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A COMPARISON BETWEEN SCHIZOPHRENIC AND
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PROACTIVE INTERFERENCE.

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CUEING TO FORGET IN A SHORT-TERM MEMORY TASK: A COMPARISON BETWEEN SCHIZOPHRENIC AND CONTROL SUBJECTS IN THE ABILITY TO REDUCE PROACTIVE INTERFERENCE

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

Edwin Mark Greenberg, B.A., M.A.

* * * * *

The Ohio State University
1970

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Introduction

Tasks which involve short-term memory (STM) yield two results of central interest to the present investigation. First, the amount of retention decreases as a function of the amount of previously learned material (i.e., a buildup in proactive interference) (Keppel & Underwood, 1962). Second, the effects of proactive interference (PI) can be reduced in some situations if subject (S) can classify new information differently from previously learned material (Wickens, Born, and Allen, 1963; Wickens and Simpson, 1968; and Turvey and Wittlinger, 1970). Testable schizophrenic Ss have been shown consistently to be inferior to normal or control Ss in inhibiting the interference effects of negative transfer and have also demonstrated less precision in dealing conceptually with verbal symbols (Buss and Lang, 1965; Lang and Buss, 1965). This suggests that schizophrenic Ss should be inferior to control Ss in reducing PI effects on a STM task in which items can be classified on the basis of their functional properties.

Crumpton (1963) compared performances of schizophrenic and normal Ss in motor learning. The experimenter used a task on which S was trained to take a straight-line approach on a concealed-maze pattern. After each S learned the straight-line method the concealed pattern was changed so that only a detour procedure could result in reaching the goal box. Schizophrenic Ss required significantly more trials to
alter their performance strategies from the nonfunctional straight-line procedure to the new detour route. Also, IQ scores were not significantly related to the ease with which Ss were able to modify their strategies. Crumpton's (1963) data indicated that schizophrenic Ss have more difficulty in reducing the interference effects of negative transfer.

Zahn, Rosenthal, and Shakow (1961) studied transfer effects on a reaction-time (RT) task by varying the duration of the preparatory interval. The preparatory interval designated the length of time between a warning signal and the actual signal to respond to a stimulus. The experimenters presented blocks of trials and each successive block represented preparatory intervals of longer or shorter duration. The effect of an upward progression of increasingly longer intervals was a steady increase in RTs for a schizophrenic and a control group. However, the slope of the function was significantly steeper for the schizophrenic group. The effect of a downward progression of increasingly shorter preparatory intervals was different between the same two groups of Ss. The data showed that RTs by schizophrenic Ss to the first block of trials on which there were long preparatory intervals were slow and remained unaffected by the progressively shorter preparatory intervals which followed. In contrast, control Ss showed a function of decreasing RTs as a function of shorter preparatory intervals. The overall results indicated that on a RT task in which negative transfer was produced by changing the length of the preparatory interval, schizophrenic Ss showed much larger performance decrements than control Ss. Houston, Shakow, and Riggs (1937), Rodnick and Shakow (1951), Rosenthal, Zahn and Shakow
(1960), Tizard and Venables (1956), and Zahn, Rosenthal, and Shakow (1963) have reported similar results.

Schizophrenic Ss also show deficits on paired-associate (PA) learning tasks in which negative transfer has been built-in. Kausler, Lair, and Matsumoto (1964) tested schizophrenic and hospitalized-control Ss on a two-stage PA learning transfer paradigm. The experimenters presented each S with two consecutive lists of nine pairs of words each. The second list was of the mixed variety. It contained three A-C pairs (stimuli were taken from List 1 and paired with three entirely new response words designated C); three A-Br pairs (three different stimulus response pairs were taken from List 1 but the terms were re-paired in order to form three new stimulus-response combinations); and three C-D control pairs (three entirely new stimuli designated C were paired with three novel response terms designated D). Control Ss produced significantly fewer number of errors than schizophrenic Ss on each of the three kinds of paired terms on List 2. Moreover, the difference between groups was statistically greatest on the A-Br terms. The A-Br terms typically bring about more negative transfer than the A-C pairs, because S must learn not only to associate a different response to a familiar stimulus, but he must also resist a strong tendency to pair the A-Br items on List 2 in accordance with how those same items were learned initially on List 1. Lang and Luoto (1962) obtained a similar outcome on a three-stage mediated PA learning task. Both the Kausler et al. (1964) and Lang et al. (1962) results extend to the domain of verbal learning the theory that schizophrenic Ss are more adversely
influenced by the effects of negative transfer.

Testable schizophrenic Ss yield deficits relative to control
groups or normal Ss on verbal-type tasks in which negative transfer
is not a major variable. In such cases performance decrements are
usually manifested as approximations to normal usage of words and con­
cepts. Johnson, Weiss, and Zelhart (1964) studied verbal-response
habits in a group of psychotic (predominantly schizophrenic) and
normal Ss. Verbal-response habits were defined by affective ratings
of words (a la Osgood, 1953), word associations (percentage of word
associations which were nonidiosyncratic, and percentage of Ss who
made the most common single association), and meaningfulness. Mean­
fulness was the mean number of associations evoked by a word in a
1-minute interval (Noble, 1952). The data indicated that the patient
group responded with greater word goodness. Further, the patient
group demonstrated markedly lower meaningfulness, fewer nonidiosyncratic
responses, and fewer Ss used the most common single association.

Verbal-response habits in schizophrenia have also been invest­
igated by examining S's understanding and use of common-word meanings
(Moran, 1953). The investigator presented a list of 25 common words
to schizophrenic and hospitalized nonschizophrenic Ss. The two groups
were matched on Wechsler-Bellvue vocabulary scores, age, and level of
education. Each S was given several verbal tasks. The data did not
reveal any significant difference between schizophrenic and control Ss
in defining words and recognizing synonyms. On the other hand, the
verbal behavior of schizophrenic Ss was found to be significantly less
precise than control Ss in constructing sentences, finding similarities
between pairs of words, recalling synonyms, and explaining analogies.

Epstein (1953) showed experimentally that schizophrenic Ss over-included relative to a matched control group when S was instructed to identify attributes of word meanings. The task involved the presentation of a key word like MAN, and the response words arms, shoes, hat, toes, head, and none. The Ss had to underline all response words which designated things or concepts about the key word. Schizophrenic Ss tended more frequently to underline response words like shoes and hat. Similar results have been reported by Lovibund (1954), Chapman (1956), Chapman and Taylor (1957), Payne and Hewlett (1959), Payne (1960), and Chapman and Chapman (1965).

Price (1968) set out to examine other sources of variance in schizophrenic conceptual performance besides the contribution made by imprecisions in verbal-symbol manipulation. The task was that of concept identification and S was required to judge whether a concept shown on a cue card was the same as one appearing 15 sec. later on a test card. Half of the cue cards represented positive instances of a concept (i.e., they were identical to the test card) and the other half represented negative instances (i.e., they were similar but not identical). Schizophrenic Ss produced significantly more incorrect "same" responses than normal Ss, and in addition, there was an increase in number of false positives at higher levels of pathology as rated by the Social Adjustment Behavior Rating Scale. Price proposed that the large number of false positives was a function of having used a 15-sec. delay between cue and test card. That delay required that S remember every dimension of the cue card. Moreover, in a negative
instance of a concept there were several dimensions which cue and test
card shared in common. False positives could have resulted if Ss were
guessing "yes" on the basis of the dimensions which they remembered
the cue card had in common with the test card. A second experiment
was conducted in order to compare a simultaneous presentation of cue
and test cards (i.e., zero-second delay) with a successive-presentation
method (i.e., 15-sec. delay). The results from the second experiment
demonstrated that the number of false positives decreased relative to
correct "yes" responses under zero-sec. delay, and that Ss designated
high pathology benefited most by the method of simultaneous presen­
tation. Price (1968) concluded that retention of concept information
is an independent source of variance in schizophrenic conceptual per­
formance, however, he was not able to elaborate upon the nature of
that retention deficit.

In Price's (1968) successive-presentation method the 15-sec.
delay introduced between cue and test card is similar to the cue-test
delay period used frequently in tests of short-term memory (STM). Tests
of STM typically follow some modification of a paradigm first reported
by Peterson and Peterson (1959). The Peterson and Peterson paradigm
entails a very brief presentation (greater than 1-sec. and usually less
than 5-sec.) of a submemory-span item such as a consonant trigram (CCC).
The trigram is followed immediately by a brief task (10-to 15-sec. in
duration) that minimizes rehearsal (e.g., color-naming task) until S
receives a signal to recall that item. The performance function
that typically results from three-to-four consecutive trials of differ­
et CCCs yields an increasing decrement in retention. This phenomenon
is considered to reflect a buildup in proactive interference (PI) (Keppel and Underwood, 1962). Price's successive-presentation method has several procedural similarities to a STM paradigm. These similarities are as follows: A cue card presented 15-sec. before a test card, a 15-sec. retention interval, and a test card to which S must recall to mind the dimensions of the cue card.

Wickens, Born, and Allen (1963) suggested that interitem interference in a STM task is limited to members of the same class of information. Wickens et al. (1963) used a modification of the Peterson and Peterson paradigm and demonstrated a release from PI for digits that were presented after several trials of CCCs. Wickens and Simpson (1968) showed a PI-shift effect when the series two, nine, four; five, three, eight; and four, one, six was followed by ate, too, won, but a shift did not occur when followed by eight, two, one. These results reported by Wickens and his students suggest that the effects of PI can be reduced for an item in STM provided that S can classify that item differently from previously learned material.

Turvey and Wittlinger (1970) were able to reduce the effects of PI on a STM task by providing Ss with differential instructions "to forget" and "to remember" certain items. In their first experiment, two groups of college Ss were each presented with a different CCC on each of 20 consecutive trials. The experimental group (Cond I) was instructed before the task that the items on Trials 2 to 6, 10 to 12, 13 to 14, and 15 to 19 were "to be forgotten", that is, not to be recalled. Also, for those same Ss the items appearing on Trials 1, 5, 10, 15, and 20 were cued "to be remembered". For the control group
(Cond II) each of the 20 trigrams were "to be remembered". These two conditions were compared on the critical trials (5, 10, 15, and 20) and the data revealed that Cond I recalled correctly significantly more items at each of the four critical trials and there was no difference manifested between conditions at Trial 1.

Turvey and Wittlinger (1970) exempted a rehearsal-strategy explanation on the basis of a test that showed no differences between conditions on the distraction task that occupied the retention intervals. Another test revealed that differences between Cond I and Cond II remained unchanged at each of the four test trials. It was concluded that a novelty variable had not been operative, because there was no evidence of an habituation effect across the 20 trials.

The superiority shown by Ss from Cond I at the four test trials could have been related to their having been cued "not to recall" on those test trials. That is, the effect of cueing S "not to recall" on specific trials might have been a corresponding decrease in response-generated interference across the 20 trials. That possibility was tested in a second experiment in which an experimental and control group were treated identically to their counterparts of the first experiment except that Ss in Cond I of the second experiment were cued "not to recall" after the distraction task. The data from the second experiment demonstrated that Ss who were cued "not to recall" at the time of recall were not significantly different than control Ss on the four critical trials.

The results from the first and second experiments suggested that the critical variable in Cond I of the first experiment was operative
during the presentation of the to-be-forgotten items. In other words, rehearsal and retrieval factors did not appear to have any significant impact on those obtained differences in the buildup of PI.

A third experiment was conducted in order to determine the availability of the to-be-forgotten trigrams. Three treatment conditions were formed and each received six trials. The three conditions differed in the following ways. In Cond I, the trigram at Trial 1 was cued "to be remembered", the items at Trials 2 to 5 were cued "to be forgotten, Trial 6 was "to be remembered", and Trial 6 was a repetition of Trial 5. In Cond II, Trial 1 was "to be remembered", Trials 2 to 4 were "to be forgotten", Trials 5 and 6 were "to be remembered", and Trial 6 was a repetition of Trial 5. In Cond III, all items were cued "to be remembered", and Trial 6 was a repetition of Trial 5. The relationship between these three conditions is summarized in Table 1.

The results from the third experiment showed that there was no significant difference between the three conditions at Trial 6. Also, both Cond II and Cond III showed an increase in retention as a function of repetition. The data indicated that the reduction of PI effects in Cond II was not accompanied by any noticeable loss in the availability of the to-be-forgotten material. Turvey and Wittlinger's (1970) results appear to extend the conclusions of Wickens et al. (1963) and Wickens et al. (1968). Thus, not only can Ss show a release from PI when there is a shift in information class, but that the effects of PI can also be reduced when a functional property of information (i.e., to-be-forgotten vs. to-be-remembered) is manipulated.
The present experiment was similar in design to Turvey and Wittlinger's (1970) third experiment. There are, however, modifications to accommodate different issues and different populations of Ss. The major features of the paradigm used by Turvey and Wittlinger are presented in Table 1. The modified conditions and procedures established for the present study are shown in Table 2. The salient changes which the present method introduced were: 1. Another control condition (Cond III) to yield an estimate of the recall level for Cond I if a repeated item were not presented at Trial 5. 2. A novel trigram followed a repeated item to observe the level of retention at a postrepetition trial. 3. An interpolated trial of to-be-remembered material was placed between the original presentation of a to-be-forgotten trigram and its repetition (Cond III).

In summary, the present experiment was designed to test whether deficits by schizophrenic Ss on a STM task could be accounted for on the basis of conceptualizations that have been already linked to schizophrenia. Much research has indicated that in comparison to control Ss, schizophrenic Ss are less able to cope with the interference effects of negative transfer and less precise in their usage of verbal symbols and concepts. The cueing "to forget" technique allows for a comparison between schizophrenic and control Ss in the ability to reduce PI effects via a process which involves differential classification of learned material. Specifically, control Ss were expected to produce a significantly larger reduction of PI effects in Cond II relative to Cond IV than were anticipated by schizophrenic Ss for those same conditions.
Method

Subjects

Forty inpatients from the Columbus State Hospital in Columbus, Ohio and forty inpatients from the Veterans Administration Hospital in Palo Alto, California formed the sample of 80 schizophrenic Ss. The criteria of eligibility were as follows. Patients were selected if they had at least six months of uninterrupted hospitalization and a consistent diagnosis of schizophrenia indicated in their clinical records. Patients who were suspected of brain damage, chronic alcoholism, and who has any previous participation in shock therapy were excluded.

Nineteen tubercular inpatients from Means Hall of the Ohio State University Hospital plus 21 physical rehabilitation inpatients from Dodd Hall of the Ohio State University Hospital in Columbus, Ohio were joined by 40 tubercular inpatients from the Veterans Administration Hospital in Livermore, California to form the sample of 80 control Ss. Patients who were suspected of brain damage, chronic alcoholism, or any history of psychiatric disturbance were excluded.

Each S was assigned to one of four test conditions and each condition contained 20 schizophrenic and 20 control Ss. The schizophrenic and control groups within each condition were matched approximately on age and level of education. In addition, each type of S was equally
represented by Ohio and California Hospitals within each of the four conditions. The four groups of 20 schizophrenic Ss were matched separately on age, level of education, and number of months of present- and past hospitalization. The four groups of control Ss were matched similarly except on past hospitalization.

A two-factor analysis of variance revealed no significant difference between any of the eight groups on level of education. Another two-factor analysis of variance showed that on the average control Ss were older than schizophrenic Ss by about five years (F=8.71, df=1/152, p < .01). However, there were no differences between each of the four schizophrenic and each of the four control groups on the age variable. Also, F tests indicated no reliable differences between the schizophrenic groups on present- or past hospitalization. Finally, no differences emerged between the control groups on past hospitalization. The means and standard deviations for each of the eight groups on age, education, and length of hospitalization are shown in Table 3.

Participation for each of the 160 testable patients was on a voluntary basis. Each volunteer had to show an average ability to read as well as perform the color-naming exercise used as a rehearsal-prevention task. There was no experimental control over the effects of various medications which were being consumed therapeutically by each of the 160 testable inpatients. However, studies by Mason-Brown and Borthwick (1957), Datson (1959), Vestre (1961), Dimascio (1963), Downing (1963), Payne and Friedlander (1963), and Hum, Livingston, and Shader (1969) have indicated that the most frequently used antipsychotic drugs have only a minimal affect upon performance by schizophrenic Ss.
on tasks involving short-term retention. Finally, a total of 43 schizophrenic and 14 control patients who volunteered were found to be untestable and their data were discarded.

Lists

The retention items were consonant trigrams (CCCs) taken from Witmer's List (Underwood and Schultz, 1960). The CCCs had association values ranging from 25 to 33% and there were no repeated letters. The trigrams were GKN, XHB, JZS, QDL, and RMF. The five trigrams were rotated so that each appeared about an equal number of times at each trial position within each of the four conditions.

Apparatus and Procedure

Each S was tested individually. The order of testing was unsystematic and was determined by S's availability at the time of testing. A Kodak Carousel projector, programmed by a taped-timer and placed a distance of six feet from a viewing screen, was used to present slides containing the elements from each trial. A trial consisted of the following events. First, a ready signal exposed for a 2-sec. duration. Second, a trigram with a 5-sec. duration which S read out-loud two times. Third, a printed list of six different colors with the names of each color shown in its respective color. The order of the colors were arranged differently during each retention interval in order to prevent S from memorizing a single sequence. The slide with the names of the six colors was exposed throughout a 10-sec. retention interval and S was instructed to read out loud the names of the colors as many times as possible before the slide was changed. Last, a recall signal lasting for 10-sec., during which S had to recall a to-be-remembered
CCC or remain silent for a trigram which had been cued "to be forgotten. A ready signal followed the termination of the 10-sec. recall interval and it announced the beginning of the next trial.

Printed words and color cues were used to help S understand and perform the operations of each trial. The ready signal was an asterisk shown in the middle of the slide and the words "get ready" appeared above that symbol. The slide containing the CCC had the word "read" appear above the trigram and the word "remember" or "forget" appeared below the trigram. A yellow or green colored background was used as an additional cue to help S discriminate between trials on which items were "to be remembered" or "to be forgotten". Each color was used as a cue for both classes of trigrams so that half the Ss in each group saw yellow as a cue "to remember" and green "to forget" and the remaining Ss saw green "to remember" and yellow "to forget". If S was required to recall an item following the color-naming task he saw a question mark in the middle of the slide, the word "recall" printed above it, and the appropriate color (i.e., yellow or green) that designated it as one "to be remembered". If the CCC was "to be forgotten", S saw the words "do not recall" and the appropriate color. The Ss in Cond IV, for whom all trials were cued "to be remembered", received the same pattern of color backgrounds (Trials 1, 4, 5, and 6 in one color, and 2 and 3 in the other) in order to control for novelty or any possible facilitation effects which color might have provided for the other conditions.

Conditions

In Cond I, items that appeared on Trials 2 to 4 were cued "to
be forgotten", that is, S was instructed "not to remember" and "not to recall". Items presented on Trials 1, 5, and 6 were cued "to be remembered", that is, "to be recalled". In addition, Trial 5 was a repetition of Trial 4. In Cond II, the items on Trials 1, 4, 5, and 6 were cued "to be remembered", Trials 2 and 3 were "to be forgotten", and Trial 5 was a repetition of Trial 4. In Cond III, Trials 2 to 4 were "to be forgotten", 1, 5, and 6 were "to be remembered, and Trial 6 was a repetition of Trial 4. In Cond IV, all trials were "to be remembered" and Trial 5 was a repetition of Trial 4.

The Ss in each condition were given detailed instructions prior to the actual task. Each S was trained on a sample sequence of digit trigrams in order to be sure that S could follow the procedures in the actual testing condition. The consonant trigrams were not presented until S exhibited a proficiency on the sample items. A three-min, rest period was introduced between the sample task and the actual test in order to minimize fatigue effects which might have accrued.
Results

A scoring system first reported by Wright (1967) and later adopted by Turvey and Wittlinger (1970) was used as a measure of STM in the present experiment. One point was assigned for correct recall of a consonant and a second point was given if that consonant was recalled in its correct position in the three-letter sequence. A value of zero was given for each omitted consonant and for each incorrect consonant. Each S's performance could vary from a low score of zero to a maximum of six. Therefore, this scoring system allowed for an analysis of responses which were only partially correct. The performance functions by schizophrenic and control groups for each Condition across all Trials is shown in Figure 1.

Buildup of PI effects

Schizophrenic and control Ss were compared first on the buildup of PI effects in Cond IV. Performances were tested by way of a 2 X 4 analysis of variance. The two factors were Type of S and Trials (1, 2, 3, and 4). The results are summarized in Table 4 and Figure 2. It can be seen that Type of S and Trials main effects were significant, however, the Type of S by Trials interaction did not reach an acceptable level of confidence. These data suggest that both schizophrenic and control Ss manifested a decrement in recall performance from Trial 1 to Trial 4, that is, a buildup in PI effects.

Reduction of PI effects

Schizophrenic and control Ss were compared next on reduction of PI
effects. An \( F_{\text{max}} \) test performed on the scores of Trials 1 and 4 from Cond II and Cond IV was not statistically significant. Performances were then tested by way of a 2 X 2 X 2 analysis of variance. The three factors were Conditions (II and IV), Type of S, and Trials (1 and 4). The results are summarized in Table 5 and Figure 3. It can be seen that there was an overall significant decrease in mean recall scores from Trial 1 to Trial 4. Tests on simple effects showed that the drop in retention was a reliable effect for both control (\( F=14.32, df=1/76, p<.01 \)) and schizophrenic Ss (\( F=48.23, df=1/76, p<.01 \)). However, the significant triple interaction indicated that the drop in retention across trials was a function of Type of S as well as Conditions.

Individual cell means were tested separately. A simple effects test on the scores by control Ss at Trial 4 resulted in no difference between the means of Cond II and Cond IV. In addition, an analysis of variance was performed only on the scores by control Ss in Cond II and Cond IV at Trials 1 and 4. Trials produced the only reliable effect. These results suggest that control Ss were unable to reduce PI effects in Cond II relative to Cond IV. Schizophrenic Ss showed a significant decrease in recall scores from Trial 1 to Trial 4 in Cond II (\( F=23.52, df=1/76, p<.01 \)) and Cond IV (\( F=4.22, df=1/76, p<.05 \)). Furthermore, not only was there a significant difference at Trial 4 between the mean recall scores of Cond II and Cond IV, but as can be seen in Figure 3 performance in Cond IV was superior to Cond II (\( F=5.19, df=1/76, p<.05 \)). Clearly, schizophrenic Ss were unable to reduce PI effects and in relation to control Ss the schizophrenic group emitted fewer correct responses at the transition point between
items cued "to be forgotten" and those cued "to be remembered" at Trial 4, Cond II.

It is possible that the level of recall by schizophrenic Ss at Trial 4, Cond II was lower than at Trial 4, Cond IV, because Ss had been set not respond on Trials 2 and 3. In other words, schizophrenic Ss might have failed to change back to a responding set on Trial 4. This possibility was tested by comparing the number of schizophrenic Ss who failed to respond. A total of 17 Ss responded at Trial 4, Cond II and 20 Ss responded at Trial 4, Cond IV. A chi-square test showed that the difference between frequency of Ss who responded in the two conditions was not significant.

The recall scores from Trial 4 were examined further in order to probe for any idiosyncratic responses which schizophrenic Ss might have produced. It was found that of the 17 Ss in Cond II who responded 15 Ss emitted at least one consonant that was not a member of the to-be-recalled trigram. Consonants which were given out of context were found by inspection to have their origins in Trials 1, 2, or 3 and from extra-experimental sources. Of the 20 Ss who responded in Cond IV only 4 Ss gave consonants which were out of context. The difference between these two frequencies was statistically significant.

The retention level of an item which follows immediately after a repeated trigram purportedly reflects the amount of PI which was operative prior to repetition (Cermac, 1969). In other words, recall performance on a postrepetition trial returns to the recall level immediately preceding the presentation of the repeated trigram. It was expected that if any condition yielded reduction of PI effects
that this would be reflected in postrepetition scores. The postrepetition recall scores (Trial 6) for control and schizophrenic Ss in Cond II and Cond IV were tested in a 2 X 2 X 3 analysis of variance. The three factors were Conditions (II and IV), Type of S, and Trials (4, 5, and 6). It can be seen in Table 6 and Figure 4 that main effects due to Type of S and Trials yielded the only significant sources of variance. Since there was not a significant Conditions main effects nor any significant interaction with Conditions, no reliable amount of variance was accounted for on the basis of the cueing "to forget" technique.

The data that are reported in Table 5 and Figure 3 showed also that Type of S was a significant effect as was the Type of S by Trials interaction. Tests on simple effects demonstrated that control Ss produced larger mean recall scores than schizophrenic Ss at Trial 4 (F=19.64, df=1/76, p < .01). The difference between types of Ss at Trial 1 was in the same direction and almost reached the .05 level of confidence (F=9.32, df=1/76, .05 < p < .10). These results suggest that there was a generalized recall deficit which was manifested by schizophrenic Ss.

Performances were compared on the color-naming task to test whether differential rehearsal could have influenced the data. A 2 X 2 analysis of variance was used to compare control and schizophrenic Ss on mean number of colors correctly read out loud in Cond II. The two factors were Type of S and Trials (1 and 4). There were no reliable differences. Another 2 X 2 analysis of variance showed that the difference between
schizophrenic and control Ss in mean number of colors correctly read 
out loud in Cond IV was also not statistically significant.

The contribution made by Ss from widely different geographical 
regions was examined. In other words, Ss of the same type but from 
different geographical samples might not have produced equivalent 
performances. Several statistical tests were conducted in order to 
examine that possibility. The first test involved pooling schizophrenic 
and control Ss in a 2 X 2 X 2 analysis of variance. The factors were 
California vs. Ohio, Cond II vs. Cond IV, and Trial 1 vs. Trial 4. 
The Trial means produced the only reliable source of variance. A 
second analysis of variance showed that when the recall scores were 
divided into a 2 X 2 design consisting of Ohio vs. California, and 
Control vs. Schizophrenic, Type of S resulted in the only significant 
F. The contribution of the geographical factor was tested separately 
for Trial 1 and Trial 4. In each case the scores from Cond II and 
Cond IV were combined in a 2 X 2 analysis of variance design. Once 
again, Type of S produced the only reliable source of variance in each 
test.

Tubercular and physical rehabilitation Ss from the Ohio control 
group were compared in a 2 X 2 X 2 analysis of variance. The three 
factors were Conditions (II and IV), Type of S (tubercular vs. physical 
rehabilitation), and Trials (1 and 4). Trials and Conditions main effects 
were the only reliable sources of variance.

Repetition effects

Attention was turned next to the effects of repetition. Items
were repeated as a way to determine the differential availability of
CCCs which were cued "to be forgotten" and those cued "to be remembered"
as well as to compare repetition effects between control and schizo-
phrenic Ss. An Fmax test was performed on the scores of Trials 1 and
5 from Conditions I, II, III, and IV and the data revealed no violation
of the assumption of homogeneity of variance. The repetition effects
were first tested by a 4 X 2 X 2 analysis of variance. The three fact-
ors were Conditions (I, II, III, and IV), Type of S (Control vs. Schizo-
phrenic), and Trials (1 vs. 5). The results are summarized in Table
7 and Figure 5.

Significant main effects were brought about by Conditions and
Type of S, however, both of these single factors were involved in a
significant two-way interaction with Trials. The Conditions by Trials
interaction effect was subjected to further examination. The Newman-
Kuhls procedure for testing multiple means revealed no significant
differences among the mean recall scores of Conditions I, II, and IV
(4.18, 4.49, and 4.43 respectively), but that each of these means
was significantly larger than the mean recall score of Cond III (3.14).
Tests of simple effects demonstrated that the conditions differed
from each other at Trial 5 (Cond I vs. Cond III, F=25.73, df=1/152,
p<.01; Cond II vs. Cond III, F=33.75, df=1/152, p<.01; Cond IV vs.
Cond III, F=35.42, df=1/152, p<.01). None of the comparisons at
Trial 1 were statistically significant. Also, the simple-effects
tests on the Conditions by Trials interaction showed that only Cond
III manifested a significant drop in retention from Trial 1 to Trial
Since there was no reliable triple-interaction effect the Conditions by Trials interaction did not vary at the two levels of Type of S. Thus, items cued "to be remembered" as well as items cued "to be forgotten" showed an increase in recall as a function of repetition, and that the repetition effect did not differ for control and schizophrenic Ss.

The Type of S by Trials interaction effect was also significant. Simple-effects tests showed that schizophrenic Ss produced a significant overall decrease in mean recall scores from Trial 1 to Trial 5 (F=6.38, df=1/152, p<.05) whereas control Ss did not. At both Trial positions control Ss showed significantly larger mean recall scores (at Trial 1, F=9.62, df=1/152, p<.01; and at Trial 5 (F=37.07, df=1/152, p<.01). Therefore, superior recall by control Ss emerged once again as an independent factor from Conditions and Trials.

In summary, the data that bear upon the issue of repetition effects have shown that control as well as schizophrenic Ss benefited from repetition. Reliable repetition effects were obtained for items initially cued "to be remembered" as well as for those initially cued "to be forgotten". Finally, schizophrenic Ss manifested a generalized recall deficit separately from the factors of Conditions and Trials.

The geographical factor was inspected for the possibility that Ohio and California hospitals might have contributed differentially to scores by the same type of S. The data indicated once again that there were no significant sources of variance attributable to geographical locations of samples of the same type of S.

The Ohio Control group was examined and once again no significant
difference was revealed between tubercular and physical rehabilitation Ss.

The effects of repetition were inspected also in the condition (Cond III) in which an interpolated CCC was introduced between the initial and repeated presentation of a trigram. The recall scores of Trials 5 and 6 from Cond III were compared with the repeated Trials 4 and 5 from each of Cond II and Cond IV. Homogeneity of variance was evaluated by an Fmax test and the data revealed no significant violation. The results of the analysis of variance are summarized in Table 8 and Figure 6. Each of the three main effects (Conditions, Type of S, and Trials) produced a significant source of variance, and each main effect was involved in at least one interaction. Because the three-way interaction was a reliable effect there was a need for simple-effects test on the individual cell means. The data indicated no significant increase in performance by schizophrenic Ss in Cond III from Trial 5 to Trial 6, but there was such a significant increase produced by control Ss (F=5.33, df=2/114, p < .01). Therefore, only control Ss appeared to have benefited from repetition which followed after an interpolated trial. However, a more appropriate test would have included a control for Cond III; one that would be identical to Cond III except that Trial 6 would have consisted of a novel trigram instead of one repeated from Trial 5.

It can be seen in Figure 6 (comparable results were shown in Figure 5) that both control and schizophrenic Ss produced an increase in recall from Trial 4 to Trial 5 as a function of repetition.
From tests of simple effects it was found that control Ss manifested larger mean recall scores at Trial 5 under Cond II ($F=9.33$, df=$1/114$, $p<.01$) and Cond IV ($F=5.64$, df=$1/114$, $p<.05$). Schizophrenic Ss also showed an increase at Trial 5 under Cond II ($F=22.58$, df=$1/114$, $p<.01$) and Cond IV ($F=8.92$, df=$1/114$, $p<.01$).

The geographical factor was inspected and the data showed no significant difference between Ss of the same type as a function of geography. Further, there was no significant difference between tubercular and physical rehabilitation Ss from the Ohio control group.

Finally, the retention scores yielded by schizophrenic Ss in each condition were categorized so as to reflect the contribution made by different subgroups of schizophrenia. The subgroups which were involved in the present study consisted of patients diagnosed as Paranoid, Chronic Undifferentiated, and Acute Undifferentiated. Each subgroup was represented in each condition, however, patients diagnosed as Chronic Undifferentiated constituted a majority. The three subgroups in each condition were compared by way of a two-factor analysis of variance with one repeated measure. None of the F tests revealed any significant difference between the mean recall scores produced by the three subgroups of schizophrenia.
Discussion

The data failed to answer conclusively the major question raised by the present investigation concerning the reduction of PI effects. Turvey and Wittlinger (1970) reported that college Ss demonstrated an ability to overcome the effects of PI via a STM paradigm which used a cueing "to forget" technique. The present experiment used a very similar cueing "to forget" procedure, however, control Ss did not show the dramatic reduction in PI effects which was demonstrated by Turvey and Wittlinger's (1970) Ss. Control Ss in the present study on the average were about twice as old as the typical introductory psychology undergraduate student. Broadbent and Heron (1962) found that short-term retention capacity falls off gradually with increased chronological age. Perhaps Ss in the present study were disadvantaged because of their older age. Also, college students, who are expected to be intellectually gifted, receive constant and formalized practice in seeing and listening to information which they might be called upon to reproduce at some future time. The current hospitalized status and age of Ss in the present experiment most likely precluded their having been participants in formalized learning situations for several years.

Although cueing "to forget" appeared to have no impact on control Ss, schizophrenic Ss were markedly affected by it. Schizophrenic Ss showed a deficit of large magnitude on the critical trial in Cond II.
In comparison to Cond IV in which trigrams were cued "to be remembered" at each trial. Recall performances at Trial 4, Cond IV were about 36.2% correct in contrast to performance at Trial 4, Cond II which were only about 11% correct. An examination of the responses made at Trial 4 revealed that Cond II pulled for more incorrect consonants which were out of context. In other words, Cond II yielded more errors whose origins were traceable to the items from previous as well as to extraexperimental sources. Errors made in Cond IV were largely of the omitted variety or due to intrasequence rearrangements. There was no evidence that the cueing "to forget" technique produced more PI by schizophrenic Ss prior to Trial 4, Cond II. Trial 4, Cond II represented a transition where a set "to forget" was changed back to a set "to remember". Clearly, the set "to forget" had a deleterious affect on performance at Trial 4, Cond II, however, the processes involved cannot be delineated on the basis of the data that are available.

Control and schizophrenic Ss were each able to derive benefit from consecutive repetition, that is, when material was repeated on the very next trial following its initial presentation. There was no difference in repetition effects between items whose initial presentation was cued "to be forgotten" and those items that were initially cued "to be remembered". On the other hand, in interpolated repetition (i.e., when the initial and repeated presentation was separated by one trial) only control Ss seemed to demonstrate a repetition effect. Perhaps the intervening events in interpolated repetition (Trial 5, Cond III) produced more interference of the retroactive variety which schizophrenic
Ss were less able to overcome. Also, it is possible that the original traces were subjected to an unspecified decay process as a function of the greater passage of time in the interpolated condition. It should be noted, however, that the failure of schizophrenic Ss to produce a repetition effect could have been more clearly demonstrated had there been a fifth condition to serve as a control treatment for Cond III.

The data were decisive in showing that schizophrenic Ss produced smaller mean recall scores without much regard to trial position or condition. The main effect due to Type of S was a consistent and substantial independent factor in each analysis of variance. These results can be considered supportive of Price's (1968) assertion that there is a short-term retention component to schizophrenic deficits.

The testing procedures used by Price (1968) and those used in the present experiment both involved a recall procedure for establishing a criterion for S's level of retention. A recent study by Nachmani and Cohen (1969) showed that schizophrenic Ss did not differ from a matched control group of nonschizophrenic Ss in a recognition test for memory of words. However, a recall test yielded a significant difference between the two patient groups. Possibly, the processes involved in recalling as opposed to recognizing information hold a key to a better ultimate understanding of schizophrenic deficits on intellective-type tasks.

A total of 43 schizophrenic and 14 control patients, who volunteered and who otherwise met the criteria for selection, were found to be "untestable". In almost every untestable case S exhibited an
understanding of the sample STM task, but erred procedurally during the actual testing phase. Even though considerable pretraining was conducted with each S, patients who were found "untestable" were unable to recall the task instructions at the critical phase in the experiment. Thus, the very processes that were supposed to be examined were partially excluded from the purview of the present investigation. The Peterson and Peterson (1959) paradigm for measuring STM was conceived and developed as a test for college-type Ss. There is an obvious requirement for the development of techniques which would be more suited to the Ss who were characterized in the present study.
References


Chapman, L. J. and Taylor, Janet, A. The breadth of deviant concepts used by schizophrenics. *Journal of Abnormal and Social Psychology*, 1957, 54, 118-123.


Lang, P. J. and Buss, A. H. Psychological deficit in schizophrenia: II. Interference and activation. *Journal of Abnormal Psychology*, 1965, 70, 77-106.


TABLE 1

Relationship between Conditions:
Turvey & Wittlinger's Third Experiment

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repeat

a Items to be remembered and recalled
b Items to be forgotten and not recalled
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Relationship between Conditions

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a Items to be remembered and recalled  
b Items to be forgotten and not recalled
TABLE 3

Means and Standard Deviations for Age, Level of Education, and Length of Hospitalization for Schizophrenic and Control Groups

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TABLE 4
Analysis of Variance: Buildup of PI

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* p < .05
** p < .01
TABLE 5
Analysis of Variance: Reduction of PI Effects

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* p < .05
** p < .01
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** p < .01
**TABLE 7**

Analysis of Variance: Consecutive Repetition

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* p < .05
** p < .01
**TABLE 8**

**Analysis of Variance: Interpolated Repetition**

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<td>250.10</td>
<td>92.19**</td>
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<td>AC</td>
<td>2</td>
<td>9.62</td>
<td>3.54*</td>
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<td>1.21</td>
<td>1</td>
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<tr>
<td>ABC</td>
<td>2</td>
<td>8.87</td>
<td>3.27*</td>
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<tr>
<td>Error within</td>
<td>114</td>
<td>2.71</td>
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* P < .05
** P < .01
Fig. 1 Performances of control and schizophrenic Ss for all Conditions across all Trials.
Fig. 2 Performances of control and schizophrenic Ss on Cond IV across Trials 1 to 4.
Fig. 3 Performances of control and schizophrenic Ss on Cond II and Cond IV at Trials 1 and 4.
Fig. 4. Performances of control and schizophrenic Ss on Cond II and Cond IV at Trials 4, 5, and 6.
Fig. 5 Performances of control and schizophrenic Ss on Conditions I, II, III, and IV at Trials 1 and 5.
Percent Recall.

Cond II, Control
Cond IV, Control
Cond IV, Schizo.
Cond II, Schizo.

Fig. 6 Performances by control and schizophrenic Ss on interpolated repetition (Cond III, Trials 5 to 6) and consecutive repetition (Cond II and Cond IV, Trials 4 to 5).