Modification of Cognitive Processes in Schizophrenia

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The search for markers of vulnerability to schizophrenia has produced a variety of information processing indices correlated with schizophrenia and schizophrenia risk. Recently, it has been suggested that interventions aimed at modifying the information processing anomalies associated with schizophrenia might prove useful in the treatment and prevention of schizophrenia (Nuechterlein & Dawson, 1984; Spring, in press). A few attempts to alter information processing in schizophrenics have been reported, but these studies suffer from several shortcomings, including using training techniques with little or no experimental basis (Adams, Malatesta, Brantley & Turkat, 1981; Meichenbaum & Cameron, 1973), and failing to document clinical status after improvement in performance on experimental tasks (Wagner, 1968). The present study is proposed as an experimental investigation in the modification of schizophrenic information processing deficits.

Behavioral indices of deviant information processing in schizophrenia have been investigated extensively. Information processing deficits have been reported for vigilance tasks, span of apprehension, serial recall, reaction time crossover, dichotic listening, backward masking, and referential communication (see Neuchterlein & Dawson, 1984 for a review). Those tasks that assess deficits in the earliest stages of information processing and that exist in populations at risk for schizophrenia (i.e., vigilance, span of apprehension, and dichotic listening) stand as the best behavioral approximations to markers for schizophrenia available at this time. Therefore, it is proposed that vigilance,
as measured by the Continuous Performance Test (CPT, Rosvald et al., 1956), span of apprehension (Asarnow, MacCrimmon & Cleghorn, 1977), and dichotic listening (Spring, Levitt, Briggs & Benet, 1983) be investigated to determine if the reported deficits can be modified in schizophrenics, and if so, what are the clinical correlates of the improved performance.

**Continuous Performance Test**

The Continuous Performance Test (CPT, Rosvald et al, 1956) requires the subject to correctly identify a target stimulus, or stimulus sequence, that is presented briefly in a visual display. Omission of responses to target stimuli, as well as responses to nontarget stimuli are tallied. The CPT has reliably differentiated schizophrenics from normal and psychiatric controls (Orzack & Kornetsky, 1966; 1971; Walker & Shaye, 1982; Wohlberg & Kornetsky, 1973). Furthermore, CPT deficits have been found in children of schizophrenic mothers (Cornblatt & Erlenmeyer-Kimling, 1984; Grunebaum, Weiss, Gallant & Kohler, 1974; Nuechterlein, 1983), and remitted schizophrenics (Asarnow & MacCrimmon, 1978; Wohlberg & Kornetsky, 1973). Thus CPT performance deficits appear to be markers for vulnerability to schizophrenia according to the model proposed by Zubin and Spring (1977).

CPT deficits are augmented in groups at risk for schizophrenia when the CPT is presented with auditory distraction (Asarnow & MacCrimmon, 1978; Wohlberg & Kornetsky, 1973). Increasing the complexity of the task by requiring responses to a sequence of stimuli, or degrading the stimulus image, serves to
highlight the performance deficits found in relatives of schizophrenics (Nuechterlein, 1983; 1984). CPT performance on the degraded stimulus version has been found to be consistent (r=.75 to .85) over six month and one year intervals for chronic schizophrenics (Neuchterlein, personal communication, May 31, 1985).

Some researchers have commented that the impaired CPT performance by schizophrenics and their relatives indicates a difficulty with high moment to moment demands for processing capacity rather than an inability to sustain attention over a period of time (Nuechterlein & Dawson, 1984, Spring, in press). The processing capacity dysfunction hypothesis appears to place the schizophrenic processing dysfunction at an earlier stage of information processing than originally suggested in the attention deficit hypothesis. At this moment, though, no information is available that could determine whether the information processing dysfunction observed in schizophrenics on the CPT is indicative of an overall dysfunction or represents a specific deficit found in some schizophrenics.

Span of Apprehension

The span of apprehension task involves the subject in identifying which of two target letters was present in a briefly presented stimulus array. As the arrays increase in complexity, the task becomes harder, and all subjects will show a performance decrement at some point of complexity. However, schizophrenics will show a greater performance decrement than normals as the
number of elements in the array increases (Asarnow & MacCrimmon, 1978; 1981). Similar performance decrements on the span of apprehension task have been reported for schizophrenic outpatients that are not in a psychotic episode (Asarnow & MacCrimmon, 1978; 1981), nonpatients who score high on scales measuring schizotypal processes (Asarnow, Nuechterlein & Marder, 1983), and foster children at risk for schizophrenia (Asarnow, MacCrimmon & Cleghorn, 1977). Deficits on the span of apprehension task, by virtue of their presence before (in individuals at risk for schizophrenia), during, and after schizophrenic episodes qualify the span of apprehension deficits as markers of risk for schizophrenia. It has been suggested that span of apprehension deficits are indicative of some sort of dysfunction in early visual information processing, including slowed posticonic processing, inefficiency of early visual search processes, and reduced sensitivity to signals presented in patterned noise (Nuechterlein & Dawson, 1984).

**Dichotic Listening**

In a typical dichotic listening task, a subject will verbally repeat an auditory stimulus presented to one ear while a competing auditory stimulus is presented to the opposite ear. Numerous methods of administering the dichotic listening task have been tried with equally varied results. Straube & Germer, 1979) presented a well controlled study in which subjects shadowed lists of words under various distraction conditions and found no differences between schizophrenics and normals under any
conditions. Spring et al. (1983) presented a more rigorous test of selective attention by analyzing the shadowing performance of schizophrenics, their parents, and their siblings by analyzing responses at a phoneme level rather than at a word level. Spring et al. found that schizophrenics and their relatives had significantly more intrusions of phonemes from the distractor channel than normal and psychiatric controls. Spring (personal communication, April 21, 1985) also reports that, after an initial practice period, the performance of schizophrenics remains relatively stable on her version of the dichotic listening task.

Aims of the Proposed Study

The proposed study seeks to answer two primary questions:

1) Can the performance deficits found in the degraded stimulus CPT, the span of apprehension task, and Spring et al.’s dichotic shadowing task be modified in chronic schizophrenics?

2) Assuming an affirmative answer to the first question, is improvement on the three tasks mentioned associated with any changes in schizophrenic behavior?

Methods

Subjects

Subjects will be 8-10 patients with an RDC (Spitzer, Endicott, Endicott & Robins, 1978) of chronic schizophrenia. Patients with substance abuse history or known organic etiology will be excluded, as well as patients with vision not correctable to 20-30, and/or gross hearing impairment.
Measures

**Diagnosis and Clinical Status.** Each subject will be diagnosed using the Schedule for Affective Disorders and Schizophrenia: Lifetime version (SADS-L). Clinical status will be assessed biweekly using the "current" version of the Schedule for Affective Disorders and Schizophrenia (SADS-C).

**Continuous Performance Test.** Degraded visual stimuli (either a blurred number, or a dimly illuminated number) will be presented for a duration of 40 msec with an interstimulus interval of 1000 msec via a microcomputer controlled video monitor. The target stimulus will be a "0" (zero). Other stimuli (numerals 2-9) will be presented in a quasi-random order, balanced for the number of times the target stimulus follows each stimulus. Subjects will be instructed to press a key every time they recognize the target stimulus. 486 trials will be presented over a period of almost 8.5 minutes during each training session. Programs for an Apple IIe computer are already available for a similar version of CPT. The Apple CPT programs will be adapted to the needs of the present study and are expected to produce rapid sensitivity decrements similar to those found in Nuechterlein's (1983) work. The CPT will yield two important indices: response sensitivity, and response criterion. Response sensitivity refers to the relationship between the number of correct target identifications and the number of incorrectly identified nontarget stimuli. Response criterion is an indicator of a subject’s willingness to respond. The target stimulus will be fully degraded for the
practice and the first baseline sessions. For the three training sessions, the stimulus will be presented at three levels of degradation, from little to full degradation, consecutively.

**Span of Apprehension.** Between two and ten letters will be presented randomly within a 9 x 9 matrix via a microcomputer controlled video monitor for a duration of 70 msec. Subjects must identify which of two target letters appeared in the array. The number of correct identifications will be tallied. Stimuli will be presented for thirty trials in each training session. A computer program is already available to administer the span of apprehension task on an Apple IIe computer. Approximate time of administration will be five minutes. Practice and baseline sessions will be with ten letter arrays. Training sessions will proceed from two to six to ten letter arrays respectively.

**Dichotic Listening.** Subjects will listen to and shadow word strings presented to the main channel ear while ignoring distractor words presented to the distractor channel. Words used on both channels have been matched for contextual constraint. Specific details on the development of the dichotic listening materials appear in Spring, Maller, Wurtman, Digman, and Cozolino (1983). Each subject will practice shadowing without distraction until the subject performs to at least a 90 per cent correct criterion. Subjects will shadow 45 word strings in each training session, switching the main channel ear halfway through the procedure. Subjects' responses will be audio recorded, transcribed, and scored according to Spring et al.'s (1983)
criteria for intrusions from the distractor channel. Approximate
time of administration is 20 to 45 minutes. Decibel level of the
main and distractor channels will be equated for the practice,
baseline and last training session. Training sessions 1 and 2
will be performed with the distractor channel played at a volume
set at 40db SPL and 20db SPL respectively.

Procedures

Subjects will participate in one practice session, one
baseline session, and three training sessions for each task over a
two week period. The three tasks will be presented in succession
over a six week period, counterbalanced between subjects to
control order effects. Baseline measures will be the first
session after the practice session to reduce practice effects.

Data Analysis

Though data for all subjects may be combined to study changes
in group performace over time, the primary analysis will be within
subjects with each subject serving as his own control. For the
CPT, changes in perceptual sensitivity and response criterion from
baseline to last training session will be compared using a t-test.
The same procedure will be followed in examining changes in the
number of targets correctly identified in the span of apprehension
task and the number of intrusions from the distractor channel of
the dichotic listening task. Changes in clinical status will be
noted at each two week interval, but will not be subjected to
statistical analysis due to the small sample size and the
tentative nature of the hypothesis that clinical improvement will
follow improvement on the experimental tasks.
References


Meichenbaum, D., & Cameron, R. (1973). Training schizophrenics to
talk to themselves: A means of developing attentional controls. *Behavior Therapy*, 4, 515-534.


