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Cognitive performance as a predictor of functional capacity in schizophrenia

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COGNITIVE PERFORMANCE AS A PREDICTOR OF FUNCTIONAL CAPACITY IN
SCHIZOPHRENIA

A Thesis

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the requirements
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by
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ABSTRACT

Previous literature has demonstrated that persons with schizophrenia suffer from cognitive deficits and struggle with deficits in everyday living skills, two areas of functioning that are related in some way. Nearly all cognitive domains are affected in schizophrenia, and most of them have been associated with poor functioning. Therefore, a possible link is the existence of an attentional bottleneck where the demands of attentional load and the lack of attentional resources to handle these demands, decreases capacity to carry out everyday living skills. Researchers have suggested the existence of a structural bottleneck that limits individuals' ability in the use of cognitive resources. This limit is manifested experimentally in an inability to attend to two tasks at once (Ruthruff, Pashler, and Klassan, 2001). A way to examine attentional load is by evaluating performance in different cognitive tasks that vary the amount of cognitive load or cognitive demands needed to perform those tasks.

The primary goals of this project were to: 1) replicate previous findings that individuals with schizophrenia display increased deficits in everyday living skills compared to controls, 2) determine whether individuals with schizophrenia demonstrate exacerbating verbal fluency deficits under higher cognitive (or attentional) load demands compared to controls, and 3) examine whether performance changes under these different cognitive loads are associated with deficits in everyday living skills.

Consistent with previous findings, the results indicate that individuals with schizophrenia perform worse in everyday living skills and have deficits in working memory and verbal fluency. However, the findings also suggest that performance under high cognitive verbal fluency load (used to represent a high attentional load) is difficult for both non-psychiatric controls and individuals with schizophrenia. In addition, our results suggest that verbal fluency performance

is not predictive of everyday living skills, regardless of group membership. Interestingly, we found that working memory performance was predictive of everyday living skills capacity at a trend level. We also found some interesting sex differences that suggest verbal fluency may be a more difficult cognitive task for males, regardless if they were in the schizophrenia or non-psychiatric control group.

CHAPTER 1. INTRODUCTION

Schizophrenia is a severe mental illness characterized by cognitive deficits as well as vocational impairment and interpersonal difficulties. Individuals with schizophrenia also tend to have deficits in everyday living and limits in attention, focus, and vigilance. These difficulties contribute to the pervasiveness of the disorder, creating problems in job seeking, job maintenance, and activities of daily living (Wu et al., 2005). These deficits also lead to increased suffering for those with the illness as well as significant societal costs. Though struggles in this area are well documented in the literature, connecting the deficits in everyday living skills and cognitive deficits together and illuminating whether and how they influence one another is still in early stages. This study attempts to examine how difficulty with increasing cognitive demands may relate to impairment in the area of everyday living skills.

This project assumes that deficits in cognitive ability are related to deficiency in everyday living skills. It also assumes that the magnitude of deficits, which can be displayed by difficulty with increased cognitive load, is related to a greater magnitude of functional impairment in everyday living skills. This would indicate that with more cognitive resources necessary to complete a task, greater cognitive deficits would be revealed. Therefore, individuals (regardless if they have serious mental illness or are healthy individuals), who have the most difficulty in performance during an increase in cognitive load, would also have difficulty in everyday living skills, because these tasks require the ability to adapt cognitively and socially to environmental demands.

The primary goals of the project were to: 1) replicate previous findings that individuals with schizophrenia display increased deficits in everyday living skills compared to controls, 2) determine whether individuals with schizophrenia demonstrate exacerbating verbal fluency

cognitive deficits under higher cognitive (or attentional) load demands compared to controls, and 3) examine whether performance changes under different cognitive loads are associated with deficits in everyday living skills.

1.1 Schizophrenia

Schizophrenia is a mental illness that is typified by debilitating symptoms of disordered thought, behavior, and emotions. The illness affects approximately 1% of the world's population and accounts for 1-2% of national healthcare costs in industrial countries (Hu, 2006; Tsuang, Stone, and Faraone, 1999; Wu et al., 2005). This estimate does not include the indirect costs related to societal and personal suffering that are, in large part, immeasurable.

Schizophrenia is a heterogeneous disorder in terms of symptoms, illness course, and etiology (Cohen and Docherty, 2005). This heterogeneity is expressed clinically in many ways. For example, patients vary in presence and severity of positive and/or negative symptoms. Positive symptoms include delusions (false beliefs) and hallucinations (false perception of sensory experience). Negative symptoms include a withdrawal of normal affect such as alogia (poverty of speech), anhedonia (inability to feel pleasure), alexithymia (inability to express emotion), as well as social withdrawal (Adams and Sutker, 2001). Other clinically significant evidence for heterogeneity in this population are differences in the duration and amount of psychotic episodes, illness comorbidity, cognitive ability, and treatment response (Bruder et al., 2011; Case et al., 201; Kendler, McGuire, Gruenberg, and Walsh, 1994). A diagnosis of schizophrenia is satisfied by meeting two or more of the following symptoms (or only one symptom in the case of a delusion of bizarre nature) that are present for the majority of the time during a one-month period: delusions, hallucinations, negative symptoms (e.g., alogia, alexithymia, and/or blunted affect), disorganized or catatonic behavior, and disorganized speech.

To meet criteria for schizophrenia, an individual must also have experienced pervasive disturbance of social or vocational functioning resulting from the symptoms lasting for at least six months. Symptoms must not be a product of a medical condition or substance use disorder or better classified by a pervasive developmental disorder (American Psychiatric Association, 2000).

Literature has demonstrated that schizophrenia exists on a continuum. Support from data that includes genetically predisposed relatives of individuals with schizophrenia and non-psychiatric controls have helped demonstrate that many individuals have risk factors for schizophrenia. These risk factors, which include a host of sub-clinical positive and negative symptoms, cognitive disorientation, and abnormal speech, establish a schizophrenia-spectrum (Cohen and Docherty, 2005; Erlenmeyer-Kimling et al., 2000). The spectrum identifies those who are at risk for developing schizophrenia both genetically (those with relatives with schizophrenia) and environmentally. An example of this are those classified with schizotypy. Research reveals that schizotypy impacts 10% of the population and manifests as a personality organization with some or all of the sub-clinical symptoms discussed above. Schizotypy is evidence for a schizophrenia-spectrum that encapsulates individuals who show elevated risk, as well as sub-clinical symptoms that help inform possible biomarkers and predisposition for symptoms of schizophrenia (Gottesman, 1991; Meehl, 1962).

There is no cure for schizophrenia or those identified in the schizophrenia-spectrum, at present. Treatments target symptom amelioration, and research development may inform these treatments. Certain treatments hold potential for remission of the disorder. Some of these treatments include the use of psychopharmacology, interpersonal therapy, cognitive restructuring, and psychosocial intervention for reduction of symptoms (Bustillo, Lauriello, Horan,

and Keith, 2001; Kurtz, and Mueser, 2008). Additionally, cognitive enhancement therapy (CET), also called cognitive remediation therapy, can perhaps reverse or stop the cognitive and life skill deficits related to the illness. Trials are currently taking place to examine changes in both cognitive and everyday living skills deficits resulting from these treatments (Eack et al., 2009; Keshavan et al., 2010). CET will be discussed later as it relates to potential improvement in symptomology (pg. 18-20).

1.2 Everyday Living Skill Deficits in Schizophrenia

Disruptions in independent living, social skills, and vocational functioning are characteristic of schizophrenia. Problems in self-care and maintenance contribute to decreased quality of life (general well-being and satisfaction with daily life and circumstance) and societal costs, such as the high cost of Medicare, Medicaid, and tax related hospital costs. Many of these deficits are pervasive, often begin in the early stages of the illness, and can be related to a great deal of the suffering that typify this disorder (Addington and Addington, 1999; Bowie, Reichenberg, Patterson, Heaton, and Harvey, 2006; Galuppi, Turola, Nanni, Mazzoni, and Grassi, 2010; Simon, 2003).

Functioning is a multi-dimensional concept. For individuals with schizophrenia, deficits in functioning occur in everyday living skills such as planning and keeping appointments, appropriate dressing, contacting appropriate people in emergency situations, medication management, and appropriate conversation with strangers (Addington and Addington, 1999; Galuppi et al., 2010). These impairments also manifest in difficulty maintaining jobs or living independently. For example, approximately 62% of individuals with schizophrenia do not live independently (outside of supervised group housing or without relatives), and employment rates for those with schizophrenia are below 10% cross-culturally (Marwaha et al., 2007). To

operationalize our definition of functioning in everyday living skills or capacity, we use a description of functioning that includes ability to appropriately address emergency situations, interact in social situations, focus on attending to personal needs in social situations, appointment keeping, and independent bill paying, as well as how to figure out transportation. We suggest that these are adaptive abilities needed for everyday living and interpersonal/social activities. Other definitions of functioning in schizophrenia include basic assessment of activities of daily living, such as problems with fundamental hygiene care (e.g., teeth brushing and showering) that prevent independent living and hospital discharge (Ikebuchi, Satoh, and Anzai, 2008). For this study, we are more interested in functioning in everyday life skills, as there is a demonstrated relationship with independent living and quality of life (Pitkänen et al., 2012), and a relationship between deficits in these skills and general cognitive deficits (Green, 1996).

In the laboratory, functioning in schizophrenia can be assessed by a number of different measures including tasks of everyday living. The University of California San Diego (UCSD) Performance-Based Skills Assessment-Brief Version (UPSA-2) is one example of such a measure (See Appendix). The UPSA was specifically designed for the assessment of individuals with schizophrenia. This particular measure, used in this study, is a 30 minute evaluation of performance in everyday living skills, like those mentioned above, and is credited for being tolerable, valid, reliable, and cross-culturally sound (Harvey et al., 2009; Patterson, Goldman, McKibbin, Hughs, and Jeste, 2001). Based on this and similar tests, evidence suggests impairments in functioning for individuals with schizophrenia, and these impairments seem to be pervasive throughout the course of the illness (Bruder et al., 2010). The specific domains evaluated by the UPSA-2 are pertinent to this project, as the measure elicits specific relationships between cognitive performances and deficits in everyday living skills (Green, 1996).

1.3 Cognitive Deficits in Schizophrenia and Limits to Cognitive Functioning

Cognitive functioning refers to how individuals perform in cognitive domains such as memory (e.g., visual, spatial, working), executive functioning, and attention (Lezak, 1994).

Cognitive functioning can be evaluated comprehensively to determine general intelligence ability. Cognitive domains of memory and attention can also be assessed differentially.

Individuals with schizophrenia show impairments in nearly every domain of cognition (Heinrich and Zakzanis, 1998). Researchers have shown that patients with schizophrenia tend to score in the lowest 5-10% of the general population on cognitive assessments (Keefe, Eesley, and Poe, 2007). Furthermore, at-risk and first-episode studies, representing individuals across the schizophrenia-spectrum, indicate that deficits are present at onset, and even prior to onset of schizophrenia symptoms (Albus et al., 2006; Asarnow, 1999; Ragland, 2003).

Deficits seen across the domains of memory, executive functioning, and language have come to be known as the “generalized deficit” (Chapman and Chapman, 1978). The literature is replete with evidence that many, if not most, individuals affected by schizophrenia have a generalized deficit. For example, a meta-analysis by Heinrichs and Zakzanis (1998) considered the cognitive performance of 7,420 individuals (204 studies) with schizophrenia who demonstrated a consistent pattern of marked disturbance across attention, executive functioning, visuospatial ability, memory, and language. Related to this, Keefe, Eesley, and Poe (2005) conducted a study to determine the extent to which individuals with schizophrenia differed from non-psychiatric controls in meeting expected performance in cognitive functioning. They defined the expectation by a composite of parental education and score on the wide range achievement test (WRAT). The WRAT is an achievement test often used to calculate a general premorbid intellectual quotient (IQ; Reynolds, 1986). These data revealed that 42% of control

subjects fall below their expected cognitive functioning level, and over 98% of individuals with schizophrenia fall below this line.

Related to the concept of cognitive functioning, the cognitive literature has made strides in establishing the limits of cognition in healthy individuals. A study by McCabe, Roediger, McDaniel, Balota, and Hambrick (2010) indicates that cognitive domains often overlap and that domains such as executive functioning and working memory are highly related. McCabe et al. (2010) evaluated 200 subjects on tests of processing speed, working memory and executive functioning. The authors define executive functioning as goal-directed behavior that demands the use of high-order cognition such as planning and organization. McCabe et al. (2010) also mentioned that working memory is active maintenance and management of stored information (McCabe et al., 2010; Miyake and Shah, 1999). The authors found that working memory and executive functioning were highly correlated ($r = .97$), suggesting that these two domains underlie higher-load cognitive capacity, which they refer to as *executive attention*.

The idea of executive attention suggests there is a global or broad deficit that can be looked at generally to determine higher-order cognitive capacity. Many researchers have been interested in specific domains of cognition instead of general capacity. One example of this that has been proven helpful in order to reveal a consistent deficit in individuals with schizophrenia is verbal fluency. Additionally, McCabe et al. (2010) indicated that verbal fluency was also an example of executive functioning and working memory, it requires goal directed behavior and memory retrieval. Verbal fluency deficits appears to be present throughout the life-span of individuals with schizophrenia (Rajji, Ismail, and Mulsant, 2009). Verbal fluency evaluates immediate semantic verbal memory and verbal expression, often demonstrated by naming as many words from a category as possible, or words that start with a specific letter of the alphabet

under a time limit (Ardila, Ostrosky-Solís, and Bernal, 2006). A recent meta-analysis of 53 studies, including cognitive profiles of individuals with schizophrenia, indicated that verbal fluency was the most stable cognitive deficit in individuals who were asked to repeatedly perform cognitive tasks. Verbal fluency had the lowest effect size difference pre and post practice effects (Hedges $G = 0.02$) compared to other cognitive tasks that were repeated in practice, including immediate recall (Hedges $G = 0.20$) and visual reproduction (Hedges $G = 0.53$). The authors suggest that the tenacity of the verbal fluency impairment suggests it may be a potential biomarker to identify schizophrenia. This indicates that verbal fluency is a potentially superior proxy of general impairment in cognition for those with schizophrenia, compared to other cognitive deficits such as verbal memory (Szoke et al., 2008).

Building on the theory that working memory is necessary for verbal fluency, a study by Joyce, Collinson, and Crichton (1996) indicated that verbal fluency deficits are based on a depleted semantic store (cognitive memory bank of learned words). Because executive functioning and working memory are so highly correlated (as demonstrated by McCabe et al., 2010), verbal fluency may be a particularly good task to demonstrate how both executive functioning and working memory can be a measure of a broad deficit in schizophrenia.

1.4 The Link Between Functional Deficits and Cognitive Impairment in Schizophrenia

Despite major advances in our understanding of cognitive limitations in schizophrenia, little is known as to how cognitive functioning relates to the pathophysiology of the illness and how exactly it underlies other difficulties associated with the disease (e.g., everyday living). Some researchers propose that there is a link between cognitive impairments and functional impairments. For example, the literature has demonstrated positive correlations between deficits in domains of basic living and a wide range of cognitive impairments, such as

executive functioning (Ritsner, 2007), verbal memory (Puig et al., 2008), attention (Erlenmeyer-Kimling et al., 2007), and working memory (Fujii, Wylie, and Nathan, 2004), to name a few. Interestingly, researchers have suggested that everyday living skills and cognitive symptoms are both pervasive from before diagnosis and through the lifespan. For those with schizophrenia, it is reported that attention, problem solving, and reasoning are most important in comparison to other cognitive domains in predicting performance in vocational-related tasks (Tan, 2009). Additionally, Oie, Sundet, and Ueland(2010)showed a relationship between baseline cognitive dysfunction and deficits in social functioning at a 13-year follow-up of those with early-onset schizophrenia (onset prior to age 18 years). This finding suggests both a relationship between cognitive ability and everyday living skills, and that cognitive functioning and everyday living skills seem to follow a similar trajectory over the course of the illness. Interestingly, Milev, Ho, Arndt, and Andreasen (2005)found that verbal memory was the best predictor of severity of functional impairment and suggested that psychosocial interventions should be directed at improving processing speed, verbal memory, and attention. In sum, a good deal of research connects cognitive domains and functioning, but the literature has yet to establish an underlying gold-standard cognitive substrate connected to functioning. Therefore, the nature of the relationship between cognitive impairment and functioning is still unclear.

The basis of the predictive relationship between cognitive performance and everyday living skills is a critical knowledge gap regarding our understanding of the link between these two important aspects of functioning. The research discussed above demonstrates a number of different theories to connect this possible link. Cognitive functioning is complicated and multifaceted, and there is little consensus on which specific cognitive substrata may underlie deficits in everyday living skills. Attempts to identify specific cognitive markers such as how

executive functioning or language predicts functioning have largely failed due to conflicting and unreplicated results. Perhaps this failure suggests that the concept of isolation of one cognitive variable over another as a predictor of functioning is obsolete. What may be more illuminating is to clarify whether there is a common cognitive substrate to each of these abilities that is related to functioning deficits. It seems that the cognitive literature discussed above, such as McCabe et al. (2010), demonstrates evidence for using a comprehensive attention load task to demonstrate cognitive limits. Because the literature suggests that individuals with schizophrenia reveal global deficits in attention, memory, and executive functioning, we hypothesized that individuals with schizophrenia struggle under higher attentional loads, which would be demonstrated by a decrease in cognitive performance. Related to this, as cognitive demands increase, there would be a decrease in the ability to carry out everyday living skills.

1.5 Attentional Difficulties as a Predictor of Functional Deficits in Schizophrenia

We propose that there is a critical variable to each of the cognitive abilities involving overall capacity in attention. Further, we propose that attention (broadly defined) is common to all cognitive tasks to varying degrees, and may be the common factor for understanding the relationship between cognition and everyday functioning in schizophrenia. To test this idea, we administered a task that is known to measure cognitive functioning (verbal fluency) and experimentally manipulated the attentional load of this task. The expectation was that increased attentional load would cause everyone's cognitive performance to decline, but individuals with schizophrenia would do significantly worse than non-psychiatric controls. The magnitude of this decline was thought to be a more sophisticated measure of attentional capacity (or of a possible attentional bottleneck) than simply using a single attention task. Moreover, we predicted that the

magnitude of declination (i.e., the degree to which verbal fluency performance suffers under attentional load) would be significantly related to patients' daily functioning.

In essence, individuals with schizophrenia would struggle more as demands in attention increase, and as this difficulty increases, so does the ability to achieve success at meeting demands of everyday living skills. This study evaluates how the increases in experimentally manipulated cognitive load demand (as well as the corresponding increase in attentional load), are associated with everyday living skills. We theorized that there is a limit in cognitive ability (a bottleneck), where demands of attention overwhelm individuals with schizophrenia, and that this cognitive inundation leads to a decline in performance in other aspects of their daily life. In support of this hypothesis, some researchers in the field have proposed that cognitive functioning deficits in schizophrenia are generalized and that the concept of "G" (or generalized/global cognitive impairment) is more important than differentiating specific cognitive variables/deficits (Dickinson and Coursey, 2002; Dickinson, Ragland, Gold, and Gur, 2008).

1.6 The Use of Dual-Tasks in Schizophrenia

The theory that dual-tasks reveal an attention or central structural bottleneck has been recognized in the cognitive literature. Ruthruff et al. (2001) proposed that healthy individuals demonstrate dual-task slowing while asked to perform two cognitive tasks at once, even if attempts are made to reduce experimental interference, such as interfering noise outside of the experiment and time between task questions. The authors suggested that "the central bottleneck hypothesis" demonstrates a limit in response selection that restricts participants from responding to more than one task at a time. Even after extensive exposure to and practice with two concurrent tasks, individuals are unable to respond to two tasks at the same time with equivalent accuracy or attention. Additionally, Nuechterleun, Pashler, and Subotnik (2006) suggested that

patients with schizophrenia would show a similar attentional impairment and difficulty in switching between tasks, and this would be a marked difficulty for the population due to extensive cognitive deficits inherent to this population. Results of the above research are still in progress, but this would suggest that “the central bottleneck” could be a clear structural limit to capacity for individuals with schizophrenia, that could be seen during a dual-task design.

To measure the effects of attention on verbal fluency ability, we employed a dual-task design. Although there is limited application of dual-tasks to understanding schizophrenia-spectrum pathology, there are a few studies that have been conducted. For example, Harvey, Reichenberg, Romero, Granholm, and Siever (2006) demonstrated that persons with schizotypal personality disorder perform worse on digit span tasks (visuospatial tasks) when paired with a box crossing task (a task where participants had to mark an X on paper drawings of a box) and that they also generally performed worse than controls. This finding suggests that patients on the schizophrenia-spectrum may have greater impairment when asked to perform more complex or higher load tasks compared to singular load tasks (Harvey et al., 2006). Related to this, as well as the proposed concept of impairment in manipulation of high-load cognition for those with schizophrenia, a study of patients with schizophrenia showed poor performance on both visual and spatial cognitive measures on both a baseline cognitive task and a dual-load task. The author suggested that differences in performance were not additive from the low-load task to the dual-tasks on either task (i.e., there was no group by task interaction), but instead came from general deficits in both tasks (Spindle, Sullivan, Menon, Lim, and Pfefferbaum, 1997). Similarly, Leiderman and Strejilevich (2004) suggested that working memory tasks were impaired for those with schizophrenia compared to controls, and that this impairment became worse when exposed to a dual-task. This impairment was not found in the performance of the control group

(Leiderman and Strejilevich, 2004). What is not clearly shown in the literature is how global cognitive load, specifically, changes in attention, as measured by a dual-task design, is related to functioning in everyday living.

“Cognitive load,” a term used in the cognitive psychology literature to understand how cognitive resources modulate performance on a broad array of functions, relates to the amount of working memory being utilized at a given time and that can be experimentally manipulated (Sweller, 1983). Cognitive load theory suggests that there is arrangement to stored knowledge and working memory with a limit to how much individuals can keep available at one time. It is also repeatedly found in the literature that the general population performs worse on cognitive tasks as cognitive load increases (van Merriënboer and Sweller, 2010). In sum, switching verbal fluency performance from a baseline (or a low-load cognitive measure, such as a single task) to a high-load or dual-task design causes a cognitive performance decline, and we posit that this declination would be significantly more pronounced for patients with schizophrenia compared to non-psychiatric controls. Using a dual-task design, we are able to look at verbal fluency as a task example of cognition generally, and how performance changes as attentional demands (by adding a working memory task) increase.

1.7 The Importance of This Topic

As evidence of relationships between everyday living skill functioning and cognitive performance increases, potential treatments are in development that offers rehabilitation for both potential deficits. By improving cognition, patients’ functioning in everyday living skills may improve, giving them a better chance at vocational and independent living success. However, not knowing what cognitive substrates should be targeted hampers the potential for rehabilitation.

The impetus of this project is to identify this target. By determining whether the link to

functioning deficits is connected to demands of cognitive load, we can begin to develop strategies to improve and account for cognitive load so that patients' functioning improves in everyday living. More recently, CET has shown promise in mediating cognitive symptoms and, in consequence, alleviating functional impairment (Eack, Pogue-Geile, Greenwald, Hogarty, and Keshavan, 2010). CET has shown promise for improvement for both everyday living skills functioning and cognitive functioning (Eack et al., 2010). Aspects related to everyday functioning such as learning potential and attention are also predicted to show improvement after these types of treatments (Bustillo et al., 2001; Raffard, Gely-Nargeot, Capdevielle, Bayard, and Boulenger, 2009).

Developed in the 1990s, CET was created as a potential restoration therapy to target the cognitive decline associated with schizophrenia. The treatment is designed to be administered in conjunction with antipsychotic medication and includes 50 hours of group therapy as well as 70 hours of computerized training. There are minor differences in the computer training programs and manuals employed in CET, but generally, the therapy is designed to last six months. Researchers indicate that treatment effects are better maintained if clients remain in individual therapy after the CET course. Clients work in pairs on the computer component that incorporates memory tasks and problem solving assignments (Hogarty et al., 1997; Hogarty et al., 2004). For example, patients work on mazes and verbal recall similar to tasks on an IQ test. Clients' progress is dependent on competency level, and they consistently receive feedback regarding their progress (Hogarty et al., 2004).

The group therapy portion of CET involves social situation role-plays, practice in abstract thinking, problem solving, and appraisals of social and interpersonal situations (Hogarty et al., 2004; Hogarty et al., 2006). Often, goals of these skill-building exercises encourage recognition

of a main idea in a role-play by remembering key words and being able to let go of extraneous information. For example, in a paired role play, a participant tells a story about his/her weekend, and the listener (another participant) identifies the key points of the story and is encouraged to respond by isolating and using the main points conveyed during the discussion. Another example may require that participants read a short story and isolate the important aspects of the story and what the author is trying to communicate with the story. These role-plays focus on identifying a “gist,” and ignoring information that is unnecessary to key points. Group therapy is meant to be parallel to memory of tasks that patients are practicing on the computer, such as omitting ambiguous stimuli in an n-back task (a test where participants need to indicate if they saw the same symbol twice in a row) and requires focus on a target (Hogarty et al., 1997; Miller and Mason, 2004). The integration of social practice in groups and computer training potentially increases a grasp on social and memory skills. Additionally, social cues and norms are highlighted in group therapy. A good deal of this is taught through psychoeducation and group practice in eye contact and reciprocating social communication such as shaking hands and initiating conversation (Miller and Mason, 2004).

CET aims to increase social awareness and cognitive capacity, hopefully resulting in improvement in quality of life and everyday functioning that is often lacking in the lives of individuals suffering from schizophrenia as discussed throughout this document. The results of research regarding functional improvement based on CET are at an early stage. Evidence for a limiting cognitive component that contributes to deficits in everyday living skills may help guide potential rehabilitation of functioning. Understanding how and when cognitive demands begin to underlie or interfere with everyday functioning is imperative in the development of such treatment strategies.

1.8 Hypotheses

For the present study, we were interested in testing the hypothesis that basic attention, which is common in varying degrees to most cognitive abilities such as language, executive, perceptual and memory, is the primary cognitive deficit in schizophrenia. This theory, that attention reflects a “cognitive bottleneck” limiting performance in other cognitive domains, has been proposed by several other theorists (Nuechterlein, Pashler, and Subotnik, 2006; Ruthruff, et al.,2001). To test this idea, we evaluated performance on tests of verbal fluency across varying levels of attentional load in patients with schizophrenia and non-psychiatric control subjects. This way we would be able to use verbal fluency performance, at different load demands, to illuminate an attentional bottleneck. We theorized that increased attentional demands would limit the attentional resources available for people to effectively perform the verbal fluency, and hence, that verbal fluency performance would decline. More importantly, we hypothesized that this decline would be significantly more pronounced in schizophrenia patients compared to non-psychiatric controls, and that the decline in cognitive performance would predict impairment in everyday living skills.

I. Schizophrenia Group versus Control group

- a. The schizophrenia group would display significant deficits in basic skills and daily functioning (per the UPSA-2) in contrast to the control group. Means in overall performance of functioning would be significantly better for non-psychiatric controls, replicating previous findings in the literature.
- b. There would be a main effect for group on cognitive performance, such that the schizophrenia group would perform significantly worse on the cognitive tasks (verbal fluency tasks). This would be a replication of previous literature.

- c. There would be a group by condition interaction, where individuals with schizophrenia would perform worse in the change from baseline to high-load verbal fluency tasks. This would be an extension of the existing literature regarding cognitive performance and dual-task performance in individuals with schizophrenia compared to controls.

II. Poorer Performance from Baseline to High-Load on a Cognitive Task as a Predictor of Everyday Living Skills Performance.

- a. The magnitude of change in verbal fluency between baseline and high-load conditions (computed using regressions) would be significantly related to everyday living skills performance. As we already hypothesized that individuals with schizophrenia would perform worse in everyday living skills, a moderation analysis, would be computed (using regression) to reveal if the change score (difference score from baseline to high-load verbal fluency task) would moderate the relationship between individuals with schizophrenia and non-psychiatric controls in UPSA performance. This hypothesis is a novel contribution to the literature regarding potential links between cognitive functioning as well as everyday living skills for patients with schizophrenia compared to controls.

CHAPTER 2. METHOD

2.1 Participants

Participants were stable community mental health outpatients with a diagnosis of schizophrenia under the care of a treatment team and medication management plan. Inclusion criteria for participants with schizophrenia included a Diagnostic and Statistical Manual of Mental Disorders, 4th edition, text revision (DSM-IV-TR) diagnosis of schizophrenia for individuals between the ages of 18 and 55 years. Exclusion criteria included a current diagnosis of substance dependence as determined by the Structured Clinical Interview for DSM-IV Disorders (SCID; see Appendix C), neurological disease or head injury as determined by self-report, medical records, and meetings with personal clinicians. Healthy volunteer controls had no history of, or current diagnosis of, psychotic illness or affective disorder, and the intention was that the controls would be matched with the schizophrenia group by age, education level, and race. However, despite efforts of matching, difficulty in recruitment resulted in an uneven sex split. Participants in the schizophrenia group were predominantly male, and the controls were evenly distributed for sex (see Table 1).

Table 1

Demographic data for participants in the schizophrenia and control group

	Control		Schizophrenia	
	Percent	Frequency (n)	Percent	Frequency (n)
Sex (female)	53.0	17	15.0	4
Ethnicity				
Caucasian	53.0	17	38.5	10
African-American	37.6	12	61.5	16
Other	9.4	3		
Age (years)	Mean: 39.84	SD: 12.6	Mean: 40.82	SD: 11.26

Participants were recruited from the community. Participants were contacted via email or phone and invited to participate in an “in-person” testing session at their own group homes or in our laboratory. All participants involved in the study were compensated with \$40. This study was part of a broader research study conducted under the supervision of Dr. Alex Cohen (See Appendix D for a list of all tasks included in this study).

2.2 Measures

Structured Clinical Interview for DSM-IV Disorders (SCID). The SCID (modules used were those for mood disorders and psychotic disorders) for Axis I disorders (SCID- I) is a valid and reliable structured evaluation and is the gold-standard for evaluating Axis I diagnoses according to the DSM-IV-TR in research settings (Lobbestael, Leurgans, and Arntz, 2011; Steiner, Tebes, Sledge, and Walker, 1995). The interview usually takes 1-2 hours to administer. All individuals who administered the SCID were graduate students in clinical psychology with intensive training, and a consensus meeting led by Dr. Alex Cohen was used to derive 100% inter-rater reliability. During this meeting, every participant was discussed and separately evaluated by two trained graduate students, guaranteeing diagnostic agreement.

UCSD Performance-Based Skills Assessment Test (UPSA2). The UPSA-2(see Appendix B) is the brief version of the UCSD performance-based skills assessment test and is a performance measure of a person’s everyday living skills in five selected domains of daily living: 1) Financial Skills, 2) Communication, 3) Organization/Planning, 4) Transportation, and 5) Household Management. The UPSA-2 takes approximately 30 minutes to administer and has been shown to have high test-retest reliability and participant tolerability above and beyond other co-primary measures (Harvey, Green, and Nuechterlein, 2010). In each subsection, participant’s role-play tasks that are involved in activities of daily living such as being able to make a doctor’s

appointment, read a utility bill, plan a day trip, and cook a dessert. This test has typically been employed for participants with schizophrenia-spectrum related disorders compared to controls (Harvey et al., 2010; Patterson et al., 2001).

Dual-task– Cognitive Load Task. We used a within-subjects dual-task design requiring subjects to provide responses during a task while engaging in separate baseline (low cognitive load) and high cognitive load tasks. There was a baseline verbal fluency task and a high-load condition that included the verbal fluency task and a visual working memory task. The baseline task consisted of a verbal fluency task requiring participants to “name as many fruits (or vegetables) as possible, as quickly as possible.” Participants named either fruits or vegetables in the low- or high-load were counterbalanced for order. During the baseline condition, subjects were asked perform the verbal fluency task without an additional dual-task. Verbal fluency has often been associated with vocational and social functioning (Bellack, Gold, and Buchanan, 1999; Buchanan, Holstein, and Breier, 1994), and therefore, this was a good task to use in order to demonstrate differences in performance under baseline and high-load demand condition, and to use as predictor of everyday living skill capacity. During the high-load task, participants were asked to perform a verbal fluency task (naming as many fruits or vegetables as possible) while engaging in an n-back test, a commonly used test of attention and working memory (visual working memory). The n-back test, specifically, a one-back test, involved responding to stimuli when consecutively appearing visual symbols are repeated. In this task, participants were presented with a forced choice where they were required to indicate whether they were viewing a target (i.e., a match in consecutive stimuli) or a nontarget (a lack of match in consecutive stimuli). The design ensured that participants were paying attention and engaged during this challenging course. Before each task, patients underwent five, one minute-long practice blocks

of the visual working memory task without the verbal fluency task in order to become familiar with the one-back task. We employed visual stimuli informed by the Baddeley-Hitch model. This theory proposes that there are domain specific aspects of memory separated by audio or visual stores. We employed a verbal fluency task, in order to demonstrate whether visual stimuli during the n-back would affect performance through depletion of attentional resources, which would not directly interfere with verbal processes. Presentation of the n-back stimuli was for 2000 milliseconds, and the interstimulus intervals were 10,000,15,000, and 2,000 milliseconds. We chose a visual n-back task so that we could tap into a visuospatial store and verbal fluency, and not just verbal memory or storage (Cocchini, Logie, Della Sala, MacPherson, and Baddeley, 2002).

2.3 Analyses

The analyses for this study were conducted in four parts. First, we investigated whether the schizophrenia and control groups differed on demographic categories including age, gender, and ethnicity. We controlled for significant demographic differences in all relevant analyses. We made efforts to match control and patients during data collection; however, these data did show a significant difference between males and females in cognitive performance, and therefore the resulting analyses controlled for sex when necessary.

Our first hypothesis, that individuals with schizophrenia would have decreased performance on the UPSA (everyday living skills) measure compared to controls, was assessed using a between-subjects t-test. In this analysis, group (schizophrenia, control) served as the independent variable (IV), and total score on the UPSA served as the dependent variable (DV). This hypothesis was a replication of the current literature to reveal differences in functioning between individuals with schizophrenia and controls.

Next, we hypothesized that individuals with schizophrenia would differ in performance on cognitive tasks (here we looked at baseline and high-load performance in verbal fluency tasks) compared to controls, and we tested this through a multivariate analysis of covariance (MANCOVA), controlling for sex. Again, in this analysis, group (schizophrenia, control) served as the IV. The DVs included 1) composite scores on the baseline cognitive task (verbal fluency) and 2) composite scores on the high-load/dual-task. This was also a replication of current literature identifying differences in cognitive ability between those with schizophrenia and controls.

A repeated-measures analysis of covariance (ANCOVA) was employed to test our hypothesis that there would be differences in performance from the baseline cognitive task to the high-load cognitive task in the schizophrenia and control group, controlling for sex. The IV was group (schizophrenia and control) and the DV was verbal fluency performance scores (baseline and high-load). We looked at group condition interactions to evaluate our hypothesis that there was a difference in performance from baseline to high cognitive load between the schizophrenia group and control group. Group (schizophrenia, control) served as the IV, and the DV was the change in scores of the composite scores from the baseline test to the high-load cognitive test. This evaluated whether there were differences in performance from a baseline task to a high-load cognitive task generally, and whether there were differences in performance based on group.

A hierarchical regression was performed to test whether the score changes discussed above predict UPSA composite scores. Step one was sex (due to significant differences in sex and verbal fluency cognitive load mentioned above), step two was the group and change score, and step three was a computed variable of change score multiplied by group with the DV being UPSA score performance. The change score was the difference score for each individual from

baseline to high-load verbal fluency performance; an average difference score was computed by group for group comparisons. This model examined whether change score predicted UPSA performance across groups, as well as whether change score acted as a moderator to explain group differences in UPSA performance. This evaluated our hypothesis that individuals with greater difficulty in performance when changing from a baseline task to high-load cognitive task would predict poor performance in functional ability.

In total, at least 60 individuals (30 schizophrenia group, 30 controls) were expected to participate in this study. After ruling out ineligible participants based on outliers (3 standard deviations outside of the mean on performance measures) as well as participants who, for various reasons, did not complete all measures, 58 participants were included in the final analyses (32 in the control group and 26 in the schizophrenia group). We were able to assume adequate power for all of our analyses (excepting some of the secondary analyses discussed below). An alpha level of 0.05 was used for all analyses in this study and is the standard critical value. A power level of $\beta = 0.80$ was used in analyses and is the standard for the analyses discussed below (Cohen, 2008). Power analyses conducted for each of the primary hypotheses using G*Power software 3.1 (G*Power, 2008) indicated that a large effect size could be observed with at least 36 participants in total (Linear Multiple Regression, Fixed Model R^2 increase), $f=0.8$, $\alpha= 0.05$, $\beta= 0.80$, predictors=three (included sex). The tests for homogeneity of variance were not significant ($p > .05$) indicating that homogeneity of variance could be assumed for the MANCOVA and repeated measures ANCOVA (Cohen, 2008). None of the bivariate correlations exceeded 0.9, which suggests that there was no multicollinearity (Tabachnick and Fidell, 2007).

CHAPTER 3. RESULTS

3.1 Group Demographic Comparisons

We conducted group comparisons to determine if there were demographic differences between the control group and the schizophrenia group in order to account for any confounding variables that could impact later analyses (see Table 1 for full demographics). No significant differences in ethnicity or age were found using chi square analysis. However, there was a significant discrepancy in sex between the control group and schizophrenia group, indicating that the schizophrenia group had significantly fewer females than the control group. Though recruitment efforts were made to match groups, we had particular difficulty finding females for the schizophrenia group. To investigate whether this would impact our analyses, a t-test was performed to examine whether this difference significantly impacted any of the outcome measures. We found that sex differences did impact our baseline and high-load verbal fluency cognitive conditions respectively, $t(56) = 2.42, p = .018$ and $t(56) = 2.42, p = .029$, (see Table 1). Therefore, we controlled for sex in all of our later analyses that included the verbal fluency conditions. We further explored the impact of sex on our analyses (see secondary analyses).

3.2 Manipulation and Condition Check

As mentioned above, the dual-task paradigm was counterbalanced for order so that participants would receive either a baseline task requiring the naming of fruits or vegetables, or a high-load task naming of fruits or vegetables first. In order to make sure there were no conditional differences between groups, we checked to make sure that semantic naming condition (vegetable or fruit) did not impact the results of the low-load or high-load performance.

The analyses indicated that semantic condition did not impact verbal fluency performance, regardless if participants had a vegetable or fruit task on either of the conditions of verbal fluency(baseline or high-load). There were no significant differences in baseline performance, $t(56) = 1.43, p = 0.16$, or high-load condition, $t(56) = -1.8, p = 0.08$, based on semantic naming condition(saying fruit or vegetable).

3.3 Hypotheses and Result

Hypotheses I. Schizophrenia group versus control group.

Hypothesis Ia. The schizophrenia group would display a significant deficit in UPSA2(basic skills and daily functioning). Individuals with schizophrenia ($M = 28.32, SD = 7.3$) performed significantly worse than healthy controls ($M = 39.87, SD = 4.7$) on UPSA performance, $t(55) = 6.89, p < .001, d > 1$. As anticipated, individuals with schizophrenia performed worse in a test of everyday living skills (see Figure 1).

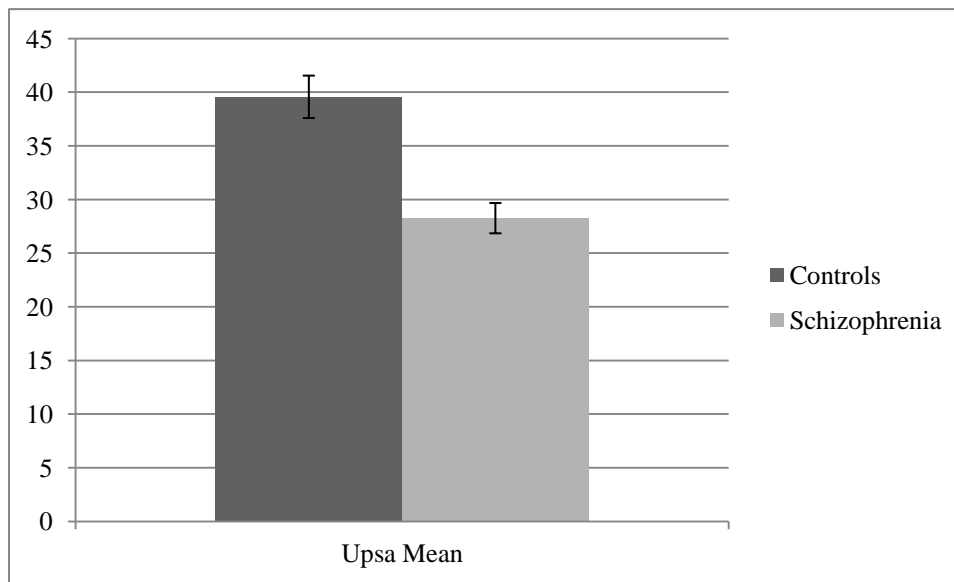


Figure 1. Comparing performance on the UPSA (a measure of everyday living skills) between the schizophrenia group and the control group.

Hypothesis Ib. There would be a main effect for group for cognitive performance, the schizophrenia group would perform significantly worse on cognitive tasks (verbal fluency tasks). A multivariate MANCOVA showed a significant main effect for cognitive load condition while controlling for sex. There was a significant interaction between groups for the verbal fluency cognitive condition, $F(2, 56) = 7.02, p = .01, d > 1$, controlling for sex. Individuals with schizophrenia performed worse on baseline verbal fluency compared to controls. There was no significant interaction between groups in the high-load condition, $F(2, 56) = 2.74, p = 0.10$, controlling for sex. During the high-load condition, control participants performed similarly to individuals with schizophrenia on verbal fluency performance (see Figure 2).

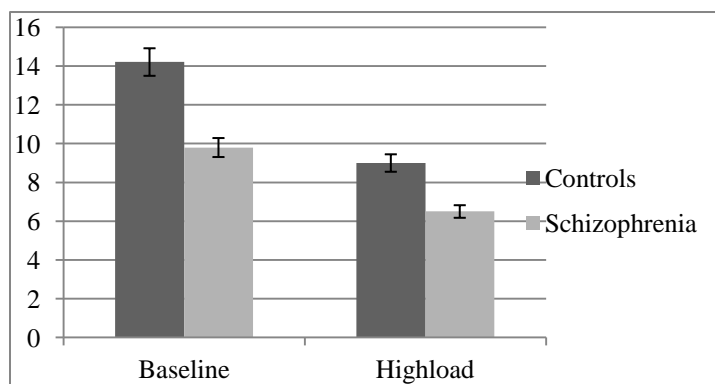


Figure 2. Group differences in performance on a base-line verbal fluency task and high-load verbal fluency task.

Hypothesis Ic. The schizophrenia group would show poorer performance compared to controls in the difference between baseline cognitive task to a high-load cognitive task.

A repeated measures ANCOVA (controlling for sex) indicated that there was a condition effect from baseline to high-load in verbal fluency, $F(2, 56) = 33.45, p < .01, d = .20$. Participants performed worse from baseline to high-load on verbal fluency tasks. There was no interaction between groups from baseline to high-load, $F(2, 56) = 2.45, p = 0.13$ (see Figure 2).

Groups did not significantly differ in the decline from a baseline to a high-load verbal fluency task (see Table 2).

Table 2

Specific mean differences between groups on a baseline and high-load verbal fluency condition

	Control		Schizophrenia	
	Mean	SD	Mean	SD
High-Load	9.0	4.0	6.9	3.4
Low Load	14.2	5.6	7.5	4.6

Hypothesis II. Poorer performance with more attentional demand as a predictor of basic skills performance. The magnitude of change in verbal fluency between baseline and high-load conditions (computed using regressions) would be significantly related to everyday living skills performance. As we already proposed that individuals with schizophrenia would perform worse in everyday living skills, a moderation analysis would be computed (using regression) to reveal if the change score (from baseline to high-load verbal fluency task) would moderate the difference between individuals with schizophrenia and non-psychiatric controls in UPSA performance.

In a step-wise hierarchical regression guided by Fields (2009), we controlled for sex by entering it into step 1. Step 2 included a group and change score (based on the change in performance from baseline to high-load performance in verbal fluency) after being standardized, and step 3 included a group by change score variable. This was created by multiplying the group and change scores. The DV was UPSA performance. The regression indicated that there was a group difference predicting UPSA performance (see Table 3). Individuals with schizophrenia performed worse in everyday living skills. However, the regression indicated that the change

from a baseline task to a high-load task did not significantly predict UPSA Scores $F(3, 54) = 1.38, p = .28$, and that the change score did not moderate the difference between UPSA scores and group (see Table 3).

Table 3

Regression Model Predicting Everyday Living Skills

	B	St. Error	β	ΔR^2	t	p
Step 1						
				.059		
Gender	-4.214	2.31	-.243		-1.82	.074
Step 2						
				.415		
Gender	.477		.027			.806
Group	-	1.93	-		.246	.000
ChangeScore	11.72		.699		-	.995
	-0.006	1.87	-		6.25	
Step 3						
				.008		
Gender		.860			.007	.724
Group	.695					.000
ChangeScore	-		.040			.654
GroupXChangeScore	11.86	1.96	-		.355	.395
	.459	1.88	.706		-	
	-1.61	1.01			6.29	
		1.87	.055		.450	
			-		-	
			.105		.857	

Note: ΔR^2 is reported for each step only; Dependent Variable: UPSA Total Scores; Independent Variables: Change Score: Difference between baseline verbal fluency and high-load verbal fluency task. Group: schizophrenia, non-psychiatric controls.

3.4 Secondary Analyses and Hypotheses

In order to further clarify our results, we completed a number of secondary analyses described below.

We have discussed broad literature that has demonstrated that everyday living skills are related to cognitive abilities in schizophrenia; therefore, our first secondary tests were to carry-out bivariate correlations to look at relationships between our variables that represent everyday living skills(UPSA) and cognition(verbal fluency tasks).

Secondary Hypotheses I. There would be positive relationships between UPSA and cognitive load conditions in both the schizophrenia and control groups. This follows from previous research that has suggested a relationship between everyday living skills and verbal fluency cognitive capacity (Green, 1996). Bivariate correlations indicated that cognitive condition was related UPSA Performance, but only for our control group (see Table 4).

Table 4

Bivariate correlations between cognitive conditions and UPSA performance for the control group

	Baseline Verbal Fluency	High-Load Verbal Fluency
UPSA Performance	.39*	.40*
N	30	30

*Indicated significance at the $p < .05$ level

However, the relationship between verbal fluency task and everyday living skills was not significant for participants with schizophrenia(see Table 5). UPSA performance was not positively correlated with our measures of verbal fluency. Therefore, we did not see the expected relationship between verbal fluency and UPSA performance (see Table 5).

Table 5

Bivariate correlations between cognitive conditions and UPSA performance for the schizophrenia group

	Baseline Verbal Fluency	High-Load Verbal Fluency
UPSA Performance	-0.01	0.09
N	25	25

*indicates significance at $p < .05$ level

Secondary Hypothesis II. Working memory performance would be worse for the schizophrenia group compared to the control group. As a manipulation check, we measured the accuracy of performance on the n-back task or working memory task that was added to the verbal fluency task to create a high-load condition (and dual design). In order to make sure this worked, we checked to see that each groups' performance was better than chance on this task. We found that both the schizophrenia group ($M=.69$ accuracy, $SD = .05$) and the control group ($M=.73$, accuracy $SD = 08$) performed at a level higher than chance (see Figure 3).

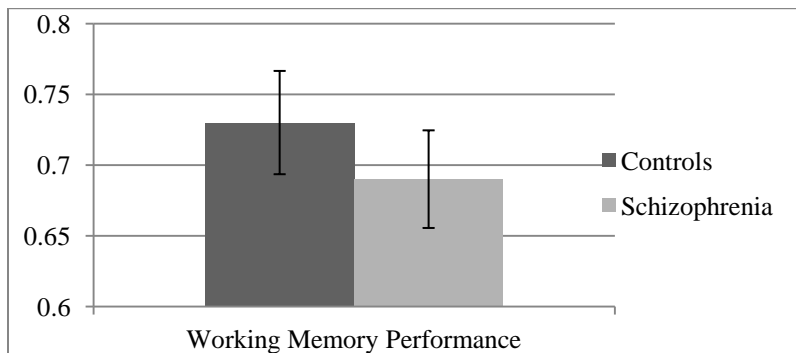


Figure 3. Comparison of group performance (control group v. schizophrenia group) in working memory performance.

We saw a significant difference in baseline performance in verbal fluency between groups as shown above (see Figure 2). As the literature suggests that working memory performance is impaired for individuals with schizophrenia, we predicted that individuals with schizophrenia

would also do worse on the n-back compared to non-psychiatric controls. A multivariate MANCOVA revealed that groups performed differently in working memory tasks $F(2, 56) = 4.43, p = 0.04, d = .60$ controlling for sex.

As shown above, individuals with schizophrenia did significantly worse in accuracy on the n-back task. Additionally, a bivariate correlation was performed to see if UPSA performance was related to n-back task performance. We found that for healthy controls, UPSA performance was not significantly related to n-back performance, indicating there was no relationship between working memory performance and everyday living skills for controls(see Table 6).

Table 6

Bivariate correlations between cognitive conditions and UPSA performance for the control group

	Working Memory n-back Task
UPSA Performance	-.05
N	30

*indicates significance at $p < .05$ level

We did, however, find that working memory performance was positively correlated to performance in everyday living skills for individuals with schizophrenia (see Table 7).

Table 7

Bivariate correlations between working memory n-back task and UPSA performance for the schizophrenia group

	Working Memory n-back Task
UPSA Performance	.44*
N	25

*indicates significance at $p < .05$ level

Because we found the expected relationship between working memory and everyday living skills that we had anticipated between verbal fluency and everyday living skills, we wanted to further explore this relationship. McCabe et al. (2010) demonstrated that correlations between working memory and executive functioning are very high ($r=.97$). They suggest that these two domains underlie an overall executive attention ability, which would describe a fundamental incapacity to attend to cognitive demands. This would give credence to the idea that working memory could better represent attention as the critical variable underlying everyday living skills.

Secondary Hypothesis III. Working memory performance would predict UPSA

Performance. In a step-wise hierarchical regression guided by Fields (2009; see Table 8), we controlled for sex by entering it into step 1. Step 2 included a group and working memory score (based on n-back performance) after being standardized, and step 3 included a group by working memory score. This was created by multiplying the group and working memory score. The regression indicated that there was a group difference in UPSA score. Individuals with schizophrenia were more likely to perform poorly in everyday living skills. Working memory was significant at the trend level ($p=.06$) as a predictor of everyday living skills across groups. The composite model indicated that working memory moderated the group difference in UPSA performance also at a trend level ($p=.07$).

Table 8

Regression Model Predicting Everyday Living Skills

	B	Std. Error	β	ΔR^2	t	p
Step 1				.06		
Gender	-4.21	2.31	-0.24		-1.82	.07
Step 2				.51		
Gender	-0.102	1.86	-0.01		0.05	.96
Group	-10.77	1.84	-0.64		-5.83	<.01
Working Memory	25.07	12.65	0.20		1.98	.05
Step 3				.54		
Gender	0.01	1.82	0.00		0.01	.10
Group	-44.40	17.90	-2.64		-2.48	.02
Working Memory	-4.29	19.86	-0.03		-.22	.83
GroupXWorking Memory Score	47.38	25.09	1.97		1.88	.07

Note: ΔR^2 is reported for each step only; Dependent Variable: UPSA Total Scores; Independent Variables: Working Memory: Performance Score on n-back working memory task. Group: Schizophrenia, non-psychiatric controls.

Secondary Hypotheses IV. The influence of sex on our analyses. There was a sex discrepancy within our sample; specifically, there were only four females in our schizophrenia group, resulting in significant sex differences worthy of making sex a covariate in our analyses. Therefore, we were interested in whether our results would change looking purely at a male sample. This reduced the total sample down to 35 from 58 (14 controls and 21 schizophrenia participants). Although we recognize that this does not meet all of our standards of power, we still repeated all of our original analyses to see if there would be resulting differences in a sample that was purely male, based on our hypotheses.

Secondary Hypothesis Iva. The male schizophrenia group would display a significant deficit in UPSA-2 (basic skills and daily functioning). We conducted a between subjects t-test with group

as the independent variable and with UPSA as the dependent variable. We found that patients with schizophrenia performed worse on the UPSA compared to male controls, $t(33) = 2.87$, $p < .01$, $d = .70$ (Figure 4).

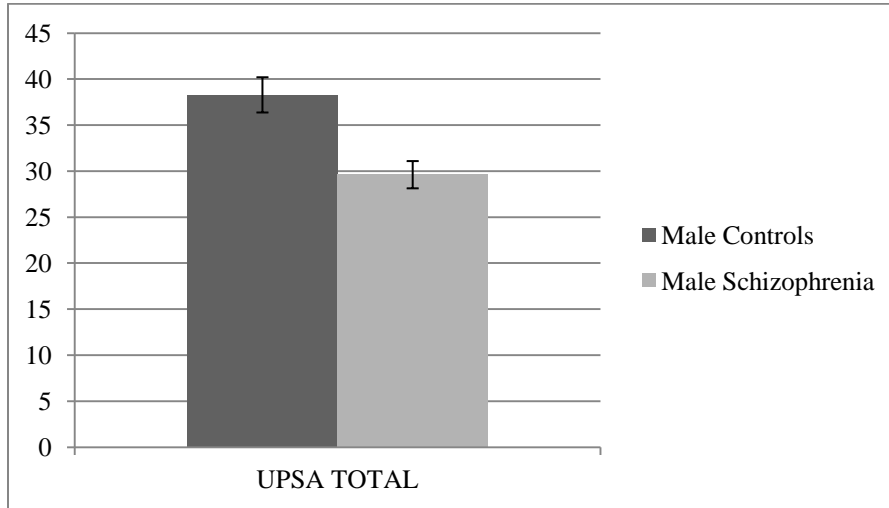


Figure 4. Comparison of males with schizophrenia compared to male healthy controls in UPSA performance.

Secondary Analysis Hypotheses IVb. The male schizophrenia group would perform significantly worse on cognitive tasks compared to the male control group. We conducted a multivariate ANOVA with verbal fluency cognitive condition (baseline and high-load) as the dependent variables and group as the independent variable. The ANOVA results showed no main effect for cognitive condition, and no group by condition interaction between male individuals with schizophrenia and male healthy controls, $F(2, 34) = 0.51$, $p = 0.48$ (baseline load), $F(1, 34) = 1.59$, $p = 0.22$ (high-load). Though there was a relative difference in performance, indicating that males with schizophrenia did worse in cognitive performance, there were no significant group differences in performance on baseline or high-load cognitive tasks (see Figure 5).

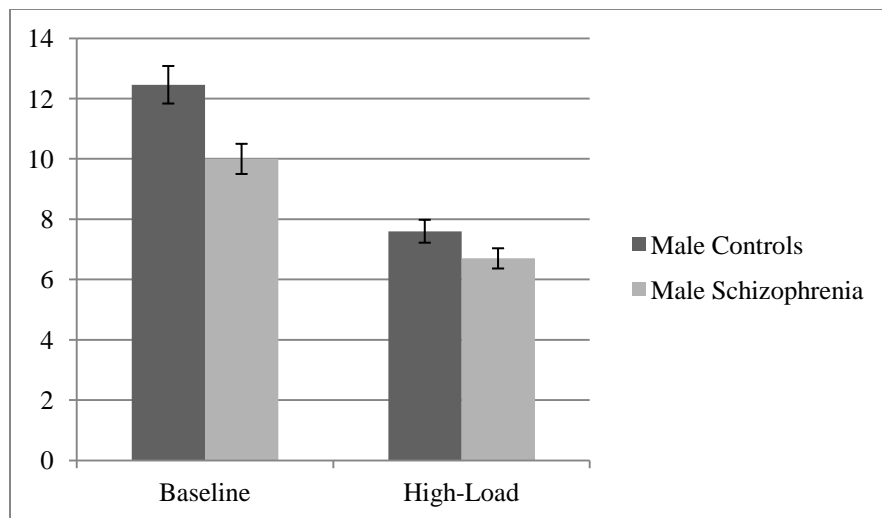


Figure 5. Baseline and high-load cognitive performance between male controls and male participants with schizophrenia.

Secondary Hypothesis IVc. The schizophrenia group would show poorer performance compared to controls when moving from a baseline cognitive task to a high-load cognitive task. We wanted to see the results of our predicted hypotheses regarding cognitive performance while just looking at a male sample due to our lack of female participants. A repeated measures ANOVA was conducted with baseline verbal fluency as the first condition and high-load verbal fluency as the second condition. The repeated measures ANOVA indicated there was a decline in baseline to high-load condition performance in male participants $(1, 35) = 12.75, p < .001, d > 1$. However, there was no group difference between individuals with schizophrenia and non-psychiatric controls in the change in performance from baseline to high-load condition, $F(1, 35) = 0.73, p = 0.39$. Again, we found that non-psychiatric controls and individuals with schizophrenia both decline when cognitive load is increased, and this change is not significantly different based on group.

Secondary Analysis V. The decline in performance from baseline to high-load condition would predict UPSA performance in male participants. In a step-wise hierarchical regression

guided by Fields (2009), step 1 included standardized group and change score (change score was the change in performance from baseline to high-load verbal fluency). Step 2 included a group by change score, created by multiplying the group and change scores. The DV was UPSA performance. There was a group difference, indicating that male patients with schizophrenia performed worse in everyday living skills (UPSA performance). However, verbal fluency did not moderate this group difference (see Table 9).

Table 9

Regression Model Predicting Everyday Living Skills in an All-Male Sample

	B	Std. Error	β	ΔR^2	t	P
Step 1				.33		
Group	-8.9	-.57	.56		-3.94	<.01
Change Score	-1.16	-.15	.12		-1.03	<.01
Step 2				.03		
Group	-8.61	-.56	.48		-3.82	<.01
Change Score	-0.08	-.01	.04		-0.05	.96
GroupXChangeScore	-2.58	-.22	.23		1.13	.26

Note: ΔR^2 is reported for each step only; Dependent Variables: UPSA Total Scores; Independent

Variables: Change Score: Difference between baseline verbal fluency and high-load verbal fluency task. Group: schizophrenia, non-psychiatric controls.

Therefore, our prediction regarding decline in verbal fluency cognitive condition predicting poor everyday living skills was not confirmed in this male sample.

CHAPTER 4. DISCUSSION

This project examined the link between cognition and everyday living skills. A primary goal of this project was to replicate previous findings that individuals with schizophrenia struggle with everyday living skills compared to non-psychiatric controls. Another study aim was to determine whether individuals with schizophrenia demonstrate exacerbating verbal fluency cognitive deficits under higher cognitive load demands compared to controls. Additionally, the objectives were to evaluate whether cognitive performance changes under these different cognitive loads are associated and predictive of everyday living skill deficits. Below is a detailed account of the implications of our findings.

The first aim of this study was to compare everyday living skills between controls and patients with schizophrenia. The results of this project indicate that individuals with schizophrenia perform worse in everyday living skills compared to healthy controls. This finding is supported by the literature (Addington and Addington, 1999; Bowie, Reichenberg, Patterson, Heaton, and Harvey, 2006; Galuppi, Turola, Nanni, Mazzoni, and Grassi, 2010; Green, 1996; Patterson, 2001; Simon, 2003) and suggests that those with schizophrenia suffer from severe disruptions in the capacity to carry out everyday living skills, which in return make vocational and social functioning difficult. There was a large effect size difference between groups. These findings further advocate the need for research regarding etiology of this deficit in everyday living skill functioning and the call for treatment to compensate for these skill deficits.

Our next aim was to evaluate whether the schizophrenia group would perform significantly worse on verbal fluency tasks. As predicted, results revealed baseline verbal fluency is impaired for individuals with schizophrenia compared to controls. As purported by the cognitive profile of those with schizophrenia (Heinrichs and Zakzanis, 1998), we see that

those with schizophrenia perform worse in a single design cognitive task of verbal fluency compared to non-psychiatric controls.

Interestingly, we found that during a high-load task of verbal fluency, non-psychiatric controls do not perform differently than individuals with schizophrenia (see Figure 2, page 26). We predicted that we would see a difference between groups on changes scores, or that the schizophrenia group would show poorer performance compared to controls in the difference between baseline cognitive tasks to a high-load cognitive task. However, we found no significant difference in the change from baseline verbal fluency to high-load verbal fluency, as well as no significant difference between groups on high-load verbal fluency performance. Though past research has demonstrated that individuals with schizophrenia struggle appreciably in a dual-task design, additional literature supports that a dual-task design is also difficult for healthy populations (van Merriënboer and Sweller, 2010). In a dual-task of considerable attentional demands (a working memory task and a verbal fluency task), all individuals (regardless of group) performed poorly in verbal fluency. These data support the notion that a central bottleneck prevents individuals from attending to two different tasks at the same time, forcing individuals to choose which task to attend to (Carrier and Pashler, 1995; Ruthruff et al., 2001). This is consistent with our findings, as non-psychiatric controls performed better than patients with schizophrenia on the working memory task (see Figure 3, page 30) but did poorly in verbal fluency at a high-load condition (see Table 2, page 27). This potentially indicates that they attended to the working memory task at the expense of verbal fluency performance. This would explain why we do not see a group difference in high-load verbal fluency, as well as no difference in the change from baseline to high-load (see Table 2, page 27).

Our next aim was to examine whether the cognitive change score would moderate the difference between groups in everyday living skills. We demonstrated that individuals with schizophrenia do worse in everyday living skills compared to non-psychiatric controls. However, these data do not indicate that change scores (computed as a difference between a baseline verbal fluency task and a high-load verbal fluency task) predict everyday living skills. Additionally, these data do not indicate that the verbal fluency change score is a moderator explaining why non-psychiatric controls perform better in everyday living skills. A possible explanation of this would be that verbal fluency is the wrong measure of G, or the general deficit, in order to predict everyday functioning.

To follow-up on these findings we developed a number of secondary hypotheses to further illuminate our findings. We looked at whether there was a relationship between UPSA and cognitive performance measures. We saw that verbal fluency, at both the baseline and high-load condition was correlated to everyday living skills for the control group. So, performance in everyday functioning was related to verbal fluency performance. Schmitter-Edgecombe, McAlister, and Weakley (2012) recently published a study that suggested that individuals with mild cognitive impairment also show deficits in everyday living. This study suggested that mild problems in memory are related to impairment of everyday situations such as keeping track of scheduling and planning. Additional literature supports the same relationship between everyday functioning and individuals with mild cognitive impairment, as well for older adults at risk for declining cognitive performance (Giovannetti et al., 2008; Hughes, Chang, Bilt, Snitz, and Ganguli, 2012). This may explain why otherwise healthy individuals would demonstrate difficulty in verbal fluency performance at a high-load condition compared to a baseline

cognitive condition, as well as whether they would also show difficulties in everyday living skills.

We did not see that the baseline verbal fluency condition for those with schizophrenia was related to UPSA performance or everyday living skills. A possible explanation of this would be that verbal fluency is the wrong measure of G, or the general deficit, in order to predict everyday living skills for those with schizophrenia. If verbal fluency is difficult for everyone at a high-load, then perhaps it is not the right task example to demonstrate cognitive differences that those with schizophrenia specifically experience. This brought us to our second secondary hypothesis that perhaps a different measure of cognitive functioning would be better representative of G.

Researchers have demonstrated that working memory is significantly impaired for individuals with schizophrenia (Heinrichs and Zakzanis, 1998), and the literature has demonstrated problems in dual-task specifically for this population (Leiderman and Strejilevich, 2004). We wanted to look at whether working memory would be a better representation of the general deficit (G) for those with schizophrenia compared to non-psychiatric controls, so we predicted that working memory performance would be worse for the schizophrenia group compared to the control group. The results suggest that working memory performance, demonstrated by an n-back task, was worse for the schizophrenia group at a high attentional load (working memory task and verbal fluency task), and that this task was correlated with everyday living skills. This finding suggests that this might be a better representation of the generalized deficit. These results also promote the need for future research to examine comprehensive performance on a dual-task. This would mean being able to compute a score of both working

memory and verbal fluency together in order to examine the relationship between G and deficits in everyday living skills.

These results brought us to our next hypothesis regarding working memory as a better task example of cognition for prediction of everyday living skills. We looked at whether working memory performance predicted everyday living skills. We found that at a trend level, working memory predicted UPSA performance. When accounting for group membership in a moderation analysis, we also saw a trend that working memory was moderating the difference in UPSA performance between groups (schizophrenia compared to non-psychiatric controls). These data promoted the connection between working memory and everyday living skills and may be a better representation for an attentional bottleneck that make everyday living skills difficult for individuals with schizophrenia. Still, further research is needed to determine what cognitive demands would represent cognitive difficulties that underlie why individuals with schizophrenia do so poorly in everyday living skill functioning compared to non-psychiatric controls.

Because there was a discrepancy in our groups, in that there were more males than females in our schizophrenia group, we wanted to look at how a purely male group would differ on these tasks. We predicted that the male schizophrenia group would be worse than the male control group in everyday living skills. Again we saw a marked difference in that those with schizophrenia did worse than non-psychiatric controls in everyday living skills.

There was a significant difference in performance at baseline verbal fluency between males and females. This is a common finding in verbal fluency performance, suggesting that females do better in verbal fluency performance than males (Burton, Menninger, and Hafetz, 2005; Lanting, Haugrud, and Crossley, 2009; Weiss et al., 2006). Results suggested that our lack of matching in sex between the two groups led to a lower performance for individuals with

schizophrenia (as the group was predominantly male) compared to the healthy control group. Without controlling for sex, the results did demonstrate a general difference between groups from baseline to high-load verbal fluency. This finding has a number of implications. It suggests that females were driving up the average performance in verbal fluency in the healthy control group and the predominance of males in the schizophrenia group was driving the average performance down in the schizophrenia group. In the future, additional research should focus on whether or not different mechanisms, based on sex, may be driving relationships between impairment in everyday living skills and cognitive functioning. There has been some research indicating that females use different strategies in cognitive performance than males, such as clustering or remembering words in chunks in verbal fluency, whereas males do not employ this strategy(Weiss et al., 2006). Whether these strategies are, also impacting functional performance is yet to be determined.

Therefore, we wanted to see how our results in cognitive performance would change looking purely at a male sample. We predicted that the male schizophrenia group would perform significantly worse on cognitive tasks compared to the male control group. When looking only at the males in our sample, the group difference in baseline cognitive performance disappeared, indicating that males do struggle with verbal fluency regardless of group or condition. It also again raises questions about whether verbal fluency is a correct mechanism to measure the link between functioning and cognition. Here, verbal fluency was difficult for both groups at a high-load and baseline verbal fluency task. Lastly, the differences indicated the importance of replicating these results with sex matched groups to determine whether results would be different in a sample with the same amount of males and females.

We predicted that the change in performance from baseline to high-load condition would predict UPSA performance in male participants. Again, we saw that verbal fluency does not predict everyday living skills capacity, and that it does not moderate the difference in performance between groups. This further proposes that verbal fluency may not be the correct mechanism to evaluate everyday living skills, and that a more comprehensive dual-task measure could reveal more insight into the relationship between cognitive demand and everyday living skills.

4.1 Limitations

The lack of female representation in our schizophrenia group was a limitation of this study. Recruitment of females for this group was a challenge that resulted in a disparity between samples. However, the results concerning sex are intriguing as mentioned above and add to implications and questions regarding how males and females differ in performance in cognition. The measure of verbal fluency, which has consistently demonstrated deficits in schizophrenia populations, supports our use of this measure. However, in future studies, being able to collapse performance across a dual-task design, or measure a general performance outcome based on both the working memory task and verbal fluency measure may help to explain more regarding differences in high-load performance for patients with schizophrenia compared to non-psychiatric controls. Perhaps results would show a steeper decline from baseline to high-load (like the one seen in verbal fluency performance for non-psychiatric controls) between groups, with the addition of this computation of dual-design. In future research, looking at a potential general deficit produced by dual-tasks that could be computed together (working memory and verbal fluency) would reveal more about differences in cognitive performance at a high-load.

4.2 Conclusions

This study sought to identify a specific point during the increase of cognitive load that would predict a limit in the ability to carry out everyday living skills. The goal was to detect whether poor performance during an increase in cognitive load demands would act as a mechanism to predict functional deficits. Based on these data, the mechanism moderating the relationship between functioning and cognition for those with schizophrenia or non-psychiatric controls is yet to be determined. These results show that general cognitive deficits are maintained during cognitive load increase, and that this deficit is not related to deficits in everyday living skills for patients, at least in the case of manipulation of verbal fluency load. However, the data repeatedly indicated everyday living skills deficits for those with schizophrenia, demonstrating the need to target this deficit in treatment. In addition, the data further support the need to demonstrate how G, or the general deficit, is a driving force in the relationship between cognition and everyday functioning. Individuals with schizophrenia did show a generalized deficit in cognitive domains such as baseline verbal fluency and working memory. However, high-load verbal fluency seemed to be difficult for everyone in the sample, so perhaps verbal fluency is not the right measure of this deficit when evaluating those with schizophrenia. Would manipulating a working memory and an executive functioning task (e.g., executive attention) be a better predictor of this? Does the inability to attend to two different tasks drive the cognitive performance decline from baseline to high-load? Based on this, more research is needed to determine where and what represents an attentional bottleneck that underlies dysfunction (both cognitively and in everyday living capacity). Efforts in treatment and prevention that include cognitive remediation should be continued. Future research must investigate how to experimentally manipulated dual-task design in order to examine whether individuals are more

focused on one task compared to another, in order to elicit whether verbal fluency suffers during a working memory task, but working memory performance is less affected. From this research, we could examine whether inability to perform under high cognitive demands results in functional deficits. This will help to determine what specifically needs to be targeted in rehabilitation of cognitive symptoms for those with schizophrenia, and that may reveal remediation in functional capacity as well.

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APPENDIX A ACRONYMS USED

UPSA: University of California San Diego Performance-Based Skills Assessment Test

SCID: Structured Clinical Interview for DSM-IV Disorders

WRAT: Wide Range Achievement Task

IQ: Intelligent Quotient

CET: Cognitive Enhancement Therapy

APPENDIX B
DESCRIPTION OF UNIVERSITY OF CALIFORNIA SAN DIEGO SKILLS
ASSESSMENT TEST (UPSA-2)

UCSD performance-based skills assessment test (UPSA-2) UPSA-2 is the brief version of UCSD performance-based skills assessment test and is a performance measure of a person's Everyday living skills deficits in five selected domains of daily living. 30-minute administration includes props (including disconnected telephone, newspaper article, fake bill, fake bus schedules, and ingredients for rice pudding recipe.

1) Financial Skills

- a. Making change
- b. Interpreting an electricity bill

2) Communication

- a. Demonstrate how to use a phone in case of an emergency or to get information from 411

3) Organization/Planning

- a. Read an article in a newspaper about a water park
 - i. Answer questions about how to get to and from the water park
 - ii. Be able to name 4 activities they read about
 - iii. Name 7 items they would need to bring to spend a full day at the water-park

4) Transportation

- a. Interpret a bus schedule
 - i. How to find a number for information
 - ii. How to get from one place to another
 - iii. Figure out the time you would need to budget to get to one place to another

5) Household Management

- a. Read a recipe and determine a shopping list needed to attain all ingredients from the recipe, while looking at a pantry full of items(some of which are part of the recipe

**APPENDIX C
DATA COLLECTION SHEET**

Participant # _____
Rater _____

Date _____

**STRUCTURED CLINICAL INTERVIEW FOR THE DSM
I/P WORKSHEET**

Sex

Age of 1st Treatment

DOB

Age of 1st Hospitalization

Current Age

Most Recent Hospitalization

Education Level

Number of Hospitalizations

Ethnicity

Total Time Hospitalized

of Times Married

Fathers Education Level

of Children

Fathers Occupation

hours worked per week

Mothers Education Level

Mothers Occupation

Current Medications

Current Global Assessment of Functioning (GAF) _____

Current Social and Occupational Functioning Assessment Scale (SOFAS) _____

No Symptoms	Sub-clinical	Diagnosis			
Bipolar I	—	History	Current	History	Current
Bipolar II	—			History	Current
Major Depression	—	History	Current	History	Current
Schizophrenia	—	History	Current	History	Current
Schizoaffective disorder	—	History	Current	History	Current
Subtype:	Paranoid	Catatonic	Disorganized	Undifferentiated	

Mood Disorders (Module A)

Depressive Episodes	Last Month			Worst		
1. Depressed Mood	1	2	3	1	2	3
2. Diminished interest	1	2	3	1	2	3
3. Appetite Changes	1	2	3	1	2	3
4. Sleeping Changes	1	2	3	1	2	3
5. Psychomotor Changes	1	2	3	1	2	3
6. Fatigue	1	2	3	1	2	3
7. Worthlessness/Guilt	1	2	3	1	2	3
8. Concentration/Indecisiveness	1	2	3	1	2	3
9. Suicidal Ideation	1	2	3	1	2	3

NOTES _____

Manic Episodes (Module A)

	Last Month			Worst		
1. Elevated/Irritable Mood	1	2	3	1	2	3

2. Grandiosity	1	2	3	1	2	3
3. Decreased Need for Sleep	1	2	3	1	2	3
4. Pressured Speech	1	2	3	1	2	3
5. Flight of Ideas	1	2	3	1	2	3
6. Distractibility	1	2	3	1	2	3
7. Hyperactivity/Agitation	1	2	3	1	2	3
8. Excessive Hedonic Activity	1	2	3	1	2	3
Hypomania	Y	N				
Mania	Y	N				

NOTES _____

Psychotic Disorders (Module B)	Last Month			Worst		
1. Delusions	1	2	3	1	2	3
a. Referential	Y	N		Y	N	
b. Persecutory	Y	N		Y	N	
c. Grandiose	Y	N		Y	N	
d. Somatic	Y	N		Y	N	
e. Religious	Y	N		Y	N	
f. Guilt	Y	N		Y	N	
g. Jealousy	Y	N		Y	N	
h. Erotomanic	Y	N		Y	N	
i. Thought Insertion	Y	N		Y	N	
j. Thought Withdrawal	Y	N		Y	N	
k. Thought Broadcasting	Y	N		Y	N	
2. Hallucinations	1	2	3	1	2	3
a. Auditory	Y	N		Y	N	
b. Commenting	Y	N		Y	N	
c. Conversing	Y	N		Y	N	
d. Visual	Y	N		Y	N	
e. Tactile	Y	N		Y	N	
f. Olfactory	Y	N		Y	N	
3. Disorganized Thought	1	2	3	1	2	3
4. Disorganized Behavior	1	2	3	1	2	3

5. Negative Symptoms	1	2	3	1	2	3
Paranoid type	Y	N				
Catatonic Type	Y	N				
Disorganized Type	Y	N				
Undifferentiated Type	Y	N				
Schizo affective disorder	Y	N				

NOTES _____

Substance use questions related to physiological dependence (adopted from the SCID):

1. Has drinking or drug use ever caused you to experience “blackouts” – not just falling asleep or “passing out”, but being completely unable to remember events from when you were using?

How many times in the last 12 months?

Never < Monthly Monthly Weekly Daily

How many times in your lifetime?

Never < Monthly Monthly Weekly Daily

2. Has drinking or drug use ever caused significant physical problems or made a physical problem worse?

How many times in the last 12 months?

Never < Monthly Monthly Weekly Daily

How many times in your lifetime?

Never < Monthly Monthly Weekly Daily

3. Have you found that you needed to drink a lot more or use a larger amount of drugs in order to get the feeling you wanted compared to when you first started drinking or using drugs?

How many times in the last 12 months?

No A little Somewhat Very Much Extremely

How many times in your lifetime?

No A little Somewhat Very Much Extremely

4. Have you found that when you drank the same amount, it had much less effect than before?

How many times in the last 12 months?

No A little Somewhat Very Much Extremely

How many times in your lifetime?

No A little Somewhat Very Much Extremely

5. Have you ever had any withdrawal symptoms when you cut down or stopped drinking or using drugs? (i.e., sweating, racing heart, handshakes, trouble sleeping, feeling

nauseated,) vomiting, agitation, anxiety, seizures, and seeing, feeling, or hearing things that were not there.)

How many times in the last 12 months?

Never < Monthly Monthly Weekly Daily

How many times in your lifetime?

Never < Monthly Monthly Weekly Daily

5. Have you ever started the day with a drink or taken some other drug or medication to keep yourself from getting the shakes or becoming sick from withdrawal symptoms?

How many times in the last 12 months?

Never < Monthly Monthly Weekly Daily

How many times in your lifetime?

Never < Monthly Monthly Weekly Daily

6. Have you ever inhaled an aerosol or compressed gas substance, or “huffed”, in order to get high?

How many times in the last 12 months?

No 1 2 3 4+

How many times in your lifetime?

0 1-2 3-4 4-5 6+

APPENDIX D
TASK SHEET FOR RESEARCH PROTOCOL

Participant # _____
Rater _____

Date _____

TEST LIST
PTCANS1 STUDY

SESSION 1

COMPLETED

Consent	_____
Demographics/Contact Sheet	_____
Contact Information	_____
Forced Choice CANS (c)	_____
Autobiographical CANS (c)	_____
Structured Clinical Interview for the DSM-IV (i)	_____
WRAT IV – Word Reading (c)	_____
UPSA (i)	_____
Verbal Fluency Task (c)	_____
Alternate Uses Task (c)	_____
PANAS - Quality of Life Inventory (c)	_____
GAF, SOFAS, BPRS, SAPS, SANS	_____
 PAID, WITH SIGNED RECEIPT	_____

SESSION 2

Toronto Alexithymia Scale (c)	_____
Referential Thinking Scale (c)	_____
Emotion Experience film (c)	_____
Substance Use Questionnaires (c)	_____
Brief Assessment of Cognition in Schizophrenia (i)	_____
SPQ (c)	_____
Ambiguous Intentions Hostility Scale (c)	_____
**MOCA – Mini Mental Exam (i)	_____
Suggestibility Task	_____
 PAID, WITH SIGNED RECEIPT	_____

APPENDIX E IRB APPROVAL

Project Report and Continuation Application

(Complete and return to IRB, 203-B1 David Boyd Hall.
Direct questions to IRB Chairman Robert Mathews 578-8692.)



Institutional Review Board
Dr. Robert Mathews, Chair
203 B-1 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.6792
irb@lsu.edu | lsu.edu/irb

IRB#: 2679 Your Current Approval Expires On: 6/21/2011

Review type: Full Risk Factor: Minimal

Date Sent: April 29, 2011

PI: Alex Cohen Dept: Psychology Phone: (225) 578-7017

Student/Co-Investigator:

Project Title: Understanding Negative Symptoms in Schizophrenia Using Novel Technologies

Number of Subjects Authorized: 200

Please read the entire application. Missing information will delay approval!

I. PROJECT FUNDED BY: LA Board of Regents-RCS LSU proposal #: 31075

II. PROJECT STATUS: Check the appropriate blank(s); and complete the following:

- 1. Active, subject enrollment continuing; # subjects enrolled: 35
- 2. Active, subject enrollment complete; # subjects enrolled:
- 3. Active, subject enrollment complete; work with subjects continues.
- 4. Active, work with subjects complete; data analysis in progress.
- 5. Project start postponed
- 6. Project complete; end date / /
- 7. Project cancelled: no human subjects used.

III. PROTOCOL: (Check one).

- Protocol continues as previously approved
- Changes are requested*
 - List (on separate sheet) any changes to approved protocol.

IV. UNEXPECTED PROBLEMS: (did anything occur that increased risks to participants):

- State number of events since study inception: 0 since last report: 0
- If such events occurred, describe them and how they affect risks in your study, in an attached report.
- Have there been any previously unreported events? Y/N N ?
(if YES, attach report describing event and any corrective action).

V. CONSENT FORM AND RISK/BENEFIT RATIO:

- Does new knowledge or adverse events change the risk/benefit ratio? Y/N ; N/A
- Is a corresponding change in the consent form needed? Y/N

VI. ATTACH A BRIEF, FACTUAL SUMMARY of project progress/results to show continued participation of subjects is justified; or to provide a final report on project findings.

VII. ATTACH CURRENT CONSENT FORM (only if subject enrollment is continuing); and check the appropriate blank:

- 1. Form is unchanged since last approved
- 2. Approval of revision requested herewith: (identify changes)

Signature of Principal Investigator: [Signature]

Date: May 6th 2011

IRB Action:	<input checked="" type="checkbox"/> Continuation approved: Approval Expires: <u>5/9/12</u> <input type="checkbox"/> Disapproved <input type="checkbox"/> File closed
Signed	<u>[Signature]</u> Date <u>5/10/11</u>

Form date: April 16, 2008

VITA

Tracey Lauren Auster was born in Westchester County, New York, to parents Julie and Peter Auster. Tracey attended Franklin and Marshall College and studied psychology where she received a Bachelor's of Arts. From there, Tracey worked in clinical psychology research in Boston at Beth Israel Deaconess Medical School. As she had always planned, Tracey then pursued a graduate degree in clinical psychology. She to enrolled in the doctoral program in clinical psychology at the Louisiana State University where she currently studies schizophrenia and psychotic disorders under the mentorship of Alex S. Cohen. She also currently works as a graduate level therapist and plans to integrate both clinical and research into her future career.