naming task, no manipulation of practice is possible since the frequency of occurrence of the word "lemon" is already fixed.

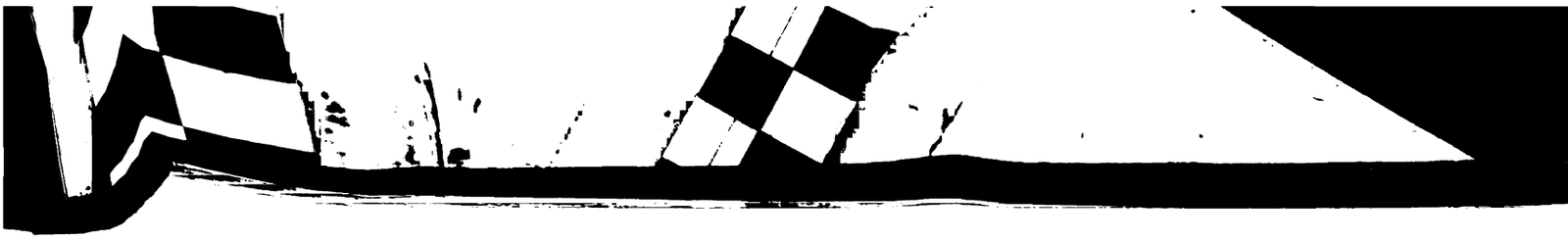
This problem makes it desirable to devise a study analagous to Klein's but one in which semantic relatedness and amount of practice may be independently manipulated. In such a study, a clearer indication of the relative contribution of practice and semantic relatedness may emerge.

The approach employed in the present study is to take stimuli which are initially neutral with respect to the color naming task (i.e., nonsense syllables). These syllables are then paired with different semantic classes of words. The classes vary in their relatedness to the color meaning task. Thus, one group of subjects is given paired associate training on a set of nonsense syllables paried with color names. Another group of subjects is trained on the same nonsense syllables, but the syllables are paired with a set of words which are irrelevant to color naming. A third group is instructed to look at the set of syllables, in order to control for the effects of exposure to the stimuli. Practice is independently

manipulated by varying the number of training or looking trials. Following training, the nonsense syllables are used as the interfering stimuli on the CW card. An advantage of this technique, in addition to the independent manipulation of practice and relatedness, is that the interfering stimuli for all groups are identical.

Two supplementary variables are also included in this study. Bakan, Belton and Toth (1963) have shown that extraversion predicts within task decrement of performance in a vigilance task. It is of interest to see is a similar relationship holds for within task Stroop performance.

The second supplementary variable is tachistoscopic duration threshold of the conditioned syllables. This variable predicts interference when the interfering stimuli are real words (Bakan and Alperson, 1967). The present study attempts to assess the predictive validity of this variable when the interfering stimuli are conditioned nonsense syllables.



CHAPTER III

METHOD

Experimental Design

The experiment employed a factorial design with two independent variables (semantic relatedness and amount of practice) which assumed three levels each. These variables represent the content and amount of paired associate training undergone by each S. The levels of semantic relatedness were labeled "direct," "irrelevant" and "looking." The levels of practice were 3, 10 and 50 trials. An additional control group which received no paired associate training was added to the experiment. The basic design is, therefore, a 3 x 3 + 1 factorial (Winer, 1962, pp. 263-267) as represented in Table 1.

TABLE 1.--Experimental design.

Semantic Relatedness	Control	Amount of Practice (Trials)		
	0	3	10	50
Direct		n=22	n=22	n=22
Irrelevant		n=22	n=22	n=22
Looking		n=22	n=22	n=22
	n=22			

Subjects

Two hundred twenty Ss were unsystematically assigned to the 10 treatment groups. These Ss were students in Introductory and Advanced General Psychology courses at Michigan State University. They received course credit for their participation in experiments.

Procedure

Each S was tested individually in one 20-30 min. experimental session. An experimental session consisted of four tasks which were administered in the same sequence for all Ss. These tasks are described below.

Task I: Tachistoscope Pretest

Nine nonsense syllables were presented in an ascending method of limits on a screen approximately 5 ft. in front of S. These syllables were shown on a Polymetric model V-1459-A projection tachistoscope. Each syllable was shown at a duration of 10 msec., and was repeated with a 10 msec. increment in duration on each repetition until S correctly identified the syllable. The first four syllables (pim, fod, fet, and bot) were "warm-up" syllables. These syllables were followed by three "experimental" syllables (dap, lar, and fon) and two "filler" syllables (rel and sog). S was not informed of the distinction between these syllables; he was simply told that he would be shown a series of syllables (see Instructions, Appendix A).

The syllables were shown in the same order to all Ss. The room was not darkened for the presentation of the syllables and neutral density filters were used in front of the projector lenses to decrease the illumination. The use of the lighted room and the filters was an attempt to reduce figure-ground and thus to reduce the probability of having S see the syllable on the first (10 msec.) presentation. A "pre-exposure" slide consisting of two vertical black lines which framed the area in which a stimulus would appear, was projected on the screen continuously both before and after stimulus presentation during this task.

Task II: Paired-Associate Training

Three pairs of items were presented in a 1:1 anticipation method (Runquist, 1966) on a Stowe model 459B memory drum. Ss were required to say aloud both stimulus and response terms. All Ss had either 3, 10 or 50 trials of training, with a trial defined as one complete presentation of the three pairs of items. At each level of practice there were three levels of semantic relatedness as described below. All pairs were typed in black ink.

Direct Conditioning.--The stimulus items dap, lar and fon, were paired with the response items red, blue and green, respectively.

Irrelevant Conditioning.--The stimulus items dap, lar and fon were paired with the response items girl, boy and man, respectively.

Looking.--Only the stimulus items dap, lar and fon were shown at a rate of one syllable every 2 sec. Ss were told to say each item aloud as soon as it appeared.

Ss in the control group[1] had no paired-associate training. They went directly from Task I to Task III.

Task III: Color-Word Test

This task consisted of four 9 x 12 cards presented in the same sequence to all Ss.

The Word (W) card consisted of 80 color names (red, blue and green) printed in black ink, eight to a line. These words were randomly ordered with the restriction that no word could follow itself. Ss were instructed to read the names as fast as possible.

The Color (C) Card was made up of 80 colored rectangular patches, approximately .15" x .50", of red, green or blue ink. These patches were randomly ordered with the restriction that no color could follow itself. S was told to name the colors as fast as possible.

The Experimental Color Word (EXPCW) Card consisted of the three stimulus items used in the paired-associate training printed in red, blue or green ink. The order of ink colors was identical to the order of colors on the C card. Two restrictions were placed on the syllables. First, a syllable could not follow itself. Second, a

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[1]It should be noted that the first 12 Ss in this group were run consecutively since the group was added after the study was in progress.

syllable could not appear in a color with which it had been paired in the Direct Conditioning groups (i.e., fon never appeared in green, lar never appeared in blue, and dap never appeared in red). There were 80 items on the card, eight to a line. S was told to ignore the words and name the colors in which the words were printed.

The Standard Color Word (STDCW) Card consisted of the words red, blue and green, printed in conflicting colors of red, blue and green ink. The order of ink colors was identical to the order of ink colors on the C and EXPCW cards. The order of color names corresponds to the order of nonsense syllables on the EXPCW card. Ss were told that the instructions for this card were the same as the instructions for the card they had just finished.

Each card was placed on an easel which was a comfortable reading distance from S. The complete instructions for this task may be found in Appendix A. The intended effect of these instructions was to emphasize both speed and accuracy, but to place the primary emphasis on speed. Responses on all four cards were tape recorded for later analysis.

Task IV: Tachistoscope
Posttest

With the exception of the selection of warm-up syllables, this task was identical to Task I. Four new warm-up syllables (rec, ish, fid and dal) were employed here.

Extraversion

Ninety-five of the Ss in this study had taken the Maudsley Personality inventory as part of their Introductory Psychology course. Their scores on this test comprise the Extraversion variable in the present study.

CHAPTER IV

RESULTS

Table 2 is a summary table consisting of the means of all dependent variables to be discussed in this section, along with their associated standard deviations.

Time Data for Individual Cards

Time data were measured by listening to the tape recordings of S's performance on the four cards (W, C, EXPCW, STDCW), and marking times with an Esterline-Angus event recorder. Chart speed of the event recorder was .10"/sec. and subsequent measurements on the records were rounded to the nearest tenth of an inch (i.e., to the nearest second). The first line was omitted from the time measurements of all cards; thus, the time measurements are on lines 2 through 10.

Since some investigators have used individual card times instead of difference scores, separate analyses were performed for each card. No specific predictions were made for the W and C cards. The analyses of the CW cards, however, may be used to supplement the analyses for the difference scores.

TABLE 2.--Summary of means and standard deviations for all dependent variables.[1]

Type of Conditioning:		Direct			Irrelevant			Looking			Control
Trials:		3	10	50	3	10	50	3	10	50	0
Dependent Variable											
W-Card	$\bar{X}$	27.14	26.82	26.27	28.00	27.50	26.09	29.00	27.05	26.42	27.23
	S	3.73	2.91	3.56	4.29	3.74	4.61	4.42	4.54	3.22	3.01
C-Card	$\bar{X}$	34.86	35.45	37.18	34.91	34.44	34.73	36.00	36.00	36.86	35.00
	S	4.76	5.81	4.48	5.70	4.55	6.78	5.44	6.13	4.82	3.79
EXPCW-Card	$\bar{X}$	42.82	43.32	46.55	40.50	41.00	43.09	43.55	42.73	42.82	42.18
	S	6.06	7.35	7.16	7.00	4.83	9.96	6.76	6.59	5.65	5.23
STDCW-Card	$\bar{X}$	70.14	76.73	79.36	69.91	70.36	69.18	73.95	73.73	74.73	71.32
	S	13.03	19.93	17.17	16.62	13.98	18.20	14.88	15.63	11.02	12.20
Experimental Interference	$\bar{X}$	7.95	7.86	9.36	5.59	6.45	8.36	7.55	5.86	5.31	7.18
	S	4.87	4.05	4.82	3.92	3.31	6.48	5.03	3.93	3.97	3.85
Standard Interference	$\bar{X}$	35.27	41.27	42.18	35.00	35.82	34.45	39.86	36.86	37.23	36.32
	S	12.18	16.40	16.15	13.19	12.87	14.40	9.75	12.04	9.91	10.70
Experimental Interference$_1$	$\bar{X}$	1.68	2.73	2.86	1.59	1.50	2.59	1.95	1.50	1.86	2.41
	S	2.10	2.39	2.19	2.02	1.41	2.15	2.06	1.87	2.01	1.76
Experimental Interference$_2$	$\bar{X}$	3.05	3.00	3.41	1.82	2.45	2.41	3.05	2.64	1.41	2.55
	S	2.42	1.77	1.84	1.92	1.53	3.11	3.11	1.94	1.89	2.04
Experimental Interference$_3$	$\bar{X}$	3.23	2.14	2.82	2.18	2.50	3.32	2.55	1.73	2.05	2.23
	S	2.29	2.03	1.99	2.40	2.06	3.75	1.95	2.69	2.57	1.85
Standard Interference$_1$	$\bar{X}$	11.82	15.55	14.95	12.64	12.27	12.41	13.82	11.91	14.18	13.00
	S	4.69	6.64	5.72	4.63	5.48	5.33	4.14	4.83	4.53	3.84
Standard Interference$_2$	$\bar{X}$	11.86	12.68	13.95	11.55	12.36	11.41	13.36	12.77	12.59	12.32
	S	5.07	6.09	6.84	5.60	5.06	5.97	3.49	4.75	5.40	4.21
Standard Interference$_3$	$\bar{X}$	11.59	13.05	13.27	10.82	11.18	10.64	12.68	12.18	10.45	10.55
	S	4.54	6.71	5.23	4.76	4.72	5.55	4.72	5.77	4.40	5.00
Syllable Conflict Errors	$\bar{X}$	.09	.27	.59	.09	.09	.14	.14	.09	0.00	.09
	S	.43	.77	1.18	.42	.29	.47	.64	.29	0.00	.43
Tachistoscope PreTest	$\bar{X}$	9.86	10.18	10.68	10.40	9.72	9.18	10.22	10.45	9.95	8.09
	S	4.51	5.34	4.92	3.84	2.39	4.52	4.55	6.01	3.59	3.36
Tachistoscope PostTest	$\bar{X}$	9.36	8.91	8.36	8.55	7.59	8.50	8.27	7.95	8.23	7.00
	S	4.15	3.10	2.06	2.87	1.71	4.04	3.04	2.80	2.62	2.60

[1]Each mean is based on 22 observations.

W Card

A 3 x 3 + 1 analysis of variance was performed on the time taken to read lines 2 through 10 of the W-card (Apendix B, Table 1). The main effect for the amount of practice is reliable ($F_{2,210} = 3.56$, $p < .05$). Neither the semantic relatedness main effect nor the Relatedness by Practice interaction reached the .05 level. Figure 1 shows the means for the 10 groups in this analysis. This figure indicates that as amount of practice in paired associate learning and naming nonsense syllables increases, the time taken to read color names decreases. This relationship probably indicates nothing more than a warm up effect.

C-Card

An analysis of variance on the time taken to name the colors in lines 2 through 10 of the C-Card revealed no reliable main effects or interactions (Appendix B, Table 2). Thus there is no evidence in the present study for an effect of either amount of practice or semantic relatedness on the speed of color naming.

EXPCW-Card

Analysis of the EXPCW-Card revealed no reliable main effects or interactions, although the main effect for relatedness approached significance ($F_{2,210} = 2.61$, $.10 > p > .05$; Appendix B, Table 3).

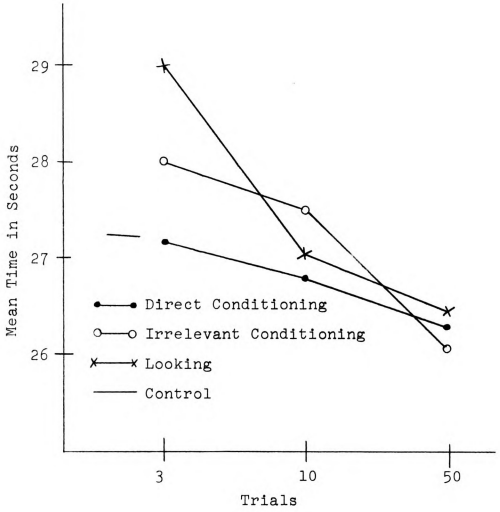


Figure 1.--Word card times as a function of semantic relatedness and amount of practice.

STDCW-Card

No main effect or interaction reached the .05 level in the analysis of the STDCW-Card. The main effect for relatedness, however, approached significance ($F_{2,210} = 2.36$, $.10 > p > .05$; Appendix B, Table 4).

Interference

The scoring formula chosen to represent interference in this study was CW-C. Jensen's (1965) factor analysis suggests that this formula is the "purest" interference formula of the 16 proposed formulas he studied.

If the independent variables have any effect, they should be expressed in the experimental interference scores (EXPCW-C). An analysis of these scores reveals a reliable main effect ($F_{2,210} = 4.05$, $p < .05$) for relatedness (Appendix B, Table 5). Neither the practice main effect nor interaction are reliable. Figure 2 is a graph of the means for all groups on this variable.

Scheffe's test (Winer, 1962, pp. 209-210) reveals no reliable difference for the looking vs. irrelevant condition comparison collapsed over trails. Direct conditioning is reliably different from looking and irrelevant conditioning combined ($F = 7.59$, $p < .05$ where $F_{.05,2,200} = 6.08$).

A similar analysis was performed on the standard interference scores (STDCW-C) to determine if the effect of relatedness was specific to the experimental interference dependent variable. This analysis revealed no significant

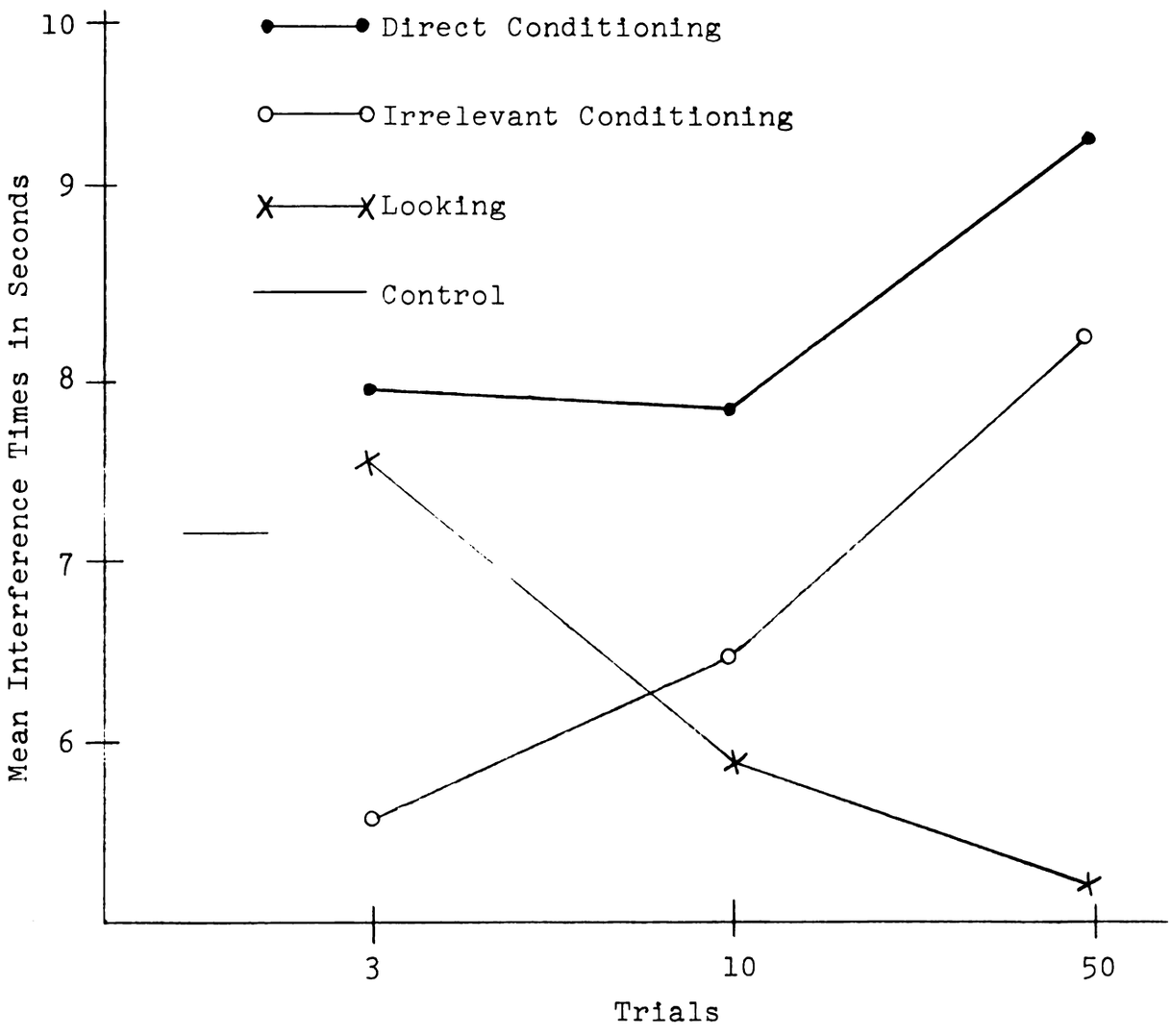


Figure 2.--Experimental interference as a function of semantic relatedness and amount of practice.

main effects or interactions (Appendix B, Table 6). Thus the effect of relatedness seems to be confined to the specific interfering items conditioned in the paired associate task.

Within Task Interference Effects

In addition to measuring total times on each card, the time necessary to complete each 1/3 of a card was also measured. Thus, C_1 = the time necessary to name the colors in lines 2, 3, and 4 of the C-card; C_2 = time necessary for lines 5, 6 and 7; and C_3 = time necessary for lines 8, 9 and 10. Measurements were made in a similar fashion for the CW-cards. Interference scores were then calculated using the formulas:

$$\text{Experimental Interference}_i = \text{EXPCW}_i - C_i$$

and

$$\text{Standard Interference}_i = \text{STDCW}_i - C_i$$

This method of scoring yielded three experimental interference scores and three standard interference scores for each S, i.e., one score for each third task.

The analysis for these scores were two 3 x 3 x 3 (Relatedness x Practice x Thirds) analyses of variance with repeated measures on one Variable (Appendix B, Tables 7 and 8). The between subjects' portion of this

analysis is only partially redundant with the previous analyses of total interference scores since the control group is omitted. The omission of the control group does not alter the interpretation of the previous analyses as the main effect for relatedness remains reliable in the experimental interference condition ($F_{2,189} = 3.49$, $p < .05$).

The main effect for thirds of the task is reliable for both the experimental ($F_{2,378} = 4.32$, $p < .05$) and standard ($F_{2,378} = 9.03$, $p < .01$) conditions.

Figure 3 shows the within subjects effect for both the standard and experimental interference conditions.

The linear trend in this figure for standard interference is significant ($F_{1,131} = 19.92$, $p < .0005$), and the linear trend for experimental interference is also significant ($F_{1,131} = 5.55$, $p < .05$). The quadratic trend for experimental interference approaches significance ($F_{1,130} = 3.35$, $.10 > p > .05$). In general, Figure 3 shows that standard interference declines as the task progresses while experimental interference increases.

Two within subject analyses of variance were performed on the control group alone. These analyses show the same within task effect as the analysis of the other groups in the standard interference condition ($F_{2,42} = 9.34$, $p < .01$). However, there is no reliable within task effect for experimental interference in the control group (Appendix B, Tables 9 and 10).

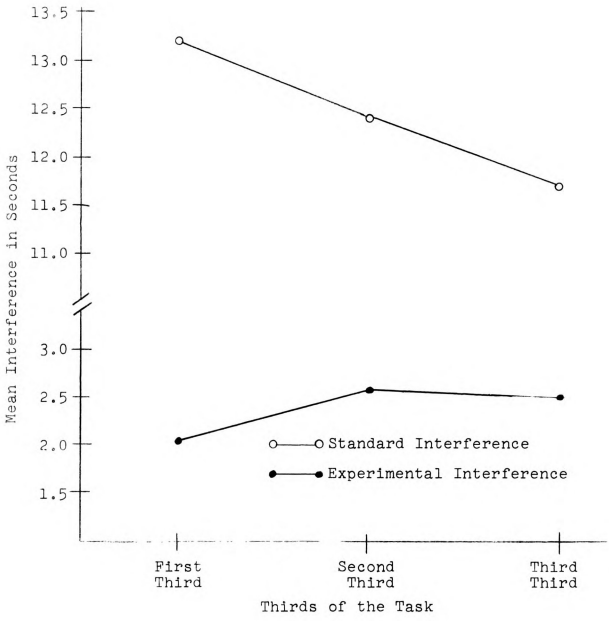


Figure 3.--Interference as a function of thirds of the task.*

*Note discontinuity of ordinate.

Content Data

Data on the types of overt errors made by Ss in the experimental interference condition were also gathered from Ss tape recorded performance. The scoring classification is analagous to the classification system originated by Rand et al. (1963). Some modifications were necessary since the interfering items are nonsense syllables rather than color names.

The following categories were employed.

1. "Syllable Conflict": If S responds by reading the syllable rather than naming the color of the syllable, he has made a syllable conflict error. If "dap" is printed in green and S says "dap" or "da...," he has made a syllable conflict error.
2. "Color Direct": S says the name of a color which had been conditioned to the particular syllable in the direct conditioning groups. For example, "dap" was always paired with "red" in the direct conditioning groups. If the appropriate response to "dap" is "green" on the CW-card (i.e., "dap" is printed in green ink) and S says "red," this response would be scored as a color-direct error. Partial response, e.g., "re...," are also included in this category.

3. "External Color": This class includes any inappropriate color response which is not a color direct error if it is one of the three colors on the card. Considering "dap" printed in green, again, if S had responded "blue," he would have made an external color error. Partial responses are again included in the total.

Four other types of errors, articulate utterances, inarticulate utterances, omissions, and irrelevant external colors (e.g., orange, brown, purple, etc.) were also scored. The frequencies of these errors were insufficient to permit analysis (raw data may be found in Appendix C).

It was felt that independent judgments of error scores were unnecessary since these errors are quite obvious on the tapes. There is practically no ambiguity in selecting the appropriate category for an error. The only ambiguous classification in this respect is the inarticulate vocal utterance category. It is difficult, at times, to discriminate heavy breathing from a sigh.

Syllable Conflict

A 3 x 3 + 1 analysis of variance on syllable conflict scores (Appendix B, Table 11) revealed a reliable main effect for relatedness ($F_{2,210} = 3.48$, $p < .05$).

Neither the practice main effect nor the Practice by Relatedness interaction reached the .05 level. The mean number of syllable conflict errors for each group is shown in Figure 4.

Scheffe's test for all comparisons within a logical grouping shows that the direct conditioning 50 trial mean is reliably different from all other means at at least $p < .05$ (Appendix B, Table 12). There is some question about the Relatedness x Practice interaction. The overall F test reveals no reliable interaction while Scheffe's test suggests that practice interacts with relatedness on this dependent variable. Further research may resolve this ambiguity. This interaction is not crucial to the interpretation of this study.

When collapsed over trials, the irrelevant and looking treatments are not significantly different from one another. Direct conditioning is significantly different from the other two treatments combined ($F = 6.89$, where $F_{.05,2,200} = 6.08$).

Color Direct vs. External Color

"Color direct" and "external color" are not necessarily independent scoring categories. It may be that, in some cases, an error scored as a color direct error may actually be an external color error. Consider the consecutive items "dap" and "fon" which are printed in

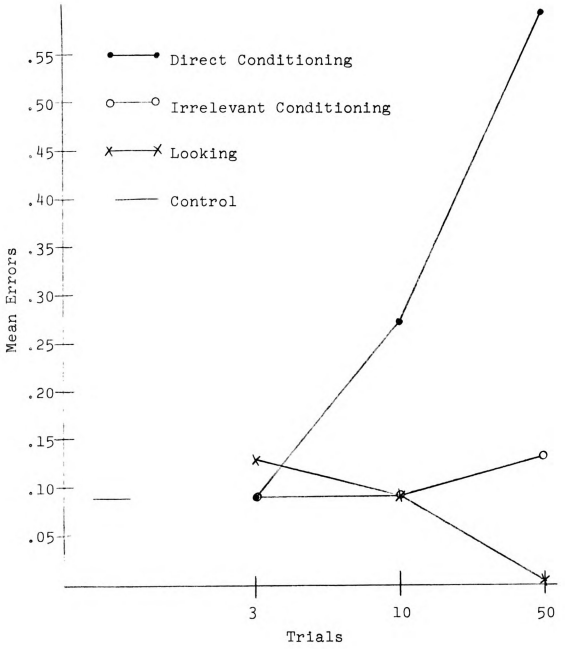
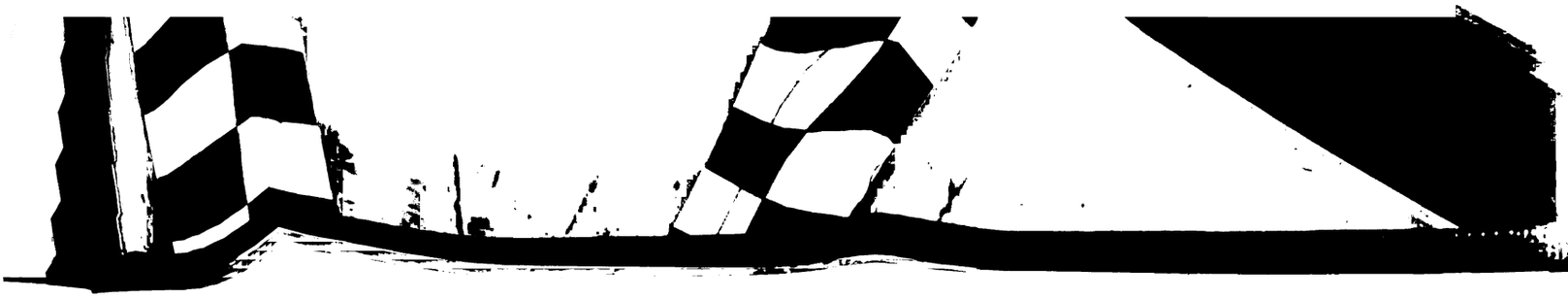


Figure 4.--Mean "syllable conflict" errors as a function of semantic relatedness and amount of practice.



blue and red ink, respectively. If S responds to "dap" with "red," he would be scored as having committed a color direct error. Actually, S may have been anticipating the response for the next item ("red"), meaning that his error is not produced by the syllable "dap." With only three colors being used it is impossible to construct a card which is unambiguous in this respect and still meets the criteria of randomness used in the construction of stimulus materials in this study.

Consequently, the analysis of these scores must be concerned with the relative proportion of color direct and external color errors rather than mean number of errors of each type. Further, "color-direct" is a meaningless classification for the irrelevant conditioning and looking groups. The nonsense syllables were not conditioned to colors for these groups. Color direct scores in these groups, however, can be used to form a baseline against which to compare the direct conditioning groups. The appropriate question here is, "Does the direct conditioning group show a greater proportion of color direct errors to external errors than do the other two groups?"

Each S who made color direct and/or external color errors was classified as a color direct responder or an external color responder depending upon the dominant type of error made. Thus a S who made five color direct errors and four external color errors would be called a color

direct responder. Two frequency analyses were performed. S had to make at least one dominant error to be included in one analysis and at least two dominant errors to be included in the other. Both analyses lead to the same conclusions. Figure 5 shows the proportion of Ss classified as color direct responders in the three relatedness conditions using the criteria of "one or more" and "two or more." In both the "one or more" ($\chi^2_2 = 7.32$, $p < .05$) and the "two or more ($\chi^2_2 = 10.77$, $p < .005$) there are reliable differences among groups (complete contingency tables may be found in Appendix B, Tables 13 and 14).

Tachistoscope Data

Three tachistoscope variables were analyzed: the sum of thresholds of the conditioned syllables on the pretest, the sum of thresholds of the conditioned syllables in the posttest and the pretest-posttest difference score (Appendix B, Tables 15, 16 and 17). It was expected that the practice variable would be reflected in either the posttest or the pretest-posttest difference scores. Correlation coefficients were then calculated between these two variables and experimental interference as a further test of the attensity variable.

In the analyses for the pretest and posttest, only the comparison for "Control vs. all other Groups" proved reliable (Pretest: $F_{1,210} = 4.01$, $p < .05$; Posttest: $F_{1,210} = 4.44$, $p < .05$). In both pretest and posttest

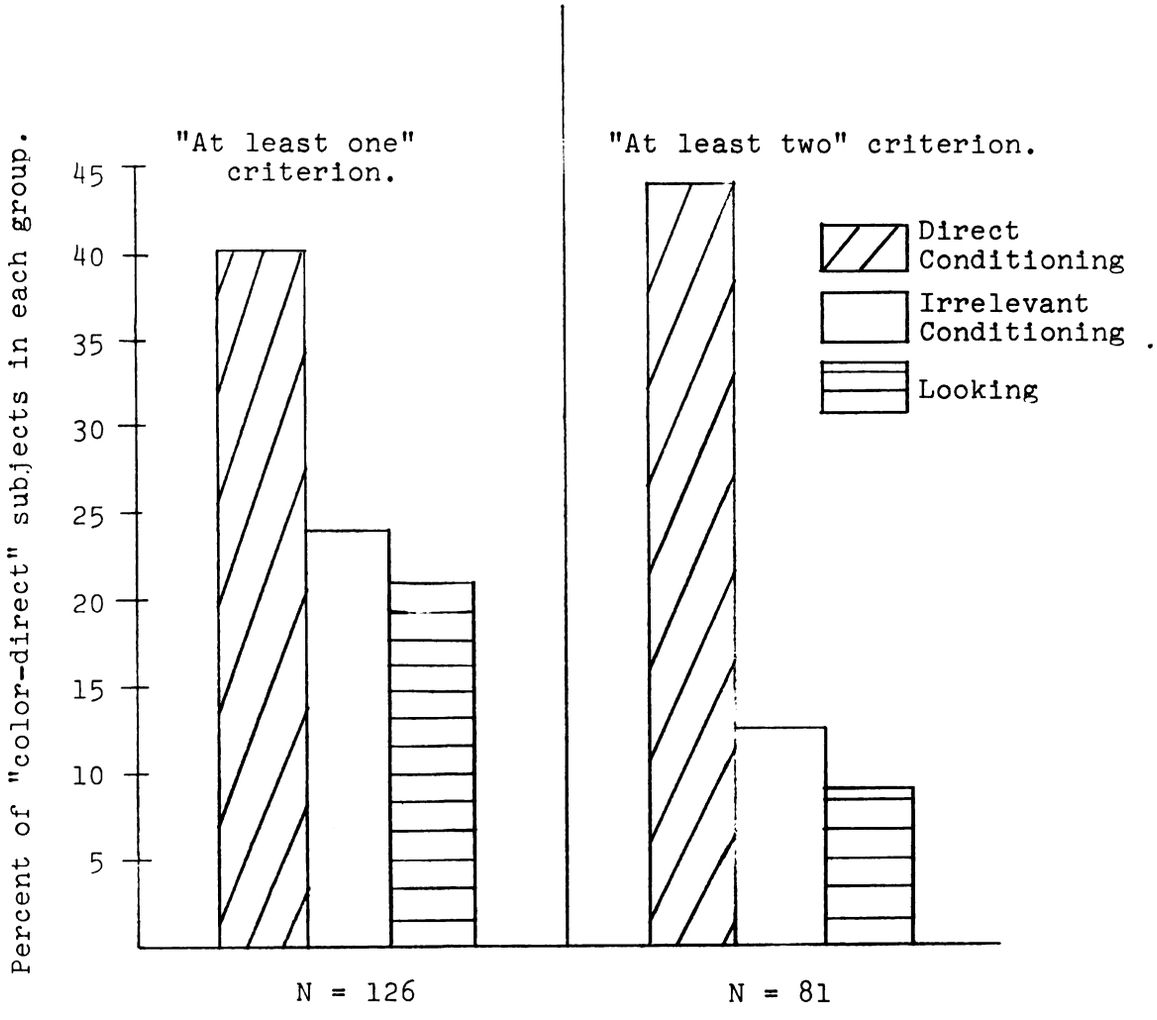


Figure 5.--Proportion of subjects classified as "color-direct" responders in each semantic relatedness treatment.

the control group displayed lower thresholds than the mean of all other groups combined (Table 2). There were no reliable effects in the analysis of the difference scores and none of the variables were reliably correlated with experimental interference.

Extraversion Data

Using the data from the Maudsley Personality inventory, two groups of Ss were formed for the purpose of analysis. These groups consisted of the lowest 44 and the highest 33 Maudsley Ss. A low score on this test represents interversion while a high score represents extraversion. These groups were then compared in a 2 x 3 analysis of variance on their standard interference scores. Thus, the two dimensions in this analysis represent extraversion and within task interference (i.e., interference in thirds of the task). The cell means for the analysis are presented in Table 3. This analysis (Appendix B, Table 18) produced a reliable main effect for thirds of interference ($F_{2,227} = 4.07$, $p < .05$). Neither the extraversion main effect nor the Extraversion by Thirds interaction was reliable. The direction of the main effect for thirds is similar to the direction of the main effect for thirds for all Ss combined (c.f. section on "Within Task Interference").

TABLE 3.--Means of within task standard interference for extraverts and introverts.

	First Third	Second Third	Third Third
Introverts[1]	13.6	13.3	13.2
Extraverts[2]	14.3	12.3	12.2

[1] $N = 44$.

[2] $N = 33$.

CHAPTER V

DISCUSSION

Interference and Content Data

Without exception, the analyses performed in this study suggest that semantic relatedness is a more powerful variable than practice in terms of the amount of interference produced. This conclusion is not particularly surprising in light of the data published by Klein (1964). The magnitude of differences in interference among nonsense syllables, rare words, and common words in his study is on the order of two to four seconds, while the difference in interference between common words and directly conflicting color names is about 25 seconds. Only two effects may be attributed to practice in the present study: (1) practice in reading and making verbal responses increases the speed of reading aloud, and (2) practice may interact with relatedness in the production of syllable conflict errors. As demonstrated by both Klein and Bakan and Alperson, there is a practice effect on interference or at least an effect of word frequency and duration threshold, variables which should be analagous to practice. The failure of the present study to detect this effect probably means that the effect is too subtle for the paired associate technique which was used.

Klein's analysis of the reason for interference is that seeing a word causes a rise ". . . in excitatory level of [the] representational structure of the word, in part or whole, which includes reverberations to the word's motor facilitations within the schema" (p. 585). In other words, the word stimulus evokes not only an increased tendency to say the word, but also an increased tendency to say other words which are in the same "associative network." The tendency to say these words competes with the tendency to say the appropriate color name (i.e., the color in which the word is printed) for the single vocal response channel. The content analyses of the present study strongly support this analysis. The groups showing the greatest amount of experimental interference, the direct conditioning groups, also showed the greatest tendency to say both the interfering syllable ("syllable conflict" errors) and its associated response ("color-direct" errors).

Within Task Effects

The fact that standard interference declines through the task while experimental interference increases is an unexpected finding. Unfortunately, the design of this experiment is not appropriate for this comparison since the standard condition always followed the experimental condition. Although it is difficult to explain how a

sequence effect could account for the direction of the trends, the possibility of such an effect cannot be excluded.

Apparently there are no published accounts of the trend within task interference. However, both Jensen (1965) and Smith and Nyman (1959) report that interference decreases with successive presentations of the same CW-card. These studies reduce the probability that a sequence effect accounts for the trend of standard interference.

The trend of within task standard interference in this study clarifies the confusion on the nature of improvement in color-word performance. Jensen and Rohwer (1966) point out that it is not clear whether improvement is a function of specific practice with a particular CW-card or if it represents an increase in whatever ability accounts for superior performance. The results of the present study suggest that an increase in ability accounts for at least some part of the improvement observed by these authors. Performance improves even though the order of responses varies unsystematically from line to line.

The interpretation of increasing within task experimental interference is difficult. A reasonable interpretation is that naming colors on the EXPCW-card is a relatively easily mastered task (the magnitude of interference here is about 7 sec. while on the STDCW-card

interference is about 37 sec.). It may be that having mastered this task in the early portion of the card. There is a temptation to ascribe this increment to a specific learning effect, since analysis of the control group did not show a reliable within task experimental interference effect. This temptation should be tempered by the relaization that the difference between the control and conditioned groups may represent nothing other than a loss of power in the control group analysis, i.e., the use of 22 Ss as opposed to the use of 198 Ss.

Tachistoscope Data

It was expected that posttest thresholds of the conditioned syllables or pretest-posttest difference scores would show a regular relationship with amount of practice. The failure of this study to find such a relationship may indicate that the tachistoscope technique is not sensitive enough to reflect changes based on about 5 minutes of paired associate learning. The relationship which has been found between duration threshold and word frequency presumably develops over years of familiarity with the language.

Winnick and Nachbar (1967) have recently published a study similar to the present one. They trained three groups of subjects with a paired associate learning task (using real words) to a 50% learning criterion, a 100% criterion and a 150% criterion. These authors also failed

to find a reliable relationship between tachistoscopic duration threshold of the stimulus items and amount of practice.

The Bakan and Alperson study relating duration threshold to interference was an independent groups design. Consequently, this study did not deal with possible within subjects relations between these variables. The function of the correlational analyses in the present study was to determine if such relations do, indeed, exist. In view of the insensitivity of the threshold scores to the practice variable, however, these correlations between interference and the threshold measurements are of questionable value.

Since the difference between the control group and all other groups in this study exists in both the pretest and the posttest, it is reasonable to assume that this difference represents nothing more than sampling bias. It will be remembered that the first 12 Ss of the control group were run in sequence after the study was in progress. The order of testing Ss in this group could have easily allowed their observed scores to be biased either by sampling error or any systematic change which might have been present in the administration of the tachistoscope task.

Extraversion Data

Bakan, Belton and Toth (1963) have demonstrated that extraverts and normals display a greater performance decrement than introverts in a vigilance task. The present study was an attempt to see if a similar relationship holds for Stroop Interference. The fact that the present study failed to find such a relationship may reflect the considerable difference in the statistical power of these two studies. The Bakan et al. study used 155 subjects while the present study used only 77. A study using a larger sample might be a better test of the relationship between Stroop performance and Extraversion.

CHAPTER VI

CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Three conclusions may be drawn from the results of the present study.

1. Although the nature of the relationship between practice and semantic relatedness has not been clarified by this study, it is clear that semantic relatedness is the more potent of the two variables in the production of interference.
2. As Klein's theoretical analysis suggests, both specific effects of the inferfering stimulus and effects due to associative connections of this stimulus are implicated in the production of interference.
3. Some authors have noted an improvement in Stroop performance with repeated testing. The within task decrement in interference found in this study suggests that at least some part of this improvement may be accounted for by an increase in ability, as opposed to specific practice effects.

The fact that within task standard and experimental interference display opposite trends is a finding which deserves further research. The possibility that implicit rehearsal accounts for the trend of experimental interference might be explored by simply making it clear to a group of subjects that they will not have to recall the paired associates. If this technique reverses or eliminates the trend, then the finding is trivial. On the other hand, if the opposition of trends turns out to be specifically related to paired associate learning, such a finding would have broad implications for verbal learning in general. Comparisons of laboratory production of verbal events with the effects produced by "real" verbal units are not often made in psychological studies. Such comparisons should prove fruitful in assessing the limits generalization from the laboratory to the real world.

A more powerful study of the effects of extraversion on within task interference is called for. A study coupling a larger number of subjects with more extreme criteria for assigning subjects to groups might clarify the effect of this variable as it did in the Bakan et al. study.

Finally it should be pointed out that the Klein study, the Bakan and Alperson study, and the present study all avoid the central question concerning the nature of interference. It is easy to imagine that variables such as attensity, response-competition for a single vocal

channel, and increase in the tendency to say inappropriate responses account for differences in interference. However, none of these variables can account for the tremendous difference in magnitude of interference when the interfering stimuli are color related as opposed to when the interfering stimuli are irrelevant to the color naming task. In other words, why is it so much more difficult for a subject to overcome response competition when the competing responses are similar than when they are dissimilar?

A promising direction for research on this question lies in the use of content analyses of errors made by subjects. Comparison of different types of errors produced by different interfering stimuli may shed some light on this problem.

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APPENDICES

APPENDIX A

INSTRUCTIONS FOR ALL TASKS

T-Scope Instructions

This part of the experiment is a test of how keen your vision is when a word is briefly flashed before your eyes. When you press this button, a three letter nonsense syllable will appear very briefly on the screen, between the two vertical black lines. When I say "NOW," press the button firmly and then release it. After each presentation, tell me what you have seen by both spelling and pronouncing the syllable. If you see only part of the syllable, spell whatever you have seen. There is no objection to guessing, but if you have absolutely no ideas of what was presented, please say the word "nothing."

The first presentations will be very brief and you will probably be unable to recognize the syllable. Each presentation will be slightly longer than the one before it. This will continue until you have correctly recognized the syllable. We will then move on to another syllable. I will notify you before I change the syllable which is being flashed.

Do you have any questions?

[illegible] "nothing."

[illegible] and you

[illegible] the syllable. Each

[illegible] the one before

[illegible] you have correctly recognized

[illegible] another syllable.

[illegible] the syllable which is

[illegible]

[illegible] have any questions?

Paired-Associate Instructions

This part of the experiment is a learning experiment in which you will learn to associate nonsense syllables and words. It is very important that you follow the instructions to the best of your ability. Should you fail to follow any instruction, be sure to tell me since the interpretation of the results may be affected.

The list will consist of three pairs of items like the pair in this window. When we begin, the nonsense syllable will always appear in the window alone, while the word is covered by a piece of metal called a shutter. After a short time, the shutter will lift and reveal the word. Your task is to associate or connect the word with the nonsense syllable so that you will be able to say both the word and syllable while the syllable alone is in the window, that is, before the shutter goes up. Since the order in which the pairs follow each other will not always be the same, you must learn these pairs as pairs and not in the particular order in which the pairs follow each other.

Always try to anticipate the word just after the syllable has appeared. If you are able to say the syllable and word before the shutter goes up, I will count it as correct; on the other hand, if you say nothing or say the syllable or word after the shutter goes up, I will count it as incorrect.

Do you have any questions?

W-Card Instructions

For this part of the experiment I will give you a page with color names printed on it. When I tell you to begin, read the color names aloud. Please read rapidly as I will be timing you. If you make a mistake, please correct it before going on but remember you are working for speed. Read the page from left to right as though you were reading the page of a book.

Do not pause at the end of lines as you are being times on the whole page rather than for individual lines. Please do not point to the words you are reading, and do not use a singsong voice.

Read the names as fast as you possibly can. The faster you can read the names, the better your score will be. When you finish the whole page say the word "Stop."

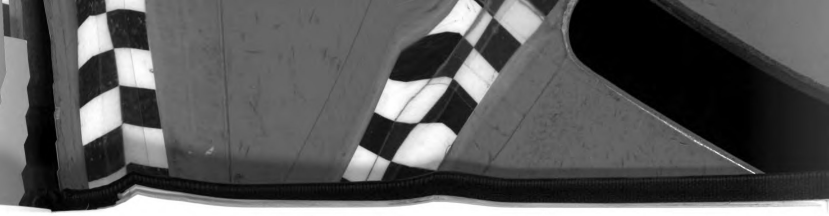
Do you have any questions?

C-Card Instructions

This part of the experiment is similar to the preceding part, except that the page contains a series of patches of color rather than words. You are to name the colors from left to right after I tell you to begin. Again, do not pause at the end of lines; work through the entire page. I will be timing you again so remember to work for speed as well as accuracy. If you make a mistake, please correct it before going on, but remember you are working for speed.

Name the colors as fast as you possibly can. The faster you can name them, the better your score will be. When you reach the end of the page, say the word "Stop."

Do you have any questions?



CW-Card Instructions

On this page you will find a series of words which are printed in different colors. Your task is to ignore the words and name the colors in which the words are printed. If, for example, the word, "Door" was printed in yellow and the word "Chair" was printed in red, you would say "yellow, red" and so on. Again, do not pause at the end of lines; name all of the colors on the page before stopping.

There are certain rules we would like you to follow. You are to name the colors one by one. Do not squint or de-focus your eyes to blur the words; do not point, and do not use a singsong voice. If you make a mistake, please correct it before going on again remembering you are working for speed. When you finish the page say the word "Stop."

Remember, I will be timing you again, so work for speed as well as accuracy. Name the colors as fast as you possibly can. The faster you can name the colors, the better your score will be.

Do you have any questions?

APPENDIX B

STATISTICAL TESTS

TABLE 1.--Analysis of variance of the word (W) card.

Source	SS	df	MS	F
Control vs. All Others	.146	1	.146	< 1
Relatedness (R)	18.49	2	9.245	< 1
Practice (P)	105.52	2	52.760	3.56*
R x P	26.21	4	6.553	< 1
Within	3111.68	210	14.818	

*p < .05.

TABLE 2.--Analysis of variance of the color patch (C) card.

Source	SS	df	MS	F
Control vs. All Others	12.143	1	12.143	< 1
Relatedness (R)	140.37	2	70.185	2.503
Practice (P)	51.07	2	25.535	< 1
R x P	39.17	4	9.793	< 1
Within	5889.05	210	28.04	

TABLE 3.--Analysis of variance of the experimental color word (EXPCW) card.

Source	SS	df	MS	F
Control vs. All Others	11.07	1	11.07	< 1
Relatedness (R)	241.04	2	120.52	2.61
Practice (P)	148.01	2	74.01	1.60
R x P	124.05	4	31.01	< 1
Within	9699.19	210	46.19	

TABLE 4.--Analysis of variance of the standard color word (STDCW) card.

Source	SS	df	MS	F
Control vs. All Others	64.44	1	64.44	< 1
Relatedness (R)	1133.54	2	566.77	2.36
Practice (P)	338.54	2	169.27	< 1
R x P	683.10	4	170.78	< 1
Within	50430.68	210	240.15	

TABLE 5.--Analysis of variance for experimental interference. (Experimental Color Word Card minus Color Patch Card).

Source	SS	df	MS	F
Control vs. All Others	.02	1	.02	< 1
Relatedness (R)	164.43	2	82.22	4.05*
Practice (P)	31.40	2	15.70	< 1
R x P	147.60	4	36.90	1.82
Within	4262.59	210	20.30	

*p < .05.

TABLE 6.--Analysis of variance for standard interference. (Standard Color Word Card minus Color Patch Card).

Source	SS	df	MS	F
Control vs. All Others	30.10	1	30.10	< 1
Relatedness (R)	682.43	2	341.22	2.03
Practice (P)	69.61	2	34.81	< 1
R x P	689.18	4	172.30	1.03
Within	35232.54	210	167.77	

TABLE 7.--Analysis of variance for within task standard interference. (Standard Color Word Third minus Color Patch Third).

Source	SS	df	MS	F
Between Subjects	11423.66	197		
Relatedness (R)	227.48	2	113.74	1.97
Practice (P)	23.20	2	11.60	< 1
R x P	229.73	4	57.43	< 1
Subj. W. Gr. [error (between)]	10943.25	189	57.90	
Within Subjects	5200.67	396		
Thirds (T)	228.83	2	114.42	9.03*
R x T	19.46	4	4.86	< 1
P x T	38.13	4	9.53	< 1
R x P x T	120.45	8	15.05	1.19
T x Subj. W. Gr. [error (within)]	4793.80	378	12.68	

*$p < .01$.

TABLE 8.--Analysis of variance within task experimental interference. (Experimental Color Word Third minus Color Patch Third).

Source	SS	df	MS	F
Between Subjects	1464.85	197		
Relatedness (R)	50.16	2	25.08	3.49*
Practice (P)	8.14	2	4.07	< 1
R x P	46.98	4	11.75	1.63
Subjects Within Gr. [error (between)]	1359.57	189	7.19	
Within Subjects	1635.67	396		
Thirds (T)	34.99	2	17.50	4.32*
R x T	14.04	4	3.51	< 1
P x T	26.78	4	6.70	1.65
R x P x T	30.79	8	3.85	< 1
T x Subj. W. Gr. [error (within)]	1529.07	378	4.05	

*$p < .05$.

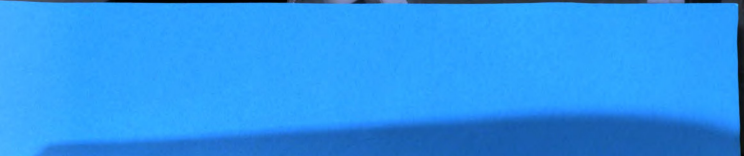


TABLE 9.--Analysis of variance of within task standard interference (control group only).

Source	SS	df	MS	F
Between people	1041.53	21		
Within people	237.34	44		
Thirds	70.64	2	35.32	8.90*
Residual	166.70	42	3.97	
Total	1278.87	65		

*$p < .01$.

TABLE 10.--Analysis of variance for within task experimental interference (control group only).

Source	SS	df	MS	F
Between people	103.76	21		
Within people	122.00	44		
Thirds	1.12	2	.56	< 1
Residual	120.88	42	2.88	
Total	225.76	65		

TABLE 11.--Analysis of variance for syllable-conflict errors.

Source	SS	df	MS	F
Control vs. All Others	.114	1	.11	< 1
Relatedness (R)	2.30	2	1.15	3.48*
Practice (P)	.64	2	.32	< 1
R x P	2.42	4	.605	1.83
Within	69.96	210	.33	

*$p < .05$.

TABLE 12.--Syllable conflict errors (Scheffe's Test).

	Looking, 50 tr.	Control	Irrelevant, 50 tr.	Direct, 50 tr.	Critical Values		
			Means				
50 Trials Comparisons	0	.091	.136	.590			
			Differences				
Looking, 50 tr.		.091	.136	.590*	.393	.473	.521
Control			.045	.499*		.393	.473
Irrelevant				.454*			.393

*p < .05.

TABLE 13.--Number of subjects classified as color direct and external color responders (1 or more criterion).

	Direct	Irrelevant	Looking	
CD	16	10	7	33
EXT	24	32	37	93
	40	42	44	126

$\chi^2_2 = 7.32$, $p < .05$.

TABLE 14.--Number of subjects classified as color direct and external color responders (2 or more criterion).

	Direct	Irrelevant	Looking	
CD	11	3	3	17
EXT	14	21	29	64
	25	24	32	81

$\chi^2_2 = 10.77$, $p < .005$.

TABLE 15.--Tachistoscope posttest analysis of variance.

Source	SS	df	MS	F
Control vs. All Others	39.63	1	39.63	4.44*
Relatedness (R)	21.49	2	10.74	1.20
Practice (P)	11.19	2	5.60	< 1
R x P	13.91	4	3.48	< 1
Within	1875.45	210	8.93	

*p < .05.

TABLE 16.--Analysis of variance for tachistoscope pretest.

Source	SS	df	MS	F
Control vs. All Others	78.09	1	78.09	4.01*
Relatedness (R)	9.12	2	4.56	< 1
Practice (P)	1.91	2	.96	< 1
R x P	24.97	4	6.24	< 1
Within	4093.68	210	19.49	

*p < .05.

TABLE 17.--Analysis of variance for pretest-posttest difference scores.

Source	SS	df	MS	F
Control vs. All Others	7.28	1	7.28	< 1
Relatedness	11.49	2	5.75	< 1
Practice	12.49	2	6.25	< 1
R x P	66.11	4	16.52	2.23
Within	1557.55	210	7.41	

TABLE 18.--Analysis of variance for extraversion.

Source	SS	df	MS	F
Between Subjects		76		
Extraversion (E)	1.89	1	1.89	< 1
Subj. W. Gr.	4251.78	75	56.69	
Within Subjects		231		
Thirds (T)	89.07	2	44.54	4.07*
E x T	21.13	2	10.57	< 1
T x Subj. W. Gr.	2484.48	227	10.94	

*$p < .05$.

APPENDIX C

RAW DATA

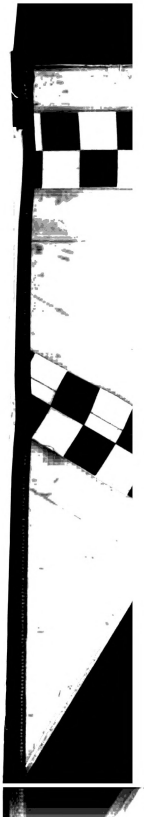
[illegible] -01 09 09 -06 15

CONTENT AND T-SCORE DATA

EXPLANATION OF COLUMNS

1. SUBJECT ID. D=DIRECT, I=IRRELEVANT, L=LOOKING, 0=CONTROL
2. SUBJECT ID. L=3 TRIALS, M=10 TRIALS, H=50 TRIALS, 0=CONTROL
3. COLOR DIRECT ERRORS.
4. SYLLABLE CONFLICT ERRORS.
5. EXTERNAL COLOR ERRORS.
6. INARTICULATE UTTERANCES.
7. ARTICULATE UTTERANCES.
8. IRRELEVANT EXTRA COLORS.
9. OMISSIONS.
10. SUM OF CONDITIONED SYL DIFF MINUS SUM OF FILLER SYL DIFF (T-SCORE)
11. SUM OF CONDITIONED SYL, AFTER (T-SCORE).
12. EXPERIMENTAL INTERFERENCE.
13. DIFFERENCE SCORE FOR CONDITIONED SYL (T-SCORE).
14. SUM OF CONDITIONED SYL, BEFORE (T-SCORE)

12	3	4	5	6	7	8	9	10	11	12	13	14
DH01 CONTENT - T-SCORE	2	0	01	00	0	0	0	-02	07	14	-04	12
DH02 CONTENT - T-SCORE	3	1	02	00	0	0	0	00	08	03	-04	12
DH03 CONTENT - T-SCORE	0	0	00	00	0	0	0	-01	09	06	-04	13
DH04 CONTENT - T-SCORE	1	0	03	00	0	0	0	-01	09	09	-06	15



I408	CO	TENT	-	T-SCORE	0	0	00	00	0	0	1	00	10	15	-02	12
I409	CO	TENT	-	T-SCORE	1	0	01	00	0	0	0	-01	06	05	-03	09
I410	CO	TENT	-	T-SCORE	1	0	00	01	0	0	0	+02	08	07	-01	09
I411	CO	TENT	-	T-SCORE	1	0	02	01	0	0	0	+03	11	08	+01	10
I412	CO	TENT	-	T-SCORE	0	0	02	00	0	0	3	-03	08	05	-03	11
I413	CO	TENT	-	T-SCORE	0	0	01	00	0	0	0	+03	17	11	+04	13
I414	CO	TENT	-	T-SCORE	0	0	02	00	0	0	0	+04	05	00	+02	03
I415	CO	TENT	-	T-SCORE	0	0	03	01	0	0	0	+02	07	08	00	07
I416	CO	TENT	-	T-SCORE	1	0	01	00	0	0	0	00	08	05	00	08
I417	CO	TENT	-	T-SCORE	2	2	03	02	0	0	0	+01	08	07	+01	07
I418	CO	TENT	-	T-SCORE	1	0	01	01	0	0	0	+03	05	11	00	05
I419	CO	TENT	-	T-SCORE	1	1	01	01	0	0	0	00	06	10	-01	07
I420	CO	TENT	-	T-SCORE	3	0	01	00	0	0	0	00	05	01	-02	07
I421	CO	TENT	-	T-SCORE	0	0	05	00	0	0	0	-03	03	05	-03	06
I422	CO	TENT	-	T-SCORE	1	0	00	01	0	0	0	+01	04	15	00	04
I501	CO	TENT	-	T-SCORE	0	0	00	00	0	0	0	-01	08	07	-04	12
I502	CO	TENT	-	T-SCORE	1	0	02	00	0	0	2	+04	09	04	00	09
I503	CO	TENT	-	T-SCORE	0	0	01	01	0	0	0	-05	07	08	-05	12
I504	CO	TENT	-	T-SCORE	0	0	01	01	0	0	0	-01	07	03	-04	11
I505	CO	TENT	-	T-SCORE	0	0	00	00	0	0	0	-03	07	08	-04	11
I506	CO	TENT	-	T-SCORE	0	0	04	00	0	0	0	+01	11	06	-01	10
I507	CO	TENT	-	T-SCORE	1	0	01	02	0	0	0	+03	08	08	-03	11
I508	CO	TENT	-	T-SCORE	0	0	02	00	0	0	0	+02	09	02	-01	10
I509	CO	TENT	-	T-SCORE	0	0	01	00	0	0	0	-01	10	12	-03	13
I510	CO	TENT	-	T-SCORE	1	0	00	01	0	0	0	-02	08	05	-04	12
I511	CO	TENT	-	T-SCORE	1	1	01	00	0	0	0	+02	07	02	00	07
I512	CO	TENT	-	T-SCORE	1	0	00	00	0	0	0	00	04	13	-03	07
I513	CO	TENT	-	T-SCORE	0	0	04	01	0	0	0	-06	07	06	-06	13
I514	CO	TENT	-	T-SCORE	0	0	00	02	0	0	0	00	07	05	-05	12
I515	CO	TENT	-	T-SCORE	2	0	02	02	0	0	0	00	09	10	-02	11
I516	CO	TENT	-	T-SCORE	0	0	01	00	0	0	0	+01	08	11	-01	09
I517	CO	TENT	-	T-SCORE	0	1	02	00	0	0	0	-01	09	03	-01	10
I518	CO	TENT	-	T-SCORE	1	0	03	05	0	0	0	+01	04	08	-02	06
I519	CO	TENT	-	T-SCORE	1	0	00	00	0	0	0	-01	07	00	-03	10
I520	CO	TENT	-	T-SCORE	0	0	00	01	0	0	0	+02	08	05	+02	06
I521	CO	TENT	-	T-SCORE	0	0	02	01	0	0	0	+03	08	01	+02	06
I522	CO	TENT	-	T-SCORE	0	0	00	00	0	0	0	-03	05	06	-01	06
IL01	CO	TENT	-	T-SCORE	0	0	01	00	1	0	0	00	10	05	00	10
IL02	CO	TENT	-	T-SCORE	1	0	00	02	1	0	0	+04	11	13	00	11
IL03	CO	TENT	-	T-SCORE	1	0	00	01	0	0	0	-05	11	04	-06	17

[illegible]												
I119 CO TENT - T-SCOPE	1	0	00	00	0	0	0	-01	07	00	-03	10
I120 CO TENT - T-SCOPE	0	0	00	01	0	0	0	+02	08	05	+02	06
I121 CO TENT - T-SCOPE	0	0	02	01	0	0	0	+03	08	01	+02	06
I122 CO TENT - T-SCOPE	0	0	00	00	0	0	0	-03	05	06	-01	06
IL01 CO TENT - T-SCOPE	0	0	01	00	1	0	0	00	10	05	00	10
IL02 CO TENT - T-SCOPE	1	0	00	03	1	0	0	+04	11	13	00	11
IL03 CO TENT - T-SCOPE	1	0	00	01	0	0	0	-05	11	04	-06	17