A Pilot Study Comparing Two Cognitive Training Approaches in Psychosis-Spectrum Disorders: Effects on Cognition, Symptoms, and Functioning

by
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Class of 2018
This thesis is dedicated to all the patients I have worked with at River Valley Services during the past year. Your trust, patience, and willingness to work together is what truly made this project possible. Thank you for letting me in.
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1. Acknowledgements

First and foremost, I would like to express my gratitude for my advisor and mentor, Dr. Matthew Kurtz. It was truly a privilege to work with you. Thank you for trusting me to take complete ownership over this project and for all your support and advice along the way. Your undying faith in my ability to succeed as a researcher has gotten me through this thesis. Thank you for your patience, for your willingness to talk through any idea, and for always remaining calm and reassuring in moments of stress. Thank you for encouraging me to not shy away from science, and for showing me the beauty of research; your passion for this field is contagious and inspiring.

Thank you to Dr. Margaret Meskill for filling my days at RVS with laughter. Thank you for your clinical supervision and unwarranted support of this project. Without you, this thesis would truly not have been possible. Thank you for your clinical mentorship, for making me feel at home at RVS, and for teaching me to find meaning and value in every clinical interaction, be it just the exchange of a smile. Our experience working together validated and solidified my dreams to pursue clinical psychology.

Thank you to all the members of the Wesleyan Schizophrenia Cognition Lab, past and present. Thank you particularly to Shyle, for starting this project and for trusting me to finish the job. Many thanks also to current lab members Christina, Bela, and Julianna. Without each of you and your willingness to jump into testing, this thesis would not have come together in the end.

Thank you to my parents, for instilling in me from a young age the importance of empathy and hard work, and for teaching me that no one is defined by their mental illness. Also thank you for your many loving, encouraging phone calls and helpful edits these past few weeks. I don’t tell you enough how much I appreciate you. Thank you also to my sisters, for inspiring me with your own talents in the arts and sciences. This is my attempt to meet you both somewhere in the middle.

Thank you to the ladies of 202 Cross, for filling this year with laughter, chocolate chips, coffee, gin rummy, and truly exceptional friendship. Each evening I spend with all of you in our nourishing and loving home fills me up and keeps me going. Thank you to all my other friends at Wesleyan and beyond for your unwavering support, listening, and pep talks from near and far. Finally, thank you to Marshall, for your stability, your infectious love for life, and for always being there, virtually or otherwise.
2. Abstract
Cognitive impairment is a core feature of schizophrenia. Deficits in cognition are independent of clinical symptoms, resistant to antipsychotic medication, and are one of the most reliable predictors of functional outcome. Cognitive Remediation (CR) is an avenue of behavioral treatment designed to enhance cognition and, in turn, daily living skills and psychosocial functioning. Two CR models have been identified as effective in schizophrenia: the drill-and-practice approach and the strategy-based approach. The present study is the first to compare the two models directly in a randomized controlled trial. 21 clinically stable community-dwelling adults with psychotic disorders were enrolled, and 14 completed a three-month trial of either a computerized drill-and-practice program (PSSCogRehab), a strategy-based compensatory cognitive training group (CCT), or treatment as usual. All research was done at a public mental health center in Middletown, CT. It was hypothesized that both models of CR would have positive effects on cognitive performance, while CCT would produce greater improvements on functioning. Consistent with past research (Cella et al., 2016; Twamley et al., 2012), both CR groups improved in clinical symptom severity. Within group analyses revealed that PSSCogRehab produced improvement in negative symptoms ($p=0.017$), and CCT produced improvement in both general psychopathology symptoms ($p=0.016$) and self-efficacy ($p=0.048$). To date, significant changes have not been observed in cognition or psychosocial function. While a larger sample size is needed before meaningful conclusions can be drawn about the efficacy of either treatment protocol, initial results regarding symptoms and self-efficacy are promising. Moreover, high attendance rates indicate the feasibility and success of CR implementation in the public sector.
3. Introduction: Schizophrenia

3.1 The Case of Randall\(^1\)

Randall is a tall, thin man with a fierce love for his family and for football. Randall was a successful student and athlete throughout childhood and high school, leading him to receive a football scholarship to attend a Division 1 university. Despite his academic achievements, Randall suffered from depression throughout early adolescence and “self-medicated” with marijuana almost daily. He never sought care and didn’t think of himself as really having a mental illness. However, during his first year of college his chronic depression progressed into something else, something very strange and unusual. He started to hear mumbles, occasionally progressing into clear voices, even while he was alone in his dorm room. Randall felt incredibly isolated by these experiences and was afraid to share his lived reality with friends and family; he feared their judgement. He felt paralyzed, isolated himself, and did not seek care.

After missing a week of classes and athletic practices, he was found in a catatonic stupor by university staff and was hospitalized at a local state psychiatric institution where he stayed for four months. There Randall received a diagnosis of schizophrenia and was prescribed antipsychotic medications. Upon initial release from the hospital’s inpatient unit, Randall was offered no follow-up care or institutional support to return to school or work. The support of his immediate family kept him out of homelessness, but Randall never returned to college and spent much of his adult life in and out of the hospital. The only treatment he has received for his mental illness has been pharmacological; he has never participated in a psychosocial intervention or

\(^1\)The case of “Randall” is a fictitious synthesis of details from several cases.
individual therapy. Now, at the age of 60, he lives in an apartment alone, supporting himself with disability checks. He leaves only to visit his family who live locally, to exercise at a local gym, and to attend his monthly psychiatry appointments. He spends most of the day alone watching sports, listening to the Soul Town radio station, and smoking cigarettes.

Randall may be considered an example of a “good outcome” considering his psychiatric diagnosis. His auditory hallucinations are muffled by his antipsychotic medication, and he’s been stable for about 20 years, capable of living in the community and coming to the hospital only for outpatient medical treatment. However, Randall is isolated, disengaged from his community, and still plagued by debilitating negative and cognitive symptoms for which he receives no treatment. He feels an extreme lack of motivation to join in activities with others or to look for a job. What’s more, he has trouble reading emotional expression and social cues, making it difficult for him to connect with others. Despite sharing with clinicians that his main goal is to socialize and make friends, Randall shows no initiative and feels largely incapable of participating in social events. Randall’s cognitive impairments are exhibited by his extremely slow thinking, reading, and speech; limited problem-solving skills; and his inability to remember to take his medications, go to appointments, or to call family members on holidays. Although he lives independently, Randall’s inability to care for himself requires a visiting nurse to come on a daily basis to help him clean, cook, and take his medications.

At the suggestion of his case worker, Randall began to participate in a cognitive remediation group at his local community mental health center. Although at
first intimidated by the commitment to attend a two-hour group each week and to engage with unknown patients and clinicians, Randall reluctantly agreed to participate. At the age of 60, this was Randall’s first experience participating in a treatment specifically targeting his cognitive symptoms. The group got Randall out of his house and gave him the opportunity to engage and communicate with other clients and clinicians. In the group, Randall learned compensatory cognitive skills, such as using a calendar and putting up post-it note reminders around his apartment. The idea is that these habits would help him achieve independence in everyday tasks without having to rely on his own memory or that of the visiting nurse. Randall began to use a calendar that helped him remember to attend doctors’ appointments and his new weekly group. The group members also practiced attention and memory strategies together -such as conversational attention, paraphrasing, and information “chunking”- through games and role plays. Randall recognized the possibility of applying these new name-learning and conversational attention strategies to his personal goals of socializing more and making friends. During the last session of the course, Randall shared that he had successfully held sustained conversations with two men whom he had met playing flag football at a local park, and that he had made plans with them to play together again. Over the course of the cognitive training group, Randall became much more confident in his ability to remember tasks and carry them out, to remember the names of individuals he meets, and to engage in rational and substantive conversations with those around him. Most importantly, participation in the cognitive remediation group brought Randall closer to accomplishing his personal goals.
Randall’s case indicates the importance of behavioral interventions in schizophrenia treatment. While antipsychotics may be a necessary first step, they are not enough, as they have a limited effect on the negative and cognitive symptoms of the disorder which may be actively inhibiting a client from reaching functional recovery. While Randall may fit “good outcome” criteria due to the remission of his overtly psychotic symptoms and his ability to live “independently,” this categorization does not take into account Randall’s personal needs or goals. Cognitive remediation therapy is a potential avenue for individuals with schizophrenia to learn and practice the cognitive skills inherently necessary for self-care, independent living, stable friendship, and occupational success.

3.2 A Brief History of Cognition in Schizophrenia
Schizophrenia is a complex, heterogeneous condition that can be characterized by a loss of connection with reality exhibited through unusual thought content, disorganized behavior, irregular emotional affect, and social withdrawal. Schizophrenia is estimated to affect between 0.5% and 1% of people worldwide, and due to its early onset and chronic nature, can cause a profound amount of suffering in its patients and their families (Andreasen, 2011). Cognitive impairment is a core feature of schizophrenia, present in almost all of those with the diagnosis, and was central to the first clinical observations of the illness in the late 1800s. Despite this early representation, the recognition of cognition as central to schizophrenia has been inconsistent throughout history. Only in the past thirty years has cognition emerged in the field of schizophrenia research as an important object of scientific inquiry, and cognitive symptoms as an essential target for treatment. The subsequent paragraphs outline a brief history of the study of cognition in schizophrenia.
The first iteration of the disease model was presented in 1887 by German psychiatrist Emil Kraepelin (1856-1926) (Johnstone, Humphreys, Lang, Lawrie, & Sandler, 1999). Kraepelin coined the phrase “dementia praecox” for what he considered to be a degenerative disorder classified by a cluster of 36 “psychic” symptoms and 19 “bodily” or physical symptoms (Lavretsky, 2011). “Psychic” symptoms ranged from “catatonic excitement” to “hallucinations,” but focused on those which we would now characterize as “negative symptoms,” such as abnormalities in emotional expression (Andreasen, 2011, p. 4). However, Kraepelin’s (1919) symptom profile not only included psychiatric components of the diagnosis, but also a number of cognitive deficits that he considered to be characteristic of the illness, such as abnormalities in attention and memory. One particularly striking component of Kraepelin’s clinical profile was his description of impairment in “attentional processing,” which he differentiated into two distinct types: active attention (aufmerksamkeit) and “passive attention” (auffassung) (Green and Harvey, 2014). Kraepelin described impairment in “active attention” as the incapacity for sustained focus; today we might label this as “vigilance.” He defined abnormality in “passive attention” as a tendency to shift focus to external stimuli; today, we might label this as “passive attention distractibility” (Green and Harvey, 2014). Kraepelin’s classifications of attentional processes indicate that abnormalities in cognition were integral to the earliest understanding of schizophrenia.

In 1908, Swiss psychiatrist Eugen Bleuler (1857-1939) proposed the term “schizophrenia” as a replacement for Kraepelin’s “dementia praecox,” arguing that the illness should not be defined by deterioration (Bleuler, 1950). Bleuler divided the
features of schizophrenia into “fundamental” and “accessory” symptoms, and posited that the truly fundamental components of schizophrenia were impairments in basic cognitive and emotional processes. The symptoms deemed by Bleuler to be “accessory” were hallucinations, delusions, and disorganized behavior that we would now label as “positive” symptoms (Bleuler, 1950). Bleuler’s definition asserted that cognitive impairments were present in all persons with the diagnosis, were stable over the course of illness, and served as the underlying basis for florid psychotic symptoms (Green & Harvey, 2014).

Despite these early understandings of the role of cognition in schizophrenia, research, treatment, and diagnostic categorization throughout the 20th century largely cast aside impairments in cognition, characterizing them as secondary to the more overtly psychotic features of the illness. One contributing factor was the early stigmatization of individuals with the diagnosis. Another factor was the delayed acceptance of cognitive theories in American psychology, which did not occur until the “cognitive revolution” of the 1960s and ‘70s. Only then did cognitive science begin to shape the development of clinical practice.

In the early 1900s, schizophrenia was considered to be the most extreme form of mental illness. This period was also characterized by a huge explosion in psychiatric asylums across Europe and the United States. The severely mentally ill were institutionalized by the thousands, and were also targeted by Eugenics efforts, subjected to mistreatment and even sterilization (Whitehead, 2011). It is conceivable that this historical -and ongoing- stigma contributed to a dearth of understanding of schizophrenia, particularly with regards to the role of cognition in treatment. For the
first few decades following Kraepelin’s initial definition, individuals with schizophrenia were most likely not considered worthy of treatment or capable of improvement, least of all in their “irrational” thought processes or cognitive capabilities.

Not only were individuals with schizophrenia stigmatized as untreatable and incapable of rational thought, but cognition was not accepted as a viable theory in American psychology until the 1960s and ‘70s and did not influence clinical practice until the ‘80s and ‘90s (Smith, 2009). Despite the rise of studies and perspectives on cognitive psychology in Europe in the 1940s, there was limited communication between European and American psychologists at this time, and behaviorism continued to prevail as the dominant theory of psychology in the U.S. (Baars, 1986). Three main forces contributed to the “cognitive revolution” in American psychology: WWII technology, Chomsky’s linguistic theory, and gestalt psychology learning theories (Smith, 2009).

Advancements in technology and communication during WWII led to the emergence of new psychological theories that drew parallels between human thought and computational information processing. New theories of the human mind as an “information processor” led to conceptualizations of memory encoding and retrieval that were similar to understandings of computational input and output. Another important catalyst for the cognitive revolution was Noam Chomsky’s research and theory of human language. Chomsky argued that behaviorist theories of association and conditioning as the key to learning were limited, as they did not fully explain the complex mental structures necessary for the learning and production of human
language (Smith, 2009). Lastly, the popularization of new works in gestalt psychology in the late 1950s further triggered a turn to cognition in the field; this school of psychology was much more in line with an information processing model of learning than with the “associative relations” approach taken in behaviorism (Smith, 2009).

The “cognitive revolution” shaped schizophrenia research practice in the fields of experimental psychology and clinical neuropsychology throughout the second half of the 20th century. Experimental psychologists tried to understand the etiology of schizophrenia and to examine the role of cognition as a risk factor for illness onset. Meanwhile, the clinical neuropsychological approach largely consisted of the development of tests to differentiate between brain abnormalities related to schizophrenia and those resulting from traumatic brain injury (Green & Harvey, 2014). While these approaches helped shift the popular understanding of schizophrenia towards including cognition, they did not analyze cognitive impairments as symptoms of the illness. In the late 1950s and early ‘60s, while cognitive psychology was replacing behaviorism in experimental psychology, behaviorism remained the predominant theory driving clinical practice (Baars, 1986). It was not until about 30 years ago, when findings began to indicate a link between cognition and outcome, that research turned to the development of cognitive interventions for schizophrenia. This research was also spurred by experimental studies that began to use clinical neuropsychological tests as measures of cognitive impairment. For example, Saykin et al. (1991) used standardized neuropsychological assessments and revealed generalized impairment in cognition in patients with
schizophrenia relative to healthy controls, along with particular deficits in memory and learning compared to other domains of functioning. Initial studies of cognitive remediation therapies began in the 1980s and ‘90s (Green & Harvey, 2014). This research was foundational, as it revealed that cognitive deficits could be remediated, and countered stigma by proving that patients with schizophrenia could succeed in therapy.

Green and Harvey (2014) hypothesized that we have “learned more about schizophrenia in the past 10 years than we learned in the previous 100.” While the introduction of pharmacological interventions in the 1950s led to advancements in the treatment of psychotic components of the disorder -such as delusions and hallucinations- research has indicated that stabilizing these symptoms is insufficient for the treatment of schizophrenia (Roder & Medalia, 2010). Other symptoms, such as deficits in cognition, motivation, and socialization, are strong predictors of functional recovery, as they can be linked directly to one’s daily life skills and adaptability to new living, work, and social environments. Enhancements in cognitive ability therefore may lead to improvements in functional outcomes that are not possible with treatment approaches that focus solely on the remission of clinical psychiatric symptoms (Harvey, 2013). Schizophrenia is no longer thought of as a degenerative illness. Recent advancements in the development of psychosocial and cognitive interventions have indicated that many individuals respond well to behavioral treatments and can experience full symptom remission and functional recovery.
3.3 **Diagnostic Criteria**

The diagnostic criteria for schizophrenia have changed over the course of the six different editions of the Diagnostic and Statistical Manual of Mental Disorders. However, despite changes made to the exact definition, Kraepelin’s emphasis on chronicity, poor outcome, and positive symptoms has been present across all versions of the manual (Tandon et al., 2013). Despite this Kraepelinian influence, current diagnostic criteria most closely resemble the illness definition laid out by German psychiatrist Kurt Schneider (1887-1967). Schneider presented nine psychotic behaviors that he characterized as “first-rank symptoms” (FRS) of schizophrenia (Green and Harvey, 2014). These were: “audible thoughts, arguing or commenting voices, feeling controlled or influenced by an external force, thought withdrawal, diffusion of thought, and delusions” (Lavretsky, 2008, p. 4). Distinct from Kraepelin and Bleuler’s definitions, none of Schneider’s FRS described abnormalities in cognition. The English translation of Schneider’s 1959 *Clinical Psychopathology* became popular in American psychology and heavily influenced diagnostic criteria for schizophrenia, as it was precise, pragmatic, brief, and easy to follow (Nordgaard, Arnfred, Hanest, & Parnas, 2007). Schneider’s FRS played an integral role in the classification of schizophrenia within diagnostic systems such as the Diagnostic and Statistical Manual of Mental Disorders, Third and Fourth Edition (DSM-III-IV), and the International Statistical Classification of Diseases, Tenth Revision (ICD-10) (Nordgaard et al., 2007). These diagnostic criteria were further validated by the World Health Organization International Studies of Schizophrenia, completed in the 1970s, which confirmed the feasibility of their application in a transnational context (Green & Harvey, 2014). The inclusion of FRS in DSM and ICD definitions of
schizophrenia has also been met with criticism. Some researchers have argued that FRS imply a poor outcome that is not universal in schizophrenia, and others assert that FRS are not specific enough to serve as diagnostic features, as they arise in non-schizophrenic populations (Nordgaard et al., 2007).

For the present study, all participants were assessed using the most recent diagnostic criteria found in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5). Criterion A, Characteristic Symptoms, is defined as the presence of two or more of the following symptoms, for a significant portion of time during a one-month period: (1) delusions, (2) hallucinations, (3) disorganized speech, (4) grossly disorganized or catatonic behavior, and (5) negative symptoms (e.g., diminished emotional expression, alogia, or avolition). For a formal diagnosis to occur, at least one of the symptoms present has to be number one, two, or three. Criterion B describes disturbance in one or more areas of functioning, such as work, social relationships, or self-care. Criterion C describes continuous disturbance for at least a 6-month period. Criterion D excludes schizoaffective disorder and depressive or bipolar disorder with psychotic features. Criterion E excludes substance/general medical condition, asserting that the disturbance cannot be explained by a substance or medical condition. Lastly, Criterion F maintains that if there is a history of autism spectrum disorder or other communication disorder schizophrenia will only be made as an additional diagnosis if prominent delusions or hallucinations are also present for at least 1 month (American Psychiatric Association, 2013).
3.4 Symptoms

3.4.1 Positive Symptoms

Positive symptoms are perhaps the most easily identifiable symptoms of schizophrenia, as they are psychotic behaviors not typically seen in healthy populations. Positive symptoms are marked by a distorted sense of reality, including delusions and hallucinations. Delusions are quite variable in content but are generally understood as unwavering false ideas or beliefs that cannot be explained by one’s social or cultural background (Arango & Carpenter, 2011). Hallucinations are defined as perceptions—such as images, noises, and smells—not present in one’s environment. Although hallucinations can occur in any sensory form, auditory hallucinations, typically described as “hearing voices,” are most common in schizophrenia, experienced by over 70% of individuals with the diagnosis (Hugdahl et al., 2007).

3.4.2 Negative Symptoms

Negative symptoms are defined as the omission of certain normative processes seen in healthy populations. They are associated with abnormalities in typical emotional and social behaviors, including the reduction of speech, emotional expression, and feelings of pleasure (American Psychiatric Association, 2013). The most common negative symptoms are difficulty speaking (alogia), blunted affect, the inability to experience pleasure (anhedonia), asociality, lack of motivation (avolition), and overall lack of interest in daily activities. Negative symptoms are commonly present both before the onset of positive symptoms and following their remission (Arango & Carpenter, 2011).

3.4.3 Disorganized Symptoms

Although once categorized under the domain of positive symptoms, disorganized thought and speech, also known as “formal thought disorder” or
“conceptual disorganization,” is now believed to form its own distinct cluster of symptoms (Green, 2003, p. 16). This disorganization is characterized by unusual or disordered ways of thinking and behaving, and can result in the derailment of thought processes and the inability to link a series of conceptual ideas. People with schizophrenia may exhibit their disorganized symptoms through abnormal speech patterns; for example, they may have difficulty forming coherent sentences and skip from one idea to another (Green, 2003). Disorganized thought processes may inhibit one’s capacity to understand abstraction and symbolism (Arango & Carpenter, 2011; Green, 2003).

3.4.4 Cognitive Symptoms

Neurocognition

Research has shown that approximately 90% of individuals with schizophrenia exhibit clinically significant dysfunction in at least one domain of neurocognition, while about 75% of patients exhibit deficits in at least two (Kern & Horan, 2010). Research has also indicated that the patients rated as “not impaired” by clinical neuropsychological assessment tend to be the ones with the highest levels of premorbid functioning, and that their cognitive functioning is lower than what would be expected of them based on their IQ levels (Kurtz, Donato & Rose, 2011).

Broadly, neurocognition can be understood as one’s overall thinking ability, including processing speed, attention, memory, executive skills, and visuospatial perception (Kern & Horan, 2010). The National Institute of Mental Health’s Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) panel developed a consensus on the seven domains of cognition most important in schizophrenia research and treatment: “processing speed,
attention/vigilance, working memory, verbal learning and memory, visual learning and memory, reasoning and problem-solving, and verbal comprehension” (Fett et al., 2011, p. 574). Schizophrenia research has commonly focused on deficiencies in executive function, attention, and memory, as difficulties in these three areas of cognition have been shown to negatively affect many features of everyday functioning (Medalia & Richardson, 2005).

Executive functioning can be understood to encompass the cognitive capabilities required to adapt to changes and demands in one’s environment (Loring & Meador, 1999). Executive functions, also sometimes referred to as modes of “cognitive control,” are top-down processes that are necessary in order to concentrate, self-regulate, and make decisions (Diamond, 2014). Executive skills include cognitive flexibility, the capacity to anticipate outcomes and problem-solve in order to achieve the successful incorporation of non-routine events into daily life. This flexibility in thinking can in turn allow for longer-term, goal-oriented behavior (Palmer & Heaton, 2000). Deficits in executive functioning can be traced back to Kraepelin’s (1919) disease model, as he suggested an underlying dysfunction in “higher intellectual abilities” leading to difficulties in attention and judgment (p. 219).

Attentional deficits seen in schizophrenia often manifest themselves as the inability to distinguish between relevant and irrelevant stimuli in one’s environment, or as the lack of capacity for sustained and focused attention (Savla, Moore, & Palmer, 2011). Working memory is a mechanism for short-term storage and manipulation of auditory and visual information (Palmer & Heaton, 2000). A classic test of working memory requires an individual to listen to a string of numbers and
then recall them in reverse order; this task requires rapid storage, manipulation, and retrieval of information.

Importantly, studies have indicated that neurocognitive functioning is relatively independent of positive symptoms (hallucinations and delusions), medication effects, and age. These findings suggest that neurocognitive deficits are central features of the disorder, rather than artifacts of other elements of psychosis. A meta-analysis of longitudinal studies of schizophrenia revealed the stability of cognitive deficits throughout one’s lifetime by reporting that, on average, individuals with schizophrenia experienced no further decline in cognitive capacity over the course of a one-to-six-year follow-up period (Irani, Kalkstein, Moberg, & Moberg, 2011). To further substantiate this claim, past literature has illustrated the presence of neurocognitive deficits in prodromal and first-episode populations, as well as the persistence of impairments following the remission of other psychotic symptoms (Kern & Horan, 2010). A meta-analysis of 47 studies of early stage schizophrenia found medium-to-large impairments across all 10 domains of neurocognition analyzed in first-episode populations compared to healthy controls (Mesholam-Gately, Giuliano, Goff, Faraone, & Seidman, 2009). In short, cognitive deficits are relatively stable over the course of schizophrenia and are already reliably present in first-episode populations at levels comparable to those seen in older clinical samples.

**Social Cognition**

In addition to neurocognitive impairments, many people with schizophrenia exhibit deficits in the domain of “social cognition.” Social cognition is a multidimensional construct that describes the mental operations that underpin social interactions (Kern & Horan, 2010, p. 9). In schizophrenia research, social cognition is
most frequently identified as encompassing four domains of ability: emotional perception (EP), social perception or knowledge (SP), theory of mind (ToM), and attributional style (AS) (Couture, Penn, & Roberts, 2006). EP is understood as emotional and affect recognition, or the ability to infer emotional information from facial expressions and vocal intonations (Couture et al., 2006). SP includes both the comprehension of social norms and the capacity to catch social cues in order to characterize social interactions based on witnessing behaviors in context. ToM is the ability to infer the underlying intentions, moods, and beliefs of others; this includes the ability to pick up on irony, hints, humor, and deception in social interactions (Kern & Horan, 2010). AS describes the ability to assign causes to positive and negative events in one’s life (Couture et al., 2006). Individuals with schizophrenia are shown to experience clinically significant impairments across multiple domains of social cognition (Kern & Horan, 2010). Furthermore, evidence suggests that social cognition is closely associated with functional outcome, as the ability to rapidly process social stimuli is necessary to succeed in social interactions, maintain appropriate behavior in educational and vocational settings, and effectively problem-solve in peer and family relationships (Couture et al., 2006). In the realm of schizophrenia research, research has shown that social cognitive impairments are modifiable through psychosocial interventions (Horan, Kern, Green, & Penn, 2008).

Cognitive Symptoms and Functional Outcomes

The blend of positive, negative and cognitive symptoms experienced by persons with schizophrenia can cause a great deal of suffering and can prevent individuals from achieving their goals of living independently, working, finishing school, and establishing meaningful social relationships (Roder & Medalia, 2010).
Impairments in cognition are shown to be better predictors of functional outcomes including self-care, employment, and social/community functioning, than positive symptoms (Roder & Medalia, 2010). Research has indicated that deficits in specific domains of cognition may be associated with distinct types of functional outcome; for example, attention with social functioning, and executive functioning with independent living (Brekke & Nakagami, 2010, p. 27).

A review of longitudinal studies found that neurocognition accounted for only 20-60% of the variance in functional outcome seen in individuals with schizophrenia (Green, Kern, & Heaton, 2004). This finding provoked a search for other factors that may play a role in functional outcome, and many researchers have proposed social cognition as a possible mediator. A meta-analysis conducted by Schmidt, Mueller, and Roder (2011) found that in 14 out of 15 studies reviewed, social cognition was a significant mediator between neurocognitive performance and functional outcome. The mediator hypothesis may be crucial in the development of therapies that remediate cognitive deficits, as social cognition could be a key intervening mechanism that aids in the generalization of therapeutic effects to functional outcomes. Combining treatment of neurocognition and social cognition may have a synergistic effect necessary to ensure long term improvements in functioning (Schmidt et al., 2011).

When considering the hypothesis of social cognition as a mediator, it is also important to recognize that social cognition seems to be a valid predictor of outcome in itself. A meta-analysis of 52 studies consisting of 2,692 individuals with schizophrenia found that social cognitive domains such as emotion processing, social
processing, and ToM were strongly correlated with functional outcomes (Fett et al., 2011). Within this review, studies that directly compared social cognition and neurocognition found that social cognition accounted for 16% of the variance seen in functional outcome measures, while neurocognition accounted for only 6% (Fett et al., 2011).

When considering the effects of cognition on functional outcome, a growing body of research has highlighted the importance of metacognition (Wykes, Crowther & Reeder, 2016). “Metacognition,” colloquially described as “thinking about thinking,” is defined by the *Oxford Dictionary of Psychology* as “knowledge and beliefs about one’s own cognitive processes… also sometimes applied to the regulation of cognitive functions, including planning, checking, or monitoring” (Wykes et al., 2016, p. 90). In the context of cognition in schizophrenia, metacognition is the integration of three main components: self-monitoring (e.g., evaluating one’s own cognitive capacity), regulation (e.g., directing one’s own cognitive and behavioral performance), and knowledge (e.g., understanding the difficulties inherent in a task and identifying the resources necessary to carry it out) (Wykes et al., 2016). Metacognition provides individuals with a capacity for self-reflection that may be required in order to seek out resources needed to bypass or restore cognitive deficits. Some researchers have proposed that impairments in metacognition may serve as better predictors of functioning than neurocognitive deficits (Wykes et al., 2016).

3.5 **Etiology**

Despite over a hundred years of research, the exact cause of schizophrenia remains unknown. To this day, no lab tests or biomarkers can directly measure one’s
likelihood of developing the disorder, and its underlying pathophysiology remains a mystery. The initial neurodevelopmental theory of schizophrenia was one of a “single hit,” or the idea that one abnormal prenatal event could disrupt brain development and lead to the emergence of schizophrenia later in life (Davis et al., 2016). This model was deemed inaccurate, as it failed to account for the longitudinal structural changes in brain volume that are characteristic of schizophrenia, such as a decline in gray matter (Dietsche, Kircher, & Falkenberg, 2017). The alternative “two-hit” model—the first an individual genetic predisposition, and the second an environmental disruption later in life—was also insufficient, as the two-hit binary does not fully account for the heterogeneity seen across clinical populations (Davis et al., 2016). Rather than having reached consensus on an exact causal model of the disorder, it has been widely accepted that the diverse phenotypes—behavioral, observable expressions—of schizophrenia arise from the convergence of multiple risk factors including both genetic susceptibility and environmental influences (McGrath, Saha, Chant, & Welham, 2008).

3.5.1 Genetic Factors
Evidence from family studies indicates that having a first degree relative with a diagnosis of schizophrenia is the best predictor of illness development (Waddington et al., 2007). The risk of illness is as high as 10% for individuals with a 1st degree relative carrying a schizophrenia diagnosis, and 3% for individuals with a 2nd degree relative (Patel, Cherian, Gohil, & Atkinson, 2014). If both parents have a diagnosis of schizophrenia, their child has a 40% risk of developing the illness (Patel et al., 2014). Genomic studies of schizophrenia have revealed that cognitive deficits are among the most heritable of all illness-related traits, and that they meet “endophenotype” criteria
Endophenotypes are biological or behavioral variations that are quantifiable and serve as indicators of an inherited vulnerability for a disease (Allen, Griss, Folley, Hawkins, & Pearlson, 2009). Endophenotypes are defined by four criteria: they are stable over the course of the illness, genetically simpler than illness phenotypes, among the most heritable of all illness-related traits, and are found in family members at higher rates than the general population (Flint & Munafo, 2007; Braff et al., 2007). Results of family studies of schizophrenia have illustrated the heritability of cognitive impairments (Gur et al., 2007). Moreover, cognitive deficits are present prior to illness onset, and remain relatively stable over a patient’s lifetime (Harvey, Reichenberg, Bowie, Patterson, & Heaton, 2010). Past research has also indicated that individuals in the prodromal phase of schizophrenia who exhibit cognitive deficits are at higher risk for developing full psychosis than those without impairments (Green and Harvey, 2014).

3.5.2 Other Risk Factors

Literature reveals that potential vulnerability factors for schizophrenia include nutrition, smoking, cannabis use, childhood trauma, and social defeat. While each of these factors most likely has a relatively weak effect on its own, the simultaneous presence of multiple factors in a person who is genetically pre-disposed could have a significant effect on the development of schizophrenia.

Based largely on studies of major famines, it has been hypothesized that maternal malnutrition prior to and during pregnancy may be a vulnerability factor for schizophrenia. Specifically, low levels of maternal vitamin D during in utero development are thought to underpin increased risk for schizophrenia, as population-based research has found that newborns with vitamin D levels in the lower quintile
are at two times the risk for schizophrenia (McGrath, Burne, Féron, Mackay-Sim, & Eyles, 2010). Smoking is associated with an earlier age of onset of schizophrenia, and prospective studies have shown that daily smokers have double the risk of schizophrenia compared to non-smokers (Davis et al., 2016). One hypothesis behind this association is that smoking addiction may alter the dopaminergic neurotransmitter system in the brain, which is thought to be implicated in the pathophysiology of schizophrenia. Cannabis use is another potential vulnerability factor, although literature on the subject indicates mixed results: ongoing cannabis usage in schizophrenia is associated with worse outcomes such as longer periods of hospitalization, higher relapse rates, and less medication adherence. However, usage may also be associated with better cognitive and social functioning (Davis et al., 2016). Lastly, childhood trauma is a risk factor for schizophrenia; meta-analyses have suggested that individuals with a history of childhood trauma have nearly three times the risk of developing psychosis. Interestingly, one meta-analysis found that no specific type of trauma – be it sexual abuse, physical abuse, or parental loss - bestows a greater risk of psychosis compared to others (Varese et al., 2012). Childhood trauma is associated particularly with worse positive symptoms and their non-remission (Davis et al., 2016).

The social defeat hypothesis of schizophrenia conceptualizes “social defeat,” defined as "the negative experience of being excluded from the majority group," as a potential causal factor in the development of schizophrenia (Selten, van der Ven, Rutten, & Cantor-Graae., 2013, p. 1180). Evidence for this theory comes from the reality that multiple vulnerability factors for schizophrenia – including homelessness,
income inequality, and childhood trauma—are associated with being part of a socially oppressed and alienated group. Moreover, research has indicated that social stressors, which are often worse among marginalized or excluded groups, may heighten the influence of an individual’s underlying genetic and environmental risk for developing schizophrenia (Davis et al., 2016). Social defeat may serve then as a valuable addition to the classic theory of “social drift,” which suggests that people with schizophrenia inevitably drift to lower social classes and roles in society due to severe stigma and lack of access to treatment and resources (Kamens, 2016). The social defeat hypothesis highlights how social marginalization may not only be a result of exclusion and stigma post diagnosis, but also may serve as a valuable indicator of vulnerability prior to the development of the clinical syndrome.

3.6 Pathophysiology

As is common in the formation of neuroscientific models of mental illness, most theories of the pathophysiology of schizophrenia have been constructed following the discovery of a drug that is effective in treating clinical symptoms. After a successful treatment is found, scientists try to locate the neurochemical basis of its efficacy, which leads to theories of neurotransmitter systems that underlie the disorder (Green, 2003). For example, the “Dopamine Hypothesis” was formed in part because patients with schizophrenia responded well to chlorpromazine, a drug originally used to calm patients before surgery. When used in psychiatric treatment, chlorpromazine reduced psychotic symptoms by dampening hallucinations and delusions (Green, 2003). Because chlorpromazine acts on dopamine in the brain, it was theorized that irregular dopamine activity may in fact be the basis of the positive symptoms that the drug suppressed.
Rather than tracing backwards from an effective drug, the “Glutamate Hypothesis” is being developed in the opposite fashion, out of new neuroscientific understandings of the possible neural pathways that underpin symptoms. Neuroscience research has found that when the N-Methyl-D-Aspartate (NMDA) glutamate receptor subtype is blocked in healthy people, they exhibit subtle clinical changes in neurocognition, similar to the deficits that are characteristic of individuals with schizophrenia (Green, 2003). Findings such as this one are important steps towards the development of pathophysiological theories of schizophrenia based on the association between neural pathways and symptom presentation.

3.6.1 Dopamine Hypothesis

Historically, symptoms of schizophrenia were hypothesized to result from hyperdopaminergic brain pathways. Limitations to this understanding were brought to light with both the discovery of cases of schizophrenia that were unresponsive to the blockage of dopamine receptors, and of certain antipsychotic medications, such as clozapine, that are effective despite low affinity for dopamine receptors (Downar & Kapur, 2011). Revised understandings of the hypothesis suggest that symptoms of schizophrenia are the result of abnormal dopamine activity in the nervous system, particularly an imbalance of opposing dopamine activity in the mesolimbic and mesocortical pathways (Downar & Kapur, 2011). The mesolimbic pathway projects from the ventral tegmental area (VTA) to multiple subcortical areas including the amygdala and the hippocampus (Kurtz, 2016). It is thought that an excess of dopamine in this pathway may lead to the expression of positive symptoms, such as hallucinations and delusions. In support of this, dopamine agonists such as amphetamines and cocaine provoke psychotic-like symptoms, and many effective
antipsychotics bind and block dopamine receptors. The mesocortical pathway projects from the VTA to the overlying cortex, as well as innervating several areas of the prefrontal cortex (Kurtz, 2016). Dopamine hypoactivity in the mesocortical pathway may contribute to the cognitive and negative symptoms of the disorder. Additionally, abnormal dopamine activity in the nigrostriatal pathway—which projects from the substantia nigra up to the striatum—may be linked to some of the disorganized motor symptoms of schizophrenia, as low dopamine levels in this pathway are believed to be the cause of Parkinsonian motor symptoms (Downar & Kapur, 2011).

3.6.2 Glutamate Hypothesis

The Glutamate Hypothesis posits that dysfunction in NMDA glutamate receptors may be a primary deficit underlying positive, negative, and cognitive symptoms of schizophrenia. Glutamate is a major excitatory neurotransmitter in the central nervous system that binds to NMDA receptors that play key roles in cognitive processes such as attention and perception (Downar & Kapur, 2011). Support for the hypothesis came initially from low glutamate levels found in the cerebral spinal fluid (CSF) of individuals with schizophrenia. Further evidence for the hypothesis is derived from postmortem studies of people with schizophrenia that have found abnormalities in NMDA receptors and related hormones, and the fact that NMDA antagonist drugs mimic some of the key symptoms of the disorder (Downar & Kapur, 2011). For example, the use of non-competitive NMDA glutamate antagonists such as phencyclidine (PCP) and ketamine can induce schizophrenia-like symptoms in healthy individuals (McGrath et al., 2008). PCP usage can cause psychotic symptoms, thought disorder, blunted affect, and cognitive impairments. Ketamine can trigger behaviors that mimic the positive, negative, and disorganized symptoms of
schizophrenia in healthy users, while its usage by individuals with the diagnosis may briefly heighten their symptoms (Krystal et al., 2003).

However, despite these similarities, it is important to note that drugs like PCP and ketamine can also trigger sedative and euphoric states that are not characteristic of schizophrenia. Additionally, the perceptual effects of these drugs often include a dissociative component not common in schizophrenia. Likewise, the cognitive abnormalities associated with drug usage are different from those characteristic of the disorder (Krystal et al., 2003). Some research has suggested that the glutamate model may work in conjunction with the existing dopamine hypothesis, rather than as a replacement theory. For example, Downar and Kapur (2011) proposed that reduced prefrontal glutamate neurotransmission may cause a reduction in prefrontal activity. This reduction may, in turn, result both in decreased mesocortical activity and in the decreased regulation of mesolimbic dopamine projections. As laid out by the dopamine hypothesis, it is this imbalance in dopamine activity that may trigger schizophrenia symptoms.

3.7 Treatment
In the early 1900s, for decades following Kraepelin’s initial proposed definition of schizophrenia, there were no effective, evidence-based treatments. Remedies at the time were largely administered on a “trial and error” basis and were desperate attempts by the psychiatric community to provide some kind of care to the severely mentally ill (Lavretsky, 2011). The initial treatments of schizophrenia were mainly somatic, acting directly on the brain and body. While based on the hypothesis that symptoms of schizophrenia stemmed from fixed physical abnormalities, these treatments had little empirical basis, and were largely the result of popular treatment
“fads” (Kurtz, 2016). Common treatments in the early 1900s included hydrotherapy, malaria induction (the “fever cure”), insulin-induced coma, electroconvulsive therapy, and psychosurgeries such as pre-frontal lobotomy (Green, 2003). These treatments were administered at a time before the standardization of randomized controlled trials. They were minimally evaluated and largely ineffective.

With limited therapeutic options available, prospects for patients with schizophrenia were quite dim; during the first half of the 20th century, thousands were confined to psychiatric institutions indefinitely. By the mid-1950s, psychiatric institutions in the US and Canada alone housed more than 500,000 psychotic patients (Lavretsky, 2011, p. 6). While the development of antipsychotic medications in the 1950s was widely celebrated as having transformed schizophrenia treatment, these medications were by no means curative, and many patients responded poorly and experienced severe negative side-effects. Moreover, despite advancements in treatment research and design, the late 1950s was also characterized by rapid deinstitutionalization of psychiatric patients (Lavretsky, 2011). Without adequate access to structures of social support, health care, and housing, many of the severely mentally ill patients who were released were at risk for relapse, poverty, homelessness, and damaging social stigma (Lavretsky, 2011). Given this history, advocacy for increased access to mental healthcare and to structures of social support should occur alongside the development of new evidence-based treatments for schizophrenia.

3.7.1 Pharmacological Treatments
The first generation of antipsychotic medications (including chlorpromazine, haloperidol, thioridazine, and fluphenazine) emerged in the 1940s, and dominated the
treatment of schizophrenia for about fifty years. First generation antipsychotics (FGAs) primarily target dopamine 2 (D2) receptors in the brain; as antagonists, they block the receptor and inhibit the binding of dopamine (Green, 2003). These medications were largely effective in treating positive symptoms such as hallucinations and delusions. However, FGAs are not effective in the reduction of negative or cognitive symptoms; nor do they improve overall functional outcome for most users (Green, 2003). Furthermore, about 20-25% of early FGA users were non-responsive and deemed “treatment resistant” (Green, 2003, p.125). FGAs come with a host of damaging extrapyramidal side effects. Some common examples of these disturbances in movement are: tremor, rigidity, akinesia (motor slowing), dystonia (involuntary muscular contractions or twists), and akathisia (restlessness or the inability to sit still). Long-term usage of FGAs can also damage the central nervous system and lead to the development of tardive dyskinesia, a condition characterized by the random, writhing movement of body parts, mainly of the mouth and tongue (American Psychiatric Association, 2013).

In the 1990s a second generation of antipsychotics (SGAs) was developed, including drugs such as risperidone, olanzapine, and quetiapine. SGAs help to decrease positive symptoms and are successful at doing so in certain individuals who do not respond well to the first-generation equivalents. Some research also suggests that SGAs may be effective in the reduction of negative symptoms (Marder, Davis, & Chouinard, 1997). While SGAs may have fewer extrapyramidal effects than FGAs, users experience severe metabolic side-effects such as weight gain and diabetes (Green, 2003). SGAs also act on dopamine receptors, but it is theorized that they do
so in a manner distinct from their first-generation counterparts (e.g., acting on receptors for shorter periods of time, or acting on different receptor types such as serotoninergic receptors) (Green, 2003). Researchers Kapur and Seeman (2001) propose that it is the SGAs’ quick dissociation from D2 receptors – when compared to FGAs, which block D2 receptors for longer periods of time – that allows for antipsychotic benefits without as many extrapyramidal side effects.

Notably, while there is no doubt that long-term exposure to antipsychotic medications, particularly those of the first-generation, can cause movement disorders, early understandings of schizophrenia did include involuntary movements. For example, prior to the introduction of pharmacological interventions, Kraepelin observed the “spasmodic phenomena” in his patients with schizophrenia, a condition he characterized by distorted and unregulated facial movements (Kraepelin, 1971, p. 83). His description of this phenomenon resembles what we today call tardive dyskinesia (Green, 2003). Additionally, researchers have observed tremor and rigidity in first-episode populations who have never taken antipsychotic medication (Chatterjee, Chakos, Koreen, & Geisler, 1995). Both of these findings suggest that movement disorders may not only be a side-effect of antipsychotic medications, but also perhaps a symptom of the illness itself.

3.7.2 Behavioral Treatments
Reasonably so, positive symptom reduction has long been the primary goal of schizophrenia treatment; when a floridly psychotic individual is hospitalized, other forms of rehabilitation are often not feasible without first attending to the remission of active hallucinations or delusions. However, the distinction needs to be made between remission of psychotic symptoms and functional recovery. When
antipsychotic medications were introduced in the 1940s, they barely influenced overall recovery rates or community integration despite successfully reducing psychotic symptoms (Green & Harvey, 2014). Following positive symptom relief, difficulties with cognition, motivation, and socialization often still prevent a patient from returning to premorbid levels of functioning. This suggests that behavioral therapies, along with community and family interventions, are essential to recovery (Roder & Medalia, 2010). Advocacy work pushing for patient-centered models of treatment has led to more research on non-pharmaceutical possibilities, and a growing body of evidence now indicates that behavioral approaches can improve psychosocial functioning (Kurtz, 2016). Cognitive behavioral therapy, social skills training, vocational interventions, and cognitive remediation have all been empirically studied and are deemed “evidence-based interventions” in schizophrenia treatment (Kurtz, 2016). Family-centered treatments can also be useful, as schizophrenia can affect an entire family network, often due to inadequate understanding of the diagnosis and associated stigma. Through psychoeducation, clinicians can provide families with educational materials and practical and emotional support to aid them in the development of strategies to best support their loved one’s treatment plan (Green, 2016).

3.7.3 Reimagining Recovery
In light of the widely held understanding of schizophrenia as a chronic and deteriorating disorder, it is important to recognize the possibility of recovery. Many individuals do in fact experience full symptom remission and achieve functional recovery. A review of longitudinal studies of outcome in schizophrenia indicates that most people with the diagnosis experience sporadic periods of symptomatic relief and
functionality, and that 20-65% of the studied samples reported overall “good outcome” (Davidson, Schmutte, Dinzeo, & Andres-Hyman, 2007). Perhaps most importantly, a minority of people, less than 20%, who are diagnosed with schizophrenia experience increasing impairments over time (Davidson et al., 2007). This finding counters the popular notion that the functioning of individuals with schizophrenia deteriorates over the course of the illness.

There is a growing movement of advocates and researchers pushing for a more patient-centered model of recovery that takes personal, subjective perspectives into account (Roe, Mashiach-Eizenberg, & Lysaker, 2011). Scientific definitions of recovery are typically based on the reduction of “objective” clinical symptoms and improvements in social and role functioning. Alternatively, patient-centered approaches to recovery tend to focus on a client’s subjective experiences, such as ongoing processes of identity change and the achievement of self-determination regardless of the remission of clinical symptoms (Roe et al., 2011). In this light, “recovery” can be understood as not only the reduction of objective problems, but also the change in subjective experience of an illness that helps patients feel empowered and capable of reaching their personal goals. While behavioral and psychosocial interventions in schizophrenia have been shown to have substantial benefits in terms of functional outcomes, they often do not include a great deal of space for personal reflection. Psychotherapy may be a useful tool for these clients to develop a positive sense of self and to recognize their capacity to achieve recovery goals, even those not directly targeted in treatment (Lysaker, Glynn, Wilkniss, & Silverstein, 2010).
3.8 Cognitive Remediation Therapy

Cognitive remediation (CR) is a behavioral intervention created to assist in the improvement of cognitive abilities in individuals who have suffered a decline in neuropsychological functioning, either as a response to head trauma or as a symptom of a psychiatric disorder (Medalia & Richardson, 2005). The clinical model of CR is to teach and practice cognitive skills that clients may be lacking, in order to help facilitate a reduction in everyday difficulties associated with neurocognitive and social cognitive impairment. Meta-analyses evaluating the effects of CR on individuals with schizophrenia have found that it is associated with significant improvement in cognitive performance, clinical symptoms, and functional outcomes (McGurk, Twamley, Sitzer, McHugo, & Mueser, 2007; Wykes, Huddy, Cellard, McGurk, & Czobor 2011). Positive effects of CR have been shown even in relatively low intensity interventions administered over a short period of time, for example, two to three times per week for a period of three months (Kurtz, 2016). Behavioral CR approaches can be administered in many formats including individual, group, non-computerized, and computerized interventions (Medalia & Richardson, 2005).

Two main types of CR are the restorative drill-and-practice approach (either “bottom-up” or “top-down”) and the compensatory strategy-based approach. Drill-and-practice is defined by the repetitive rehearsal of exercises designed to restore cognitive skills in domains such as attention and memory. A “bottom-up” approach refers to a hierarchical training style with exercises that focus on specific impaired processes (Masson et al., 2015). In this method, more basic neurocognitive functions are trained first, starting at a baseline level in which the client can perform highly (Kurtz, Seltzer, Shagan, Thime, & Wexler, 2007). Once elementary cognitive tasks
are mastered, more complex functions are practiced. A “top-down” remediation approach also trains through repetition, but emphasizes the simultaneous training of multiple cognitive domains, rather than targeting them one at a time. Moreover, “top-down” approaches supply participants with strategies for applying the cognitive skills they are practicing in treatment to real-world situations (Masson et al., 2015). Drill-and-practice therapies are typically administered on the computer. Research has shown that repetitive practice on cognitive exercises over time engages and strengthens neural systems in areas of cognition that may have been under-performing (Kurtz, 2016).

Strategy-based approaches to cognitive remediation are typically non-computerized paper-pencil tasks administered by a therapist (Kurtz, 2016). This approach focuses less on the drilling and restoration of specific cognitive skills –such as attention or memory- but rather, on the training of compensatory strategies. Compensatory strategies encourage clients to employ external aids or environmental modifications to bypass deficit areas, rather than working to explicitly restore these lost cognitive functions (Twamley, 2016). For example, if a client struggles with memory, a therapist may coach him/her to start writing appointments on a calendar, or to put post-it notes with reminders up around the house. Strategic processing and cognitive flexibility are taught in this approach in order to help clients meet their goals and successfully incorporate non-routine events and any associated cognitive skills into their real-world daily habits (Twamley, 2016).

Meta-Analytic Results of Cognitive Remediation Studies

A meta-analysis of 26 randomized, controlled studies of CR involving 1,151 individuals diagnosed with schizophrenia found that CR was associated with
significant improvement across three domains: cognitive performance, psychosocial functioning, and psychiatric symptoms (McGurk et al., 2007). After CR, improved cognitive performance was indicated across six of the seven cognitive domains defined by the MATRICS. Additionally, across the six studies in the review that reported cognitive performance at a posttreatment follow-up, CR was associated with improvements in overall cognitive performance eight months later on average (McGurk et al., 2007). These effects were similar across the studies analyzed, despite variants in training approaches and length of treatment, suggesting that CR produces improvements across a variety of program and participant characteristics (McGurk et al., 2007). Surprisingly, the number of hours of training in a CR program was not related to immediate improvements in cognitive functioning, and the review suggested that a small number of hours, possibly as low as five to fifteen, may be enough to boost cognitive functioning.

However, while the McGurk et al. (2007) review showed largely homogenous effects across studies of CR on overall cognitive functioning, effects of CR on functional outcomes varied considerably. The strongest effects on functioning were found in the programs that combined CR with social skills training, rather than in the programs that offered either of these interventions alone. Additionally, CR programs that included strategy coaching had stronger effects on functioning than the programs focused solely on drill-and-practice (McGurk et al., 2007). This suggests that explicit teaching of cognitive skill development techniques may be necessary in order for CR effects to translate to functional outcomes.
Another meta-analysis of 40 CR studies with 2,104 participants found that cognitive remediation had a positive effect on improvement in all domains of cognition with the exception of visual learning and memory (Wykes et al., 2011). In terms of participant characteristics, while the review found that the presence of more clinical symptoms was associated with smaller effect sizes, symptomatic participants still benefitted from CR. The review also found that improvements in functional outcomes were best achieved when CR interventions were done in conjunction with another rehabilitation program. In these cases, strategy-based approaches to CR led to better outcomes when compared to drill-and-practice approaches, potentially because the additional treatment program helped to support increased transfer of strategies to real-world functioning (Wykes et al., 2011).

Main conclusions from past meta-analytic work on CR in schizophrenia indicate that non-specific cognitive stimulation, across many different approaches and styles, is moderately beneficial in the improvement of cognition. Additionally, patients who receive cognitive training with one-on-one strategy coaching from a therapist, particularly when CR is offered as part of a more comprehensive rehabilitation program, show better overall functional outcomes. However, little evidence thus far has indicated which form of CR intervention is most effective; nor has existing evidence shaped our understanding of which personal characteristics are most likely to benefit from each style of CR.

Correlation Between Cognitive Remediation and Functional Outcomes

In order to see if effects of cognitive training can be generalized to participants’ daily lives, a few studies have looked at the correlation between changes in cognition and changes in functioning. For example, Fiszdon, Choi, Goulet, and
Bell (2008) found that improvements in memory during cognitive training predicted improvements in scores on a measure of quality of life. Wykes et al. (2012) found that improvements in planning were associated with improved work quality, but that other components of cognition such as cognitive flexibility and working memory, which improved in response to CR, had no effect on work quality. Eak, Pogue-Geile, Greenwald, Hogarty, and Keshavan (2011) examined the efficacy of cognitive training in a group of 58 individuals with early-stage schizophrenia. These authors found that improvements in executive functioning and social cognition partially mediated the effects of cognitive training on functional ability. Rispaud, Rose and Kurtz (2016) examined 117 individuals enrolled in a one-year trial of either computerized drill-and-practice cognitive remediation therapy or a computer skills training group. These authors found that various cognitive skills improved in response to cognitive remediation, including working and episodic memory, problem-solving, and processing speed. However, only improvement in working memory and processing speed was correlated with improvement in functionality (Rispaud et al., 2016). These correlations are important indications, as they help to hone our understanding of the beneficial role that improvements in cognition can play in improved functional outcomes, and ultimately, functional recovery.

**Generalization of Cognitive Skills to Real-World Functioning**

There are a number of factors that influence one’s ability to generalize cognitive skills to everyday functionality. These relate to participant characteristics, cognitive training characteristics, and living environment post-training. Personal characteristics such as performance anxiety, self-esteem, and intrinsic motivation may affect one’s ability to transfer cognitive skills to his/her daily life (Medalia &
Saperstein, 2013). In terms of CR characteristics, research indicates that the contextualization of training tasks in real-life situations promotes generalization (Medalia & Choi, 2009). For example, a computerized memory task designed to simulate shopping for groceries may be more effective than one that simply requires users to remember an arbitrary sequence of colors and shapes. Additionally, strategy-coaching during CR enhances generalization. Strategy-coaching typically consists of a therapist offering clients strategies for success in cognitive tasks, such as “chunking,” the tactic of dividing a large amount of information into smaller chunks to be more easily remembered. While past research has revealed that strategy-coaching enhances generalization, more research is needed in order to determine whether it is the clinical interaction between therapist and client during the delivery of strategy coaching, or the actual strategy tips themselves, that helps to enhance functional outcomes. While participant and treatment characteristics play a role in promoting the generalization of cognitive skills, one’s living environment during and after treatment is also influential. For example, a lack of opportunity to practice new skills in one’s everyday life and community could inhibit generalization, as individuals may be unable to apply and practice their cognitive improvements if they live in an environment that does not support or trust in their autonomy.

Some researchers have suggested that the social cognitive deficits characteristic of individuals with schizophrenia could potentially hinder the effective implementation of CR (Horan, Roberts, & Holshausen, 2016). For example, impairments in social and emotional perception could cause the misinterpretation of social interactions either between the therapist and the client during individualized
CR, or between clients if administered in a group format. Additionally, if social
cognition is understood as a mediator between cognition and functional outcomes, the
presence of social cognitive skills is critical for neurocognitive capacities to be
generalized to everyday functioning. Therefore, the integration of social cognitive
training into CR may be necessary for populations to fully benefit from the treatment.

3.9 Present Study
The aim of the present study was to implement and directly compare the
effects of two therapeutic models of cognitive remediation -the restorative drill-and-
practice approach and the strategy-based compensatory approach- at River Valley
Services (RVS), a public outpatient mental health center in Middletown, CT that
provides services to individuals with severe and persistent psychiatric illness.
Although the strengths of each model have been investigated independently, this is
the first study to our knowledge that directly compared the two. The primary goal of
the study was to assess the feasibility of the integration of CR services into a public
community mental health center with individuals with psychosis-spectrum disorders.
The secondary goal was to determine which of the two therapeutic techniques was
more efficacious in producing improvements both in neurocognitive performance and
in functional outcomes. This study responds to the acute need in the field of
schizophrenia research for the development of evidence-based treatments that not
only remediate neurocognitive impairments, but that also have effects on participants’
“real life” outcomes, such as their social functioning and everyday living skills.
Moreover, this study responds to the need for more accessible treatments and
structures of support for people with psychosis. Conducting this research is the first
step towards the establishment of an ongoing cognitive remediation therapy program at RVS.

Attendance at cognitive remediation sessions was tracked in order to assess participant intrinsic motivation and treatment feasibility. Additionally, input from clinical staff at RVS was taken to both enhance the study protocol and gauge the viability of CR dissemination. Assessment measures were chosen in order to analyze and compare the effects of the two interventions on clinical symptoms, neurocognition, social cognition, self-efficacy, and both self-reported and clinician-reported functional outcomes. With a growing body of evidence for the disabling effects that both neurocognitive and social cognitive deficits have on the daily functioning of people with schizophrenia, the results of the present study have direct and important clinical applications. Furthermore, as a pilot study analyzing the implementation of CR in the public sector, our results have policy implications, and may serve as evidence in support of increased funding and resource allotment to psychosis-specific treatments.

3.10 Hypotheses
Our principal hypothesis was that the implementation of CR at RVS would be feasible, and that both therapeutic models of cognitive remediation would enhance participants’ neurocognitive performance relative to those in the control condition. We also hypothesized that participants receiving the strategy-based compensatory cognitive training would exhibit greater improvements on functional outcome measures than those receiving the restorative drill-and-practice approach. Past literature has indicated that explicit strategy-coaching and the contextualization of cognitive practice in “real-world” simulations boost the generalization of cognitive
skills to real-world functioning (McGurk et al., 2007; Medalia & Choi, 2009; Wykes et al., 2011). Both of these tactics are integral components of the strategy-based compensatory training curriculum.
4. **Methods**

4.1 **Participants**

Participants were clinically stable community-dwelling individuals recruited to the study by staff at River Valley Services. All participants were fluent in English and had a DSM-5 diagnosis of schizophrenia, schizoaffective disorder, or a mood disorder with psychotic features. Potential participants were excluded if they had a history of services for intellectual disability, were actively using illicit substances, or were enrolled in another cognitive training program. A convenience sampling method was utilized. If a client expressed interest in participating, she or he would meet first with an RVS staff member to sign a Release of Health information form, and then with a researcher on the study to complete an informed consent. 21 individuals were originally enrolled and completed informed consent. Of those who consented, three were excluded from randomization; of the 18 who were randomized, four dropped out of the study protocol prior to follow-up testing (see Figure 1 for CONSORT Flow diagram). 14 participants made it through all phases of the randomized controlled trial and were included in data analysis.

<table>
<thead>
<tr>
<th>Table 1. Demographic Characteristics of Overall Sample (n=14).</th>
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<tbody>
<tr>
<td><strong>Age:</strong> Mean=51.57±10.87, Range=28-62</td>
</tr>
<tr>
<td><strong>Education (years):</strong> Mean= 12.93±1.89, Range=9-16</td>
</tr>
<tr>
<td><strong>Diagnosis:</strong> 50% schizophrenia, 35.7% schizoaffective, 14.3% psychotic features</td>
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<tr>
<td><strong>Illness Duration (years):</strong> Mean= 23.50±12.61, Range=5-43</td>
</tr>
<tr>
<td><strong>Age of Illness Onset:</strong> Mean= 28.07±11.65, Range=16-48</td>
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<tr>
<td><strong>Number of Hospitalization:</strong> Mean= 10.36±12.04, Range= 1-50</td>
</tr>
<tr>
<td><strong>FSIQ:</strong> Mean= 96.85±12.83, Range= 73-119</td>
</tr>
<tr>
<td><strong>Sex:</strong> 64.3% male, 35.7% female</td>
</tr>
<tr>
<td><strong>Ethnicity:</strong> 64.3% Caucasian, 28.6% African-American, 7.1% Hispanic/Latino</td>
</tr>
<tr>
<td><strong>Living Status:</strong> 64.3% live alone, 28.6% live with family, 7.1% live in group home</td>
</tr>
</tbody>
</table>
4.2 **Design**

All study procedures received Institutional Review Board (IRB) approval from both the Connecticut Department of Mental Health & Addiction Services (DMHAS) and Wesleyan University, and all individuals who chose to participate completed written, informed consent. Following the consent, subjects were randomly assigned to one of three conditions: computer-assisted, drill-and-practice cognitive remediation (PSSCogRehab; Bracy, 1995), a manualized strategy-based compensatory cognitive training group (CCT; Twamley, Savla, Zurhellen, Heaton, & Jeste, 2008), or a treatment-as-usual (TAU) control group, receiving no active intervention. All participants were being treated with their standard doses of antipsychotic medications throughout the course of the study. Group assignment was determined by a trained research assistant using an online random number generator (random.org). De-identified subject numbers were used during randomization to maintain confidentiality and blindness. There was equal probability that each participant would be assigned to each group. Participants who were assigned to the TAU control condition were given the option to participate in one of the cognitive remediation therapies following successful completion of all research protocol.

Both of the cognitive training interventions were administered over the course of a 12-week period: CCT in weekly two-hour sessions, and PSSCogRehab in sessions ranging from 45 to 60 minutes three times per week. As a pragmatic clinical trial, the number of hours per intervention was chosen based on what past literature has indicated to be an effective dose of each, rather than being matched directly. Subjects in all three conditions were assessed with a comprehensive test battery once before treatment, to measure baseline functioning, and again immediately following
the 12-week intervention. At baseline testing, personal and demographic information was gathered from each participant including race, gender, years of education, living status, parents’ education, age of illness onset, number of hospitalizations, and current medications. Any information that could not be answered by the participant directly was confirmed through the Electronic Medical Record. Trained research assistants administered the test battery which included measures of neurocognition and social cognition, along with structured-clinical interviews and surveys to measure participants’ clinical symptoms, self-efficacy, and social functioning. Additionally, all participants were given the UPSA, a performance-based measure evaluating basic daily living skills, such as check writing and telephone communication. Participants were compensated with a $30 gift card for each completed round of testing.

A single-blind study design was used to eliminate selective bias: all personnel who administered or scored follow-up testing were blind to the experimental group assignment of the participants. Follow-up assessment procedures were almost identical to those administered at baseline; the only test not administered at follow-up was the WTAR, as this was used to provide a baseline estimate of FSIQ and to analyze any between-group differences. Additionally, alternate forms of some measures were administered at follow-up to avoid practice effects.
Figure 1. CONSORT Flow Diagram. This figure illustrates participant progress through phases of the randomized control trial.

4.3 Experimental Conditions

4.3.1 CCT

Compensatory Cognitive Training (CCT) is a 12-week long manualized, group-based, computer-free treatment intervention developed by Dr. Elizabeth Twamley and colleagues at University of California, San Diego. The treatment focuses on the teaching and practicing of compensatory strategies that help clients bypass their cognitive difficulties (Twamley et al., 2008). The overall goal of the
treatment is for these compensatory strategies to become habitual, allowing the client to become less reliant on others (such as family members and clinicians) when going about daily tasks, functioning socially, and reaching their personal long-term goals. The intervention specifically targets four cognitive domains: prospective memory (“remembering to remember”), sustained attention, learning and memory, and executive functioning (described as problem-solving and cognitive flexibility). These domains were chosen based on specific impairment seen in patients with psychosis along with their relevance for everyday functioning (Twamley, Vella, Burton, Heaton, & Jeste, 2012). The curriculum includes paper-pencil practice activities and games, making the sessions more engaging for participants. The intervention modules teach participants to utilize both internal supports (such as acronyms and visual imagery) and external supports (such as list writing and written reminders) in order to work around their cognitive impairments and reach their long-term goals.

Each CCT training session lasts two hours with a short break taken half-way through. While varying in topic, all sessions follow the same basic structure: first, leaders facilitate a review of the previous session’s main topics and accompanying home exercises. Next, a new topic is introduced, along with relevant compensatory strategies. For example, in session three, the concept “short-term perspective memory” is introduced, and participants are provided with strategies that can be used to remember things in short-term situations. Strategies taught in session three include: “write things down on your hand,” “leave yourself a message,” and, “can’t miss reminders.” After these strategies have been sufficiently explained and practiced using paper and pencil tasks, group facilitators lead a conversation about how
memory strategies can help clients reach their long-term goals. At the end of each session, home exercises are assigned for group members to practice newly learned strategies throughout the week.

Pilot testing has shown that participation in this compensatory cognitive training intervention is associated with improvements in cognitive performance, psychiatric symptoms, functional outcomes, and quality of life (Twamley et al., 2008). A randomized, controlled trial of 69 participants with psychosis-spectrum disorders found that when compared to standard pharmacotherapy, individuals receiving CCT improved in objective measures of attention, verbal memory, daily functioning, negative symptoms, and subjective quality of life (Twamley et al., 2012). Each CCT treatment group of the present study had three participants and three facilitators. In the first intervention cohort the facilitators were clinical psychology pre-doctoral interns, and in the second intervention cohort the facilitators were a clinical psychologist, an occupational therapist, and an undergraduate research assistant. Facilitators remained consistent across all 12 sessions of the intervention. All sessions were audio recorded.

4.3.2 PSSCogRehab
Psychological Software Services Cognitive Rehabilitation Therapy System (PSSCogRehab) is a computerized cognitive training program that utilizes a repetitive drill-and-practice model to aid in the training and restoration of impaired cognitive areas (Bracy, 1995). Since its development, PSSCogRehab has been used in over 32 studies of cognitive remediation, many of which have demonstrated its efficacy. This program is accessible online (via neuropsychonline.com). All patient data stored on the site is secured using a username and password in a manner compliant with
HIPAA protocol. The program consists of 84 exercises designed to improve attention, verbal and non-verbal memory, and language processing. PSSCogRehab uses a neuropsychological approach, in which the therapy is hierarchically organized so that users begin at a more elementary level of neurocognitive training in which they can succeed. Clients work at their own pace, and only advance to the next level upon gaining 90% accuracy on their current training exercise. In the present study, participants randomly assigned to PSSCogRehab completed three sessions per week of computerized cognitive training for a three-month period. Each month, exercises targeted a distinct cognitive domain. The first month focused on attention, the second on memory, and the third on executive functioning. Descriptions of each of the exercises used can be found in Table 2. The training sessions were supervised by a community clinician in a computer lab on the River Valley Services campus.

Table 2. Descriptions of PSSCogRehab Exercises (Bracy, 1995).

<table>
<thead>
<tr>
<th>ATTENTION EXERCISES:</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIMPLE VISUAL REACTION (FIXED)</td>
<td>A task of focused, sustained visual attention. The participant must click on a series of targets (for example, a red square) positioned at a fixed point in the center of the screen.</td>
</tr>
<tr>
<td>SIMPLE AUDITORY REACTION (FIXED)</td>
<td>A task of focused, sustained auditory attention. The participant must maintain focused attention to a white plus sign located at a fixed point on a colored square at the center of the screen. The participant must also click on a pink circle in the corner of the screen in response to tones occurring at random intervals.</td>
</tr>
<tr>
<td>SIMPLE VISUAL REACTION (RANDOM)</td>
<td>A task of focused visual attention. The participant must simultaneously maintain focus to the center of the screen while also attending to ambient vision by clicking on colored square targets that appear in the periphery.</td>
</tr>
<tr>
<td>SIMPLE AUDITORY REACTION (RANDOM)</td>
<td>A task of focused, sustained auditory attention. The participant must maintain focused attention to a white plus sign located at a</td>
</tr>
</tbody>
</table>
random point on a colored square at the center of the screen. The participant must also click on a pink circle in the corner of the screen in response to tones occurring at random intervals.

<table>
<thead>
<tr>
<th>CHOICE VISUAL REACTION (FIXED)</th>
<th>A task of focused visual attention. The participant must maintain focused attention on a fixed point at the center of the screen and click when a square of a specific color appears on the screen. Participants are instructed not to click when a square of a different color appears.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHOICE AUDITORY REACTION (FIXED)</td>
<td>A task of focused selective auditory attention. The participant is asked to click on a fixed target at the center of the screen in response to a specified tone. The task requires participants to determine if the auditory stimulus matches the target tone in order to not click on the screen if they hear the incorrect tone.</td>
</tr>
<tr>
<td>CHOICE VISUAL REACTION (RANDOM)</td>
<td>A task of focused visual attention. The participant must maintain attention to the entire screen in order to respond quickly and click on colored squares in the periphery that match the designated target color. Participants are asked not to click on the targets of distinct colors.</td>
</tr>
<tr>
<td>CHOICE AUDITORY REACTION (RANDOM)</td>
<td>A task of focused auditory attention. The participant clicks on the target in response to sound at a specified frequency. Participants are not to respond to sounds at different frequencies.</td>
</tr>
</tbody>
</table>

**MEMORY EXERCISES:**

<table>
<thead>
<tr>
<th>SEQUENCED RECALL (DIGITS VISUAL)</th>
<th>A task of short-term memory. The participant is presented visually with a sequence of numbers and must recall them in order.</th>
</tr>
</thead>
<tbody>
<tr>
<td>REVERSED RECALL (DIGITS VISUAL)</td>
<td>A task of working memory. The participant is presented visually with a sequence of numbers and must recall them in reverse order.</td>
</tr>
<tr>
<td>COLORMATCH</td>
<td>A task of short term memory. A participant must match face down cards based on color. Stage one is the learning stage and stage two is the recall stage.</td>
</tr>
<tr>
<td>RECALL FOR LOCATIONS</td>
<td>A task of short term memory. The participant must first observe where blue balls are placed in a grid on the screen and memorize the positions. After the balls disappear, one must</td>
</tr>
</tbody>
</table>
RECALL FOR OBJECTS AND LOCATIONS

A task of short term memory. The participant is first presented with a visual array of objects positioned at various locations on the screen for a short time duration (Ex: banana, flag, and scissors). Next, one is shown a grid of 30 objects, and must select the specific combination of objects they had previously been shown.

RECOGNITION RECALL

A task of short term memory. Participants are first given the chance to study a display of 6-12 objects presented visually on the screen. Following, one must choose all of the items they saw from a 32-word list of objects.

EXECUTIVE FUNCTIONING EXERCISES:

<table>
<thead>
<tr>
<th>BASIC CONCEPTS</th>
<th>A task of basic executive functioning. The participant is visually presented with multiple objects on the screen. The participant is asked to analyze and compare characteristics of the presented objects such as shape, color, size and number, to determine which of the objects share a common attribute.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVEN OR ODD</td>
<td>A task of executive functioning. The participant must determine if the number or sum of numbers shown on the screen is even or odd within a given time limit, requiring quick information processing and response speed.</td>
</tr>
<tr>
<td>DIGIT SYMBOL TRANSFER</td>
<td>A task of visuospatial processing. The participant must correctly analyze the contents of a grid and transfer digits to accurately fill the grid based on a key.</td>
</tr>
<tr>
<td>STROOP EFFECTS I</td>
<td>A task of executive functioning. Participants are shown a colored ball and two word choices that each spell a color. Each of the words is colored a different color than the word actually spells. The participant must resist this distractor attribute and select the word that spells the color of the ball.</td>
</tr>
<tr>
<td>STROOP EFFECTS II</td>
<td>A task of executive functioning. Participants are shown one frame at the top of the screen and two frames below; each frame is filled with a number of the same numbers (for example: four “threes”). One must select the bottom frame that</td>
</tr>
</tbody>
</table>
contains the same number of numbers as the top frame does.

**SIMULTANEOUS MULTIPLE ADDITION**
A task of both working memory and executive functioning. Participants must sum a series of five numbers continuously as each new number appears on the screen.

**KEEPING TRACK**
A task of executive functioning. Participants are shown multiple, randomly moving stimulus items and must track 1-3 specified target items as they move throughout 3-5 distractor items.

**MIRROR IMAGE**
A task of executive functioning. Participants must imagine a mirror image of the visually presented stimuli (colored balls in a grid), and correctly produce this mirror image within a specified time limit.

4.4 **Clinical Assessment**

*Structured Clinical Interview Positive and Negative Syndrome Scale (SCI-PANSS)*

Participants were interviewed by trained research assistants using the Structured Clinical Interview Positive and Negative Syndrome Scale (SCI-PANSS; Kay, Fiszbein, & Opler, 1987). The SCI-PANSS is a 30-item measure assessing positive symptoms, negative symptoms, and general psychopathology. The positive and negative symptom scales each contain seven items, while the general psychopathology scale contains 16 items. Each item is rated on a 7-point scale, with 7 being the most severe symptom presentation. Subscales (positive, negative, and general) are calculated by summing all items, with higher scores representing greater symptom severity. In order to maintain interrater reliability on this measure, all data collectors attended a series of training sessions. In these meetings, research assistants met with a senior investigator to watch and rate previously recorded PANSS interviews. Ratings were discussed and compared, and each research assistant achieved an inter-class correlation of 0.7 or higher with a senior investigator on all rating items prior to conducting PANSS interviews on their own.
Wechsler Test of Adult Reading (WTAR)

Premorbid IQ was also estimated using the Wechsler Test of Adult Reading (WTAR; Wechsler, 2008). IQ was measured in order to ensure that the participant had the capacity to complete remaining test items, and to analyze any between group intelligence differences. During WTAR administration, the participant is prompted to pronounce a progressively difficult list of 50 irregularly spelled English words. The words are difficult to pronounce if they have not been previously learned, due to their irregular grapheme-phoneme translation (for example, the pronunciation of “gnat” as “nat”).

4.5 Self-Efficacy Measure

Participants’ self-efficacy was assessed using The Revised Self-Efficacy Scale (SES; McDermott, 1995), a measure designed specifically for people with schizophrenia. The scale solicits ratings of one’s confidence in his or her ability to complete a variety of tasks and behaviors (e.g. “How confident are you in your ability to go shopping for groceries?”). These ratings are given on a 100-point scale, with a rating of “0” indicating no confidence, and a rating of “100” indicating total confidence. The SES is comprised of 57 items divided into three subscales, each containing 19 items. Subscales measure confidence in one’s ability: (1) to manage positive symptoms, (2) to manage negative symptoms, and (3) to perform social behaviors.

4.6 Neurocognitive Measures

Wechsler Adult Intelligence Scale (WAIS-IV)

To measure attention/vigilance, working memory, and processing speed, subtests of the Wechsler Adult Intelligence Scale were given (WAIS-IV; Wechsler, 2008). The Digit Span (DS) and Letter-Number Sequencing (LN) subtests were
administered as indications of working memory and attention. The DS consists of three parts: forward, backward, and sequencing. In the DS forward, the examinee is read a string of numbers and asked to recall the sequence in order. In the DS backward, the examinee is also read a string of numbers, but asked to recall these numbers in reverse order. In DS Sequencing, the examinee is read a string of numbers and asked to recall them in order from lowest to highest. In the LN subtest, the examinee is read a string of numbers and letters and is asked to recall the numbers first in order from lowest to highest, followed by the letters in alphabetical order. To measure processing speed, the WAIS-IV Symbol Coding (CD) subtest was utilized, in which the examinee uses a key to pair symbols with a string of numbers. The examinee is prompted to fill out as many correctly matched symbols in a number grid as quickly as s/he can in two minutes. Raw scores were converted to age corrected scaled scores for all WAIS-IV subtests.

**Hopkins Verbal Learning Test Revised (HVLT-R)**

The HVLT-R was administered as a brief test of verbal learning and memory (Shapiro, Benedict, Schretlen, & Brandt, 1999). The HVLT-R includes three learning trials, in which the examiner reads a list of 12 nouns out loud to the examinee, who then immediately recalls as many of the words as s/he can remember, in any order. There are six alternate forms. The 12 nouns on each list are not random; rather, they fall into three semantic categories. For example, Form 1 includes the semantic categories “four-legged animals,” “precious stones,” and “human dwellings.” The HVLT-R also includes a fourth delayed recall trial, in which the examinee is asked to recall the word list following a 20-25 minute delay, but for the present study, only the first three learning trials were administered. Total correct responses from each
learning trial were summed to find the raw score, which was then converted to a standard score using normative data on participant age and years of education found in the HVLT-R manual.

**Controlled Oral Word Association Test (COWAT-FAS)**

The COWAT-FAS is an assessment of verbal fluency (Lezak, 2004). The test has two subparts: letter fluency and category fluency. In the letter fluency subtest, the examinee is asked to spontaneously produce as many words as possible beginning with a given letter of the alphabet. Three trials are administered, each one lasting 60 seconds and using a different letter (e.g. “F,” “A,” and “S”). Examinees are instructed not to include proper nouns or multiple versions of the same word with different endings, such as “eat” and “eating.” The category fluency subtest has the examinee produce as many words as they can think of that fall under a given category, such as “Animals.” The examinee is given 60 seconds to say as many words (e.g. types of animals) as s/he can.

**The Memory for Intentions Screening Test (MIST)**

The MIST is a measure of prospective memory (Raskin, 2009). Prospective memory is a part of declarative memory that requires one to construct, maintain, and carry out intentions; it is described colloquially as “remembering to remember” (Woods et al., 2007). Examples of prospective memory in action include remembering to take one’s medication or remembering to return a phone call. The MIST is a measure in which participants are asked to carry out eight prospective memory tasks during a 30-minute period. During administration, the participant is completing a word-search puzzle as a distractor task. The eight prospective memory trials are balanced in terms of (1) delay period (i.e., participant has to complete a task
after either a 2-minute or 15-minute delay), (2) cue (i.e., task is prompted by either a
time-based or event-based cue), and (3) type of response (i.e. task requires either a
verbal or physical response) (Woods et al., 2007). Each trial is scored out of two
points: one point is given if the participant completes a correct response, and one
point is given if the response is done at the correct time, or in response to the
appropriate cue. Following the test, the examinee is also asked eight “retrospective
recognition” multiple choice questions about the tasks s/he was assigned to
remember.

Wisconsin Card Sorting Test (WCST)
The 64-card WCST was used to measure executive functioning, as it is
sensitive to difficulties in problem-solving, concept formation, and cognitive
flexibility. During the test, subjects are asked to sort cards according to shape, color,
and number, but are not told the matching rule. Subjects are only told if they
responded correctly or incorrectly after each trial. After 10 correct responses, the
matching principle changes, and the examinee must adapt to the new rule. In the
present study, eight of the participants were assessed using the manual version of the
test, while the other six participants were assessed using the computerized version. As
this study is ongoing, all future participants will be tested using the computerized
version of the WCST to standardize study protocol and eliminate the possibility of
human error in test administration and scoring.

4.7 Social Cognitive Measures
The Awareness of Social Inference Test (TASIT)
A growing body of literature indicates that social cognitive deficits in
schizophrenia may significantly influence functional outcomes, such as one’s ability
to participate in meaningful work and to maintain strong interpersonal relationships
Therefore, the present study not only tracked the effects of cognitive training on neurocognitive domains, but on social cognitive ones as well, using “The Awareness of Social Inference Test” (TASIT; McDonald et al., 2003). TASIT uses video vignettes of actors performing everyday social interactions and follow-up questions in order to measure the viewer’s basic emotion perception and more complex ToM skills, as an indication of social cognition. Participants were tested on all three parts of the TASIT, and given practice items for each (Sparks et al., 2010):

1. Part I: *The Emotion Evaluation Test* includes 28 short videos of actors portraying one of six basic emotions: happiness, surprise, sadness, anger, anxiety, and revulsion.

2. Part II: *Social Inference (Minimal)* includes 15 video clips showing spoken interactions between actors that can be described as either “sincere” or “sarcastic” (with a distinction made between simple sarcasm and paradoxical sarcasm). In “sincere” vignettes, the target actor says what they really mean, while in “simple sarcastic” clips, the target actor says the opposite of what they mean, with the intention that the viewer will understand the real, underlying meaning. In the “paradoxical sarcasm” video clips, the dialogue makes no sense unless it is understood as sarcastic. Following each video, the participant is asked four yes or no questions designed to solicit an interpretation of what s/he believes the target actors were thinking, doing, meaning to say, and feeling. Part II examines participants’ ToM capacity, as it requires the viewer to pay attention not only to what the actors are saying, but
also to determine their level of sincerity using their tone of voice, body
language, and facial expressions as cues.

3. Part III: *Social Inference (Enriched)* includes 16 video vignettes similar to
those seen in Part II, but with additional actor dialogue at the start or end of
the scene that informs the viewer of the “true state of affairs.” Viewers’
responses to four yes or no questions after each scene measures their ability to
detect the actors’ lies and sarcasm.

Correct answers in each subset were summed to calculate an overall score, with
higher scores indicating stronger performance. The Social Cognition Psychometric
Evaluation Study (SCOPE) used an expert survey and RAND Panel to identify the
best existing measures of social cognition for use in large-scale studies of
schizophrenia treatment (Pinkham et al., 2013). The SCOPE study established a
consensus on TASIT, Part III as one of the three best measures of ToM in
schizophrenia research.

4.8 Functional Outcome Measures

*Social Functioning Scale (SFS)*

The SFS (Birchwood, Smith, Cochrane, Wetton, & Copestake, 1990) was
designed as a self-report outcome measure for patients with schizophrenia. Rather
than assessing “role” functioning, such as work, marital, and parental roles, this scale
was designed to address the “fundamental” areas of social functioning, such as level
of independence, social engagement/withdrawal, interpersonal functioning, and daily
activities (Birchwood et al., 1990). The SFS has seven subscales: (1) social
engagement/withdrawal (time spent alone, social avoidance, conversation initiation),
(2) interpersonal behavior (number of friends, quality of conversation), (3) pro-social
activities (level of engagement in a range of social activities including sports, clubs),
(4) recreation (level of engagement in common pastimes, hobbies), (5) independence-
competence (ability to perform skills needed to live independently, such as grocery
shopping), (6) independence-performance (how often independent living skills are
actually performed, and (7) employment/occupation (engagement in steady
employment, structured programs, or job-search).

The Specific Level of Functioning Scale (SLOF)
The SLOF (Schneider & Struening, 1983) is a clinician-rated instrument
including 43 directly-observable behavioral items, each of which is rated on its own
five-point scale. Items are grouped into six subscales: (1) physical functioning (eg,
hearing, walking) (2) personal care skills (eg, personal hygiene, grooming), (3)
interpersonal relationships (eg, forming and maintaining friendships, participating in
groups), (4) social acceptability, (eg destroying property, verbally or physically
abusing others) (5) activities of community living (eg, self-medication, using public
transportation), and (6) work skills (eg, employable skills, follows verbal instructions
correctly). The scale also includes an “Other Information” section, giving the
clinician the opportunity to describe any additional skills or problem areas not
directly addressed in the scale. In the present study, raters of the SLOF were
clinicians such as therapists and case managers who knew the participants they rated
closely, and saw them on a regular basis.

UCSD Performance-based Skills Assessment Brief (UPSA-B)
The University of California, San Diego Performance-based Skills
Assessment (UPSA), was designed for the evaluation of an individual’s functional
capacity in various domains of basic living skills. The UPSA-B has participants role-
play tasks from two domains likely to be encountered on a daily basis: Finance and Communication (Mausbach, Harvey, Goldman, Jeste, & Patterson 2007). Performance on these role-plays predicts distal functional outcomes, such as one’s ability to live independently. The Finance domain involves the participant counting out given amounts of currency and writing out a check to pay a utility bill. The Communication domain has the subject use a telephone to make an emergency phone call, call directory assistance, and call a doctor’s office to reschedule a medical appointment. Participants receive scaled scores ranging from 0-100, with higher scores indicating better functional capacity. The UPSA-B is the most widely used assessment of everyday living skills and has been validated as a reliable predictor of real-world functional outcomes, including independent living, community responsibility, and employment (Keefe & Harvey, 2012; Mausbach et al., 2007; 2011). A comparative study of multiple measures of functional capacity found that the UPSA was both the most user friendly and converged most highly with the MATRICS Consensus Cognitive Battery (MCCB) (Green et al., 2011).

4.9 Statistical Procedure
Due to the small sample size of the control condition (n=3), only measures that were completed by all three of the TAU participants post-training were included in between-group data analysis. All statistical analysis was done using either the IBM Statistical Package for the Social Sciences 23.0 (SPSS) or the George Mason University Effect Size Calculator, developed by David B. Wilson, Ph.D. Prior to analysis, raw scores on relevant assessments were converted to z-scores based on standardized norms, and averaged to produce a “Composite Neurocognition” score. An alpha of 0.05 on two-tailed tests was selected, with p≤0.05 indicating statistical
significance. In light of the small sample size, we computed effect sizes to further explore the nature of the effects of the experimental interventions. Cohen’s d was calculated to find the standardized mean difference between groups on immediate post-training measures of cognition and functioning. For our analysis, Hedge’s g was also calculated. Recommended for use in small samples (n<20), Hedge’s g weights each group’s standard deviation by its sample size in order to remove the small positive bias that is associated with Cohen’s d (Ellis, 2010). In our analysis, we used anchors suggested by Cohen (1988) that label effect sizes as small (d=0.2-0.49), moderate (d=0.5-0.79), and large (d≥0.8). The following formulas were used for the calculations of Cohen’s d and Hedge’s g:

\[
Cohen's\ d_s = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(n_1 - 1)SD_1^2 + (n_2 - 1)SD_2^2}{n_1 + n_2 - 2}}}
\]

\[
Hedge's\ g_s = Cohen's\ d_s \times \left(1 - \frac{3}{4 \left(n_1 + n_2\right)} - 9\right)
\]

The first step in our analysis was to run a series of one-way Analyses of Variance (ANOVAs) to analyze between-group demographic and performance differences on all measures pre-training. Additionally, a series of chi-square tests were run to analyze between-group differences on categorical demographic variables, such as sex and ethnicity. Our second step was to run a series of within-group paired samples t-tests to compare changes in performance on pre-training and post-training measures of neurocognition, social cognition, functioning, and symptoms. Thirdly, Analyses of Covariance (ANCOVAs) were run for each outcome measure using group assignment (PSSCogRehab vs. CCT vs. TAU) as the between-subjects factor,
the post-training score as the dependent variable, and the pre-training score as the covariate. This allowed for the analysis of the effects of the experimental interventions on the outcome measures while controlling for differences in baseline scores. Lastly, using the means and standard deviations of group change scores (post-training minus pre-training) on outcome measures, effect sizes were calculated to determine the magnitude of difference observed between changes in each experimental group and the control.
5. **Results**

5.1 **Baseline Demographics**

As a check for true randomization, a series of one-way ANOVAs and chi-square tests were run to compare demographic statistics between groups (CCT, PSSCogRehab, and TAU). Post-hoc analyses found no statistically significant between-group differences on any of the following variables: age, sex, living status, years of education, FSIQ, number of hospitalizations, age of illness onset, duration of illness, mother’s education, and father’s education. Chi-square analyses revealed that the groups differed significantly only by ethnicity, with the CCT having more non-white participants than both the PSSCogRehab group and the control, $\chi^2(2, N=14) = 6.886, p = .032$.

**Table 3. Chart of Mean Baseline Differences Between Groups.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>PSSCogRehab (n=6)</th>
<th>CCT (n=5)</th>
<th>TAU (n=3)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographic</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>46.33(±11.98)</td>
<td>56.22(±8.53)</td>
<td>54.33(±10.79)</td>
</tr>
<tr>
<td>Gender, % Male</td>
<td>66.7%</td>
<td>60%</td>
<td>66.7%</td>
</tr>
<tr>
<td>Race/Ethnicity, % Caucasian</td>
<td>83.3%</td>
<td>20%</td>
<td>100%</td>
</tr>
<tr>
<td>Housing, % Living Independently</td>
<td>33.3%</td>
<td>80%</td>
<td>100%</td>
</tr>
<tr>
<td>Education (years)</td>
<td>11.83(±1.6)</td>
<td>13.6(±1.82)</td>
<td>14.00(±2.00)</td>
</tr>
<tr>
<td>Mother’s Education</td>
<td>12.00(±0.0)</td>
<td>14.75(±3.77)</td>
<td>12.50(±.71)</td>
</tr>
<tr>
<td>Father’s Education</td>
<td>14.5(±3.00)</td>
<td>7.5(±6.36)</td>
<td>16.5(±6.36)</td>
</tr>
<tr>
<td><strong>Diagnosis</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schizophrenia</td>
<td>66.67%</td>
<td>40%</td>
<td>33.33%</td>
</tr>
<tr>
<td>Schizoaffective</td>
<td>16.67%</td>
<td>40%</td>
<td>66.67%</td>
</tr>
<tr>
<td>MDD with psychotic features</td>
<td>16.67%</td>
<td>20%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Illness Burden</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Hospitalizations</td>
<td>14.67(±17.61)</td>
<td>5.8(±4.92)</td>
<td>9.33(±3.06)</td>
</tr>
<tr>
<td>Duration of Illness (years)</td>
<td>20.67(±14.06)</td>
<td>26.4(±15.29)</td>
<td>24.33(±5.03)</td>
</tr>
<tr>
<td>Positive Symptoms*</td>
<td>17.5(±6.59)</td>
<td>13.20(±5.36)</td>
<td>11.00(±2.00)</td>
</tr>
<tr>
<td>Negative Symptoms*</td>
<td>17.33(±5.35)</td>
<td>18.20(±4.32)</td>
<td>16.00(±3.00)</td>
</tr>
</tbody>
</table>

*Ratings from the Positive and Negative Syndrome Scale (PANSS)
5.2 Pre-Training Performance
Analysis of pre-training scores on all 18 dependent measures of cognition, self-efficacy, functioning, and symptoms revealed no significant differences between groups with the exception of the negative symptom sub-test of the Self-Efficacy Scale (SES-Negative). Participants in the TAU control group scored significantly higher on the SES-Negative than did participants in both the PSSCogRehab condition, $F_{(2,11)} = 9.276$, $p=.001$, and the CCT condition, $F_{(2,11)} = 9.276$, $p=.037$. Aside from this difference, relatively equivalent levels of impairment in cognition, functioning, and symptoms were observed across groups at baseline.

5.3 Attendance
Of the five individuals who underwent the 12 sessions of CCT, two attended 12/12 sessions, two attended 11/12 sessions, and one attended 6/12 sessions. Of the six individuals who underwent the 36 sessions of PSSCogRehab, attendance data was lost for three of them. Of the three whose data was collected, one attended 36/36 sessions, one attended 30/36 sessions, and one attended 20/36 sessions. Therefore, overall attendance rates were 86.8% at CCT sessions and 80% at PSSCogRehab sessions.

5.4 Within-Group Change
Paired samples t-tests were run within each group to compare pre-training and immediate post-training performance on measures of cognition, self-efficacy, functioning, and symptoms. Participants who underwent the PSSCogRehab intervention exhibited non-significant changes on all measures with the exception of the PANSS Negative Symptom sub-scale; mean scores on this measure were found to be significantly lower post-training, $t(4) = -3.97$, $p=0.017$ (Figure 2). Participants in the CCT condition experienced a significant increase in scores on the Self-Efficacy
Scale Negative Symptom sub-scale, $t(4) = 2.82$, $p=0.048$ (Figure 3), and a significant decrease in scores on the PANSS General Psychopathology Symptom sub-scale, $t(3) = -4.90$, $p=0.016$ (Figure 4). Participants in the TAU control condition showed all non-significant changes in mean scores on measures taken at baseline and at post-training. A series of ANCOVAs were run in order to compare between-group differences on follow-up measures while controlling for baseline performance. Post-hoc analyses revealed non-significant differences in mean scores between groups on all post-training measures.

*Indicates $p$-value<0.05
**Figure 3.** Change in SES-Negative Scores. This figure illustrates the results of a paired-samples t-test that showed the increase in mean scores on the Self-Efficacy Scale Negative Symptom Sub-Scale in CCT participants. *Indicates p-value<0.05

**Figure 4.** Change in PANSS-General Scores. This figure illustrates the results of a paired-samples t-test that indicated the decrease in mean scores on the PANSS General Psychopathology Symptom Sub-Scale in CCT participants. *Indicates p-value<0.05
5.5 Effect Size for Group Differences

5.5.1 PSSCogRehab vs. TAU

Neurocognitive Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>PSSCogRehab Post-treatment minus baseline change score Mean (±SD) N=6</th>
<th>TAU Post-treatment minus baseline change score Mean (±SD) N=3</th>
<th>Effect Size (Hedge’s g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVLT</td>
<td>.06(±.82)</td>
<td>-.33(±1.10)</td>
<td>0.38*</td>
</tr>
<tr>
<td>COWAT (Letter)</td>
<td>.07(±.84)</td>
<td>.07(±1.00)</td>
<td>0.0</td>
</tr>
<tr>
<td>COWAT (Category)</td>
<td>.05(±1.42)</td>
<td>.20(±.63)</td>
<td>-0.11</td>
</tr>
<tr>
<td>Digit Span</td>
<td>-0.06(±1.10)</td>
<td>.22(±.19)</td>
<td>-0.27*</td>
</tr>
<tr>
<td>Letter Number</td>
<td>.00(±.59)</td>
<td>1.11(±1.95)</td>
<td>-0.85***</td>
</tr>
<tr>
<td>Symbol Coding</td>
<td>.11(±.75)</td>
<td>-.22(±.51)</td>
<td>0.43*</td>
</tr>
<tr>
<td>Neurocognition Composite</td>
<td>-.09(±.28)</td>
<td>.17(±.28)</td>
<td>-0.83***</td>
</tr>
</tbody>
</table>

Table 4. Effect Size for Group Differences in Change Scores on Neurocognitive Measures at Post-treatment. Note. All effect sizes have been presented so that a positive effect size indicates greater improvement in the PSSCogRehab group compared to the TAU control.

*Indicates small effect size, ***Indicates large effect size

Results of effect size analysis showed that, when compared to participants in the TAU condition, participants in the PSSCogRehab exhibited small-to-moderate improvements on the HVLT (g=0.38) and on the Symbol Coding sub-test of the WAIS (g=0.43). TAU participants experienced improvements on the Digit Span and Letter Number sub-tests of the WAIS (g= -0.27; g= -0.85), compared to those who underwent PSSCogRehab. Overall, TAU participants exhibited large improvements on their composite neurocognition score relative to those in the PSSCogRehab condition (g= -0.83).
Self-Efficacy and Functioning Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>PSSCogRehab Post-treatment minus baseline change score Mean (±SD)</th>
<th>TAU Post-treatment minus baseline change score Mean (±SD)</th>
<th>Effect Size (Hedge’s g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=6</td>
<td>N=3</td>
<td></td>
</tr>
<tr>
<td>SES Positive</td>
<td>6.57(±21.24)</td>
<td>.28(±10.98)</td>
<td>0.30*</td>
</tr>
<tr>
<td>SES Negative</td>
<td>7.33(±14.04)</td>
<td>-9.33(±16.53)</td>
<td>1.0***</td>
</tr>
<tr>
<td>SES Social</td>
<td>12.74(±19.52)</td>
<td>-23.48(±20.35)</td>
<td>1.63***</td>
</tr>
<tr>
<td>SFS</td>
<td>-7.0(±29.23)</td>
<td>2.33(±2.52)</td>
<td>-0.34*</td>
</tr>
<tr>
<td>UPSA</td>
<td>1.67(±9.31)</td>
<td>1.67(±10.41)</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Table 5. Effect Size for Group Differences in Change Scores on Measures of Self-Efficacy and Functioning at Post-treatment. Note. All effect sizes have been presented so that a positive effect size indicates greater improvement in the PSSCogRehab group compared to the TAU control. *Indicates small effect size, ***Indicates large effect size

Effect size analysis revealed that PSSCogRehab participants improved on all three sub-scales of the Self-Efficacy Scale (SES) relative to the control. Small improvements were seen on the SES Positive Symptom sub-scale (g=0.30), while large improvements were observed on the SES Negative (g=1.0) and SES Social Symptoms sub-scales (g=1.63). Relative to PSSCogRehab, small effect size improvements were seen in the TAU condition on the self-reported Social Functioning Scale (SFS) (g= -0.34), and no difference in change score was seen between the two groups on the performance-based measure of daily living skills (UPSA).
5.5.2  
**CCT vs. TAU**

*Neurocognitive Measures*

<table>
<thead>
<tr>
<th>Measure</th>
<th>CCT Post-treatment minus baseline change score Mean (±SD) N=5</th>
<th>TAU Post-treatment minus baseline change score Mean (±SD) N=3</th>
<th>Effect Size (Hedge’s g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVLT</td>
<td>-.14(±.25)</td>
<td>-.33(±1.10)</td>
<td>0.25*</td>
</tr>
<tr>
<td>COWAT (Letter)</td>
<td>.16(±.51)</td>
<td>.07(±1.00)</td>
<td>0.11</td>
</tr>
<tr>
<td>COWAT (Category)</td>
<td>.04(±1.09)</td>
<td>.20(±.63)</td>
<td>-0.15</td>
</tr>
<tr>
<td>Digit Span</td>
<td>.13(±.77)</td>
<td>.22(±.19)</td>
<td>-0.12</td>
</tr>
<tr>
<td>Letter Number</td>
<td>-.47(±.38)</td>
<td>1.11(±1.95)</td>
<td>-1.05***</td>
</tr>
<tr>
<td>Symbol Coding</td>
<td>-.08(±.63)</td>
<td>-.22(±.51)</td>
<td>0.20*</td>
</tr>
<tr>
<td>Neurocognition Composite</td>
<td>-.02(±.29)</td>
<td>.17(±.28)</td>
<td>-0.56**</td>
</tr>
</tbody>
</table>

*Table 6. Effect Size for Group Differences in Change Scores on Neurocognitive Measures at Post-treatment.*  
*Note.* All effect sizes have been presented so that a positive effect size indicates greater improvement in the CCT group compared to the TAU control.

*Indicates small effect size, **Indicates medium effect size, ***Indicates large effect size*

Effect size analysis revealed small improvements in those who underwent CCT relative to the control on the HVLT (g=0.25) and on the Symbol Coding sub-test of the WAIS (g=0.20). Relative to those in the CCT condition, participants in the TAU condition experienced large improvements on the Letter Number sub-test of the WAIS (g= -1.05), and moderate improvements on composite neurocognition (g= - 0.56).
### Table 7. Effect Size for Group Differences in Change Scores on Measures of Self-Efficacy and Functioning at Post-treatment.

<table>
<thead>
<tr>
<th>Measure</th>
<th>CCT Post-treatment minus baseline change score Mean (±SD)</th>
<th>TAU Post-treatment minus baseline change score Mean (±SD)</th>
<th>Effect Size (Hedge’s g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SES Positive</td>
<td>-2.97(±24.09)</td>
<td>.28(±10.98)</td>
<td>-0.14</td>
</tr>
<tr>
<td>SES Negative</td>
<td>7.60(±6.02)</td>
<td>-9.33(±16.53)</td>
<td>1.37***</td>
</tr>
<tr>
<td>SES Social</td>
<td>.95(±3.43)</td>
<td>-23.48(±20.35)</td>
<td>1.76***</td>
</tr>
<tr>
<td>SFS</td>
<td>12.4(±20.23)</td>
<td>2.33(±2.52)</td>
<td>0.53**</td>
</tr>
<tr>
<td>UPSA</td>
<td>3.0(±9.75)</td>
<td>1.67(±10.41)</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Note. All effect sizes have been presented so that a positive effect size indicates greater improvement in the CCT group compared to the TAU control. **Indicates medium effect size, ***Indicates large effect size.

Large CCT-associated effects were observed on both the SES Negative (g=1.37) and SES Positive Symptom (g=1.76) sub-scales relative to TAU. Moderate effect size improvements were also seen on the self-reported Social Functioning Scale in those who underwent CCT compared to those receiving TAU (g=0.53).
6. Discussion

6.1 Evaluating Hypotheses
   It was hypothesized that: (1) CR implementation at River Valley Services (RVS) would be feasible; (2) participants in both experimental conditions would exhibit improvements on measures of neurocognitive performance compared to participants in the control condition; and, (3) participants in the strategy-based condition (CCT) would exhibit greater improvements in functional outcomes than those in the drill-and-practice condition (PSSCogRehab).

6.1.1 Hypothesis 1
   Consistent with hypothesis 1, implementation of the CR treatments at RVS was feasible and successful. Overall participant attendance at cognitive remediation sessions was very high: the average rate of attendance was 80% at PSSCogRehab sessions and 86.8% at CCT sessions. In the field of motivation research, voluntary attendance is used as an indicator of intrinsic motivation for engagement in treatment (Sheldon, Williams, & Joiner, 2003). Schizophrenia researchers have also used frequency of voluntary attendance at psychosocial treatment sessions as a measure of participants’ intrinsic motivation (Choi & Medalia, 2005). Participants in the present study were not monetarily compensated for their attendance at CR sessions, so their high rates of attendance suggest that they were intrinsically motivated and engaged in treatment.

   In order to fully evaluate the hypothesis of whether cognitive remediation was successfully integrated at RVS, we must consider more than just attendance rates and quantifiable outcomes measures. Ongoing conversations with both clinical staff and participants have revealed the unprecedented support that this research project has
received. While the “mandate” of the public system is to provide empirically-based resources and treatment, limited budget allotments and staff time make this difficult in practice. Serving the severely and chronically mentally ill in the public sector requires much more than clinical care. Case managers and therapists must cover their clients’ basic needs; much of their paid time is spent coordinating housing, food, transportation, and medication for their patients, many of whom are chronically in crisis or in and out of homelessness. In this context, resources for developing diagnostic-specific treatments are finite. RVS’s Wellness Program runs daily groups on topics including spirituality, women’s health, and mindfulness, but there has never been a cognitive training group offered. RVS has also established diagnostic-specific treatment programs such as DBT for Borderline Personality Disorder and trauma-informed interventions for co-occurring PTSD and addiction. However, despite the fact that the majority of clients receiving care at RVS are on the psychosis-spectrum, there were no psychosis-specific treatments offered prior to the initiation of this project.

Initial staff involvement in this study was entirely voluntary, done as an unpaid add-on to their full-time workloads. Despite this fact, the project attracted a multi-disciplinary team of about 10 staff members who began actively referring their clients to the study and facilitating the treatment sessions; these staff included doctoral-level clinical psychologists, occupational therapists, social workers, and case managers. Successful integration was also due to the support of RVS leadership including the CEO and clinical director, who agreed to shift staff positions to allot paid time to clinical supervision of this project. Cognitive remediation therapy may
be particularly well suited for dissemination in the public system as it is cost-effective and requires limited training for facilitators.

Above all else, successful implementation of cognitive remediation therapy at RVS was illustrated by client-reported benefit from treatment. The clinician who facilitated the PSSCogRehab computer sessions noted that many participants actively enjoyed the sessions and were motivated to advance through exercises. CCT sessions were recorded, so direct quotes from clients exemplify the success of the treatment. The following quote is one client’s response to the question of, “How can you use the problem-solving strategies addressed in this session in your daily life?”

Every month I have tasks. I have to go shopping, pay the bills, get laundry quarters. I have to make appointments to get rides…By writing it down in advance on a calendar, what days to call to make appointments for the ride, because I’ve had problems with transportation… A week before you get your check, you should be thinking, be calling, writing down a budget, things you need from the store for the month, and what you’re going to spend

(Anonymous, personal communication, June 20, 2017).

This testimonial illustrates the ultimate goal of any CR intervention: transference of new strategies to everyday life difficulties. Prior to participation in CCT, this client rarely left her house for any reason, and received no treatment for her psychosis apart from medication. Furthermore, she never used a calendar or did any budgeting prior to participation in compensatory cognitive training. Analysis of this client’s pre- and post-training scores indicated improvement in overall neurocognition and self-reported social functioning. Her performance on the Social Functioning Scale (SFS)
improved by 36 points, the largest improvement seen on this measure in the entire sample.

6.1.2 \textit{Hypothesis 2}

With respect to hypothesis 2, while no statistically significant changes were found within-groups or between-groups on any of the neurocognitive measures, effect size analysis indicated that both PSSCogRehab and CCT produced positive effects on select domains of cognition relative to the control. Small improvements were observed on the HVLT and on the Symbol Coding sub-test of the WAIS in both models of CR compared to the control. This finding suggests that both drill-and-practice and strategy-based approaches to cognitive remediation produced improvements in participants’ verbal learning, memory, and processing speed. These results are consistent with our hypothesis, and with past meta-analyses that have identified verbal learning, memory, and speed of processing as domains of cognition capable of improvement in response to CR (McGurk et al., 2007). However, it should be noted that while we saw CR-associated improvements in these specific domains of cognition, we surprisingly saw larger improvements in TAU participants on the composite measure of neurocognition compared to both experimental groups.

6.1.3 \textit{Hypothesis 3}

Consistent with hypothesis 3, effect size analysis suggested that CCT produced moderate positive effects on the SFS, a self-reported measure of social functioning. This observation is consistent with a pilot study done by Twamley et al. (2012) that found significant CCT-associated effects on functional capacity at post-training. Moreover, these findings are encouraging as they are consistent with past literature that has suggested that strategy-based approaches to CR may yield greater
effects on functional outcomes than drill-and-practice models (Wykes et al., 2011). The CCT curriculum includes explicit strategy-coaching and hands-on practice of compensatory cognitive skills, which may aid in the generalization of treatment benefits to everyday psychosocial functioning. Additionally, the inherently social quality of the group intervention may have contributed to observed improvements in general social functioning. While social skills training was not an explicit component of the CCT curriculum, strategies such as conversational attention, name-learning, and cognitive flexibility were repeatedly taught and practiced, which may have aided in the enhancement of social skills. Furthermore, group facilitators made an effort to deliver treatment in a manner that positively reinforced social interaction and strategy practice through hands-on support and encouragement.

During the final session of CCT, participants were given the opportunity to reflect on how new compensatory cognitive skills they learned may help them reach their long-term goals. One participant’s testimonial in particular exemplifies the potential social functioning benefits of CCT. At the outset of treatment, he had indicated that his long-term goal was to feel more comfortable socializing with new people. This client attended 100% of CCT sessions, which is striking given the fact that he is otherwise homebound save occasional exercise at a community gym. During the final session, he shared a recent situation in which he had used new conversational attention and name-learning strategies to socialize with people he met at the gym:

Recently I met a junior (M) who plays on the high school basketball team and I met another guy (J), he works at Walmart, who plays on the basketball team.
And those two are going out for the same position. And I let them know that I
know both of them. J is left handed, and he’s a senior and we had a
conversation… and the next time I saw him, the atmosphere was respectful
between me and him. They had tryouts Saturday, basketball started for the
high school Saturday, and they let me know and I told them I’d check ‘em out
this season, when the season starts (Anonymous, personal communication,
December 4, 2017).

In addition to this client’s own account, his case manager noted positive changes
post-treatment. This clinician works closely with the client on a weekly basis, so she
filled out a Specific Level of Functioning Scale (SLOF) as an indicator of real-world
functional behavior both before and after treatment. In addition to rating the client
more highly at post-training assessment, this clinician also wrote a comment on the
form to illustrate the client’s improvement in social functioning:

> I feel client has always wanted to be more social and complete a task he has
> started, and he has with this group. I have also witnessed him initiating a
> conversation… with a peer in the waiting room. This is something new for
> this client. He seems to feel much better (Anonymous, personal
> communication, December, 2017).

6.2 Effects of Treatment on Symptoms and Self-Efficacy

6.2.1 PSSCogRehab

Results of the within-group analyses found that participants who underwent
the PSSCogRehab intervention exhibited significant improvements in their negative
symptoms post-training. This finding may indicate the lessening of negative symptom
severity as an effect of drill-and-practice CR, despite the fact that clinical symptoms
were not an explicit target of the therapy. This result is consistent with a recent meta-analysis conducted by Cella, Preti, Edwards, Dow, and Wykes (2016) that analyzed the effects of CR on negative symptoms of schizophrenia in 45 studies of 2,511 participants. The results of this review revealed that CR had a small-to-moderate effect on negative symptoms (Cella et al., 2016). These researchers hypothesized that CR may have an effect on negative symptoms by way of improving participant self-esteem and confidence. The same may be true in the present study. Effect size analysis revealed that PSSCogRehab produced large effects not only on negative symptoms, but also on participants’ self-efficacy, particularly with respect to their confidence in their ability to manage negative and social symptoms. Items from the negative and social symptom sub-scales of the SES include “How confident are you in your ability to accomplish your occupational goals?” and, “How confident are you in your ability to begin a conversation with a friend?” In people with schizophrenia, cognitive difficulties may be linked to reduced self-esteem (Cella, Swan, Medin, Reeder, and Wykes, 2014), while CR may aid in the increase in self-esteem (Kidd et al., 2014), and, in turn, serve to counter-act the effects of negative symptoms such as avolition and asociality. It is also conceivable that the therapeutic interaction inherent in the PSSCogRehab administration had a positive effect on participants’ self-efficacy and psychiatric symptoms. While the program does not explicitly include strategy-coaching, the clinician who facilitated all sessions provided one-on-one support to participants as they worked through the exercises.

6.2.2 CCT

Results of within-group analyses found that participants who underwent CCT exhibited a significant decrease in general psychopathology symptom severity post-
training. Additionally, both a small p-value ($p<0.05$) and large effect size ($g>1.0$) indicated that participants who received CCT expressed a significantly higher degree of confidence in their ability to manage negative symptoms post-training (indicated by higher performance on the SES Negative Symptom sub-scale). Effect size analysis found that CCT also had large effects on the social symptoms sub-scale of the SES. These results are intriguing in the context of a pilot study of CCT that found improvements in negative symptoms at post-treatment and follow-up (Twamley et al., 2012). Our findings in conjunction with those of Twamley et al. (2012) suggest that CCT may have effects on symptom severity and self-efficacy despite the fact that these domains are not explicit targets of the treatment.

While more systematic research is necessary to substantiate claims about the relationship between cognition, self-efficacy, and clinical symptoms, our findings suggest that both models of CR may produce improvements in psychiatric symptoms and self-confidence in symptom management.

6.3 Additional Findings
While no statistically significant changes were found between baseline and post-treatment scores on any measures in the treatment-as-usual condition, effect size analysis did surprisingly reveal improvements on some measures of cognition and functioning in the TAU relative to both of the experimental groups. Notably, moderate-to-large improvements were observed in composite neurocognition in TAU participants relative to both CCT and PSSCogRehab. These differences can most likely be attributed to the small sample size of the TAU ($n=3$). With only three participants, we cannot control for outside influences that may have contributed to improvements in cognition. Such uncontrolled factors may have included changes in
medication, engagement in psychosocial rehabilitation, symptom remission, or an increase in non-specific cognitive stimulation such as computer usage.

6.4 Limitations and Future Directions

A key strength of the present randomized controlled trial was that all cognitive remediation sessions were facilitated and supervised primarily by masters and doctoral-level clinicians with extensive experience working in the public state system with clients with severe and chronic mental illness. A doctoral-level licensed psychologist served as the clinical supervisor for all undergraduate research assistants involved in the study, which helped to ensure the validity of neuropsychological tests and structured clinical interviews. High attendance at treatment sessions and high levels of support from both patients and staff is emblematic of the present study’s overall strength.

The implementation of this study at an under-resourced public mental health center faced many systemic obstacles. Throughout the duration of the research, the main barrier impeding participants from receiving treatment was not their own motivation, but an amalgamation of systemic issues such as staff cuts, lack of transportation access, and faulty internet connection. The majority of research participants did not have access to a car and, while we were able to reimburse participants for bus fare, we had no control over the RVS ride program that was often understaffed or running behind schedule. Internet connection, necessary for the administration of PSSCogRehab, is unreliable at RVS, and multiple sessions had to be cut short due to internet connection failure. This may have reduced the positive effects that the drill-and-practice therapy had on participants.
The principal limitation of the present study is the small sample size, as it limited the power of the statistical analysis and the generalizability of the research findings. Due to the small size of the sample, we did not correct for alpha inflation, so some reported findings may have resulted from Type 1 Error. A high drop-out rate contributed to our limited size: while 21 individuals were initially enrolled in the study, only 14 completed the intervention and post-treatment assessment. Three subjects dropped out of the study prior to randomization. Of these three, one failed to meet inclusion criteria due to his diagnosis, one moved out of state, and one refused to complete pre-treatment testing. From the start of treatment, our overall drop-out rate was 22.22%. Of the four who dropped out following treatment allocation, one got a job so never underwent treatment, and three -who were all assigned to the TAU condition- experienced an increase in symptom severity, making them incapable of adhering to study protocol or completing post-testing. No one who was assigned to cognitive remediation dropped out during the course of their treatment, suggesting high levels of participant engagement in the therapy itself.

A meta-analysis of dropout rates from 74 randomized controlled trials of psychosocial treatments for psychotic disorders found an overall dropout rate of 13% (Villeneuve, Potvin, Lesage and Nicole, 2010). Additionally, the Wykes et al. (2011) meta-analysis of cognitive remediation in schizophrenia found that 12 of the 40 studies analyzed had dropout rates of higher than 15%. Overall, non-compliance rates for psychosocial treatments and cognitive remediation appear to be much lower than those for pharmacological interventions, which are as high as 42% among individuals with psychosis (Cramer & Rosenheck, 1998). The Villeneuve et al. (2010) meta-
analysis also reported that higher age and longer illness duration had a negative effect on dropout rate. The high mean age and length of illness duration of participants in the present study may have increased the dropout rate and limited the capacity of individuals who underwent treatment to benefit from the CR interventions.

Consisting mainly of older, chronically-ill patients, \((M_{\text{age}} = 51.57, SD = 10.87)\), all but two participants in the present study were over the age of 40. Furthermore, our study participants had been chronically sick for 23.5 years on average at the outset of treatment. Past studies that have directly compared the effects of CR across age groups (typically with participants differentiated as being over and under 40) have found that younger populations may benefit more from CR. For example, Wykes et al. (2009) found that adults under 40 benefited more from treatment than older adults, particularly showing increased cognitive flexibility and planning ability post-treatment in the younger population. Kontis et al. (2013) and Corbera et al. (2017) also directly compared effects of CR across age groups, and both found evidence to suggest that patients under 40 showed larger improvements in working memory than late-chronic patients over 40. Another study, conducted by Bowie, Grossman, Gupta, Oyewumi, and Harvey (2013) compared the effectiveness of cognitive remediation in people with early-course (within five years of illness onset) and longer-term (over 15 years since illness onset) schizophrenia. Participants were given a 12-week course of cognitive remediation including both computerized exercises and strategy-coaching. Results of this study found that duration of illness was inversely associated with improvements in neurocognition and work skills (Bowie et al., 2013). As an illustration of this trend, participants with early-course schizophrenia exhibited larger
improvements in processing speed, executive functioning, and transference of CR to real-world work skills (Bowie et al., 2013). Given these research findings, it is conceivable that our sample’s older age and long-term illness duration may have inhibited the remediation of their cognitive deficits. Future CR interventions may be most successful if they customize their techniques in order to best fit the age range of their target sample.

Future iterations of the present study may benefit from the inclusion of an active control in addition to the treatment-as-usual condition. Past studies that included active controls have found that participant cognition may improve as the result of non-specific cognitive stimulation. For example, Kurtz et al. (2007) compared the effects of a computer-assisted cognitive remediation program with those of an active computer-skills training group with matched hours of computer usage and therapist interaction. Results of this study found significant improvements in both groups on measures of working memory, executive functioning, verbal and spatial episodic memory, and processing speed, suggesting that the non-specific cognitive challenges associated with using a computer may produce improvements in neurocognition (Kurtz et al., 2007). As suggested by these findings, future research may benefit from the inclusion of an active control group in order to further tease apart the specific factors that contribute to the efficacy of each model of cognitive remediation.

6.5 Conclusion
Preliminary results from this randomized controlled trial allowed for the initial comparative exploration of two distinct models of cognitive remediation in adults with psychosis-spectrum disorders at a public mental health center. Initial findings are
promising: significant improvements in clinical symptoms were found post-treatment as an effect of both cognitive remediation approaches, and additional significant improvements in self-efficacy were found as an effect of the compensatory cognitive training. High attendance rates at treatment sessions indicated high levels of participant intrinsic motivation; this degree of engagement shows that cognitive remediation delivery is feasible at public agencies serving the severe and chronically mentally ill. Effect size analyses indicated that both models of CR produced positive effects on verbal learning, memory, and processing speed relative to the control. In addition, the strategy-based compensatory cognitive training produced moderate effects on participant social functioning. While these initial results are encouraging, a larger sample size is needed before meaningful conclusions can be drawn about the efficacy of either treatment protocol. Cognitive remediation therapy dissemination and research at RVS is ongoing and has been well received by both clinicians and patients.
7. References


Bracy, O. PSS CogRehab, Version 95. Psychological Software Services, Inc., Indianapolis, IN; 1995


Dietsche, B., Kircher, T., & Falkenberg, I. (2017). Structural brain changes in schizophrenia at different stages of the illness: A selective review of


Head Trauma Rehabilitation, 18(3), 219–238. https://doi.org/10.1097/00001199-200305000-00001


8. Appendix

8.1 Informed consent

Submitted: 12/23/16

RIVER VALLEY SERVICES /DEPARTMENT OF MENTAL HEALTH AND
ADDICTION SERVICES (DMHAS)
INFORMED CONSENT FOR PARTICIPATION IN RESEARCH

PRINCIPAL INVESTIGATOR: Matthew M. Kurtz
DEPARTMENT: Psychology
PHONE: 860-685-2072
EXPECTED DURATION: Five years
SPONSOR: Wesleyan University

I. You have been asked to participate as a participant in the research study, “Comparing the Efficacy of Two Forms of Cognitive Remediation: Strategy-Based vs. Drill-and-Practice Restoration Training for Cognitive Deficits in People with Psychosis,” because you have been diagnosed with schizophrenia, schizoaffective disorder, or some other mental health disorder involving psychosis. Drill-and-practice restoration cognitive remediation training is an intervention consisting of a series of computerized attention, memory and problem-solving exercises that you practice on and that are designed to improve your concentration skills. Strategy-based cognitive remediation training consists of a series of weekly meetings in which you are coached to develop skills in using calendars, notebooks, and other memory support tools to help you work around any difficulties you may have in your attention and memory.

In order to decide whether or not you wish to be part of this research study you should know enough about its risks and benefits to make an informed judgment. This consent form gives you detailed information about the research study, which a member of the research team will discuss with you. This discussion should go over all aspects of this research: its purpose, the procedures that will be performed, any risks of the procedures, possible benefits and possible alternative treatments. Once you understand the study, you will be asked if you wish to participate; if so, you will be asked to sign this form.

The purpose, procedures, and length of your involvement are stated below:

A. Purpose of research: To compare the efficacy of two different forms of cognitive remediation for people with schizophrenia.

B. Procedures: Your participation in this study will involve the following procedures:
1. You will be asked to answer questions about your education, illness, medications and complete a series of neuropsychological assessments before and after your treatment and 3-months after the cessation of cognitive remediation groups. These tests will take a couple of hours and are in addition to your standard clinical care. These tests will help tell us determine whether your treatment has worked and which form of cognitive skills training is more effective at improving your cognition.

2. You will be assigned, by chance, to one of three groups: a strategy-based training group, a drill-and-practice training group or a wait-list control group.
   - For the wait-list control group, you will be assigned to either the strategy-based training group or the drill-and-practice training group following a period of three months.
   - If assigned to the strategy-based training group, you will practice cognitive (thinking) exercises one to two hours a day, once a week. This training will occur over a 3-month period.
   - If assigned to the drill-and-practice training group, you will practice cognitive exercises two hours a day, three times per week. This training will also occur over a 3-month period.

You should know that data we collect in this project will likely be used for comparison to data from other studies in our center or in cooperation with other researchers. Any data used in this manner will be stripped of information that would identify whom it came from.

You should also know that you will be requested to sign a separate release-of-information form. If you sign this form you will give the researchers conducting this study access to review your hospital records. Information regarding your past and present medical history will be gathered from these files.

You may be asked to be video or audiotaped while completing some of the neuropsychological assessments or clinical treatment groups such as strategy-based training or drill-and-practice training. Confidentiality regarding video or audiotapes will be protected by the researchers running this study. More specifically, media will not be labeled with your name, will be kept in a locked file in the Principal Investigator’s lab suite at Wesleyan University and will be viewed only by staff directly involved in the research study. Recordings will be kept for a maximum of five years after collection.

We will ask whether you want to release information collected as part of this research study to your treatment team at River Valley Services. If so, we will ask you to sign a release-of-information form.
You may decide that you do not want to complete some portion of the cognitive testing and illness assessment that occurs before and after your computer training and still participate in the study.

C. **Duration of Participation:** This study will take place at River Valley Services Connecticut Valley and your participation in the cognitive remediation training will last for approximately 3 months.

II. The **possible risks**, discomforts and side effects of the procedures are described below, including what we will do to minimize risk:

1. You may become fatigued or mildly anxious during the interviews and testing. You are free to take breaks at any time. Some of the interview questions may touch on sensitive topics. You are free to skip a question if you feel uncomfortable answering it.

2. You may experience mild anxiety using a personal computer.

3. You may become mildly tired from the cognitive exercises and social skills training.

4. You may experience a feeling of mild discomfort while being video or audiotaped.

5. A breach of confidentiality could occur. Nonetheless, your confidentiality will be protected to the greatest extent possible. Your records will be maintained in accordance with applicable state and federal laws.

III. There are possible benefits to you or others to be expected from your participation in this research as described below:

1. By your participation, you may provide information that will benefit future patients with the same difficulties that you experience.

2. Individual benefits, however, cannot be guaranteed.

IV. There may be **other treatments** for your condition. You should consider these as well as the treatments in the study just described. Whether you choose to participate or not you will receive your usual care at River Valley Services.

V. The investigator is willing to answer any **questions** you may have concerning the procedures herein described. You do not have to sign this consent until all the questions you have at this time have been answered. Future questions about this study may be directed to Dr. Matthew Kurtz at (860) 685-2072.
If you have any confidential issues to discuss, such as problems or complaints, you may call Janet Storey, DMHAS IRB Chair, (860) 418-6823, who is not part of the research.

VI. Your participation is voluntary and you may refuse to participate and/or withdraw your consent and discontinue participation in the project at any time without penalty or loss of benefits to which you are otherwise entitled. Your decision whether or not to participate will not affect your future medical care at River Valley Services.

You will receive financial compensation as discussed below. If you receive compensation, it will be reported as income to the Internal Revenue Service (IRS) if you receive $600 or more in a year for research studies completed through River Valley Services.

You will be paid $30 for completion of the questions about your medical history and baseline neuropsychological assessments at entry to the study, another $30 for completion of these same questions and tests at the end of your cognitive remediation training, approximately 3 months after entry to the study and then a third time three months after the cessation of your cognitive remediation training. These payments may be reported to the federal government for tax purposes. The payments will be issued via gift cards and will be given to you directly upon completion of each portion of the study.

There is no financial cost to you for participating in the study.

VII. Your confidentiality will be protected to the greatest extent possible. River Valley Services will protect all the information about you and your part in this study just as is done for all patients at River Valley Services. Your records will be maintained in accordance with applicable state and federal laws. However, private identifiable information about you may be used or disclosed for purposes of this research project. You may request that your records be released to your personal physician.

The information that may be used or disclosed includes the following:

1. Results of tests of attention, memory and problem-solving.
2. Results of tests of your functioning in the community, e.g., ability to plan trips, plan a meal, socialize, etc.
3. The interview we conduct to for measurement of your specific symptoms related to having schizophrenia or schizoaffective disorder or another psychiatric disorder.
4. Age, race and gender.
5. Medical and psychiatric history.
6. Records of your progress in cognitive remediation.

This information may be used or disclosed by:
1. Dr. Matthew M. Kurtz and clinical research staff working under his direct supervision.

2. My treatment team at River Valley Services.

**The information may be disclosed to:**

1. DMHAS and/or Wesleyan University Institutional Review Board.

**The purpose(s) of the use or disclosure of this information is (are):**

1. To answer the research question.

2. To ensure the study is being conducted properly and that your rights as a participant are protected.

**The use or disclosure of the information is permitted until:**

Completion of the research study.

By signing this consent, you are also agreeing to the use or disclosure of your protected health information as described above. If you do not agree to the use or disclosure of the information as described and therefore do not sign this consent, you will not be in the study.

If, after signing the consent, you change your mind, you have the right to revoke your consent, in writing. However, you will be withdrawn from the study. If you have completed 5 or less hours of skills training your data will not be included in the study. If you have completed more than 5 hours of skills training, your data will be included in the study unless you notify us that you do not want your data included. If you withdraw your consent you will not be able to continue computer training. Regardless of your participation or lack of participation, the rest of your treatment at River Valley Services will not be affected in any way.

**VIII. In case of any injuries as a direct result of taking part in this research project, you will receive help in the following way:**

If you have medical insurance, River Valley Services will collect fees for medical treatment from your insurance company. RVS will not pay medical expenses at other hospitals or pay for pain and suffering, travel, lost wages, or other indirect costs of taking part in this project.

**IX. Signatures**

I hereby voluntarily agree to participate in the research study entitled, “Comparing the Efficacy of Two Forms of Cognitive Remediation: Strategy-Based vs. Drill-and-Practice Restoration Training for Cognitive Deficits in People with Psychosis,”, described in this consent form.

You will be given a signed copy of this informed consent form to keep.
I voluntarily agree to have my answers to questions about my illness video and/or audiotaped.

Participant’s Signature // Date

Conservator Signature and Relationship to Participant// Date

Investigator’s Signature or Person Obtaining Consent // Date

Witness (person observing the explanation of the above information to the participant) - optional unless consent is presented orally.

8.2 HIPAA Release Form

AUTHORIZATION TO USE AND DISCLOSE PROTECTED HEALTH INFORMATION FOR RESEARCH PURPOSES

The federal privacy law, Health Insurance Portability & Accountability Act (HIPAA), protects your individually identifiable health information from being shared without your permission. The privacy law requires that you sign an authorization (or agreement) in order for researchers to be able to use and disclose your protected health information and that you receive a copy of the Institution’s privacy practices.
Your signature on this authorization is voluntary. Whether you choose to sign or not to sign has no impact on your treatment, payment, or enrollment in any health plans, or affect on your eligibility for benefits. The only consequence of not signing this form is that you may not be allowed to participate in this research project.

By signing this form you authorize Dr. Matthew Kurtz and his staff to use and disclose your protected health information for the research project titled “Cognitive Remediation for Schizophrenia: Effects on Distal Outcome Measures and Relationship to Social-Skills Training”. You also permit your doctors and other health care providers to disclose your protected health information for this research project.

In addition, State of Connecticut statutes require that any release of information pertaining to AIDS, HIV infection, behavioral health services, psychiatric care, or treatment for alcohol and/or drug abuse be specifically authorized. If this information pertains to you, you should know that the researcher(s) and staff associated with this project might become aware of it. By signing this dual-purpose authorization you acknowledge that you understand there is a chance this information may be subject to use and disclosure as it relates to this project.

This Authorization does not have an expiration date. However, if you sign this authorization you can still change your mind at a later date. You can revoke this authorization by sending a written notice to Dr. Matthew Kurtz, Department of Psychology, Wesleyan University, Middletown, CT. 06459, to inform him of your decision. Once you revoke this authorization the researchers will no longer be able to use and disclose your protected health information. There are exceptions to this. For example, one exception under which the researchers may continue to use and or disclose your protected health information after receiving your request to revoke the authorization is if you experience(d) an adverse event (bad effect). Another example is that researchers may continue to use and /or disclose only the protected health information collected for the research study prior to receiving the request to revoke this authorization. If you revoke this authorization you may no longer be allowed to participate in this study.

If you have any questions, concerns or complaints about your privacy rights, you may write to the Federal Department of Health and Human Services (DHHS) at DHHS Regional Manager, Office of Civil Rights, U.S. Dept. of Health and Human Services Government Center, J.F. Kennedy Federal Building, Room 1875, Boston MA 02203. Complaints should be sent within 180 days of when you knew, or should have known, of the problem.

You may not be allowed to review the information collected for this research project until the study is complete. However, you have the right to request that your medical record be released to your personal physician. When the collection of information is complete, you may have the right to access all of your information.
Your protected health information that may be used and disclosed includes:

- Race, gender, age
- Neuropsychological test data, functional and social skill measurements, and symptom rating data
- Medical and psychiatric history
- The interview we conduct to confirm your psychiatric diagnosis and measurement of your specific symptoms related to having schizophrenia or schizoaffective disorder.
- Records of your progress in cognitive remediation and social skills training.

Your Health Information will be used to:

- To answer the research question.
- To ensure the study is being conducted properly and that your rights as a participant are protected.

Your Protected Health Information may be used by and shared with:

- The Hartford Hospital and/or DMHAS Institutional Review Board.
- The National Alliance for Research in Schizophrenia and Depression (NARSAD).
- The Department of Psychiatry at Dartmouth Medical School.

The researchers and staff agree to protect your health information by using and disclosing it only as permitted by you in this Authorization, as directed by state and federal law. However, once your health information has been disclosed to anyone outside of this institution, the information may no longer be protected under this authorization.
There may be studies conducted in the future for which you may be an eligible participant. Please initial your preference.

_____ You give permission to Dr. Matthew Kurtz or his designated administrator to contact you with information about future studies for which you may be an eligible participant.

_____ You do not give permission to be contacted about future studies for which you may be an eligible participant.

You are a voluntary participant in this research study, or you are authorized to act on behalf of the participant. By signing you acknowledge that you have read and understand this form and that you authorize the use and disclosure of protected health information. You will receive a copy of this form after it is signed.

<table>
<thead>
<tr>
<th>Signature of the research participant or the research participant’s legal representative*</th>
<th>Date</th>
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<th>Printed name of the research participant and if applicable the participant’s legal representative*</th>
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<th>Representative’s relationship to the research subject</th>
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*Please provide documentation of your status as an authorized representative

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8.3 DMHAS IRB Initial Approval

NOTICE OF INITIAL IRB APPROVAL

February 17, 2017

Title of Study: Comparing the Efficacy of Two Forms of Cognitive Remediation: Strategy-Based vs. Drill-and-Practice Restorative Training for Cognitive Deficits in People with Psychosis

Principal Investigator: Matthew M. Kurtz, PhD, Professor of Psychology

Reference Number: 16-13

Type of Review: Expedited

Approval Date: 02-27-17

Approval Expiration Date: 02-27-18

Dear Dr. Kurtz:

Your study, referenced above, has received approval by the DMHAS Institutional Review Board. IRB approval is valid through February 27, 2018.

Your study was eligible for expedited review under Category 7. The study must be re-approved in order for research activities to continue beyond the above noted expiration date. An Application for Continued Approval must be submitted at least 30 calendar days prior to the approval expiration date; a blank application is attached. You will be contacted regarding the date of the continuation review.

If any changes are contemplated following the date of this approval, a written request outlining the proposed changes must be submitted to the IRB for review and approval before implementation. No changes to the approved protocol or informed consent may be made without IRB approval.

The IRB should be informed, as outlined in the DMHAS IRB Policy and the DMHAS IRB Guidelines for Investigators, of any adverse events, protocol deviations, complaints or other unanticipated problem involving risks to research participants related to your study. The IRB Policy, Guidelines

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8.4 DMHAS IRB Continued Approval

NOTICE OF CONTINUING IRB APPROVAL

March 9, 2018

Title of Study: Comparing the Efficacy of Two Forms of Cognitive Remediation: Strategy-Based vs. Drill-and-Practice Restorative Training for Cognitive Deficits in People with Psychosis

Principal Investigator: Matthew M. Kurtz, PhD, Professor of Psychology

Reference Number: 16-13

Type of Review: Expedited

Approval Date: 03-09-18

Approval Expiration Date: 03-09-19

Dear Dr. Kurtz:

An annual review of your study, referenced above, has been conducted and continuation of the study has been approved by the DMHAS OOC Institutional Review Board. Continued IRB approval is valid for one year through March 9, 2019.

Your study was eligible for an expedited review for the under Category 7. The study must be re-approved in order for research activities to continue beyond the above noted expiration date. An Application for Continued Approval must be submitted at least 30 calendar days prior to the approval expiration date. You will be contacted regarding the date of the continuation review.

The DMHAS IRB Policy, Guidelines for Investigators and related IRB information may be accessed at the DMHAS IRB Webpage. As outlined in these documents, the IRB must be informed of any adverse events, protocol deviations, complaints or other unanticipated problems involving risks to research participants in your study.

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STATE OF CONNECTICUT
DEPARTMENT OF MENTAL HEALTH AND ADDICTION SERVICES
RIVER VALLEY SERVICES

DATE: November 9, 2016
TO: IRB
FROM: Michelle Leister, LCSW
Clinical Director, River Valley Services
RE.: Research Project with Dr. Kurtz

RVS would fully accept Dr. Kurtz’s proposal for conducting research on cognitive remediation at this facility with the approval of the Institutional Review Board.

Celeste Cremin-Endes, CEO, Michelle Leister, Clinical Director and Dr. Margaret Mestill, Supervising Psychologist have reviewed the research conditions. The components of the research project include random assignment to two kinds of treatment; one computer based and one group and pre and post neuropsychological assessment for participants in which they will be paid a stipend for their time ($30.00) per assessment.

In my role as Clinical Director of RVS, I feel confident that the risk of harm to clients is minimized, while the opportunity for benefit is potentially high. Participation in this study will impact the weekly structure of our clients in a positive way, and is expected to help them with key functional and social skills that would allow them to manage their illness better.

I request approval for this project.

Sincerely yours,

[Signature]
Michelle Leister, LCSW
Clinical Director

Phone: (860) 262-5200 Fax: (860) 262-5290
P.O. Box 351 • Silver Street, Middletown, CT 06457
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January 26, 2017

Celeste Cremin-Endes, LCSW, MPH
Chief Executive Officer
River Valley Services
P.O. Box 351
Middletown, CT 06457

Re: Comparing the Efficacy of Two Forms of Cognitive Remediation: Strategy-Based vs. Drill-and-Practice Restorative Training for Cognitive Deficits in People with Psychosis

Dear Ms. Cremin-Endes:

The proposed study, "Comparing the Efficacy of Two Forms of Cognitive Remediation: Strategy-Based vs. Drill-and-Practice Restorative Training for Cognitive Deficits in People with Psychosis" submitted by Matthew Kurtz, Ph.D., has been reviewed by the Office of the Commissioner. It has been determined that this project has scientific merit and that information gained would be of potential usefulness to DMHAS. The project is approved, and I send my best wishes for a successful research project.

Thank you.

Sincerely,

Miriam E. Delphin-Rittmon, Ph.D.
Commissioner

cc: Eleni Rodis, M.S.
    Janet Storey, MSW