COGNITIVE MECHANISMS OF RESPONSE INITIATION IN SCHIZOPHRENIA

by

STEPHANIE LEANNE CAISSIE

B.A., McGill University, 1998

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

MASTER OF ARTS

in

THE FACULTY OF GRADUATE STUDIES

Department of Psychology

We accept this thesis as conforming to the required standard

THE UNIVERSITY OF BRITISH COLUMBIA

July 2001

©Stephanie Leanne Caissie, 2001
In presenting this thesis in partial fulfilment of the requirements for an advanced degree at the University of British Columbia, I agree that the Library shall make it freely available for reference and study. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by the head of my department or by his or her representatives. It is understood that copying or publication of this thesis for financial gain shall not be allowed without my written permission.

Department of Psychology
The University of British Columbia
Vancouver, Canada

Date July 27/01
ABSTRACT

Psychomotor poverty is one syndrome of the three-syndrome model of schizophrenia, and refers to a subset of symptoms which includes flat affect, underactivity, and poverty of speech. The hallmark of psychomotor poverty is diminished mental and physical activity. It has been proposed that deficits in initiation are the core problem in psychomotor poverty (Liddle, 1994; Frith, 1987), although little is understood about the cognitive mechanisms mediating initiation impairments. The current study sought to investigate the role of cognitive set in response initiation using a basic choice reaction time task. The non-designated stimulus reaction time (NDSRT) task involves two conditions. In one condition, subjects are explicitly given a stimulus-response mapping, thus they have a strong set. In the other, the stimulus-response mapping is implicit and the set is weak. Pilot data indicates that both healthy controls and schizophrenia patients are slower to respond when the set is weak. In addition to replicating this result, it was hypothesized that patients would show more slowing on this condition than controls, and that this slowing would be correlated with psychomotor poverty. This would suggest that responding with a weak, incomplete set is related to symptoms of psychomotor poverty. The results support the above hypotheses. Both patients and controls were significantly slower at responding with a weak set than with a strong set, and this difference was greater in patients. The magnitude of the difference correlated significantly with psychomotor poverty score. These results support the hypothesis that responding with an incompletely mapped set may underlie the initiation deficits of the psychomotor poverty syndrome. These findings have implications for the rehabilitation of individuals with schizophrenia.
TABLE OF CONTENTS

Abstract ...................................................................................................................... ii
Table of Contents ...................................................................................................... iii
List of Tables ............................................................................................................. iv
List of Figures ........................................................................................................... v
Acknowledgements ................................................................................................. vi
Introduction ............................................................................................................... 1
Method ........................................................................................................................ 9
Analyses ...................................................................................................................... 17
Results ....................................................................................................................... 21
Discussion .................................................................................................................. 27
References ............................................................................................................... 31
Appendix I Consent form and recruitment letter. ....................................................... 45
Appendix II Certificates of ethical approval. ............................................................... 46
Appendix III Mandatory questions for the SSPI. ....................................................... 47
LIST OF TABLES

Table 1. Characteristics of Patient Sample ........................................... 36
Table 2. Demographic Characteristics of Controls and Patients .................... 37
Table 3. Ordered List of Tests Administered ........................................... 38
Table 4. Stimuli Used in Non-Designated Reaction Time Task - Letters .......... 39
Table 5. Stimuli Used in Non-Designated Reaction Time Task - Digits ............ 40
Table 6. Percentage of Trials With Errors on Each Version of the Non-designated Stimulus Reaction Time Task ........................................... 41
LIST OF FIGURES

Figure 1. Mean Response Times for Each Condition for Each Group
    on Non-Designated Stimulus Reaction Time Task - Letters ............... 42

Figure 2. Mean Response Times for Each Condition for Each Group
    on Non-Designated Stimulus Reaction Time Task - Digits .................. 43

Figure 3. Mean Differences in Response Times for Blocks 2-5 ...................... 44
ACKNOWLEDGEMENTS

I wish to thank my supervisor, Dr. Peter Liddle. His dedication to understanding the mystery of schizophrenia is contagious, and he never fails to inspire. I am also grateful to my co-supervisor Dr. Peter Graf, for his guidance over the past two years. Dr. Elton Ngan and Dr. Todd Woodward were a great source of support in my times of need, and for that I am very thankful.

This project would not have been possible without the generous financial assistance of the Dr. Norma Calder Foundation. Their support of schizophrenia research in BC has been extensive and has contributed to many advances in our understanding of schizophrenia.

Finally, I wish to acknowledge the physicians, case-workers, and clients of the Vancouver/Richmond Health Board. The desire of these individuals to contribute to schizophrenia research was an inspiration, and without them the study would not have been possible.
Central to the presentation of schizophrenia are what Crow and others have called 'negative symptoms' (Crow, 1980; Andreasen & Olsen, 1982). More recently, schizophrenic patients' symptoms have been construed in terms of three syndromes (Liddle, 1987; Andreasen & Grove, 1986). One of these, the syndrome of psychomotor poverty, refers to a subset of negative symptoms which includes flattened affect, underactivity, and poverty of speech. This combination of symptoms is resistant to conventional pharmacological treatment and the severity of the symptoms is a major predictor of future social and occupational functioning. These symptoms are also often associated with generalized brain damage (i.e., enlarged ventricles; Flaum et al., 1995), and cognitive impairments (O’Leary et al., 2000; Moritz, Heeren, Andresen, & Krausz, 2001; Nuechterlein, Edell, Norris, & Dawson, 1986).

The hallmark of the psychomotor poverty syndrome is diminished mental and physical activity. According to Liddle (1987), an inability to initiate spontaneous behaviour underlies psychomotor poverty (see also Marin, 1990). A cognitive explanation has been offered by Frith (1987), who proposes that initiation impairments are apparent during 'willed acts' that is, acts that arise endogenously, independent of any external stimulus or cue (Libet, 1985), not dictated by external circumstances (Liddle, 1994). In short, psychomotor poverty may be the clinical manifestation of an underlying difficulty initiating both unobservable and observable events.

Despite the important role impaired initiation plays in the symptomology of schizophrenia, only a few attempts have been made to investigate the cognitive mechanisms involved in initiation. Two tasks have been used for this purpose: verbal
fluency and two-choice guessing. In the standard verbal fluency task (e.g., using the Controlled Oral Word Association Test by Benton & Hamsher, 1989), subjects are asked to produce as many words as they can that begin with a specific letter. No information is provided as to how to do this. Successful performance demands the ability to initiate a systematic search through one's lexicon with little guiding information from the environment. The number of words produced is the dependent measure. In the two-choice guessing task utilized by Frith and Done (1983) as well as Baxter and Liddle (1998), subjects are required to predict in which of two empty boxes an object will appear. No information is provided as to where it will appear, thus the ability to select a response occurs without any specific cue from the environment. The dependent measure is response time, and success is dependent on the ability to quickly initiate a self-generated response.

Performance on both verbal fluency tasks (Allen & Frith, 1983; Gruzelier, Seymour, Wilson, Jolley, & Hirsch, 1988) and two-choice guessing tasks (Frith & Done, 1983) is impaired in schizophrenia relative to healthy subjects, and is correlated with symptoms of psychomotor poverty in patients (Liddle & Morris, 1991; Baxter & Liddle, 1998). This relationship with psychomotor poverty may indicate that these tasks are measuring initiation ability. However, the extent to which one can draw conclusions from either of these tasks is limited because they are not pure measures of initiation. The verbal fluency task is sensitive to individual differences in the ability to organize thought. Performance is largely dependent on the ability to use successful search strategies such as clustering, which is considered an important strategy (Estes, 1974). The two-choice guessing task is also a confounded measure of initiation ability. Time taken to begin a
response is used as a measure of initiation. However, several factors can influence how long subjects take to initiate responding, ranging from a lack of motivation to uncertainty about the instructions to side effects of neuroleptic medication. Slow response times may not necessarily indicate impaired initiation, and yield little information about the cognitive characteristics of initiation.

Initiation is a complex construct that is likely to involve a multitude of cognitive and motor processes. A core feature of initiation may be related to the concept of cognitive set. Set is a broad construct used in psychology and can be defined as “any condition, disposition, or tendency…to respond in a particular manner” (Reber, 1996). In schizophrenia research, cognitive set has been defined as a state of readiness to respond (Shakow, 1962). In the context of this study, cognitive set may be defined as the mapping relationship between a specific stimulus and a specific response. Sets are generally thought of as temporary, and within the domain of conscious control. They are usually construed in terms of a continuum of strength, with weak, incompletely mapped sets exerting less influence on behaviour.

The formation of a cognitive set may be prompted explicitly or implicitly. When given explicit instructions, subjects are given a complete mapping. Thus, they have a strong cognitive set. Implicit rules require that the stimulus-response set be deduced or inferred from experience with the stimulus-response relationship. In this situation, subjects have an incomplete mapping, or a weak set, and the cognitive system is required to configure this map for optimal responding. Responding with a weak set requires the capacity to initiate from an internally driven source because the stimulus and response are not strongly mapped. For example, when meeting someone new we often offer our hand.
The situation cues a certain response. Someone with a strong set for this situation may do so without any thought, whereas someone with a weak set may consider the appropriateness or other factors before offering their hand. In relation to the symptoms of schizophrenia, I expect individuals with psychomotor poverty will have more difficulty than controls initiating responding when the stimulus-response map is incomplete because it is this ability to self-generate responding which has been proposed to be deficient in schizophrenia.

Taking into consideration the above points, I consider the following characteristics essential to a task measuring initiation:

1. The presence of two conditions, with only the strength of cognitive set varying. In one condition the stimulus-response map would be explicitly defined; in the other condition it would be implicitly defined, and thus incomplete. In this design, subjects serve as their own control. Any impairment would be relative to a baseline.

2. Simplicity, so as to minimize the effects of motivation, education, attention, intelligence, and memory. Clinical populations often differ significantly from controls on these dimensions.

3. Brief duration, in order to maximize the performance of a clinical population. A lengthy task may be expected to tax working memory and attention, which are often compromised in clinical populations. Group differences may be attributable to these factors rather than initiation ability.
In this study, my main goal was to explore the relationship between initiation and cognitive set by using a basic choice reaction time task. It is similar to the two-choice guessing task (Baxter & Liddle, 1998) but meets the criteria outlined above. The major difference between this task and other tasks used previously to measure initiation is the presence of two conditions. In one condition, the stimulus-response mapping is explicitly defined. In the other condition, subjects are required to respond with an incomplete mapping, or a weak set. In this design, subjects serve as their own control. Performance is examined on one condition, relative to the other. This controls for some confounds mentioned above, such as motivation and ability to understand task instructions. Illustration of a relationship between performance in this condition and psychomotor poverty would yield information about what cognitive factors may influence initiation and contribute to the symptoms of psychomotor poverty. I hypothesized that schizophrenics, relative to controls, will be slower to respond when the stimulus and response are not completely mapped. I also expected that this slowing would be related to symptoms of psychomotor poverty, suggesting that impaired initiation is most apparent when the stimulus-response set is not strongly mapped.

The relationship between set and initiation was explored using two versions of the non-designated stimulus reaction time (NDSRT) task. The task consists of two conditions: the designated stimulus condition, in which a previously designated letter is presented on a monitor, and the non-designated stimulus condition, in which a different letter is presented. Subjects are instructed to press a specified key when the designated letter appears on cue, and to press a different specified key when the designated letter does not appear on cue. Concretely, subjects are told
"Press with your index finger whenever you see the letter E"

"Press with your middle finger whenever you don’t see the letter E"

In the designated condition, a response has been explicitly mapped to a stimulus (ie. “E”). However, in the non-designated condition, subjects must initially act in the presence of a weak, incomplete stimulus-response set because they are not prepared for a particular stimulus. It is expected that response times in the non-designated condition will be slower than for designated stimuli in both healthy subjects and patients, because the stimulus-response map will be less complete. The difference in reaction times between the designated and non-designated conditions will be referred to as the non-designated effect. Patients are expected to show a greater non-designated effect, and this slowing on the non-designated condition is expected to be correlated with psychomotor poverty. This would suggest that responding with a weak, incomplete set is related to symptoms of psychomotor poverty. Over a period of time, the subject might strengthen the stimulus-response map for non-designated stimuli, so the reaction time would be expected to approach that for designated stimuli.

A pilot study using the NDSRT task revealed that patients showed a greater non-designated effect than healthy controls. The mean difference between designated and non-designated response times across all 60 trials was 11 milliseconds (msec) in controls, while in patients it was 62 msec. The slowing on the non-designated condition relative to the designated condition was even greater in the first 10 trials, with a difference of 21 msec in controls and 171 msec in patients. Both of these differences were statistically significant. Based on these results, it appears schizophrenia patients have a greater
impairment in responding to non-designated stimuli than controls, but that the non-designated effect attenuates over time, suggesting that the cognitive system eventually completes the stimulus-response mapping for non-designated stimuli.

The present study expanded on the pilot study in several ways. The patient sample in this study was characterized according to demographic information, illness characteristics, and performance on tests such as verbal fluency and the Stroop test. A number of tests were administered to characterize the patients and to explore what factors may have an influence on task performance, such as intelligence. Furthermore, to permit comparison of NDSRT task performance and symptoms, the author administered the Signs and Symptoms of Psychotic Illness (SSPI; Liddle, submitted) to all patients. This is a semi-structured interview that yields global scores for each syndrome of the three-syndrome model. Control subjects were matched a priori to the first twenty patients recruited in an effort to control for age and socioeconomic status. There were two versions of the NDSRT task, one involving letters and one involving digits. These tasks differ in that one includes a number of distracter blocks (block = 12 trials). Each of the distracters is intended to introduce a new dimension not included in the test blocks, such as colour or position of the stimulus. It is not clear at the start of each new block that the same rules will apply. Thus, the distracter blocks are intended to prevent subjects from transferring learning into the next test block (see Harlow & Harlow, 1949 for a description of learning set). Furthermore, comparison of the two versions may yield information about what happens to the non-designated effect over time. The only other difference between the versions is the nature of the stimuli: letters or digits.
The letter version of the task was administered first, and included several distracter blocks. This was due to the expectation that once subjects complete the set mapping for the non-designated letter, the RT to that letter will be comparable to the RT to the designated letter. For example, assume the designated letter is E and the non-designated letter is B. The subjects already know to press with their index finger whenever they see an E. At the start of the test block, they do not know what the other letter(s) is(are), thus they do not yet have a strong, complete mapping for the non-designated condition. Once they realize there is only ever a B, it is expected that responses to the B will be as fast as those to the E because subjects will have established a strong stimulus-response map. If all test blocks are presented sequentially, subjects may quickly learn that there is only ever one non-designated letter, and that it does not vary on dimensions such as size, colour, or position. Thus, the only job at the beginning of a new test is to learn the identity of this other letter and substitute it into the existing stimulus-response map. This would illustrate transfer of learning, or the effects of a learning set (Harlow & Harlow, 1949). Learning set is illustrated by a savings of learning so that between-problem learning is facilitated by previous within-problem learning. Once this occurs, it is expected that the non-designated stimulus effect will disappear or drastically attenuate. Since I am interested in how schizophrenics respond to stimuli in the presence of an incomplete, weak set, I aimed to extend this by using distracter blocks to prevent subjects from carrying over what they learned in previous test blocks.

The primary goal of this study was to investigate response initiation in schizophrenia under circumstances in which it was anticipated that response set would be weak. This has implications for our understanding of the cognitive mechanisms
underlying psychomotor poverty. A basic choice reaction time task was used to minimize the contributions of other variables, and to demonstrate that initiation can be studied in a basic design. Thirty-one stable schizophrenia outpatients and 20 matched control subjects participated in the study.

Method

Participants

Table 1 displays the characteristics of the patient sample. Twenty-eight men and three women between the ages of 18 and 55 years with a DSM-IV diagnosis of schizophrenia or schizoaffective disorder were recruited through the Vancouver/Richmond Health Board and Vancouver Hospital (UBC site). Two of the 31 patients had a diagnosis of schizoaffective disorder, the remainder were diagnosed with schizophrenia. All subjects were stable outpatients, with persisting disability, currently taking antipsychotic medication. Stability was defined as no hospitalizations in the last 6 months, and no major change in medication type or dose. Persisting disability was defined as a Global Assessment of Functioning (GAF) score of 50 or less (modified version of the Global Assessment Scale; Endicott, Spitzer, Fleiss, & Cohen, 1976 in DSM-IV, 1994). Exclusion criteria included a history of traumatic head injury or epilepsy, and a current diagnosis of substance abuse. Subjects were initially recruited through their physician, to whom a letter was sent outlining the study and requesting assistance in recruiting subjects who fit criteria and are capable of giving informed
consent. A copy of the consent form and recruitment letter sent to the Vancouver/Richmond Health Board is attached (see appendix I).

Twenty control subjects were recruited through ads posted in the community and by contacting former research participants in the laboratory. Controls were matched *a priori* to the first twenty patients in age, gender, and parental occupational status in an effort to control for socioeconomic status. I avoided matching on subject occupation or education because the patient group was expected to be below their highest level of functioning due to their illness. I did not match on handedness because atypical handedness may be a feature of schizophrenia (see Satz & Green, 1999 for review). Using healthy control subjects with atypical handedness may introduce brain abnormality into the control sample. The same exclusion criteria applied for control subjects. Furthermore, controls were not currently taking any psychiatric medication and had no personal or family history of either schizophrenia or bipolar disorder.

Table 2 shows demographic characteristics for patients and controls. As indicated in the table, patients differed significantly from controls in number of years of education, score on the NART and Quick tests, number of cigarettes smoked daily, and number of caffeinated beverages consumed daily. Although it was that expected patients would have lower educational attainment scores, based on the evidence from prospective, longitudinal studies demonstrating that the prodromal phase of schizophrenia disrupts educational achievement (Crow, Done, & Sacker, 1995; but see Cannon et al., 1999), it is
probable that selection artifacts influenced the mean educational level in both groups of participants. The average number of years of education in British Columbia is roughly 12.7 years (Statistics Canada Census, 1996). Thus, contrary to expectation, the mean number of years of education in the patient sample (13.17 years) was similar to that in the general population of the province, while the control sample had an even greater number of years of education (17.48 years). It is possible that in both groups, more highly educated individuals are likely to consent to participate in a research study involving cognitive testing. Nonetheless, the substantially greater number of years of education in the control participants raises the possibility of a selection bias that was more marked in the healthy controls.

The study was fully approved by the University of British Columbia ethics committee and the Vancouver / Richmond Health Board. All participants gave informed consent and were paid $10 per hour for their participation. The ethics approval is attached (see Appendix II).

Tests

Table 3 lists all tests that were administered in the order in which they were given. All previously published tests were administered according to the published instructions. The non-designated stimulus reaction time tasks (identified with a * in Table 3) will be described in further detail below and in Tables 4 and 5. The auxiliary neuropsychological tests (items 6-8 in Table 3) were administered to further characterize
the patient sample according to previous literature, and to test hypotheses regarding relationships between neuropsychological test performance and NDSRT task performance. These instruments were not administered to controls.

The handedness scale (Annett, 1967) is a self-report measure, and was used to determine which hand subjects used to respond in the non-designated task. The National Adult Reading Test (NART; Nelson & O'Connell, 1978) and the Quick test (Ammons & Ammons, 1962) are tests of vocabulary, and are correlated with verbal intelligence. This information was used to ascertain whether or not any significant differences in performance on the NDSRT task are attributable to intelligence.

The Controlled Oral Word Association test (COWA; Benton & Hamsher, 1989) measures verbal fluency. This test was included to provide a characterization of the patient sample. It was also included in the interest of exploring the relationship between fluency and performance on the NDSRT task. The task requires subjects to produce as many words as possible that begin with the letters F, A, and S (on 3 different trials) in one minute. Category naming is another measure of verbal fluency. Subjects are provided with a label and asked to name as many items as they can in one minute. The categories are kitchen items, professions, and fruits. Although category naming has more constraints than the COWA because the subjects are provided with a narrower restriction on what words they can produce, category naming usually places less demands on strategic processes because of the established associations between words from a semantic category.

The colour word Stroop task measures the ability to inhibit a dominant response and has been shown to be correlated with symptoms of disorganization (Liddle & Morris,
Subjects are presented with a sheet of 100 groupings of letter X’s printed in blue, green, red, or brown ink. Subjects are asked to state the colour of ink as quickly as possible for 45 seconds. Participants are then tested on their ability to read aloud the colour of ink of colour names. For example, the word ‘blue’ written in red ink. As above, the number of coloured words read in 45 seconds is recorded. This final number is subtracted from the number of groupings of X’s read in the colored X’s condition to obtain a measure of susceptibility to Stroop interference.

Symptoms were assessed using the Signs and Symptoms of Psychotic Illness (SSPI; Liddle, submitted). See Appendix 3 for a list of required questions. Interviews were semi-structured, and the author completed all ratings. Composite scores were computed for psychomotor poverty and disorganization by summing the relevant items according to the factor structure described by Liddle (submitted). Inter-rater reliability on the SSPI (between the author and Peter Liddle) was determined for a sample of 15 patients based on archived videotaped interviews. Intraclass correlations were .73 for psychomotor poverty and .89 for disorganization.

Non-designated stimulus reaction time task - letters.

Insert table 4 about here

Table 4 lists the different blocks of this version of the NDSRT task and the order in which they were administered. There were six test blocks, each involving a different letter pair. Half of the letter pairs consisted of letters that were confusable; the other half consisted of letters that were non-confusable according to the confusability classifications.
of Briggs and Hocevar (1975). Within each letter pair, one letter was the designated letter. This letter was included in the instructions when subjects were prepared with a response. An example of the instructions is:

“Press with your index finger whenever you see the letter E”

“Press with your middle finger whenever you don’t see the letter E”

The remaining letter was the non-designated letter.

Each block of the task involved 12 trials. At the start of each trial, a fixation point (+) was presented for 800 milliseconds (msec), signalling the imminent appearance of a letter. The letter then appeared for a fixed duration of 800 msec. Subjects had an additional 2200 msec during which there was a blank screen in which to respond with the appropriate key press before the trial. Precisely 3 sec from the onset of the letter, another fixation point appeared signaling the start of the next trial. All stimuli were presented in the center of the display.

Within each block, there were a total of 12 trials. Half of these trials were designated trials, during which the designated letter appeared, and half were non-designated trials. The order of presentation of trials was randomized, but was the same for all subjects.

Reaction time (RT) from stimulus onset to key press was measured to both the designated and non-designated letters for a total of 6 trials x 6 test blocks = 36 trials of each stimulus type. Half of the subjects responded with the index finger of their dominant hand for the designated stimuli; the other half responded with the middle finger of their dominant hand for the designated stimuli. All stimuli were presented in black Helvetica 38 point bold font against a gray background. Subjects were seated at a
distance of approximately 70 cm from the monitor. Subjects always used the ‘M’ and ‘N’ keys on the keyboard to respond, and these keys were covered by a coloured piece of paper. The remainder of the keys were covered by a blank piece of paper affixed to the keyboard. Speed and accuracy were equally emphasized.

Randomly interspersed with the test blocks were 3 different types of distracter blocks, each occurring twice. These also involved responding to a single stimulus on the display, but the stimuli were varied on dimensions not manipulated in the test blocks, such as colour, position, and number of non-designated stimuli (see below). The instructions were the same as for the test blocks with the exception that the letters differed from those used in the test blocks.

In the position distracter blocks, all stimuli were always presented in one of four quadrants. In the test blocks, all stimuli were presented centrally. The number manipulation consisted of more than one non-designated letter, although only one was presented on the screen for each trial. Finally, in the colour distracter blocks, although the designated letter was always black, the non-designated letter was either black or white and was drawn from a set that included a white version of the designated letter. This introduced the added dimension of colour and was expected to slow reaction times.

**Non-designated reaction time paradigm - digits.**

---------------------------------

Insert table 5 about here

---------------------------------

Table 5 lists the details of each block within this version of the NDSRT task. There were two fundamental changes: digits were substituted for letters, and there were
no interspersed distracter blocks. The main purpose of the digit version was to test the hypothesis that healthy subjects would transfer learning from one block to the next. The subsidiary purpose was to explore the possibility of impairment in this ability to transfer learning between blocks in patients, in the event that such a transfer of learning between blocks was observed in healthy subjects.

All 10 single digits were used, ranging from 0 to 9, for a total of five digit pairs. Thus, there were five test blocks presented sequentially. Instructions were identical to those in the letter version, with the designated number substituted for the designated letter. As with the letters, there were six trials of each stimulus type in each block. The duration of stimulus presentation and inter-trial interval were identical to those used in the letter version of the task.

Both versions of the NDSRT task were administered using a Pentium PC running a stimulus presentation program accurate to within 2 milliseconds (Visual and Auditory Presentation Package; VAPP).

Procedure

Consent to contact patients was obtained from physicians. The author attended staff meetings at community mental health centers to explain the study and request assistance with recruitment. Generally, mental health workers contacted the relevant physician to determine whether a particular client was capable of participating, and then subsequently referred that person for the study. Physician consent was required to ensure the patient was cognitively capable of providing informed consent. Patient consent was obtained when they came in for testing.
All subjects were tested individually on separate days in a small testing room. The author administered all tests and interviews, and the same computer equipment was used throughout the duration of the study. The entire session lasted approximately 2 hours and was completed on the same day. There was a 20 second break halfway through the first non-designated task (letters), during which subjects were asked to remain at the computer. Any further breaks in the session were taken only upon request, and only at an appropriate time so as not to interrupt any tests.

Analyses

In the non-designated stimulus reaction time task, all response times less than 100 msec and greater than 2000 msec and all misses (no response) were eliminated from all analyses. In the letter version, this amounted to 1.72% of the total trials in patients and .56% of total trials in control subjects. In the digit version, .89% of total trials in patients and .33% of total trials in controls were excluded due to the above criteria.

Insert table 6 about here

See Table 6 for the percentage of error trials in each group. Error trials occurred when the subject pressed the wrong key. These trials were also excluded in the calculation of reaction times. In the letter version, error rates were similar for each condition in both groups. In both conditions, patients made more errors than controls. In the digit version, controls and patients had similar error rates. Error rates were similar for both conditions.

An alpha level of .05 was used for all statistical analyses.
Accuracy

A repeated measure analysis of variance (ANOVA) was performed on total correct responses to compare accuracy rates between groups and conditions. A group x condition interaction would indicate that patients performed differently than control subjects.

Reaction Time Performance of Patients and Controls

A repeated measures ANOVA with condition and group as factors was performed to explore group differences in reaction time. One of the main hypotheses predicts that patients will show a larger non-designated effect than controls. A main effect of condition and a main effect of group were expected. An interaction would suggest that the difference between conditions is different in patients than in controls.

In the letter version, due to the inclusion of distracter blocks, performance in each test block was expected to be similar. Therefore, mean reaction times for each condition were computed by taking the average across all six test blocks. In the digit version, response times were averaged across all five test blocks. In this version of the NDSRT task, the relative size of the non-designated stimulus effect was expected to decrease after the first block due to the influence of learning set. For this reason, an analysis was also performed on the first test block only.

Since the prodromal phase of schizophrenia can interfere with educational achievement, it is inappropriate to control for years of education. Such a procedure would be expected to obscure differences between patients and controls that are a manifestation of the illness itself. Nonetheless, it is of interest to establish whether or not any observed differences between patients and controls can be accounted for by
differences in years of education. Therefore, a subsidiary analysis was performed treating years of education as a covariate.

**Relationship Between Symptoms and Performance.**

To examine the relationship between symptoms and performance, Pearson correlation coefficients were calculated between difference scores (non-designated response time – designated response time) and composite score on the SSPI for the relevant symptom dimension. One of the main hypotheses is that psychomotor poverty and performance on the non-designated condition, relative to the designated condition, will be correlated. This would suggest a relationship between initiation and non-designated responding.

In the letter version, since performance was expected to be similar in all six test blocks (free from a learning set), correlations were computed for the overall difference score averaged across all six test blocks. In the digit version, due to the expectation of the formation of a learning set, correlations were computed for a) the overall difference averaged across all test blocks b) the difference in the first test block and c) the average difference score across the remaining test blocks.

To determine whether depression is a confounding variable for any significant correlation with psychomotor poverty, partial correlation coefficients were computed using depression as a covariate. Due to the lower educational level in the patient sample, partial correlation coefficients were also computed using education as a covariate to determine what influence this factor had on the relationship between reaction time and symptoms.
In addition to difficulty responding with an incompletely mapped set, schizophrenics may exhibit impairments strengthening a stimulus-response set. Impairments in establishing a set have been illustrated in schizophrenia on the Wisconsin Card Sort Test (WCST, see Weinberger, Aloia, Goldberg, & Berman, 1994 for a brief review). Furthermore, McGrath (1991) has proposed that thought disorder, the primary symptom in the disorganization syndrome, represents impairments in forming and maintaining a cognitive set. Difficulty establishing and/or maintaining a set would be expected to increase the magnitude of the non-designated effect (because it would take longer for the effect to attenuate) and potentially increase variability in responding to non-designated stimuli. Pearson correlation coefficients were calculated using difference scores (as above) to determine the influence of disorganization symptoms on performance.

Analyses of Learning Set

In the digit version of the task, it was expected that subjects would exhibit a learning set. This would be revealed by an attenuation of the size of the non-designated effect in test blocks 2-5 in the digit version compared with the blocks 2-5 of the letter version. To determine whether subjects indeed established a learning set, and whether there were any group differences, a repeated measures ANOVA was performed on test blocks 2 through 5 of each version of the task. The sixth test block of the letter version was excluded to permit a balanced comparison between the two versions, as the digit version had only five test blocks. Difference scores averaged across the blocks for each version were the within-subjects factor; group was the between-subject factor. It was expected that there would be a main effect of version, such that the non-designated
stimulus effect would be greater in the letters version than in the digits version. A version x group interaction would suggest differences in the formation or influence of a learning set between patients and controls.

**Relationship between Auxiliary Tests, Symptoms, and Performance**

Verbal fluency (letter and category) was administered to further characterize the patient sample. It was also included to determine the relationship between fluency and NDSRT task performance. Pearson correlation coefficients were computed between total words produced for letter and for category fluency and psychomotor poverty score to corroborate previous findings of a relationship. Subsequently, correlations were computed between verbal fluency performance and performance on the NDSRT task. A positive relationship would provide further support for the NDSRT task as a measure of initiation ability.

Based on previous literature, a positive correlation was expected between Stroop performance and disorganization symptoms. Correlations were calculated to verify this, and to determine the relationship between Stroop performance and NDSRT task performance.

**Results**

**Accuracy**

**Non-designated stimulus reaction time task - letters.**

Two patients were excluded due to poor performance, defined as number of errors exceeding 3 standard deviations of the group mean on at least one of the two conditions (ie. designated, non-designated). No control subjects were eliminated.
Schizophrenic subjects were less accurate than control subjects. Repeated measures analysis of variance (ANOVA) was conducted on number of correct responses with condition (designated, non-designated) and group (patients, controls) as factors. There was a main effect of group only ($F (1, 47) = 10.34, \text{MSE} = 23.59, p = .002$). There was no effect of trial type within groups, and no interaction.

Non-designated stimulus reaction time task - digits.

One patient, who was also eliminated for the analysis of the letter version, was eliminated on account of having an error score more than 3 standard deviations from the group mean, and no controls were excluded.

The accuracy of the patient group was not significantly different from that of the control group. Repeated measures analysis of variance (ANOVA) conducted on correct responses revealed no main effect of condition ($F (1, 48) = .61, \text{MSE} = .28, p = .441$) or group ($F (1, 48) = 1.19, \text{MSE} = 1.40, p > .281$) and no interaction ($F (1, 48) = 1.03, p = .314$).

Note that subjects were not given a practice session. The non-designated effect was believed to be susceptible to learning over time, therefore a practice session was not given. The fact that patients perform worse in the first version suggests that they are slower to learn the task.

Reaction Time Performance of Patients and Controls

Non-designated stimulus reaction time task - letters.

---------------------------------------------------------------
Insert figure 1 about here

---------------------------------------------------------------
Figure 1 illustrates the reaction times for patients and controls. Both groups were slower at responding in the non-designated condition relative to the designated condition. This effect was greater in patients. The planned ANOVA revealed significant effects of condition ($F(1, 47) = 27.86, \text{MSE} = 40419.71, p = .0001$), group ($F(1, 47) = 29.99, \text{MSE} = 361926.92, p = .0001$), and a significant condition x group interaction ($F(1, 47) = 4.16, \text{MSE} = 6031.92, p = .047$). Post-hoc t-tests with Bonferroni correction (4 tests) revealed a significant difference in response times between designated and non-designated stimuli for both patients ($t(1, 28) = 4.93, p = .0001$) and controls ($t(1, 19) = 3.03, p = .007$).

Consistent with the general slowing in reaction time reported in schizophrenia (see Vinogradov, Poole, Willis-Shore, Ober, & Shenaut, 1998 for a discussion), patients were slower than controls on both designated ($t(1, 47) = -4.60, p = .0001$) and non-designated conditions ($t(1, 47) = -6.42, p = .0001$).

The planned analysis using education as a covariate revealed significant effects of condition ($F(1, 46) = 7.42, \text{MSE} = 10330.34, p = .009$) and group ($F(1, 46) = 26.75, \text{MSE} = 321412.82, p = .0001$), but there was no longer a significant interaction ($F(1, 46) = .599, \text{MSE} = 833.69, p = .443$).

Non-designated stimulus reaction time task - digits.

Insert figure 2 about here

Figure 2 shows reaction times for each group on the digit version of the NDSRT task. As in the letter version, both groups were slower on non-designated trials, although patients exhibited a greater impairment on the non-designated condition than controls.
The planned ANOVA on reaction times averaged across all five blocks revealed significant effects of condition ($F (1, 48) = 60.63, \text{MSE} = 57049.16, p = .0001$), group ($F (1, 48) = 28.01, \text{MSE} = 363037.45, p = .0001$), and a significant condition x group interaction ($F (1, 48) = 5.45, \text{MSE} = 5127.05, p = .024$). Post-hoc t-tests with Bonferroni correction (4 tests) revealed significant differences between the designated and non-designated condition in both controls ($t (1, 19) = 4.80, p = .0001$) and patients ($t (1, 29) = 7.01, p = .0001$).

When education is entered as a covariate, the non-designated stimulus effect is no longer greater in patients than controls. Across all five test blocks, significant effects of condition ($F (1, 47) = 6.15, \text{MSE} = 5785.36, p < .017$) and group ($F (1, 47) = 19.29, \text{MSE} = 255307.48, p = .0001$) were retained, but the condition x group interaction no longer reached significance ($F (1, 47) = 1.86, \text{MSE} = 1752.73, p = .179$).

In the first test block only, both groups were slower at responding to non-designated stimuli relative to designated stimuli but patients did not show a significantly greater impairment. The ANOVA revealed a significant effect of condition ($F (1, 48) = 22.32, \text{MSE} = 85443.29, p = .0001$) and group ($F (1, 48) = 21.45, \text{MSE} = 330599.65, p < .0001$), but no significant interaction ($F (1, 48) = 3.27, \text{MSE} = 12514.91, p = .077$). Post-hoc t-tests indicated a significant effect of condition within both controls ($t (1, 19) = -3.52, p < .002$) and patients ($t (1, 29) = -4.26, p = .0001$).

When education is controlled for, only the group effect remained ($F (1, 47) = 14.15, \text{MSE} = 222629.64, p = .0001$), although the condition effect approached significance ($F (1, 47) = 2.84, \text{MSE} = 10958.98, p = .099$).
Relationship Between Symptoms and Performance

Non-designated stimulus reaction time task - letters.

In accord with the principle hypothesis of the study, the non-designated stimulus effect was significantly correlated with psychomotor poverty. Pearson correlation coefficients were calculated between the overall mean difference between conditions, averaged across all six test blocks, and the global psychomotor poverty score ($M = 4.03$, $SD = 2.86$). There was a significant positive correlation between performance and psychomotor poverty ($r (29) = .381$, $p = .042$).

Symptoms remained correlated with performance when controlling for depression ($r (26) = .384$, $p = .044$) and education ($r (26) = .420$, $p = .026$).

Contrary to the hypothesis that disorganization is associated with establishment or maintenance of set, global disorganization score ($M = 1.21$, $SD = 1.32$) was not significantly correlated with the overall difference score ($r (29) = .043$, $p = .826$) or with the standard deviation on non-designated trials ($r (28) = .103$, $p = .60$).

Non-designated stimulus reaction time task - digits.

Psychomotor poverty was correlated with the size of the non-designated effect in the first test block only. As discussed in the methods section, Pearson correlation coefficients were calculated for the overall average difference score, the difference score in the first test block, and the average difference score for the last four blocks. There was no significant relationship with psychomotor poverty score ($M = 3.97$, $SD = 2.83$) across all tests ($r (30) = .144$, $p = .448$), but there was a correlation for the first block ($r (30) = .391$, $p = .033$). As expected, there was also no correlation with psychomotor poverty in the last four blocks ($r (30) = -.013$, $p = .944$).
Controlling for depression score and education had no effect on the relationship between performance and psychomotor poverty. Partial correlations using depression as a covariate revealed similar results as above. Partial correlation coefficients controlling for education also revealed the same pattern of results, although the correlation with performance on the first block became stronger ($r (27) = .456, p = .013$).

Consistent with the results from the letter version, disorganization score appears to be unrelated to task performance. Using the composite score for disorganization ($M = 1.27, SD = 1.34$), there was no significant correlation with the difference score across all blocks ($r (30) = .155, p = .415$), for the first test block ($r (30) = - .126, p = .508$), or for the last 4 blocks ($r (30) = .226, p = .230$). Furthermore, disorganization was not significantly correlated with standard deviation on non-designated trials overall ($r (30) = .149, p = .431$) or in the first block ($r (30) = .048, p = .800$).

**Analyses of Learning Set**

Figure 3 illustrates the average difference scores across blocks 2-5 in each version of the task. It appears neither group benefited from the establishment of a learning set. The planned ANOVA revealed no significant effects, although the group effect approached significance ($F (1, 46) = 3.14, MSe = 12944.17, p = .083$). This indicates that patients tended to be slower than controls, but there was no difference between the two versions in magnitude of the non-designated effect for either group.

**Relationship Between Auxiliary Tests, Symptoms, and Performance**
The adjusted phonemic fluency score in patients was in the normal range (\( M = 43.39, \text{SD} = 11.80 \)). There was no correlation between psychomotor poverty score and total phonemic fluency (\( r (28) = -.255, p = .250 \)). Results also revealed no relationship between psychomotor poverty and category fluency (\( r (30) = .091, p = .632 \)). There was no relationship between performance on either verbal fluency task and reaction times on the NDSRT task.

As predicted, there was a significant correlation between Stroop performance (\( M = 25.44, \text{SD} = 1.51 \)) and disorganization symptoms (\( r (28) = .554, p = .002 \)). However, Stroop score did not correlate with reaction times on either version of the NDSRT task.

Discussion

The aim of this study was to test the hypothesis that psychomotor poverty in schizophrenia is associated with difficulty responding in the absence of an explicitly established set. Subjects were tested on two conditions in which the strength of a stimulus-response mapping varied. In the designated condition, the stimulus-response map was explicitly defined. In the non-designated condition, the map was weak and incomplete, thus requiring the ability to generate a response with little external guidance. Schizophrenia patients were expected to perform poorly on this latter condition relative to controls. Furthermore, a relationship was expected between impairment on the non-designated condition and psychomotor poverty, suggesting that the symptoms of psychomotor poverty are attributable to a problem initiating responding, in particular initiating with a weak, incompletely mapped cognitive set.

As expected, schizophrenia outpatients were more impaired on the non-designated condition than control subjects, exhibiting greater difficulty responding with an
incompletely mapped set. This slowing for non-designated stimuli occurs relative to responding in the designated condition, thus it cannot be attributed to a general slowing of reaction time. Control subjects also exhibited significantly slower reaction times on non-designated trials relative to designated trials, despite the simplicity of the task. This suggests that the non-designated effect is robust. Impairment on the non-designated condition in patients was correlated with psychomotor poverty, supporting the hypothesis that responding with an incompletely mapped set may underlie the initiation deficits of the psychomotor poverty syndrome.

When the effects of education are controlled for the interaction between group and condition is no longer significant. Patients no longer exhibit a significantly greater non-designated effect than controls. However, the correlation between psychomotor poverty and the size of the non-designated stimulus effect (i.e. the difference between RT for non-designated and designated trials) remains when education is controlled for, indicating that the reaction time in the NDSRT task in patients is nonetheless related to the illness itself. Thus the difference in NDSRT between patients and controls is unlikely to be merely an artifact of differing selection bias.

The main purpose of employing the digit version was to test the hypothesis that healthy subjects would transfer learning (learning set) from one block to the next. Another motivation was to explore whether patients would exhibit transfer of learning. The analysis suggests that neither controls nor patients establish a learning set, or transfer learning, when test blocks occur consecutively, as the size of the non-designated stimulus effect does not differ between versions.
The findings do not support McGrath's hypothesis that disorganization symptoms are related to problems establishing and maintaining set (McGrath, 1991). However, it is possible that due to the simplicity of the task, individual differences in set establishment and maintenance were obscured by a ceiling effect. As expected, performance on the Stroop task was related to symptoms of disorganization, as has been previously shown (Liddle & Morris, 1991). The lack of correlation between the Stroop effect and the non-designated stimulus effect is consistent with the lack of a correlation between disorganization and the non-designated stimulus effect.

The verbal fluency task was included as a potential additional measure of cognitive initiation. The patient group failed to exhibit the impairment in verbal fluency reported by others (Allen & Frith, 1983; Gruzelier et al., 1988; Kolb & Whishaw, 1983; Crawford, Obensawin, & Bremner, 1993), possibly because the patient sample were at a higher level of functioning than the severely ill patients used in most studies. Performance on verbal fluency did no correlate with psychomotor poverty, suggesting this is an inadequate test to assess initiation. There was also no relationship with performance on the NDSRT task.

There are a few limitations to this study. The author, who is not a trained clinician, conducted symptom assessments. Although substantial training at eliciting and rating symptoms was given, the degree to which these ratings accurately reflect the severity of schizophrenic symptoms is dependent to a certain degree on a wide range of experience. Furthermore, evaluation of the symptoms of the psychomotor poverty syndrome is based primarily on observation of affect, behaviour, and speech. This can be challenging for an inexperienced interviewer during the course of taking notes and
processing the content of speech. Although inter-rater reliability is good, the results should be interpreted with caution due to the difficulty in assessing psychomotor poverty.

As discussed above, the control sample is highly educated. Thus, it is possible that the group differences in non-designated responding could be due to some aspect of education. Future studies are needed to determine whether this is the case.

The NDRT task is not a direct measure of cognitive set. The possibility exists that subjects use different strategies to perform optimally. For example, some subjects may respond to anything that is not the designated letter, without actually developing a set for the specific non-designated letter. In this case, subjects are given a strong set during the instructions for both conditions. Future investigations could examine this by changing the non-designated letter once it is believed the set has been strengthened to determine whether there is any decrement in performance.

This study supports the hypothesis that impaired initiation plays a role in psychomotor poverty under circumstances in which the stimulus-response set is expected to be weak. This is important from a scientific standpoint, as well as for accurate assessment and treatment. The data from this study indicates that patients with psychomotor poverty may benefit from explicit stimulus-response mapping. This has implications for rehabilitation, particularly in light of the impact psychomotor poverty has on social and occupational function.
References


Kolb, B., & Whishaw, I. Q. (1983). Performance of schizophrenic patients on tests sensitive to left or right frontal, temporal or parietal function in neurological patients. Journal of Nervous and Mental Disease, 171, 435-443.


psychotic dimensions of schizophrenia. Journal of Neuropsychiatry and Clinical
Neurosciences, 12(1), 4-15.


Satz, P., & Green, M. F. (1999). Atypical handedness in schizophrenia: Some

in schizophrenia. Archives of General Psychiatry, 6, 17-33.


Experimental Psychology, 18, 643-662.

Vinogradov, S., Poole, J. H., Willis-Shore, J., Ober, B. A., & Shenaut, G. K.
(1998). Slower and more variable reaction times in schizophrenia: What do they signify?
Schizophrenia Research, 32, 183-190.

Visual and Auditory Presentation Package (VAPP). Available:
http://www.nilab.psychiatry.ubc.ca/vapp

frontal lobes and schizophrenia. The Journal of Neuropsychiatry and Clinical
Neurosciences, 6, 419-427.
Table 1

**Characteristics of Patient Sample**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of hospitalizations *</td>
<td>3.95 (4.29)</td>
</tr>
<tr>
<td>Longest stay in hospital in months *</td>
<td>3.87 (4.57)</td>
</tr>
<tr>
<td>Duration of illness in years *</td>
<td>12 (7.78)</td>
</tr>
<tr>
<td>Total number of patients taking quetiapine</td>
<td>1</td>
</tr>
<tr>
<td>Total number of patients taking Olanzapine</td>
<td>19</td>
</tr>
<tr>
<td>Mean daily dose of Olanzapine</td>
<td>19.34 mg</td>
</tr>
<tr>
<td>Total number of patients taking Risperidone</td>
<td>6</td>
</tr>
<tr>
<td>Mean daily dose of Risperidone</td>
<td>4.5 mg</td>
</tr>
<tr>
<td>Total number of patients taking Clozapine</td>
<td>4</td>
</tr>
<tr>
<td>Mean daily dose of Clozapine</td>
<td>537.5 mg</td>
</tr>
<tr>
<td>Total number of patients taking only typical antipsychotic medication</td>
<td>2</td>
</tr>
<tr>
<td>Total number of patients with both (typical dose &gt; 150 chlor eq)</td>
<td>1</td>
</tr>
<tr>
<td>Total number of patients with both (typical dose &lt; 150 chlor eq)</td>
<td>6</td>
</tr>
<tr>
<td>Total number of patients taking antiparkinsonian agents</td>
<td>5</td>
</tr>
<tr>
<td>Total number of patients taking anxiolytics (mainly benzodiazepines)</td>
<td>6</td>
</tr>
<tr>
<td>Total number of patients taking antidepressants</td>
<td>7</td>
</tr>
<tr>
<td>Total number of patients taking anticonvulsants</td>
<td>3</td>
</tr>
</tbody>
</table>

* Means are presented, with standard deviation in parentheses.
Table 2

Demographic Characteristics of Controls and Patients

<table>
<thead>
<tr>
<th></th>
<th>Controls</th>
<th>Patients</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Years</td>
<td>17.48 (3.48)</td>
<td>13.17 (2.96)</td>
<td>.0001</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age in Years</td>
<td>34.75 (10.44)</td>
<td>35.33 (8.88)</td>
<td>.833</td>
</tr>
<tr>
<td>Highest Parental</td>
<td>2.85 (1.6)</td>
<td>3.07 (1.8)</td>
<td>.663</td>
</tr>
<tr>
<td>Hollingshead Rating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NART total correct</td>
<td>38.32 (5.53)</td>
<td>32.44 (6.84)</td>
<td>.003</td>
</tr>
<tr>
<td>Quick total correct</td>
<td>45.50 (2.74)</td>
<td>43.39 (3.3)</td>
<td>.024</td>
</tr>
<tr>
<td>Number of cigarettes</td>
<td>3.05 (8.0)</td>
<td>11.83 (14.31)</td>
<td>.008</td>
</tr>
<tr>
<td>smoked daily</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of</td>
<td>1.65 (2.01)</td>
<td>3.54 (4.05)</td>
<td>.065</td>
</tr>
<tr>
<td>caffeinated beverages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>consumed daily</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Means are presented, with standard deviation in parentheses. Probability estimates are based on an independent t-test.
Table 3
Ordered List of Tests Administered

<table>
<thead>
<tr>
<th>Test</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Handedness scale</td>
<td>Annett, 1967</td>
</tr>
<tr>
<td>2 Non-designated reaction time task – letters</td>
<td>* described in method</td>
</tr>
<tr>
<td>3 National Adult Reading Test (NART)</td>
<td>Nelson &amp; O’Connell, 1978</td>
</tr>
<tr>
<td>4 Quick</td>
<td>Ammons &amp; Ammons, 1962</td>
</tr>
<tr>
<td>5 Non-designated reaction time task – digits</td>
<td>* described in method</td>
</tr>
<tr>
<td>6 Controlled Oral Word Association (FAS)</td>
<td>Benton &amp; Hamsher, 1989</td>
</tr>
<tr>
<td>7 Colour Stroop</td>
<td>Stroop, 1935</td>
</tr>
<tr>
<td>8 Category Naming</td>
<td></td>
</tr>
<tr>
<td>9 Signs &amp; Symptoms of Psychotic Illness (SSPI)</td>
<td>Liddle, submitted</td>
</tr>
<tr>
<td>10 Scale for the Assessment of Negative Symptoms (SANS)</td>
<td>Andreasen, 1983</td>
</tr>
<tr>
<td>11 Scale for the Assessment of Positive Symptoms (SAPS)</td>
<td>Andreasen, 1984</td>
</tr>
</tbody>
</table>
Table 4

Stimuli Used in Non-Designated Reaction Time Task - Letters

<table>
<thead>
<tr>
<th>Designated stimulus</th>
<th>Non-designated stimulus</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>B</td>
</tr>
<tr>
<td>O</td>
<td>Y</td>
</tr>
<tr>
<td>Q</td>
<td>Z</td>
</tr>
<tr>
<td>G</td>
<td>V, W, N</td>
</tr>
<tr>
<td>D</td>
<td>U</td>
</tr>
<tr>
<td>I</td>
<td>L</td>
</tr>
<tr>
<td>M</td>
<td>T</td>
</tr>
<tr>
<td>F</td>
<td>H</td>
</tr>
<tr>
<td>K</td>
<td>X</td>
</tr>
<tr>
<td>R</td>
<td>S</td>
</tr>
<tr>
<td>J</td>
<td>P, S, U</td>
</tr>
<tr>
<td>A</td>
<td>C</td>
</tr>
</tbody>
</table>

Test block

Distracter block - position

Distracter block - number

Distracter block - colour

*20 second break
Table 5

Stimuli Used in Non-Designated Reaction Time Task - Digits

<table>
<thead>
<tr>
<th>Designated stimulus</th>
<th>Non-designated stimulus</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>6</td>
<td>Test block</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>Test block</td>
</tr>
<tr>
<td>0</td>
<td>7</td>
<td>Test block</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>Test block</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>Test block</td>
</tr>
</tbody>
</table>
Table 6

Percentage of Trials With Errors on Each Version of the Non-Designated Stimulus

Reaction Time Task

<table>
<thead>
<tr>
<th></th>
<th>Letter Version</th>
<th>Digit Version</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Designated condition</td>
<td>Non-designated condition</td>
</tr>
<tr>
<td>Patients</td>
<td>3.83</td>
<td>3.74</td>
</tr>
<tr>
<td>Controls</td>
<td>1.39</td>
<td>.97</td>
</tr>
</tbody>
</table>
Figure 1

Mean Response Times for Each Condition for Each Group on Non-Designated Stimulus

Reaction Time Task - Letters
Figure 2

Mean Response Times for Each Condition for Each Group on Non-Designated Stimulus Reaction Time Task - Digits
Figure 3

Mean Differences in Response Times for Blocks 2-5
Appendix III
MANDATORY QUESTIONS FOR SSPI

These mandatory questions are intended only to elicit an initial indication of relevant psychopathology. Whenever there is direct or indirect evidence of psychopathology, further questions must be asked to determine the nature of the phenomena and to establish intensity, frequency of occurrence and degree of disruption of daily life. In addition, it is important to establish that the phenomena occurred within the past week.

Have you been anxious or worried in the past week?

Have you been sad or low in spirits? Have you been in a high mood at any time (in the past week)?

Have you been feeling irritable? Have you been in conflict with anyone?

Do you feel especially guilty about anything?

Are there any activities you enjoy? What has your appetite been like?

Do you feel physically well?

Have you had any difficulty sleeping? Have you been waking earlier than usual?

Have you had any strange or unusual experiences recently?

Have you any special abilities? Are you a special person in any way?

Do people talk about you? Has there been any reference to you on the television?

Has anyone been trying to harm you?

Does anything or anybody interfere with your thoughts?

Can other people hear what you are thinking?

Does any outside power or influence take control of you?

Do you hear voices even when nobody else is there?

TEST ATTENTION -- (Five serial subtractions)

TEST ORIENTATION -- in time and place.

Then ask questions about daily activities, interests, relationships.

Finally, ask the patient's own view of their illness and its treatment.