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THE RECOVERY OF COGNITIVE AND SOCIAL COGNITIVE FUNCTIONING IN RESPONSE TO SOCIAL COGNITION INTERACTION TRAINING ADMINISTERED IN COMMUNITY SETTINGS: A LONGITUDINAL STUDY

By

L. Felice Reddy

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THE RECOVERY OF COGNITIVE AND SOCIAL COGNITIVE FUNCTIONING IN RESPONSE TO SOCIAL COGNITION INTERACTION TRAINING ADMINISTERED IN COMMUNITY SETTINGS: A LONGITUDINAL STUDY

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University of Nebraska, 2011

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Psychosocial rehabilitation for persons with Serious Mental Illness (SMI) encompasses recovery of functioning in a broad array of domains, including neurocognitive, social cognitive, interpersonal, occupational, and self-care abilities. There is extensive evidence that improvements in these domains are possible as a result of targeted interventions, and that these improvements may generalize to other areas of daily functioning. The current study explored rehabilitative change over time among adults with SMI that were attending outpatient day centers. Social Cognition and Interaction Training (SCIT), a cognitive-behavioral skills-training modality, was implemented during the time period in which the data was collected. Forty adults participated in the study which included three assessment sessions over a three-month period. Participants were assessed in the areas of clinical symptoms, neurocognition, social cognition, and social functioning. The sample size prohibits drawing firm conclusions from the data but the results suggest that in general, improvements were made in several areas of social cognition and social functioning and that neurocognition and clinical symptoms may mediate these effects. The SCIT treatment was not consistently related to improvements in social cognition. Interestingly, involvement in the

study itself predicted decreased self-rated social functioning; a similar decrease in social functioning was not detected on the staff-administered social functioning measure. Principle components analyses were conducted to derive three primary factors from the array of assessment batteries. The results converge in suggesting self-report measures and clinician-administered measures are separable and meaningfully different. Implications for future longitudinal multivariate studies of rehabilitative change are discussed.

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This dissertation is dedicated to my family, and to Charles.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS …… iii
TABLE OF CONTENTS …… iv
LIST OF MULTIMEDIA OBJECTS …….. v
CHAPTER 1: Introduction ...……..1
Social Cognition ..……...1
Areas of Social Cognition Relevant to Schizophrenia …….....5
Treatment Effectiveness Research ……12
Social Cognition Interaction Training (SCIT) ……..14
Summary: Limitations in Extant Research ……..25
Chapter 2: Present Study ……...29
Hypotheses ……30
Method ……..32
Context ……..32
Participants ……38
Clinical measures and neurocognitive measures ……..38
Social cognition measures ……40
Social Functioning Measures ……42
Procedure ……..44
Statistical Analyses ……...45
Analytical Rationale ……..45
Data preparation and database compilation ……..48
Missing Data ……50
Chapter 3: Results ……51
Hypothesis 1 ……..54
Criterion 1: Multnomah Community Assessment Scale (MCAS) ……54
1. Unconditional Models ……..58
2. Conditional Models ……..61
a. Neurocognitive Measures……..61
b. Social Cognitive Measures ……...66
Criterion 2: Social Functioning Scale (SFS) ……..72
1. Unconditional Models ……..75
2. Conditional Models ……..77
Hypothesis 2 ……78
Hypothesis 3 ……79
Hypothesis 4 ……86
Hypothesis 5 ……99
Chapter 4: Discussion ……116
Limitations ……136
Implications for Future Studies ……137
References ……...140

LIST OF MULTIMEDIA OBJECTS

Table 1 Demographic Information at Time 1……52
Table 2 Descriptive Statistics for the neurocognitive, social cognitive, clinical symptoms, and functional outcome measures at baseline……53
Table 3 Parameter Estimates & Model Fit Statistics for Unstructured Piecewise Linear Model Controlled for Group; Dependent Variable: MCAS Total……..……...60
Table 4 Parameter Estimates & Model Fit Statistics for Unstructured Piecewise Linear Model Controlled for Group; Dependent Variable: SFS Total ……76
Table 5 Predicted slopes for variables that change over time ……...80
Table 6 Principle Component Analysis of Empirically-Selected Variables …….90

Figure 1 Hypothesized Piecewise Linear Change ……47
Figure 2 Hypothesized Piecewise Linear Change ……47
Figure 3 Hypothesized Piecewise Linear Change ……47
Figure 4 Group 1: Individual Trajectories for MCAS Total ……56
Figure 5 Group 2: Individual Trajectories for MCAS Total ……57
Figure 6 Both Groups: Individual Trajectories for MCAS Total ……58
Figure 7 MCAS Total by Baseline Trails-B (Controlling for Group) ……..63
Figure 8 MCAS Total by Baseline NAB-S (Controlling for Group) ……64
Figure 9 MCAS Total by Baseline LNS (Controlling for Group) ……65
Figure 10 MCAS Total by Baseline FAS (Controlling for Group) ……..66
Figure 11 MCAS Total by Baseline SPS (Controlling for Group) ……...67
Figure 12 MCAS Total by Baseline FEIT (Controlling for Group) ……68
Figure 13 MCAS Total by Baseline VEIT (Controlling for Group) ……69
Figure 14 MCAS Total by Baseline Hinting Task (Controlling for Group) ……70
Figure 15 MCAS Total by Baseline BFRT (Controlling for Group) ……71
Figure 16 Group 1: Individual Trajectories for SFS Total ……...73
Figure 17 Group 2: Individual Trajectories for SFS Total ……...74
Figure 18 Both Groups: Individual Trajectories for SFS Total ……75
Figure 19 SFS Total by Baseline Trails-B (Controlling for Group) ……77
Figure 20 SFS-Total: Means Estimated from Unstructured Piecewise Model …….80
Figure 21 SPS-Total: Means Estimated from Unstructured Piecewise Model …….81
Figure 22 SPS-Details: Means Estimated from Unstructured Piecewise Model ……..81
Figure 23 MCAS-Health: Means Estimated from Unstructured Piecewise Model ……..82
Figure 24 MCAS-Behavior: Means Estimated from Unstructured Piecewise Model …..82
Figure 25 SFS-Recreation: Means Estimated from Unstructured Piecewise Model ……83
Figure 26 SFS-Prosocial: Means Estimated from Unstructured Piecewise Model ……..83
Figure 27 Hinting Task: Means Estimated from Unstructured Piecewise Model ……84
Figure 28 MCAS Total: Means Estimated from Unstructured Piecewise Model ……84
Figure 29 FEIT: Means Estimated from Unstructured Piecewise Model …….85
Figure 30 NAB Total: Means Estimated from Unstructured Piecewise Model ……...85
Figure 31 Individual Trajectories for Self-Perceived Social Functioning Factor …….93
Figure 32 Individual Trajectories for Observed Social Functioning Factor …….94
Figure 33 Individual Trajectories for Social Perception Factor ……95

Figure 34 Individual Trajectories for Self-Perceived Social Functioning with Time Adjustment……...……...96
Figure 35 Individual Trajectories for Self-Perceived Social Functioning with Time Adjustment …….…....97
Figure 36 Individual Trajectories for Social Perception Factor with Time Adjustment …….……....98
Figure 37 MCAS-Total by Program ……...100
Figure 38 SFS-Total by Program ……101
Figure 39 MCAS-Total by Group ……...102
Figure 40 SFS-Total by Group ……...103
Figure 41 MCAS-Total by Study Completion ……104
Figure 42 SFS-Total by Study Completion ……105
Figure 43 MCAS-Total by Age ……..106
Figure 44 SFS-Total by Age ……...106
Figure 45 MCAS-Total by Gender ……107
Figure 46 SFS-Total by Gender ……..108
Figure 47 MCAS-Total by BPRS: Affect ……...109
Figure 48 SFS-Total by BPRS: Affect ……...109
Figure 49 MCAS-Total by BPRS: Thought Disturbance ……...110
Figure 50 SFS-Total by BPRS: Thought Disturbance ……111
Figure 51 MCAS-Total by BPRS: Disorganization ……112
Figure 52 SFS-Total by BPRS: Disorganization ……113
Figure 53 MCAS-Total by BPRS: Anergia ……114
Figure 54 SFS-Total by BPRS: Anergia ……115

Chapter 1: Introduction

In clinical research on the treatment and rehabilitation of schizophrenia and serious mental illnesses (SMI), numerous distinct domains of personal and social functioning have been isolated and studied. In the past decade, research has begun to identify relationships between various kinds of cognitive abnormalities and failures in real-world functioning, in areas such as independent living, occupational performance, and interpersonal relationships. In this research a distinction is often made between *neurocognition* and *social cognition*.

Neurocognition refers to relatively elemental abilities and processes, including attention, memory, spatial processing, and executive functioning. The paradigms that identify and measure neurocognition derive primarily from neuropsychology and experimental psychopathology. Neuropsychological or neurocognitive impairments are key factors in the course and outcome of SMI (Bowie, Reichenberg, Patterson, Heaton, & Harvey, 2006; Green, Kern, Braff, & Mintz, 2000; Green, Kern, & Heaton, 2004). They are generally presumed to play a role in vulnerability to disorders and etiology, although the role is so far incompletely understood.

Social Cognition

Social cognition refers to the ability to use social information in order to act wisely and appropriately in social situations (Hogarty &Flesher, 1999). Social cognition describes the ways in which people interpret and understand the behaviors and intentions of other people. Social cognition has been defined as the ability that “allows people to interpret behavior and to make sense of themselves, of others, and of the social world around them” (Kirsch, 2006, p.71). The process of social cognition is multiphasic and

nuanced, including abilities and functions that can be understood as interpersonal sensitivity, or the ability to accurately sense, perceive and respond to the intentions and actions of others. Social cognition relies on several critical abilities that combine to inform the perceiver that others have their own goals, perceptions, intentions, and attention (Tomasello & Carpenter, 2005). These critical abilities that enable appropriate social cognition are frequently studied within developmental psychology and in special population research.

Unlike neurocognitive paradigms, social cognitive paradigms derive from a broad and diverse array of psychological constructs and methods. Some originate in the psychology of normal social functioning while others evolved within a psychopathology context.

The social cognition construct provides a broad theoretical perspective that focuses on how people process information within social contexts. Social cognition is understood to be the building blocks of social behavior (Kirsch, 2006). As such it encompasses the most molecular abilities involved in perception of salient social cues as well as the more molar ability to accurately interpret gestures and words, plan and deliver appropriate social reactions to others' behavior, and learn from past mistakes to improve social adeptness and grace. Social cognition includes many abilities and processes that occur automatically for some persons and with great effort for others. These include perceiving other people's emotions and intentions, making causal attributions about feelings and behaviors performed by self and others, and bringing social judgments to decision making to influence beliefs and actions. In persons without SMI, social cognition is generally acquired and refined as a normal byproduct of development.

However, social cognition development is frequently impaired or obstructed in the face of a major behavioral-neurological psychotic disorder.

Social interaction abilities related to perception, knowledge, and decision-making are critical for persons with interpersonal deficits and thus have been studied in SMI research. However, interpersonal interaction is but one component of the larger construct of social cognition. In other realms of psychology the social cognition construct tends to be much broader and more comprehensive in addressing normal social functioning. In the developmental psychology literature, social cognition tends to include joint engagement, communicative gestures, attention following, imitative learning and referential language. In the social psychology literature, it tends to include processes such as communication, non-verbal interaction, self-consciousness, intersubjectivity, stereotypes, and self-construal. Other areas of human cognition that are frequently studied (but not necessarily included in the SMI literature) include moral cognition, stereotypic attitudes, autobiographical memory, and musical experience (Vogeley & Roepstorff, 2009). Culture is inherently important in the discussion of social cognition. There are two concepts of culture that arise in the literature on cognitive and social cognitive science. They are the distinction between culture as it pertains to the entire human race (Homo sapiens) or “universal” culture, and culture that pertains to subgroups within humans, or “particular” culture (Vogeley & Roepstorff, 2009). While the biological and imprinting influences on social cognition may be universal, the particular cultural variations might affect degrees to which certain features or aspects are expressed. Furthermore, there is extensive individual variation within in any given particular cultural context.

The SMI research literature has been preoccupied with deficits directly linked to pathology and symptom profiles and thus such nuanced areas of cognition have yet to be broached, or deemed relevant, to the etiological and treatment literature. Conversely, these other areas of social and intrapersonal cognition may be on the horizon for exploration in SMI research. Presumably it will not be long before the work that currently studies the intersection of culture and neuroscience will be incorporated into the SMI literature and will shed important light on understanding individual differences among persons with the disorder and available options for remediation and cognitive retraining.

The social cognitive areas and abilities targeted in SMI research arguably represent small, relatively arbitrary constructs within the larger domain of "social cognition." It is likely that as the field unfolds it will include additional molecular and molar skills and abilities which are currently not identified as impaired or relevant to the observable deficits. Social cognition, understanding how people think about social situations and use this information to guide perceptions and behaviors, is uniquely defined within the realm of schizophrenia research. Although the construct of social cognition is vast and relevant to many clinical disorders, as well as non-clinical social contexts, it has certain nuances within schizophrenia and SMI research that are pertinent to the majority of functional impairments, and synergize the clinical psychology research with that of social psychology, neuroscience, etc. Social cognition involves the interface between emotional and cognitive processing (Penn, Sanna, Roberts, 2008). It is understood as distinct from neurocognition (Allen, Strauss, Donohue,& van Kammen, 2007; Penn et al., 2006; Sergi et al., 2007) and may mediate the relationship between neurocognition and real-world functioning (Addington, Saeedi, & Addington 2006b;

Brekke, Kay, Kee, & Green, 2005; Green & Nuechterlein 1999; Hooker & Park, 2002; Sergi et al., 2007; Vauth, Rusch, Wirtz, & Corrigan, 2004). Social cognition is related to numerous clinical outcomes (Kohler, Bilker, Hagendoorn, Gur, &, Gur, 2000;Poole, Tobias, & Vinogradov, 2000; Sachs, Steger-Wuchse, Kryspin-Exner, Gur, & Katschnig, 2004;Shean, Murphy, & Meyer, 2005), functional outcomes (Brekke, et al., 2005; Brüne 2005a; Couture, Penn, & Roberts, 2006; Green, Kern, & Heaton, 2004; Hooker & Park 2002;Horan,Kern, Green, & Penn, 2008;McGurk, Mueser, & Pascaris, 2005; Pinkham, Penn, Perkins, & Lieberman, 2003;Poole et al., 2000; Vauth et al., 2004) and treatment outcomes (Brekke, Hoe, Long, & Greene, 2007).The following section will explore the various areas of social cognition that interact with neurocognition and the other domains to explain the impairments typical in SMI.

Areas of Social Cognition Relevant to Schizophrenia

An NIMH-sponsored consensus building workshop, attended by the leading experts on social cognition in schizophrenia and designed to integrate the current research in the area and guide future research, concluded that there are five types of social cognition considered most relevant to persons with schizophrenia and the study of deficits frequently found in SMI (Green et al., 2008). The five areas are all evident in SMI impairments; they include theory of mind, social perception, social knowledge, attributional bias, and emotional processing. These five areas were agreed upon by review of the literature and consensus among primary researchers in the field of social cognition in schizophrenia (Green et al.). Importantly, the five areas are evident in both specific impairments and in more general intra- and interpersonal functions. It is important to note that the five categorical domains are a useful structure for organizing

social cognition research and designing interventions; however, they are not steadfast between the areas and there is considerable overlap (Kern & Horan, 2010).

The first specific area in the general category of social cognition is referred to as theory- of-mind (ToM). ToM impairments are evident among persons with schizophrenia who have significant difficulty inferring the intentions, beliefs, and opinions of others. Impaired ToM often precludes a person from using cognitive flexibility to take another person's perspective and reduce the self-perspective. Research on ToM has been somewhat disparate from that on the other areas of social cognition. ToM has proven hard to objectively measure and this fact is compounded by the overlap in ToM deficits with autism spectrum disorders. Although research on nonpsychotic diagnoses can advance research within the SMI realm, it is not possible to administer the same measures and assume the same norms, scales, and real-world implications of the results (Green et al). ToM is a conceptually useful and accessible construct, however, its empirical utility is limited and there are very few measures with established reliability and validity for persons with schizophrenia.

There are mixed findings regarding the nature of ToM deficits in SMI. Supporting the notion that ToM deficits are part of a more global deficit are research findings suggesting that ToM deficits in schizophrenia may be related to more general intelligence deficits and other cognitive deficits including executive functions and attention (Bora, 2008). Additionally, it is unknown whether ToM deficits are linked to specific and specialized brain circuits, or whether ToM abilities rely on more general neural networks that are also responsible for other functions, such as executive functioning and attention (Brüne, 2005). However, other reviews indicate that theory of mind deficits are not

accounted for by cognitive deficits or associated with any specific symptom type (Penn et al., 2008) and may be more specific. Increasing the complexity of whether this impairment is stable and trait-like or episodic are several studies that have found ToM impairments to remit during non-acute phases (Corcoran, Mercer, & Frith, 1995; Drury, Robinson, & Birchwood, 1998), but others conclude ToM deficits to be trait deficits (Penn et al., 2008). Although the research is inconclusive at this time, it seems most reasonable to assume that multiple and nonspecialized brain regions and networks are involved in at least some ToM abilities (emotion recognition as well as interpreting and assimilating socio-emotive cues). The argument can most likely be resolved by further research into the precise relationship between ToM impairments and specific neurocognitive deficits. Studies using brain imaging would also lend insight into locales and mechanisms of action in the ability to perceive and make accurate sense of another person's emotions and social intentions.

The second social cognition domain is social perception. Social perception refers to the ability to make inferences about social situations, including awareness of the roles, rules, and goals that typically characterize social situations and guide social interactions (Corrigan & Green, 1993). Social perception is the ability to discern relevant person-related features related to, for example, status, mood state, relationship, or veracity (Horan et al., 2008); these features allow for more adequate perception of inter-personal relationships. Social perception is not solely based on facial affect perception or emotion recognition, it is multimodal and refers to the ability to decode and interpret communicative gestures and behavior in a social context.

Social knowledge is the third of the five skill areas in social cognition. Social knowledge is the awareness in social situations that allows a person to adequately perceive situations and interactions (Green et al.). It can be understood as a social schema to which the cues gathered through social perception are applied (Corrigan, Wallace, & Green, 1992). This sort of knowledge and awareness allows people to understand the unsaid roles, rules, goals and appropriate behaviors of any given social situation (Corrigan & Green, 1993). Social knowledge is thought to be related to social perception (Choi, Hun Lee, & Green, 2009), and describes awareness of which cues typically occur in specific social situations (i.e. social perception) and understanding of the appropriate response (Kern & Horan, 2010). Limited research has explored social knowledge in its own right; however, numerous theorists have posited that social perception is necessary but not sufficient in the absence of social knowledge.

The fourth component in social cognition in SMI is attributional bias. Attributional bias refers to negative interpretations of other peoples' behaviors, and the tendency to assign causality to ambiguous interactions or otherwise. Deficits of this type are especially prevalent in persons with paranoia. In persons with paranoia, there is often a personalizing bias, which means that negative events are attributed to others rather than situations (Bentall, Corocoran, Howard, Blackwood, & Kinderman, 2001). Similarly, a hostile attributional bias refers to the tendency to attribute hostile intentions to others' actions (Horan et al., 2008).Research has yet to thoroughly explore whether attributional bias deficits are vulnerability-linked and more trait-like, or episode-linked and related to certain psychotic symptoms (Kern & Horan, 2010).

The research on this attributional bias has highlighted some important questions regarding the mechanisms of action behind the skewed causal assumptions are whether they occur in all social situations or only those in which intention is ambiguous. Furthermore, it is unknown whether situational factors alter the accessibility of certain schemas that in turn increase the availability of explanations for negative events (Green et al., 08). The personalizing bias works to maintain a positive self-image but simultaneously increases paranoia; within schizophrenia, incorrect inferences such as these are infrequently corrected because persons with schizophrenia have a strong need for closure, lack of mental flexibility, and impairments in ToM (Penn et al., 2008)

The fifth main area identified in the social cognition research in schizophrenia is emotion processing, also called affect or emotion perception. Emotion processing refers to emotional intelligence, or the ability to identify, facilitate, understand and manage emotions (Mayer, Salovey, Caruso, & Sitarenios, 2001). Emotion perception is a known impairment in many persons with schizophrenia and is frequently the topic of research and targeted in interventions to improve social cognition and functioning. Although the terms are used interchangeably, emotion perception specifically refers to the identification of emotion displayed in facial expression or tone of voice (Penn et al., 2008), and the processing involves the more comprehensive identification and utilization of affect-related cues (Horan et al., 2008). According to the review by Penn et al., emotion perception deficits tend to be 1) evident early in course of disorder; 2) most evident in the perception of negative emotions; 3) stable over time although they may decrease in periods of remission compared to acute phases; and 4) more pronounced in reading implied social cues than in making concrete social judgments based on

observable cues. Research shows that among persons with schizophrenia, emotion processing impairments are most evident in the perception of negative emotions, in comparison with positive or neutral emotions. Emotion processing deficits are thought to contribute to paranoia, among persons with schizophrenia and among college student control groups. Although the deficit is relatively stable, it has been shown to worsen during periods of acute psychosis (Penn et al., 2000).

In a biosystemic model of schizophrenia all domains of functioning are interrelated and constantly interacting. The biosystemic psychopathology paradigm understands schizophrenia as “a stable dysfunctional cycle, involving multiple components at multiple levels of organization interacting in a reciprocal manner” (Spaulding, Sullivan, & Poland, 2003, p. 43). Researchers aim to understand the relationships between different domains of functioning, and to differentiate and isolate the independent factors. In order to treat the whole disorder, that is the person as they are affected by multiple interacting deficits, treatment technologies and modalities must be specific to target each domain of functioning. The most effective and comprehensive systematic approach must take into consideration the causal relationships among the various processes and components (Spaulding et al., 2003). Social cognition is no exception to this interrogative paradigm. In the span of research, social cognition proves to be both independent from and related to neurocognition and symptomatology (Allen, Strauss, Donohue, & van Kammen, 2007; García, Fuentes, Ruíz, Gallach, & Roder, 2003; Penn, Roberts et al., 2005; Sergi, Rassovsky, & Widmark, 2007).Some studies find social cognitive deficits may be linked to symptom profiles (Kohler et al., 2000; Poole et al., 2000;Sachs et al., 2004; Shean et al., 2005), while others find that changes in social

cognitive abilities are unrelated to changes in clinical symptoms over time (Combs, Adams, Penn, Roberts, Tiegreen, & Stern, 2007b). Similarly, social cognition has been both linked to neurocognitive functioning (Bozikas, Kosmidis, Anezoulaki, Giannakou, & Karavatos, 2004; Corrigan, 1997; Lancaster, Evans, Bond, & Lysaker, 2003; Sachs et al., 2004; Silver & Shlomo, 2001), and found to be independent from neurocognition (Horan et al., 2008). Extant research also supports the claim that social cognition is the mediator between neurocognition and psychosocial functioning (Brekke et al., 2005; Green &Nuechterlein, 1999; Hooker & Park, 2002; Sanz et al., 2009; Sergi, Rassovsky, Nuechterlein, & Green, 2006; Vauth et al., 2004), and between emotional and cognitive processing (Penn, Sanna, Roberts, 2008). Importantly, improvements in social cognition are associated with real-world outcomes (Brekke et al., 2005; Couture, Penn, &Roberts, 2006; Green, Kern, Heaton, 2004; McGurk, Mueser, & Pascaris, 2005; Pinkham, Penn, Perkins, & Lieberman, 2003; Vauth, Rusch, Wirtz, & Corrigan, 2004), and social cognition is known to have a stronger relationship with real-world outcomes than does neurocognition (Couture et al., 2006). In addition to the general findings related to social cognitive abilities, specific domains within social cognition have also been investigated with regard to functional outcome. Emotion perception and social perception have both been found to have consistent patterns of association with community functioning (Couture et al., 2006); specifically, social competence (i.e. capacity to initiate and maintain social relations) and conversational skills (Brüne 2005; Hooker and Park, 2002; Poole et al., 2000; Sanz et al., 2009).

In summary, specific areas of social cognition are known to be impaired in SMI. These deficits impact people’s ability to form meaningful relationships, perform

optimally in occupational and social settings, and perceive the world in a realistic and non-paranoid light. Social perception, affect perception, social knowledge, attributional tendencies, and ToM abilities all are important to successful interpersonal functioning in SMI (Couture et al., 2006; Penn, Combs, & Mohamed, 2001). The relationship between social cognition and functional outcomes is believed to moderated by neurocognitive abilities, but this relationship is yet to be fully elucidated. Finally, the relationship between domains of social cognition is not completely understood and individual differences create myriad combinations of strengths and weaknesses in the various domains of social cognitive and interpersonal functioning.

Treatment Effectiveness Research

The findings on the pervasiveness and impact of deficits in social cognitive functioning have stimulated development of interventions designed to target these deficits and related impairments. Social cognition can be improved in response to targeted intervention (Combs et al., 2007b; Combs et al., 2009; Horan, Kern, Penn &Green, 2008; Penn et al., 2005;Roberts & Penn, 2008; Roberts, Penn, Labate, Margolis, & Sterne, 2010). Despite evidence that social cognition interventions effect change in targeted domains in some clinical samples, there is wide individual variation and heterogeneity in treatment efficacy and functional outcomes. The evolution of effective psychotherapies and rehabilitative techniques, in conjunction with the inconsistencies in treatment outcomes, mandates that interventions be tailored according to specific phase of illness and environmental context (inpatient vs. outpatient) (Vogler, Spaulding, Kleinlein, & Johnson, 2010).

Generally, studies either examine outcomes on specific social cognitive abilities (i.e., affect perception; ToM), or they examine real-world functioning (i.e., improved social relationships, decreased interpersonal suspiciousness). The majority of social cognition intervention modalities are highly specific in that they target individual areas of social cognition in isolation (i.e., Frommann et al., 2003). Horan and colleagues (2008) reviewed a series of six targeted studies that administered short-term intensive remediation programs and resulted in improvements in facial emotion perception abilities and slight changes in ToM abilities in response to verbally administered tasks. Although these studies support the modifiability of these specific domains of social cognition, the samples used in the particular studies were small, and the tasks were very similar to the training materials, casting doubt on the generalizability of the acquired skills. Similarly, an intervention known as the Training in Affect Recognition program, when compared to neurocognitive remediation and treatment as usual (Wolwer, Frommann, Haufmann, Piaszek, Streit, & Gaebel, 2005), showed that the Training in Affect Recognition program effectively improved facial affect recognition but had no impact on verbal learning and long-term memory, while the neurocognitive remediation program improved participants' abilities in the domains of verbal learning and long-term memory, but no significant improvement in facial affect recognition. These studies demonstrate the specificity of social cognition training, but do little to measure changes in real-world functioning or generalizability of highly specific skills.

Another social cognition intervention targeting emotion recognition (Social Cognition Training Program, SCTP; Sanz et al., 2009) led to improvements in social perception and interpretation in the experimental group compared to controls, but there

were no evident improvements in emotion recognition. SCTP was designed as a targeted intervention, specific to social perception and emotion recognition. Thus, it was successful in one of the two targeted domains; it does not appear to be a comprehensive social cognition intervention but may be useful in specific skill-building endeavors. Limitations to this study include the fact that the intervention is restricted in its aim, thus does not apply to the entire arena of social cognition. Additionally, the study had a very small sample size and used cross-sectional pre-post-test design. However, in its goal of assessing the efficacy of a training program specifically to teach emotion recognition and social perception it was effective.

Social Cognition Interaction Training (SCIT)

In response to the highly targeted interventions, Social Cognition Interaction Training (SCIT; Penn et al., 2005) was developed to target the multiple areas of social cognition that are typically impaired in schizophrenia in unison, but without being so broad as to also include general neurocognitive abilities. SCIT was designed to target emotion perception, attributional style, and ToM. After pilot studies and initial implementations, emotion perception abilities appeared to improve less than hostility bias and ToM, thus an additional session was added to augment the emotion perception learning objectives, as well as increased general strategies to review and reinforce the social cognitive abilities of emotion perception, attributional style, and ToM (Combs et al., 2007b). Subsequent studies consistently show SCIT to be effective in eliciting improvements in the areas of social and emotion perception, ToM, attributional style for ambiguous situations, cognitive flexibility, need for closure, and social relationships (Combs et al., 2007b). Social functioning, operationalized as prosocial behaviors and

absence of aggression, also improves as a function of SCIT (Combs et al., 2007b; Penn et al., 2005; Roberts & Penn, 2009).

SCIT was designed to be administered in 18-24 weekly 1-hour group sessions but has been adapted for the unique requirements and structure of various inpatient programs (Penn et al., 2005; Combs et al., 2007b). In recent evolutions of the SCIT program, bi-weekly sessions have proven to be highly effective for some outpatient and day rehab settings (Roberts & Penn, 2008; Roberts, Penn, Labate, Margolis, & Sterne, 2010). SCIT is a manualized intervention with three discrete sections. The first seven sessions focus on "understanding emotions;" group exercises focus on identifying and understanding basic emotions and "suspicious feelings," (i.e., paranoia). The second section, entitled "figuring out social situations," is comprised of approximately seven sessions that teach skills needed to gather and interpret information from the real-world. The goal of the second section is to educate about the tendency to 'jump to conclusions' when interpreting social information and teach specific strategies to avoid this tendency. The third section focuses on integration of the newly acquired social cognitive skills to personal, real-life situations. The groups are typically run by two trained therapists or clinicians and include between four and eleven participants. SCIT has been replicated numerous times in a range of settings with populations of various cognitive and functional abilities (Roberts & Penn, 2009). Numerous studies evince the efficacy and effectiveness of SCIT, these studies will be reviewed in detail in the following section.

The original pilot study, published in 2005, offered preliminary support for SCIT and served as a reasonable basis for which to implement replications. The SCIT format was adjusted for the inpatient setting and groups were conducted in five sessions per

week, for a period of 12 weeks. That study showed SCIT to produce trend-level reductions in hostile and aggressive attribution biases, and a statistically significant improvement in ToM (Penn et al., 2005). The absence of improvements in emotion perception led the authors to augment the emotion perception component, as mentioned previously. Changes in social cognition were only minimally related to scores on the Beck Symptom Inventory, indicating that the observed improvements in ToM and attribution style were not solely due to a reduction in clinical symptomatology. The major limitations of this study were methodological; it used very few assessment measures (FEIT; Hinting Task; AIHQ), and simple t-tests may have prevented the detection of significant intra- and inter-individual changes over time.

In a subsequent study, Roberts and Penn (2008) compared persons in an outpatient program who participated in SCIT with those in the same outpatient program that received treatment as usual (TAU) and found the SCIT intervention to produce improvements in emotion perception and social skill, as measured by the FEIT, BLERT, Hinting Task, TASIT, AIHQ-A, and SSPA. Although the study yielded promising results for SCIT's effectiveness, the results should be interpreted and generalized with some caution because of methodological limitations. Regarding assessment limitations, the results were limited in the small number of assessment measures used to measure each area of functioning. The authors of the study indicate that there may have been both ceiling and floor effects that prevented the researchers from finding significant changes among the participants (Roberts & Penn, 2008). The Hinting Task was hypothesized to be vulnerable to a ceiling effect with this particular population and the AIHQ was assumed to be vulnerable to a floor effect, based on the restricted range of numerical

outcomes on these tasks. Furthermore, all domains of social cognition were assessed after the conclusion of SCIT, which means emotion perception abilities were assessed four months after the specific emotion perception skills were taught, as they are incorporated into the first section of the intervention, both other domains were taught much closer to the time of assessment. Other limitations of the study include the fact that the assessors were not blind to treatment condition, there was a small sample size, and the design did not include random assignment. Finally, the statistical analyses were limited to cross-sectional pre and post-treatment analyses of variance, thereby precluding longitudinal analysis.

Despite the above limitations, gains in emotion perception were robust, even with the four-month time lapse. This is strong evidence to suggest that the emotion perception gains are robust and long-lasting. However, significant improvements were not found in the areas of attributional bias or ToM, both of which were hypothesized to show improvements, based on previous studies. The equivocal findings related to these two domains of social cognition have multiple potential implications. They may mean that the abbreviated assessment battery was unable to detect significant changes, or the sample may have been unique in some way that confounded significant findings; ultimately, the lack of change may be meaningful and significant for others to take into consideration before conducting replications. Because of the apparent floor and ceiling effects and possible null effects in significant areas of social cognition, replication in other outpatient populations is of utmost importance to more reliably conclude the causal basis for the improvements in emotion perception but absence of effects in the other targeted areas. Significantly, the authors point out that the results indicate a dose-response effect

indicating that significant improvements were attenuated among persons who dropped out, namely 30% of the original SCIT sample (Roberts & Penn, 2008). Additional studies will be useful to elucidate the causal mechanisms within this apparent dose-response effect – specifically, is treatment duration and intensity a mediator of outcome?

In another study of SCIT's effectiveness, SCIT was administered in an inpatient forensic psychiatric treatment facility. Persons that completed the SCIT program were compared to those that participated in a Coping Skills group; results showed SCIT to yield improvements in social cognitive functioning and real-world social functioning as well (Combs et al., 2007b). Specifically, the SCIT participants evinced significant improvements in emotion and social perception, ToM abilities, attributional style, cognitive flexibility, social relationships and in number of aggressive incidents. One strength of this study is the comprehensive assessment battery used to measure changes in specific abilities and overall functioning. In addition to assessing symptom level and basic intellectual functioning, the researchers assessed premorbid social competence and aggressive ward behavior on the unit three months prior and post-intervention. Social cognitive abilities were quantitatively assessed using the FEIT, Social Perception Scale, Hinting Task, AIHQ, Need for Closure Scale, Trails B, and the Social Functioning Scale; all assessments were conducted by blind assessors. Statistical analyses included pre- and post-test mixed model ANOVAS; improvements in social cognition proved to be independent of changes in clinical symptoms over time.

There were some limitations to this study, including the fact that the sample was volunteer and not randomly assigned to groups (Combs et al., 2007b). This suggests that persons who volunteered may have had higher social cognition to begin with, may have

demonstrated more motivation than is typical of most prisoners diagnosed with schizophrenia, or other variables may have affected group dynamics and cohesiveness within the facility, and be unrelated to SCIT mechanisms of action. Also, the results are limited in generalizability because of the specific location and population in which SCIT was utilized; the participants were psychiatric inmates and presumably had limited freedom regarding attendance and participation – this may explain the 90%-96% attendance rates in both the SCIT and control groups for the 18 week period. More advanced statistical modeling would allow for the examination of functional changes within and between persons and groups over time, as well as lend added insight into the results related to long-term ward social behavior. However, despite the limitations, this study holds importance because it shows SCIT to be effective with diverse populations and in settings other than the typical outpatient day setting for which it was designed. Forensic populations are frequently targeted for lack of prosocial behaviors and awareness, thus the effectiveness of SCIT with this group of incarcerated persons with mentally illness suggests SCIT may be useful in other forensic populations and may lead to cognitive and behavioral social improvements, and more adaptive ward behaviors.

In order to examine the stability and generalizability of SCIT, researchers conducted a 6-month follow-up study of the forensic inpatient sample that completed SCIT (Combs et al., 2009). Assessments were administered to the eighteen original participants and to eighteen age, gender, and ethnicity matched non-psychiatric community controls. To compare the participants at the 6-month follow-up time-point with the pre- and post-treatment assessment results, the FEIT and Social Functioning Scale were administered to the original participants and the community control group.

The BLERT and SSPA were administered to assess the generalization of SCIT targeted skills to real-world social functioning.

The assessment results in this follow-up study revealed significant improvements on the FEIT and SFS in comparison to baseline, but participants' scores were generally lower than at post-treatment (Combs et al., 2009). With regard to real-world functioning, the SCIT group was not significantly different from the control group on the FEIT, SFS, or SSPA. There was, however, a difference on the BLERT such that the non-psychiatric controls evinced better emotion identification than did the SCIT participants. Although this study is significant in that it offers the first empirical evidence for the stability and generalizability of SCIT effects, there are several limitations that could be improved for future studies. The limitations include the small sample size. Although the follow-up included all of the original 18 SCIT participants, it did not include the original participants from the Coping Skills group that were in the inpatient psychiatric facility at the same time as the SCIT participants; the findings would benefit from comparison with the entire original sample. Using a control group of people with schizophrenia but that did not participate in SCIT may also lend some insight into the stability and generalizability of the outcomes. Also, there is the possibility of practice effects in this study since the experimental group had taken the measures at pre- and post-treatment and the control group presumably had no familiarity with the measures. The number of assessment measures also is a limitation because they only used one tool to assess each construct. In sum, a rigorous randomized controlled trial with longer follow-up assessments and longitudinal multilevel statistical modeling would be the optimal mechanism to assess the efficacy and effectiveness of SCIT over a period of time;

however, this study makes an important contribution to the empirical literature and supports the notion that SCIT should continue to be utilized and further studied.

The first open transportability trial of SCIT was recently conducted; in this study, some treatment effects appeared durable, and some important characteristics for future implementations were realized (Roberts, Penn, Labate, Margolis, & Sterne, 2010). The SCIT intervention was administered in three different community-based day rehabilitation programs that were unaffiliated with the creators of SCIT. The sample originally included 50 volunteer participants; this was fewer than the total number of volunteers and referrals, but this was the subset that also volunteered to partake in a pre and post assessment battery. Of the original 50 volunteers, only 38 completed SCIT training and the initial social cognition assessment battery, and only 24 completed the post-treatment evaluation. In terms of scientific rigor, the volunteer status and high attrition rate is less than desirable, however when examining feasibility and acceptability of an intervention in real-life programs, it may not be a major problem to have a self-selected sample. The participants in this study were not carefully screened research participants, and they were not paid or coerced for completing the intervention, therefore, the empirical results can be interpreted as likely generalizable to similar community populations. The SCIT group itself was offered in 20 once-weekly sessions, in conjunction with routine care. It was administered by clinicians already employed in the treatment settings, after they were trained by the SCIT authors. In addition to assessing traditional social cognitive outcomes, feasibility and acceptability were assessed with feedback questionnaires for clients and group leaders, as well as attendance records. In order to ease the assessment process, the FEIT was adjusted to be administered in group

format and accompanied by the Hinting Task and AIHQ-A. The repeated-measures ANOVA was significant, indicating overall improvement in social cognition from pre- to post-test. Follow-up paired sample t-tests examined the unique domains of social cognition independently and indicated small to medium within-group effect sizes in emotion perception (FEIT) and ToM (Hinting Task), but not for hostility bias, aggression bias, or blame tendency (AIHQ-A). The gains in emotion perception were smaller than in previous studies, the authors surmised that it is not an uncommon phenomenon for scores to attenuate when comparing an intervention's effectiveness with its efficacy and may be partially related to the increased heterogeneity and complexity of illness among community patients (Roberts et al., 2010, p. 44). The informal assessments in which participants and clinicians were asked whether they observed social functional improvements were positive but must be interpreted with extreme caution.

As stated previously, the limitations in scientific rigor may be advantageous for examining transportability of an empirically supported treatment into real-world settings. Replications in other community-based treatment facilities will verify whether the results generalize to other self-selected samples. Given the prevalence of paranoia and neurocognitive impairments it may be advantageous to use samples that volunteer to participate in SCIT but not necessarily volunteer to complete the assessment battery. However, the problem of not being able to empirically validate prevents the study from being scientifically useful, beyond clinical observations. Conversely, it may be that researchers should attempt to design assessments that are not written, but instead based on daily functioning, so that the literature base will not be hampered by persons that do not volunteer to participate in assessments. The results could be enhanced in

interpretability if the administrators had also administered the social cognition measures to persons in the community rehabilitation settings that did not participate in SCIT, thus serving as a proxy control group. Finally, this study found significant improvement in ToM following SCIT, consistent with the previous inpatient studies (Combs et al., 2007b; Penn et al., 2005), but inconsistent with two previous outpatient studies (Horan et al., 2009; Roberts and Penn, 2009). The researchers theorized that the low level of functioning among the participants in the present study prevented the ceiling effect on the Hinting task that was assumed to be in effect in preventing detection of ToM improvements in the other two outpatient samples (Roberts et al., 2010). Also, this study administered the first and second clue in the Hinting Task to all participants because of group-administration of the assessment, thus it can be argued that scores were inflated, or at least should be interpreted differently than administrations that utilized the traditional administration protocol and scoring mechanism.

In a recent study, Kleinlein and colleagues conducted an analysis of SCIT treatment effects as part of a larger study of cognitive recovery over time, including neurocognitive, social cognitive, and functional domains. The author of this dissertation was a co-investigator in that study, and assisted with SCIT implementation as well as assessment administration. SCIT was administered to a group of adults diagnosed with SMI that were attending one of two community-based adult day centers. The study utilized a two-phase implementation design in which there was a wait-list control condition that received SCIT treatment following the first SCIT cohort. Both groups were administered social cognitive, neurocognitive, clinical symptom, and real-world social functioning measures prior to the beginning of the study, following the first SCIT

implementation, and following the conclusion of the second round of SCIT, thus yielding three points of measurement for the entire sample over an approximately three month period. Assessments were administered by trained research assistants and master's level clinicians blind to experimental group assignment. The SCIT groups were run by graduate students trained in SCIT by Dr. Combs; supervision was provided by a doctoral psychologist also trained in SCIT. The SCIT groups each contained approximately 4-8 participants and were conducted in one-hour sessions on a bi-weekly schedule. Of the initial 40 participants in the study, there was attrition across assessment time points with the final sample size at the last assessment totaling 26 participants. Numerous factors interfered with SCIT attendance and with completion of the assessment battery including changes in personal schedules, intermittent day program attendance, volunteer jobs, and recurrent hospitalizations.

Despite the decrease in sample size, the Kleinlein study yielded some significant and some promising findings. Specifically, results showed significant improvements on measures of emotion perception, support for improvements in ToM abilities, and trend-level support for improvements on measures of attributional style. Importantly, the study revealed improvements in real-world social functioning, as measured with the Multnomah Community Ability Scale (MCAS) and the Social Functioning Scale's interpersonal communication subscale. Limitations in this study were that the statistical analyses were somewhat limited and low power may have been responsible for the failure to detect many significant changes over time. The data was analyzed using analysis of variance and covariance models; it is possible that multilevel longitudinal modeling may facilitate detection of more subtle or more heterogeneous changes in functioning.

Additionally, the small sample size is a weakness that may have interfered with the detection of significant results. An important line of inquiry is whether the attrition from the SCIT groups and assessment occasions was systematic; it is possible that lower or higher functioning individuals self-selected out of the study, this should be examined in future analyses of the data.

Summary: Limitations in Extant Research

Despite the increasing empirical research supporting the effectiveness of rehabilitation techniques in general and SCIT in particular, and the consistent findings that aspects of social cognition can be improved with targeted psychosocial interventions that relate to functional improvements for persons with schizophrenia, there are several conceptual and methodological limitations in the extant literature and previous research studies.

As stated previously, the relationship between social cognition and neurocognition is not thoroughly understood. There is equivocal evidence regarding whether neurocognitive functioning contributes to the variance in social cognitive outcomes (Hogarty, Greenwald, & Eack, 2006; Wolwer et al., 2005). Research should explore whether persons with low cognitive functioning benefit from SCIT, and the range of cognitive abilities that are most responsive to the SCIT techniques. Furthermore, it is yet to be determined what baseline level of social cognitive abilities is optimal for the SCIT model, and whether individual differences in baseline functioning, learning style, and cognitive profile determine SCIT outcomes. Similarly, replication studies with comprehensive and longitudinal assessment measures would help researchers understand

how baseline social cognition and neurocognition interact to predict treatment effectiveness and functional outcomes following SCIT.

SCIT stands out among the range of social cognition treatments because it constructively addresses the neurocognition-social cognition quandary while addressing the numerous areas of social cognition thought to be relevant to SMI. Specifically, SCIT is a cognitive-behavioral intervention in that it is more exclusively focused on social cognition than the alternative cognitive remediation programs (i.e. Integrated Psychological Therapy and Cognitive Enhancement Therapy) which primarily address non-social cognition. Simultaneously, SCIT includes more cognition-related abilities than interventions such as Social Skills Training and Interpersonal Problem Solving, which are purely behavioral. SCIT requires participants to evaluate their automatic thoughts and challenge distorted cognitions that relate to the social arena; it then progresses to teaching participants the skills and behaviors to gather factual social information and practice adaptive and appropriate behaviors to verify social guesses and assumptions. Thus, SCIT is one of the only interventions to bridge the gap between cognitive training and behavioral training; it also weaves together the many overlapping domains of social cognition relevant for real-world functioning. For this reason, it is expected that SCIT should be more effective in improving real-world functioning, and should cause change across the domains of social cognition.

To date, SCIT research has only minimally addressed functional outcomes related to specific improvements in social cognitive abilities. Research needs to incorporate the question of ecological validity and the functional impact of treatment. This goal could be accomplished by examining the specific domains that are involved in treatment and

recovery processes, and determining which are most accessible to treatment, and which have the greatest implications for real-world functioning.

The contextual impact/setting of SCIT is an important aspect of intervention development. Currently, only preliminary findings support SCIT's effectiveness in outpatient settings, in non-highly controlled studies, or with lower functioning individuals. Research is needed to address this gap in the literature by examining implementation in more real-world settings, and focusing on change over time and maintenance of treatment gains after termination of treatment in community settings and with low-functioning individuals.

Given the success of SCIT and the vast implications of improving social cognition, the next logical step in the research paradigm is to increase the knowledge about individual responsiveness to SCIT as well as the factors that contribute to heterogeneity in outcomes (Roberts et al., 2010). Brüne & Juckel (2010) discuss the ways in which improvements in social cognition can benefit overall functioning of persons with schizophrenia. They point out that although SCIT has proven efficacious, it is unknown whether the gains are long-lasting and whether the functional improvements withstand the test of time. The subtext of this query revolves around individual differences in treatment response and rehabilitation in general. Individual differences in outcome are another important variable that is relevant to all treatment outcome studies in SMI research, and especially relevant to the SCIT literature as it is yet unexplored.

A final limitation in the current published literature related to SCIT is that studies have relied heavily on cross-sectional data analysis. More sophisticated, hierarchical modeling of treatment outcomes and relationships among variables would likely have

significant implications for understanding the heterogeneity of treatment response and functional outcome in schizophrenia. The application of hierarchical linear modeling encompasses both the individual subject level of change over time as well as the group treatment effect of SCIT when compared to a control condition.

Social cognition interventions are one leg in a larger comprehensive attempt to remediate and rehabilitate persons suffering various functional disabilities related to mental illness. Although social cognition treatment is an intricate part of functional recovery, it is but one tool within the toolbox that equates an effective treatment approach. Understanding change over time is independent from, but equally important to, assessing treatment effectiveness, per se. The science of studying social cognition and SCIT will benefit from research that addresses individual variation and rehabilitation, separate from specific treatment effects.

Chapter 2: Present Study

The published research to date highlights important conceptual questions in need of further exploration. Although several studies have indicated that cognitive recovery does occur under sufficiently therapeutic conditions, none of those studies were designed to articulate the nature of the recovery. We know that some people show improvements and some don't, but not much else. We need to know whether different behavioral and cognitive domains of functioning show different trajectories of change, and what the relationship is between the separate domains.

The present study examines the relationships between variables related to SCIT effectiveness, neurocognition, and social cognitive functioning over time. The purpose of this examination is to identify trajectories of cognitive recovery, subgroups formed by the characteristics of these trajectories, and possible moderators or mediators of recovery, including SCIT. The examination is guided by hypotheses, in the form of predictions about relationships between specific variables to be revealed by quantitative analysis. Detection of significant results in this low power situation will guide further research on the present and future databases.

Conceptually, the study aims to answer the following questions:

1. What is the overall trend in cognitive and social cognitive functioning?
2. Is there a trend for task improvement that's common across variables? Or, are the change trends all similar and attributable to practice effects?
3. If we find a common factor that improves over time can we parse it into functional domains (i.e., neurocognition, social cognition, functional)?
4. Which particular measures are showing longitudinal change?

5. Are there specific changes (in functional domain or pattern of change) that occur while in treatment but do not occur when not in treatment?
6. Which treatment effects are robust (more significant and/or durable over time)?

The database used in this study allows for the assessment of change over time, and uses the SCIT intervention dimension as a structure for analyzing change. Specifically, all participants included in the analyses participated in SCIT, thereby maximizing likelihood of changes in social cognition. Furthermore, the participants were in SCIT at different times which allows for some analysis of the specific role of SCIT in cognitive change.

Hypotheses

The following hypotheses will be tested on a sample of individuals with diagnoses in the schizophrenia spectrum that completed the SCIT program.

The first hypothesis is that persons with higher initial levels of neurocognition and social cognition improve more and at a faster rate during SCIT than persons with lower baseline neurocognitive and social cognitive functioning levels. This hypothesis can be evaluated through piecewise univariate multilevel modeling to test whether baseline neurocognition and social cognition scores are associated with treatment outcome. Piecewise longitudinal models will be used to examine the time periods in which persons were and were not receiving SCIT treatment. It is hypothesized that regardless of the trend observed in the time period following SCIT treatment, persons with higher initial scores will continue to have higher mean levels on the outcome variables than will persons with lower baseline scores.

The second hypothesis is that treatment effects are maintained after the end of the

treatment period. In SMI treatment outcome research, it is frequently found that treatment gains do not remain stable after the end of treatment (Brekke et al., 2007). This has only been minimally researched with regard to SCIT. The present study design provides opportunity for some assessment of the maintenance of treatment gains. It is further predicted that the recency of SCIT participation is a significant factor in predicting the maintenance of treatment gains (see Figures 1-3 for alternate piecewise trajectories).

Hypothesis 3 is that there are significant differences among the various outcome measures' abilities to detect improvements over time, although this hypothesis is not specified further. There is reason to believe that measures are variably sensitive to change, but there is insufficient data to predict which is most sensitive to the particular changes that may occur in this study sample and setting. Hypothesis 3 will be further evaluated by assessing the interrelationships between measures, within and across levels of functioning, as they track changes over time. This assessment will contribute to a broader understanding of the interactions of biological, psychological and behavioral processes as recovery proceeds.

Hypothesis 4 is that there are separate and meaningfully different domains of functioning that respond differentially to SCIT treatment. Consistent with the larger literature on cognitive treatment in schizophrenia, the treatment effect is expected to be most pronounced in the same domain as the treatment procedure, in this case social cognition. However, the gradient of generalization to other domains is unknown. The longitudinal dimension of this analysis permits some distinction between relationships between measures due to shared variance (i.e. psychometric correlations) and those due

to cause-and-effect (i.e. generalization of treatment effects). Exploring these multivariate questions related to measures and domains of functioning will capitalize on the full depth and breadth of the existing database, allowing further understanding of the interrelationships among variables.

Hypothesis 5 is that there are within- and between-subject factors that mediate or moderate the treatment effect. Conclusions about this hypothesis will be especially tentative, because the limited number of variance components reduces the likelihood that these analyses will be able to detect significant moderating or mediating effects. Additional analyses in this domain include examining the possibility of a dose-response effect, by considering group averages and individual differences related to attrition. It is possible that service utilization will prove to be an important mediator of outcome.

Method

Context

The current research aims were formulated as part of a multi-year collaborative project to develop treatment and rehabilitation capabilities in community settings. Increasingly, over the last few decades, researchers, clinicians, and consumer activists have emphasized and devoted energy to transforming community-based day programs into locations of treatment and psychosocial rehabilitation. Traditionally, many day centers were unstructured and non-rehabilitative in nature; they operated primarily on the "clubhouse" model in which staff are present for regulatory purposes, and the atmosphere is one of a place to hang-out, revolving almost entirely around peer-to-peer interaction. Although there were many benefits of clubhouse and similar models, the benefits of a treatment, rehabilitation, and recovery-focused day program are measurably greater.

Thus, the University of Nebraska-Lincoln, the Lancaster County Mental Health Center, as well as researchers and collaborators from other states and countries embarked on an endeavor to transform some of the community-based services in Lincoln into comprehensive rehabilitation-centered programs. The operating principle of the transformation into true psychosocial rehabilitation treatment centers is the development of a program based on individual needs and goals, and is data-based and data-driven. The data must inform the creation of the program, the development of individualized rehabilitation plans, and the evaluation of progress- both of the clients and the program as a whole.

The Serious Mental Illness lab at the University of Nebraska – Lincoln has been the main technological resource for this effort for approximately four years. In addition to the graduate student members of the lab, numerous other collaborators from within and outside the university have joined in the effort by developing computer technologies, offering staff trainings, presenting successful models from similar programs in other states, collaborating in the development of new evidence-based treatment modalities, and collaborating in dissemination of research and clinical findings. Among the local projects, not only have several modalities for rehabilitation been developed, implemented, and evaluated, efforts to enact a paradigm shift within the pre-existing system have demanded extensive effort.

Prior to this re-tooling effort, some of the community-based treatment settings operated, to varying degrees, within a biopsychosocial (biosystemic) understanding of mental illness, guided by principles of rehabilitation and recovery. The biosystemic understanding of mental illness implies an intervention approach that targets multiple

domains of functioning in conjunction, including the physiological, neurocognitive, social, and environmental. The principles of rehabilitation and recovery, when actualized unobstructed, create a climate in which introduction of new skill training and therapy modalities are normal and routine occurrences. Although there were few, if any, other training or treatment modalities being implemented at the community day centers at the time in which SCIT was delivered, the staff and clientele were reasonably receptive and adaptive to the addition of a structured and closely evaluated treatment service.

A key part of the overall system transformation is a close working relationship between the UNL Clinical Psychology Training Program, the Community Mental Health Center of Lancaster County, and OUR Homes, Inc., a private non-profit provider of housing and assisted living services for people with psychiatric and developmental disabilities. One product of this relationship is the clinical psychology extern position that currently maintains one part-time clinical psychology graduate student at Midtown Center, a day program under the administrative auspices of the Community Mental Health Center. The extern position represents an ongoing collaborative relationship between Midtown Center and the university. The extern position has facilitated several changes, including individualized rehabilitation, rehabilitation and recovery plans for each participant that rely on evidence-based treatment modalities and quantitative progress monitoring of interventions. The extern at Midtown serves in a role similar to consultant and program evaluator and also does staff training and implements evidence-based group treatment modalities. The extern's role is to facilitate the structures and supports needed in a psychosocial rehabilitative environment that operates on behavioral principles.

An important component of a behavioral-based skill-training rehabilitation program is data collection and progress monitoring. In order to monitor treatment attendance and participation on an ongoing basis, in the effort to accomplish rehabilitative goals, a computerized data analysis program was created by members of the SMI lab. This TAC (treatment, activities, and classes) system is utilized at Midtown Center and at the residential psychosocial rehabilitation facility also associated with the Community Mental Health Center in order to objectively measure participants' treatment adherence and progress. The TAC system helps all members of the treatment team come to consensus on treatment progress and creates a vehicle to identify and rectify treatment goals that are not being met. The extern position also includes training staff in the utilization of TAC, compiling data, and graphically presenting to treatment teams and relative parties.

Other endeavors of the SMI lab and Clinical Psychology Training Program include an evaluation of the program at Southville, the other day center that housed SCIT groups for this study. One of Southville's primary initiatives is a focus on physical health and well-being. Southville asserts this goal by serving healthy food that is void of sugar, not allowing participants to smoke cigarettes, and providing exercise equipment and group. One student from the UNL SMI lab conducted a systematic evaluation of the health-related outcomes and attitudes of Southville participants (Liu & Spaulding, 2010). This project offered empirical support for rehabilitation programs that emphasize healthy eating and living.

Finally, the author of the current study worked in collaboration with colleagues to develop rehabilitation modalities not currently available in the domain of SMI treatment.

Specifically, a need was identified for a manualized budgeting and money management intervention in order to assist persons with SMI in actualizing more independence financially and in realms related to living independently. This didactic and participatory intervention is administered in group format and followed by an individualized approach that is continued between the participant and the paired staff. Staff members at the day rehabilitation facility and the residential facility are currently being trained in this approach and fidelity monitoring as well as outcome assessments will be conducted. Similarly, this writer designed a goal-setting module to help staff coach participants in identifying deficits and setting goals that are personalized and based on the participants' personal values. The goal-setting process, when guided by a structured protocol, facilitates the identification of long-term goals, and the operationalization of the short-term goals that must be met prior to achieving the long-term goals. Staff training in this modality is also currently underway in an effort to benefit the overall rehabilitation and recovery goals of the treatment programs, and ensures an individualized approach to treatment planning and outcome assessment.

In the context of the above listed efforts in system transformation, specific remediation modalities have been executed. Specifically, cognitive remediation and social cognitive remediation, as well as social skills training, symptom management skills training, employment preparation training, interpersonal problem solving skills training, and other manual-based groups and classes are offered on an ongoing basis. At the time the data for the current analysis were collected, the majority of these groups and classes had not begun, but were in the formulation and acquisition phases. The SCIT group was one of the first in a series of rehabilitation modalities to be implemented. Part and parcel

of system change and transition to a rehabilitation focus is the collection of data to assess effectiveness. In addition to the TAC data system discussed above, more comprehensive assessment batteries are administered on a periodic basis. These assessments include cognitive, social cognitive, clinical, and functional measures. Clients of the Community Mental Health Center and Midtown Center are assessed on a 6-month basis in order to evaluate changes in functioning in any of the domains. Person characteristics, including demographics, intelligence, medication information, and clinical status data are also collected and entered into a database that allows researchers and clinicians to model each individual in a longitudinal and comprehensive trajectory, and permits the analysis of group trends and significant predictor variables. This database has only begun to be mined for idiographic understandings within the heterogeneous outcomes that are innate to an SMI population.

The same data set was designed to also provide a rich source for further data mining, to address many specific issues concerning cognitive recovery and rehabilitation. The SCIT database is a portion of the larger collaborative database project, and the larger database is expected to become one of the largest outpatient SMI rehabilitation and recovery databases in the country. Treatment effectiveness, per se, is only one component in the overall goal of understanding the course of the illness and the individual variation at any given time or across any one life span. Thus, the SCIT outcome data and related neurocognitive and clinical data are being examined longitudinally for the purpose of this study. In addition to evincing support for the SCIT model, predictors of treatment response or variables related to change over time will be revealed and understood as highly relevant to the goal of creating individualized and

effective rehabilitation plans. The current study uses the archival data set that was originally collected during the pilot trial of SCIT (Kleinlein, 2010).

Participants

Participants are 40 adults with a diagnosis in the schizophrenia spectrum (schizophrenia or schizoaffective disorder), recruited from two different community-based adult day centers. All were recruited for the purpose of participating in the original SCIT pilot trial. Participants were assigned to the two treatment groups by the original PI (Kleinlein) using quasi-random assignment, in order to construct groups that were matched on social and cognitive functioning. An archival database was constructed with data obtained from these participants during the time frame of the trial.

Clinical measures and neurocognitive measures

*Brief Psychiatric Rating Scale (BPRS; Ventura et al., 1993).*The BPRS is a 24-item semi-structured interview, designed for repeated assessment of psychiatric symptoms in persons with severe mental illness. The ratings for the respective items are based on severity and/or frequency of reported or observed symptoms and range from 1 (not present) to 7 (extremely severe). Thus, the total score on the BPRS can range from 24 to 168, with higher scores indicating more severe psychopathology. Extensive factor analytic work has been done on the BPRS to identify separate symptom factors. In a confirmatory factor analysis, a 4-factor model of the BPRS (Mueser et al 1997), consisting of Thought Disorder, Anergia, Affect, and Disorganization, demonstrated longitudinal factorial invariance over a three-year period (Long & Brekke 1999) and is considered preferable to the 5-factor model for measuring the symptom structure of schizophrenia (Mueser et al., 1997). In the present study, the 4-factor BPRS structure was

used for all analyses examining psychiatric symptoms; this 4-factor structure is the most stable across different stages of the disorder (Kopelowicz, Ventura, Liberman, & Mintz, 2008).

*Neuropsychological Assessment Battery – Screening Module (NAB-Screener; Stern & White, 2003).*The NAB-Screener is designed to assess cognitive functioning in adults aged 18 to 97; it consists of subtests that target critical domains of cognitive functioning, including attention, language, memory, spatial abilities, and executive functioning, as well as a total score indicating the level of overall cognitive functioning.

*Trail Making Test – Trails A and B (Reitan & Davidson, 1974).*The Trail Making Test is a paper-and-pencil measure of visual processing and visuo-motor tracking (Lezak, 1995) and used to measure capacity for organization and speed of processing. Trails-A requires the participant to connect 25 numbered circles that are randomly spread across a sheet of paper in sequence during a timed administration (i.e. number 1 through number 25). Trails-Brequires the participant to connect a series of 25 randomly distributed dots on a sheet of paper containing numbers and letter in an alternating sequence (1-A-2-B-3-C etc.).Scores for both Trails A and B are based on the time in seconds it takes to correctly complete each task. Efficient performance on the Trail Making Test, especially Trails B, depends in part of facets of working memory and sufficient cognitive flexibility.

*Controlled verbal fluency task (FAS; Borkowski, Benton, & Spreen, 1967).*The FAS is a timed verbal fluency and generation test in which participants have 60 seconds to name as many words as possible that begin with a given letter, ‘F,’ ‘A’ and ‘S.’ The total number of correct words generated within the allotted 60 seconds for each of the three trials is added up and used as the final score.

*Letter-Number Sequencing (LNS; WAIS-III; Wechsler, 1997).*The LNS subtest of the WAIS is designed to assess attention and working memory. The test requires the participant to repeat back to the examiner, rearranged in order, increasingly longer sequences of letters and numbers. The participant is provided three trials for each length of stimuli (starting with 2 and increasing potentially to eight; the test is discontinued after the participant fails three consecutive trials of the same length. Each correctly manipulated sequence receives a score of 1, for a maximum score of 21.

Social cognition measures.

*Hinting Task (Corcoran, Mercer, & Frith, 1995).*The Hinting Task is a theory of mind (ToM) measure that consists of ten short vignettes involving two people and asks the participant to infer the intentions of one of the characters. Each vignette ends with one of the characters saying something to the other. After each vignette is presented, participants are asked a question regarding the characters intention (e.g. “What does George really mean when he says this?” or “What does Paul want Jane to do?”). Each vignette is read out loud to participants and available for participants to read through as many times as necessary. If participants cannot make an inference or arrive at an inappropriate solution, more detail is added to the interaction, giving a more obvious hint regarding the underlying meaning to the participants. Scores range from 0 to 2 per vignette (for a total score range of 0 to 20), with higher scores indicative of a better understanding of underlying intentions of the characters in the depicted interaction.

*Social Perception Scale (Garcia, Fuentes, Ruiz, Gallach, & Roder, 2003).*The SPS assesses participants’ abilities to = identify and interpret social cues in a photograph of a social interaction. Participants view four photographs depicting social scenes that

range in cognitive complexity and emotional content; participants are scored on their abilities to accurately identify stimuli (detail), interpret the images (narrative), and assign meaningful titles to the scenes (title). The Social Perception Detail, Narrative, and Title scores were summed across the four pictures for each of the three time points, as was the convention in the original utilization of the measure (Fuentes, Gallach, Ruiz & Roder, 2003).

*Face Emotion Identification Task (FEIT; Kerr &Neale, 1993).*The FEIT utilizes black and white still photographs of facial emotions developed by Ekman and Friesen (1976) and Izard (1971). It was administered in the computerized version consisting of 19 black and white still photographs presented for approximately 15 seconds each. Participants were asked to select which emotion is expressed immediately following each photograph (i.e. happy, sad, angry, surprised, afraid, and ashamed). The total number of correct answers was used as the final score for this task.

*Voice Emotion Identification Task (VEIT; Kerr &Neale, 1993).*The VEIT was administered in the computerized version consisting of 21 audio recordings of verbally presented statements with neutral content (e.g. “He tossed the bread to the pigeons;” “Fish can jump out of the water”). Participants were asked to choose the voice tone that best described each statement from a list of six basic emotions (i.e. happy, sad, angry, surprised, afraid, and ashamed). The total number of correctly identified items was used for the final score of this task.

*Benton Facial Recognition Test (BFRT; Benton, Hamsher, Varney, & Spreen, 1983).*The BFRT assesses participants’ ability to recognize facial expression details among a series of photographs. The task requires the participant to match target faces to a

corresponding face with varying degrees of complexity in visual setting and in the number of target faces. The task involves 22 trials; the first six trials consist of participants selecting one matching face photograph; the remaining trials ask participants to identify three correct matches from a total of six face photographs presented in different angles (i.e. the face changed in orientation or lighting conditions compared to the target photograph). The total number of correctly matched faces is summed as the total score (range: 0-54).

Bell Lysaker Emotion Recognition Task (BLERT; Bell, Bryson, & Lysaker, 1997). The BLERT is an affect perception task and was administered in its computerized version consisting of 21 short video clips. In each clip, an actor reads one of three neutral scripts, while displaying one of seven basic emotions (i.e. happy, sad, angry, afraid, surprised, ashamed, and neutral). After each clip, participants are asked to pick the emotion that best describes the actor in the video clip from a list of seven emotions. The total number of correctly identified emotions is used as the final score on this task.

Social Functioning Measures

*Social Functioning Scale (SFS; Birchwood, Smith, Cochrane, Wetton, & Copestacke, 1990).*The SFS is a 79-item self-report measure that assesses strengths and weaknesses in seven area of functioning: social engagement (e.g. “how much time do you spend alone?”); interpersonal communication (e.g. “how many friends do you have?”); activities of daily living (e.g. “how often do you prepare and cook a meal?”); recreation (e.g. “how often do you play a sport?”); social activities (e.g. “how often do you visit friends?”); competence at daily living (e.g. “how able are you to handle your own money?”);and occupation/employment (e.g. “are you in regular employment?”). Each

subscale provides a subscore, and a full-scale score is calculated by summing across all subscales, and higher scores indicate better social functioning (range: 0 - 246). The SFS is used as one of two separate measures of overall social functioning in this study, as the dependent or target or criterion variable in the multivariate analyses.

*Multnomah Community Ability Scale (MCAS; Barker et al., 1994).*The MCAS is a 17-item Likert-type scale designed to assess level of functioning in individuals with SMI. The scale is completed by the individual's community support worker or case manager and includes four subscales (interference with functioning, adjustment to living, social competence, and behavioral problems) and an overall (total) score of functioning (range 17-85). The items that compose the four subscales are each rated 1-5 (1 represents "very infrequently" or "very ineffectively" and 5 represents "almost always" or "very effectively" displaying the ability or attribute). Additionally, an average MCAS score was derived for each time point; it is the average across all items (range 1-5). The MCAS is the second of the two measures of overall social functioning in the role of criterion variable in the multivariate analyses.

Procedure

Potential participants were identified by staff in the day centers and then were approached by staff and given information about the study and the opportunity to enroll. After informed consent was obtained and HIPPA rules explained, the participants were selected into either one of two treatment groups: 1) first receiving SCIT and then TAU, or 2) first receiving TAU and then SCIT. Participants were selected rather than randomly assigned into treatment groups in order to maximize comparability between SCIT and TAU groups in terms of participant characteristics (e.g. age, gender). All participants,

regardless of treatment group completed both phases of the study and as such participate in SCIT treatment groups as well as the control (TAU) group, differing only in the sequence in which the phases were completed. This study enrolled a total 20 participants in each treatment condition, for a combined total of 40 participants. Previous pilot studies conducted by Penn and colleagues and an inpatient trial conducted by Combs and colleagues obtained significant study results with smaller samples (N=17 and N=18; Penn et al., 2007; Combs, Adams et al., 2007, respectively).

The assessments were administered to both groups at three time points: prior to treatment, following the first 20-session SCIT program, and following the second 20-session SCIT program (approximately 3months later). The assessments were conducted by graduate student research assistants.

Statistical Analyses

Analytical Rationale

Change over time is the fundamental indicator of treatment effectiveness and recovery. The goal of psychosocial rehabilitative techniques is improvement in social, cognitive, and behavioral functioning; persons are expected to move to an environment that fosters greater independence and less structural supports when they have acquired and demonstrated competency in many areas of social functioning and daily living and are presumed capable of functioning in a less restrictive environment. Modeling growth, rather than change, was chosen on the premise that within a day center that includes treatment modalities people are intended to improve, albeit at different rates and different optimal levels. In addition to the hypothesized overall improvement in interpersonal and

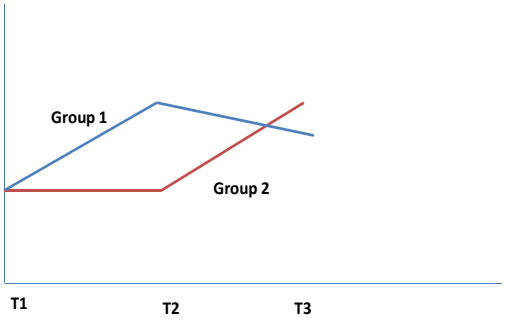
social cognitive functioning, within-person change is a fundamental exploratory goal of the current study.

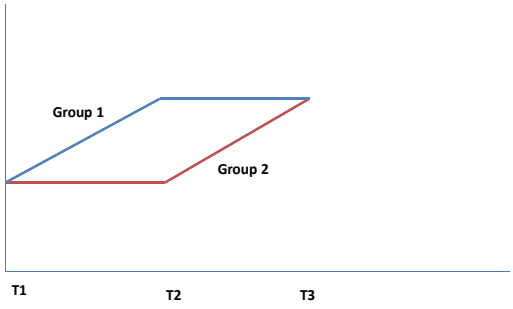
Multilevel modeling (MLM) was used to test the primary study hypotheses. Advances in longitudinal research suggest that modeling should begin on the individual subject level. This allows for the assessment of both intra-individual and inter-individual differences in change. The recommended approach is to model individual change across time and then examine the effects of covariates to see if there are systematic differences in rate of change (Snijders & Bosker, 1999).

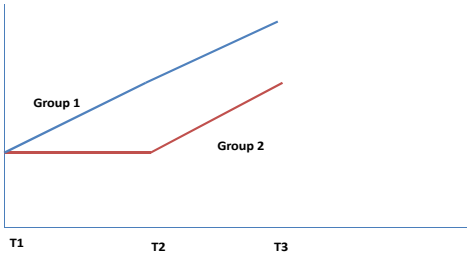
MLM involves modeling at two levels. At Level 1 each individual's scores on the functional outcome measures are regressed on time or a transformation of time. At Level 2, the Level 1 parameter estimates of the slope are treated as criterion scores and each is regressed on the covariates. Final estimates of the growth curve parameters for each individual are derived; this yields growth curve parameters for each individual that are a combination of the Level 1 and Level 2 estimates (Snijders & Bosker, 1999). In this study, there is interest in two primary covariates, neurocognition and social cognition. The central questions are whether these covariates are responsible for systematic differences in the intercept (the initial functional level at baseline) and in the growth curve rate (the magnitude of the slope of functional change over 6 months). Since the eventual goal of all social cognitive remedial efforts is improvement in social functioning, there are two primary criteria used in this study: two measures of social functioning (the MCAS and the SFS), both of which have several subscales to assess different domains of social functioning. The neurocognitive and social cognitive

measures are also used as criteria in some models, as necessitated by certain hypotheses about measure sensitivity and specificity.

Piecewise models are used to model change when individual change is expected to be explicitly discontinuous, or nonlinear (Singer & Willett, 2003). Piecewise models are ideal for an experimental design in which there are multiple baselines, or different groups of people receiving the active intervention at different times, and then experiencing periods of time with no intervention in which the research question is whether the treatment gains are maintained. Using piecewise models allows one to examine not only rates of change but also allows one to test for potential periods of acceleration, deceleration, turning points, and asymptotes. This is especially useful in the case of prolonged treatment effects, and gains that may maintain or may deteriorate with the passage of time. Figures 1-3 show alternate hypothesized piecewise trajectories.







Figures 1-3: Hypothesized Piecewise Linear Change Models

Data preparation and database compilation

Confidentiality of participants was protected and all identifying information removed as data was entered into the archival database. All participants were assigned a subject ID number (in lieu of name, date of birth, chart numbers, etc.) to represent them in the database. Once all the data was coded this way, it was entered into SPSS (SPSS, Inc., 2006) for the initial analyses of treatment effect (Kleinlein, 2010) and imported into SAS by the current author for MLM analyses.

The data were collected on three evenly spaced occasions over a six-month time period, in accordance with study design. All neurocognitive, social cognitive, clinical symptom, and social functioning measures were administered at each of the three time points. Time 1 preceded the SCIT intervention for Group 1 (SCIT then TAU) and preceded the waitlist condition for Group 2 (TAU then SCIT). Time 2 occurred at the conclusion of SCIT intervention for Group 1 and directly preceding SCIT intervention, following TAU, for Group 2. Time 3 assessment occurred at the conclusion of TAU for Group 1 and at the conclusion of SCIT intervention for Group 2. Although the assessments were conducted over a period of 6 months, at approximately 2 month intervals, exposure to SCIT (and not time, per se) was the most likely reason for changes in criterion scores, thus assessment occasion was used as the metric of time (as opposed to age or date). Assessment session was centered at the first occasion, such that the intercept represented initial status in all models.

To facilitate interpretation of main effects and interactions across levels of analysis, the effects were separated into between-person effects (i.e., whether or not a participant was higher or lower on a predictor at baseline, relative to other participants in

the sample) and within-person effects (i.e., whether a participant increased or decreased in a predictor relative to baseline). The initial scores on the social cognition and neurocognitive measures were represented by the baseline value of each predictor, which were then centered at their means to facilitate interpretation of the model intercepts and main effects. Changes in score on the predictor variables were represented as each person's deviation (change) from his or her own baseline value at each subsequent occasion.

Prior to transforming the database from a multivariate to stacked format, several variables were computed including: MCAS subscale scores for the four subscales for three time points; SPS subscale scores for the three subscales for three time points; SPS Total and SFS Total scores for the three time points; BPRS factor scores for the four factors for the three time points; and BLERT Total. The following variables were transformed from string to numeric and trimmed or corrected in the case of missing values, skewness or kurtosis: group, program, age, gender, education, study completion status, and Trails-B. Level-1 and Level-2 variables were computed for the 31 predictors.

The Level-2 time-invariant version represents the baseline centered score for each predictor. The Level-1 version represents the within-person effect, computed as the change from baseline for each person at each time point on each predictor. The time-invariant versions of the predictors were used in models to test differences between people, as were the demographic and individual characteristic variables (i.e., what's the difference between persons at the mean and those significantly above/below the mean, do they change at different rates over the course of treatment?).

Missing Data

For the MLM analyses, the PROC MIXED modeling approach was used under the *missing at random* (MAR) assumption. This is optimal because of the attrition and missing data; data are included for each person whohas complete data per each occasion, thus people are not disqualified from the analyses if they missed one occasion. The goal is to make valid inferences about the population parameters despite bias introduced by attrition; the goal is not to recover the missing data values. The models, therefore, represent the means and change rates according to the data that are present. Missing data points are not imputed.

Chapter 3: Results

The sample consisted of 40 individuals with a schizophreniform disorder (see Table 1). All participants were regular attendees at one of two adult day centers for persons with impaired functioning related to their mental illness. Almost two-thirds (65%, n = 26) of the original sample completed the entire study (attended all three assessment sessions and participated in the 20-session SCIT treatment); 77.5% (n = 35) completed two of the three assessment sessions; and 12.5% (n = 5) only participated in the first assessment session. The majority of participants were white (97.5%) and male (75%), about half had a legal guardian, all were unmarried, and the majority had completed high school or the equivalent. According to assessment on the Brief Psychiatric Rating Scale (BPRS) at the initiation of the study, the participants were not endorsing severe symptom levels; the BPRS scores ranged from 1 (*Not Present*) to 3 (*Mild*) on a scale of 1 to 7 *(Extremely Severe*). As illustrated in Table 1, the sample demographics and clinical symptom levels were consistent with a chronic SMI day program population.

Table 1
Demographic Information at Time 1 (*N* = 40)

	M (SD)	%
Completion of Study (beyond T1)		
All		65%
Part		22.5%
None		12.5%
Guardian (Yes)		47.5%
Gender (Male)		75%
Age	40.67 (12.8)	
Years of Education	12.26 (2.24)	
Received Special Education		2.5%
Marital Status (Single)		100%
Ethnicity		
White		97.5%
Hispanic American		2.5%
Axis I Diagnosis		
Schizophrenia-Paranoid type		25%
Schizophrenia-Chronic/Undifferentiated		32.5%
Schizoaffective Disorder		42.5%
Outpatient Program		
Southville		50%
Midtown		50%
BPRS		
Affect	2.31 (.85)	
Anergia	1.63 (.72)	
Disorganization	1.44 (.50)	
Thought Disturbance	1.69 (.83)	

Table 2
Descriptive Statistics for the neurocognitive, social cognitive, clinical symptoms, and functional outcome measures at baseline

	Time 1 (*N* = 40) M (SD)
NAB-Screener Total	443.20 (70.25)
Trails-B*	110.26 (64)
Letter-Number Sequencing	8 (4)
Controlled Verbal Fluency Task (FAS)	30.1(12.5)
Hinting Task	15
Benton Facial Recognition Test	40.57 (5.5)
Bell Lysaker Emotion Recognition Task	11.59 (4.3)
Facial Emotion Identification Test	11.44 (3.1)
Verbal Emotion Identification Test	9.93 (3)
Social Perception Scale	
Details	34.91 (12.8)
Narrative	7.8 (1.9)
Title	3.85 (1.9)
Total	46.56 (13.2)
*Brief Psychiatric Rating Scale**	
Affect	2.31 (.85)
Anergia	1.63 (.72)
Disorganization	1.44 (.50)
Thought Disturbance	1.69 (.83)
Multnomah Community Ability Scale	
Health	19.07 (3.9)
Adaptation	10.03 (2.8)
Social Skills	17.36 (4.4)
Behavior	17.33 (1.9)
Total	63.74 (11.8)
Social Functioning Scale	
Withdrawal/engagement	11.16 (2.3)
Interpersonal Communication	7.41 (1.6)
Independence-performance	30.52 (5.1)
Independence-competence	35.47(3.5)
Recreation	20.15(7.4)
Prosocial	21.57(9.5)
Employment/Occupation	5.64 (2.9)
Total	131.92 (21.5)

*Note: With the exception of Trails-B and the four BPRS factor scores, higher numerical scores indicate more positive/better functioning.

Linear mixed piecewise models were estimated using SAS PROC MIXED in order to test the overall pattern of and individual differences in the relation between neurocognition, social cognition, and social functioning outcome scores over three occasions during SCIT and TAU. Restricted maximum likelihood (REML) was used to report model parameters and assess the significance of random effects; denominator degrees of freedom were estimated using the Satterthwaite method. The 95% confidence interval (CI) for random variation around each fixed effect was calculated as ±1.96 standard deviations of its accompanying random variance term.

Hypothesis 1

The first hypothesis proposes that persons with higher initial levels of neurocognition and social cognition improve more and at a faster rate during SCIT than persons with lower baseline neurocognitive and social cognitive functioning levels. In order to examine the impact of baseline predictors, it was necessary to first include the dependent variables in unconditional models (no predictors) in order to examine individual trajectories and group means in the absence of moderation by other variables. The analyses are performed twice, once for the measure of overall social functioning based on clinician observation (the MCAS), and again for the measure based on self-report (the SFS).

Criterion Variable 1: *Multnomah Community Assessment Scale (MCAS)*

The intra-class correlation from the unconditional means model for MCAS (i.e. empty model, intercept only) was calculated as .86, indicating that 86% of the variance in MCAS Total scores over time can be attributed to between-person differences. Spaghetti plots of individual trajectories and group means on the MCAS social functioning measure

can be seen in Figures 4-6. Figures 4 and 5 show the two groups modeled separately and Figure 6 represents all study participants over the three time points. The unstructured saturated means model with both groups included indicates that there was significant change across the three time points in MCAS-Total scores ($p < .05$). Examination of Figure 6 reveals that in the best-fitting model, MCAS-Total increases somewhat steadily, reaching a maximum at Time 3.

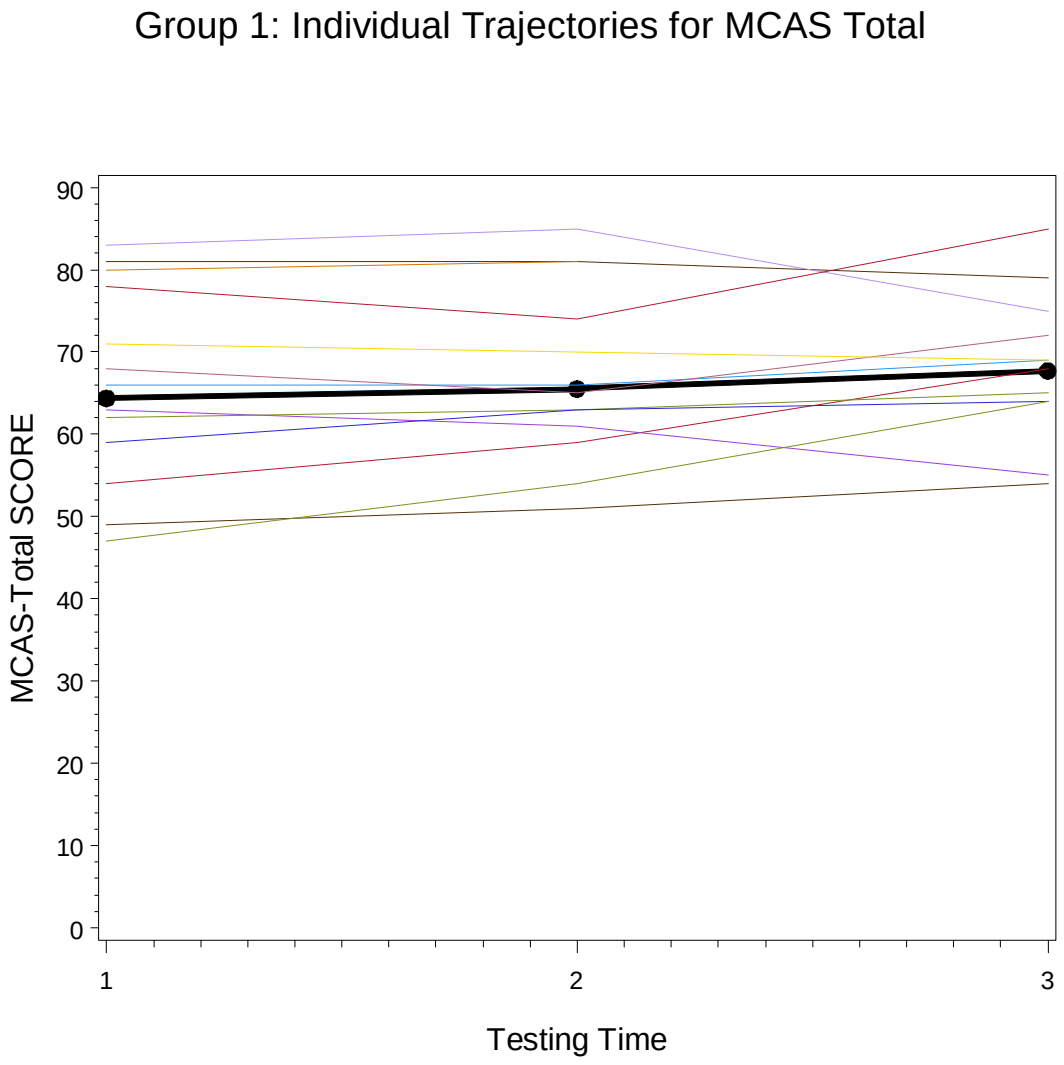


Figure 4: Group 1 MCAS-Total

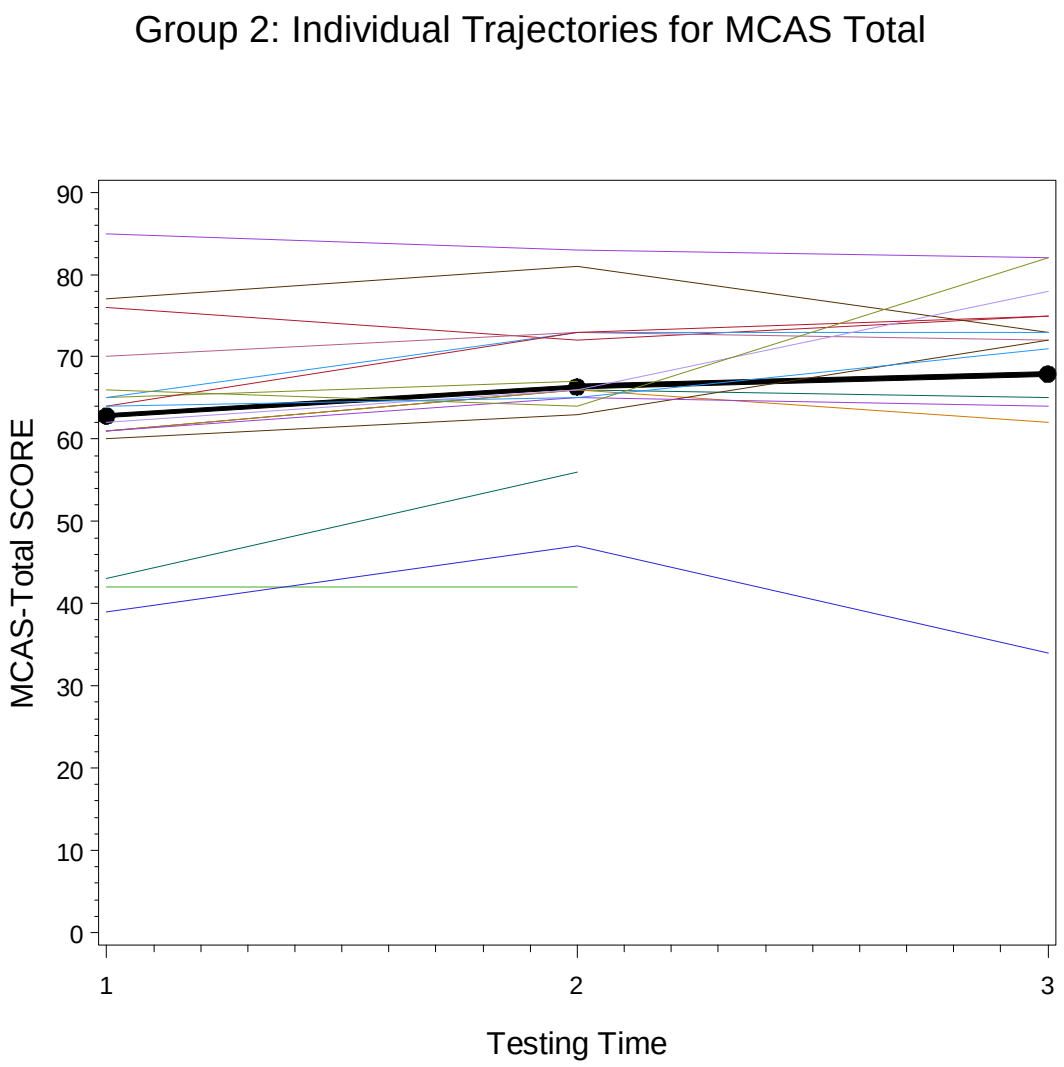


Figure 5: Group 2 MCAS-Total

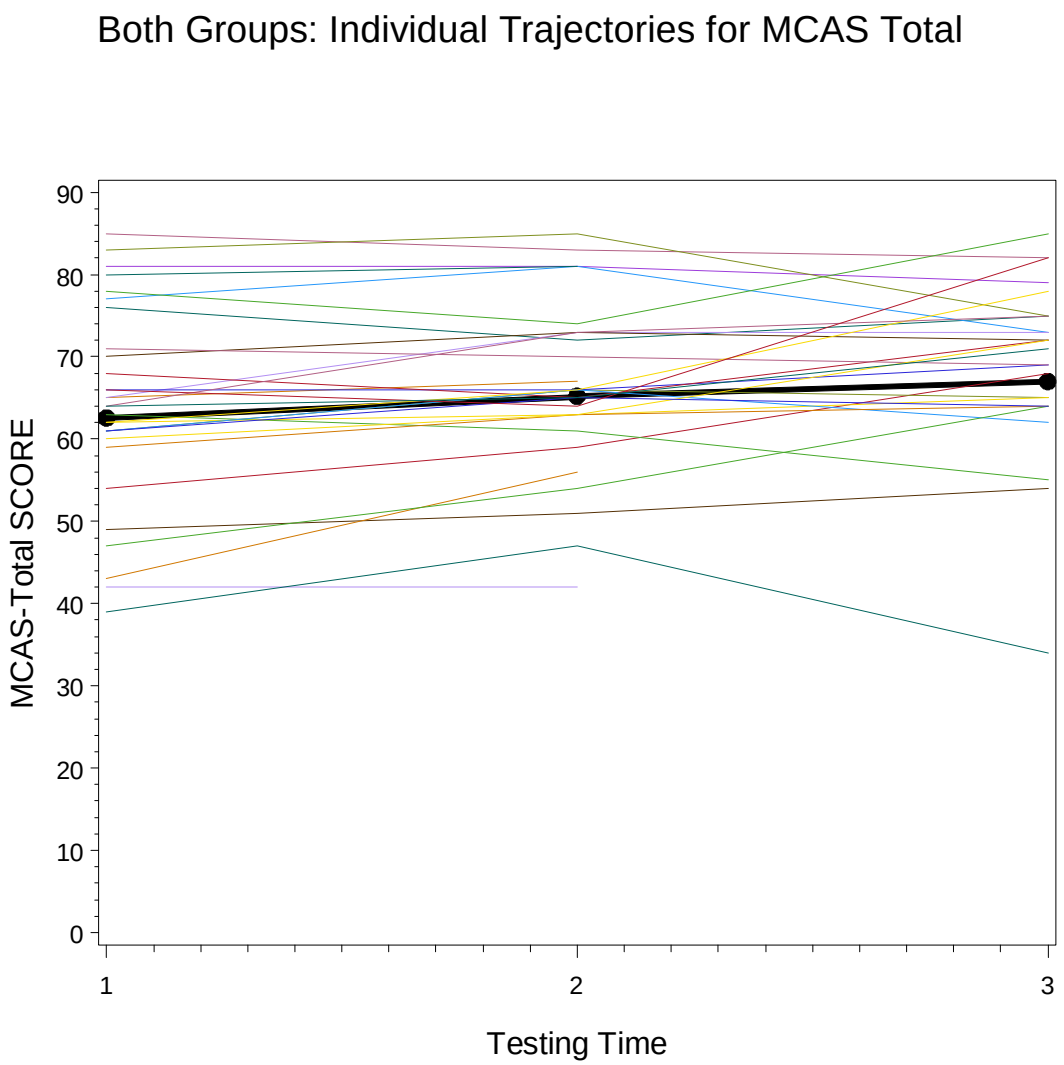


Figure 6: Both Groups MCAS-Total

1. *Unconditional Models*

In the next step of the analysis, unconditional piecewise models (i.e., without predictors) were estimated to describe the change across the three time points and specified with a random intercept only. In the random intercept only model (two fixed piecewise slopes), controlling for group, there were no significant interactions between group and slope so the interactions were removed from the model, thus allowing the

sample size to be doubled (entire sample) for the examination of main effects in the random intercept model. There was a significant effect of slope12 such that for persons in the SCIT 1st group, MCAS Total scores were expected to be 2.64 points higher at time 2 than time 1 (p = .023).The addition of a random slope between assessments 1-2 (as well as a covariance between the random intercept and slope), resulted in a model that was not significantly improved, REML deviance difference (2) = 4, p> .05.The AIC was slightly lower, although not significantly. A random slope was then added to the second piece of the model (time 2 to time 3) and the first slope was modeled as a fixed effect, controlling for group. The addition of a fixed first slope and random second slope resulted in a significant improvement to the model compared to the original model with two fixed slopes, REML deviance difference (2) =13, p<.01. This model indicated a pattern similar to the random intercept only model, in which MCAS Total scores increase over time with a significantly greater increase from time 1 to time 2 (p = .0019). A Compound Symmetry Heterogeneous model structure (each total variance estimated separately, with one constant covariance), controlling for group, was then added to the two slopes; this model was not a good fit and was significantly worse than the fixed first slope, random second slope model.

An unstructured piecewise model controlling for group was then evaluated, in which all the variances and covariances are allowed to vary. The addition of unequal correlations and varied variances and covariances across time (i.e., unstructured) evinced the best fit of the data, REML deviance difference (2) = 13,p<.01. The unstructured model evinced there was significant change across the three time points in MCAS Total

scores, and a significant slope12 indicating time 2 scores were 2.7 points higher than time 1 scores for persons in group 1 (*p*=.0007).

The model parameters from the unstructured unconditional two-piece model (i.e. without predictors) for MCAS Total, controlling for group, are shown in Table 3. The mean predicted MCAS Total score for the sample at time 1, according to the unconditional unstructured piecewise model, when controlling for group, was 64.39. The mean instantaneous linear rate of change from time 1 to time 2, controlling for group, was 2.7 points on the MCAS Total score for persons in group 1,the mean rate of change from time 2-3 was 1.97 points for persons in group 1.

Table 3
Parameter Estimates & Model Fit Statistics for Unstructured Piecewise Linear Model Controlled for Group; Dependent Variable: MCAS Total

Parameter	Piecewise Model		
	Estimate	SE	p-value
Fixed Effects:			
Intercept	62.13	2.69	<.0001
SLOPE12	2.70	0.72	.0007
SLOPE23	1.97	3.30	.1735
Variance Components:			
Intercept Variance	158.58	37.35	<.0001
Intercept-Session 1-2 Covariance	128.97	31.36	<.0001
Session 1-2 Variance	116.06	27.99	<.0001
Intercept-Session 2-3 Covariance	118.41	33.70	.0004
Session 1-2, 2-3 Covariance	97.91	28.75	.0007
Session 2-3 Variance	132.50	37.39	.0002
Model Fit:			
REML Deviance	623.2		
AIC	635.2		
BIC	645.2		
Total Number of Parameters	6		

In sum, the MCAS improved over the study period, but most of the change appears attributable to Group 1 improving during the first period, when that group was receiving SCIT. Group 2 does not show significant change on MCAS Total over time. Contrary to expectation, this pattern is consistent with an effect of SCIT on MCAS in Group 1 but not Group 2. Inadvertent differences between the two groups may therefore provide clues about factors that moderate SCIT effects on social functioning as rated by a case manager. Alternatively, an uncontrolled factor may have inhibited SCIT effects in the second treatment period.

2. Conditional Models

To test the first hypothesis, that baseline neurocognition and social cognitive functioning predict change in social functioning, conditional piecewise models (i.e., with predictors) were estimated with the various predictors.

Neurocognitive Measures

In order to test the hypothesis that baseline neurocognition moderated change over time, relevant predictor variables were added to the unstructured piecewise model. The first time-invariant neurocognitive predictor was Trails-B; this score represents time in seconds that it took the participant to complete the test of executive functioning. The Trails-B variable had some extreme outliers causing positive skewness; it was trimmed such that two scores more than 2 standard deviations above the sample mean were removed. The trimmed time-invariant baseline version of the Trails-B predictor for each person was centered at the overall mean (N = 40) of 110.26(SD=64.3; Min=47; Max=352). The centered Trails-B predictor was added to the unstructured piecewise model, controlling for group, as a main effect and interaction with the slopes. According

to p-value significance testing, the time-invariant Trails-B did show a significant main effect such that for each second above the mean on Trails-B at baseline, the baseline MCAS Total score was decreased by 0.11 points (p = .0002). Additionally, there was a significant interaction between the Trails-B time-invariant variable and Slope12 such that each point above the mean on Trails-B (poorer performance) indicated a .035 increase in the positive rate of change over time in MCAS Total points from time 1 to time 2 (p = .002).Since Time 1 to Time 2 included SCIT for half the sample and TAU for the other half, the Trails-B link to MCAS improvement cannot be interpreted as moderation of the SCIT effect. Instead, either 1) the first time period was different than the second in some other way pertinent to the link between cognitive and social functioning, or 2) Trails-B has a limited time frame of prediction of MCAS change that does not extend beyond the 6 weeks between assessments. Neither accounts for the finding of poorer Trails-B performance predicting more positive MCAS change, contrary to prediction. This is not counterintuitive, however. The lower Trails-B at Time 1 may indicate greater room for change, and hence larger positive change in the MCAS.

As can be seen in Figure 7, the estimated means for MCAS-Total for both groups combined, with Trails-B added as a main effect and interaction, indicate slight increase during the first time period and no significant change in MCAS-Total scores during the second time period. The figure includes three lines to represent participants that scored at the group mean on Trails-B (“Mean”); participants that scored above the group mean (worse performance; “1 SD above mean”); and participants that scored below the group mean on Trails-B (higher functioning; “1 SD below mean”). This same convention is used for all the figures within Hypothesis 1 (i.e., graphically representing persons who

scored at the group mean level on the predictor variable, as well as persons who scored 1 standard deviation above and below the group mean).

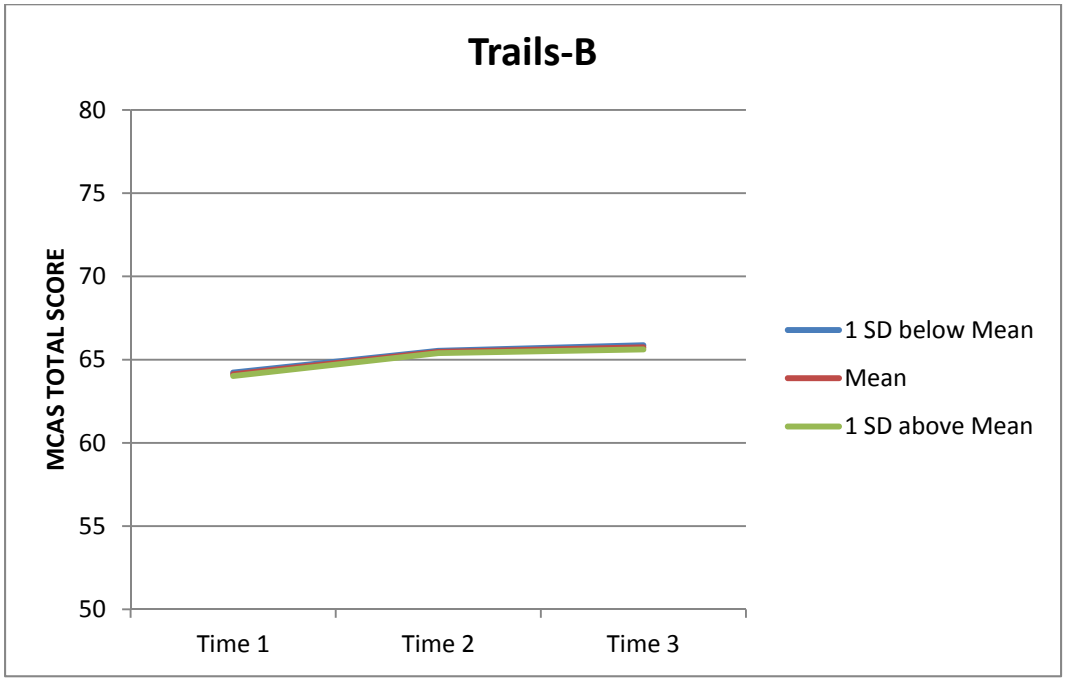


Figure 7: MCAS Total by Baseline Trails-B (Controlling for Group)

The NAB-Screener Total score (NAB-S) was the next neurocognitive predictor added to the MCAS-Total unstructured piecewise model. The NAB-S score was derived from the sum of the scores on the five NAB modules (Executive Functions, Memory, Attention, Spatial, and Language) and then centered at its overall mean for time 1 (N = 40) of 443.20(SD=70.25; Min=268; Max=575).The centered NAB-S predictor was added to the unstructured piecewise model, controlling for group, as a main effect and interaction with the slopes. According to p-value significance testing, the time-invariant NAB-S did have a significant main effect such that each point above the mean on NAB-Sat baseline, the baseline MCAS-Total score was increased by 0.1 point (p<.0001). Additionally, there was a significant interaction between the NAB-S time-invariant variable and Slope12 such that persons with higher (less impaired) scores on NAB-Shad

a less positive rate of change in MCAS-Total from Time 1 to Time 2 was (p = .011). In Figure 8, persons that scored at least 1 standard deviation below the group mean ("1 SD below mean") have the lowest MCAS-Total scores across time, compared to persons that scored at the group mean or higher. This is consistent with the Trails-B finding; persons with lower scores (poorer performance) at baseline improved at a faster rate during the first time period, but the second time period is outside the scope of the prediction.

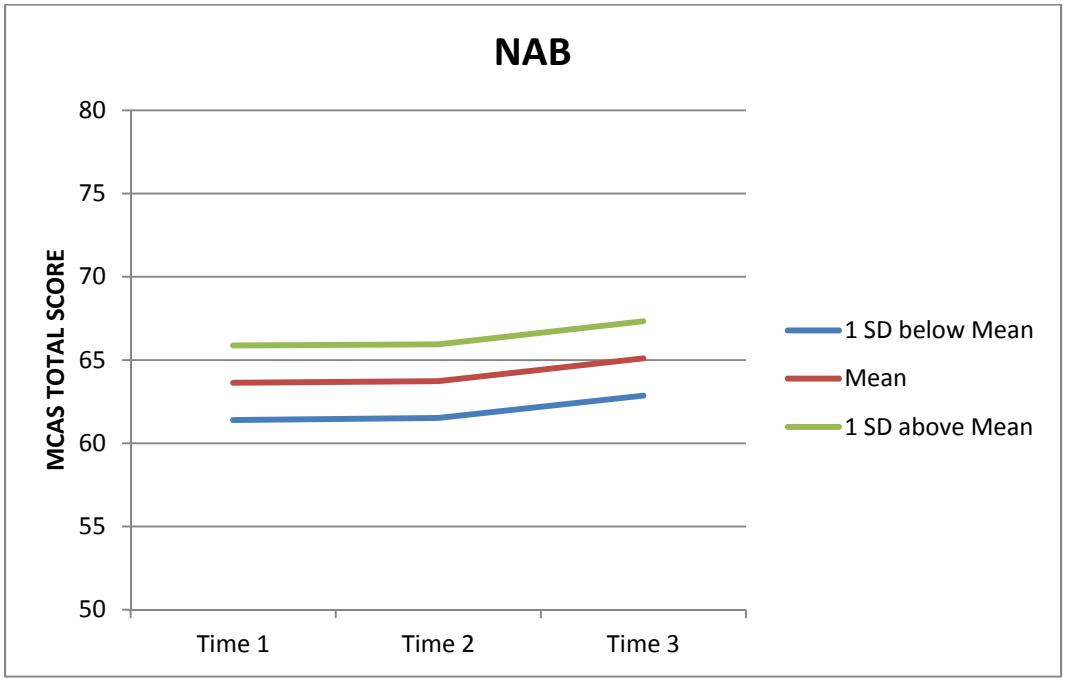


Figure 8: MCAS-Total by Baseline NAB-Screener Total (Controlling for Group)

The Letter-Number subtest score (LNS) was the next neurocognitive predictor added to the MCAS-Total unstructured piecewise model. The LNS score represents the total number of correctly remembered and manipulated letter-number sequences out of a maximum possible score of 21. The LNS score was centered at its overall mean for Time 1 (N = 40) of 8(SD=4; Min=2; Max=17).The centered LNS predictor was added to the unstructured piecewise model, controlling for group, as a main effect and interaction with the slopes. According to p-value significance testing, the time-invariant LNS did have a

significant main effect such that each point above the mean on LNS at baseline, the baseline MCAS-Total score was increased by 1.62 points (p= .002). Additionally, there was a significant interaction between the LNS at baseline and Slope12 such that for each point above the mean (better performance) on LNS, the rate of change in MCAS Total from Time 1 to Time 2 was less positive by .44 (p = .024). This is the same trend during the first time period as that observed on Trails-B and NAB-S.

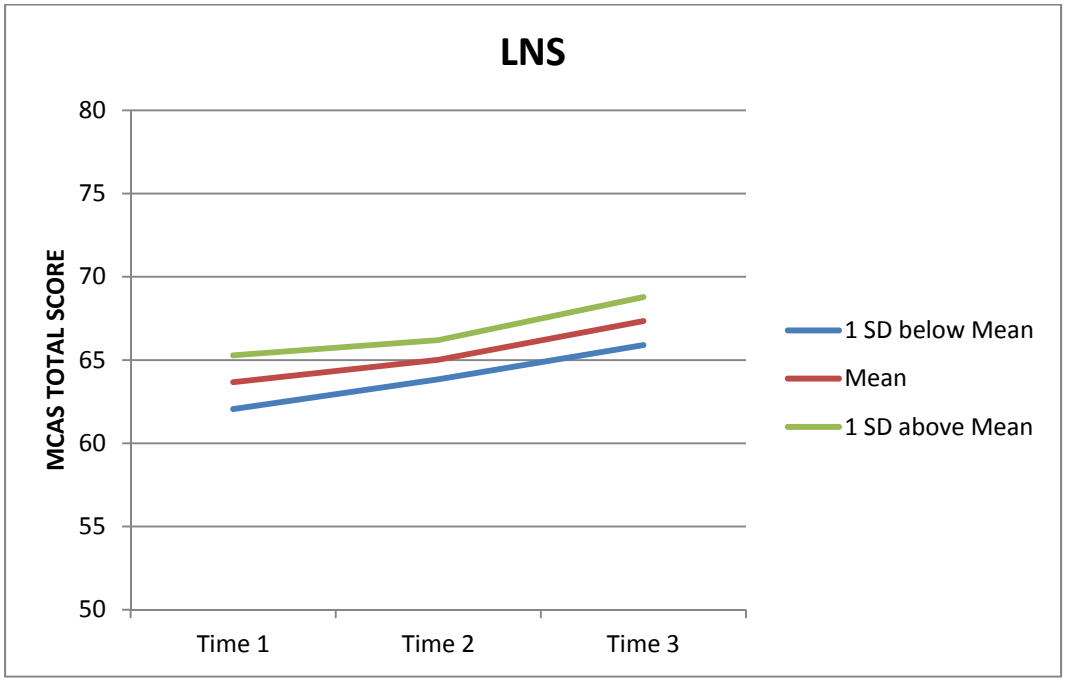


Figure 9: MCAS-Total by Baseline LNS (Controlling for Group)

The Controlled Verbal Fluency Task (FAS) score was the next neurocognitive predictor added to the MCAS-Total unstructured piecewise model. The FAS score represents the total number of appropriately generated words within the three 60-second allotted time periods. The FAS score was centered at its overall mean for Time 1 (N = 40) of 30.1(SD=12.5; Min=9; Max=62).The centered FAS predictor was added to the unstructured piecewise model, controlling for group, as a main effect and interaction with the slopes. According to p-value significance testing, the time-invariant FAS score did

have a significant main effect such that for each point above the mean (better performance) on FAS at baseline, the baseline MCAS-Total score was increased by 0.4 points (*p*= .0094). Additionally, there was a significant interaction between the FAS time-invariant variable and Slope12 such that each additional point above the mean on FAS (better performance)predicted the rate of change in MCAS-Total from Time 1 to Time 2 was less positive by .14 (*p* = .016). This is the same trend as in the three previous neurocognitive predictors; rate of improvement is less positive for persons with higher scores at baseline.

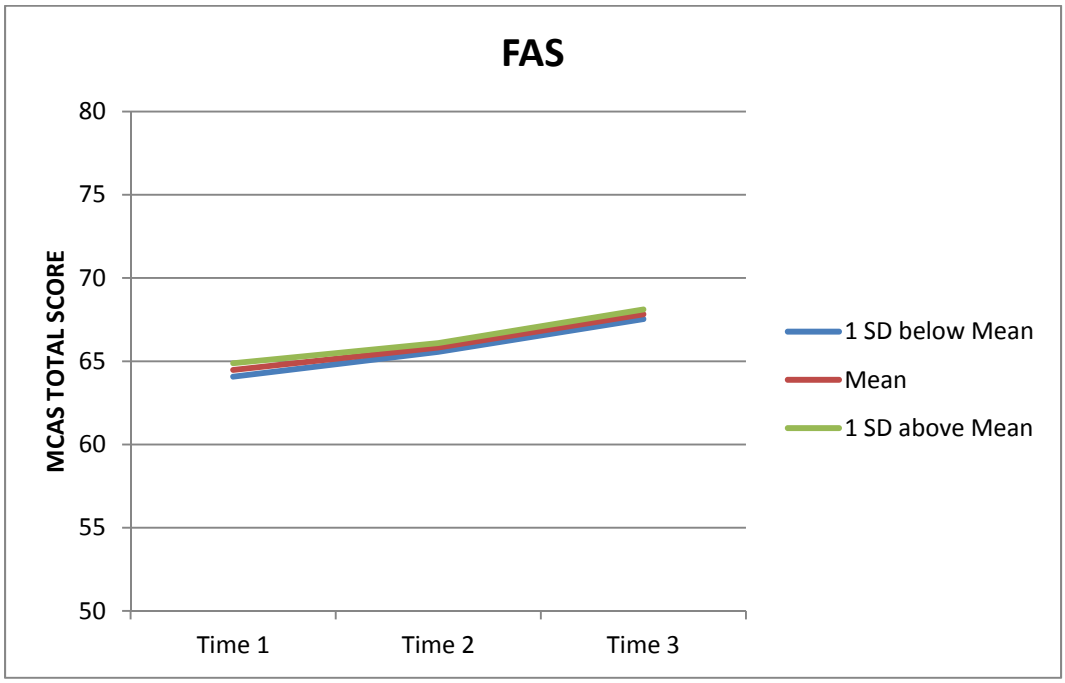


Figure 10: MCAS-Total by Baseline FAS (Controlling for Group)

Social Cognitive Measures

The Social Perception Scale-Total score (SPS) was the added to the MCAS-Total unstructured piecewise model as a time-invariant social cognitive predictor. The SPS-Total score was derived from the sum of the three subscores of the SPS measure (Detail, Narrative, and Title) and then centered at its overall mean for Time 1 (N = 40) of

46.56(SD=13.17; Min=15; Max=97).The centered SPS-Total predictor was added to the unstructured piecewise MCAS-Total model, controlling for group, as a main effect and interaction with the slopes. According to p-value significance testing, the time-invariant SPS-Total did have a significant main effect such that for each point above the mean on SPS-Total at baseline (better functioning), the baseline MCAS-Total score was increased by 0.32 points (*p*= .020). There were no significant interactions between the SPS-Total time-invariant variable and either slope.

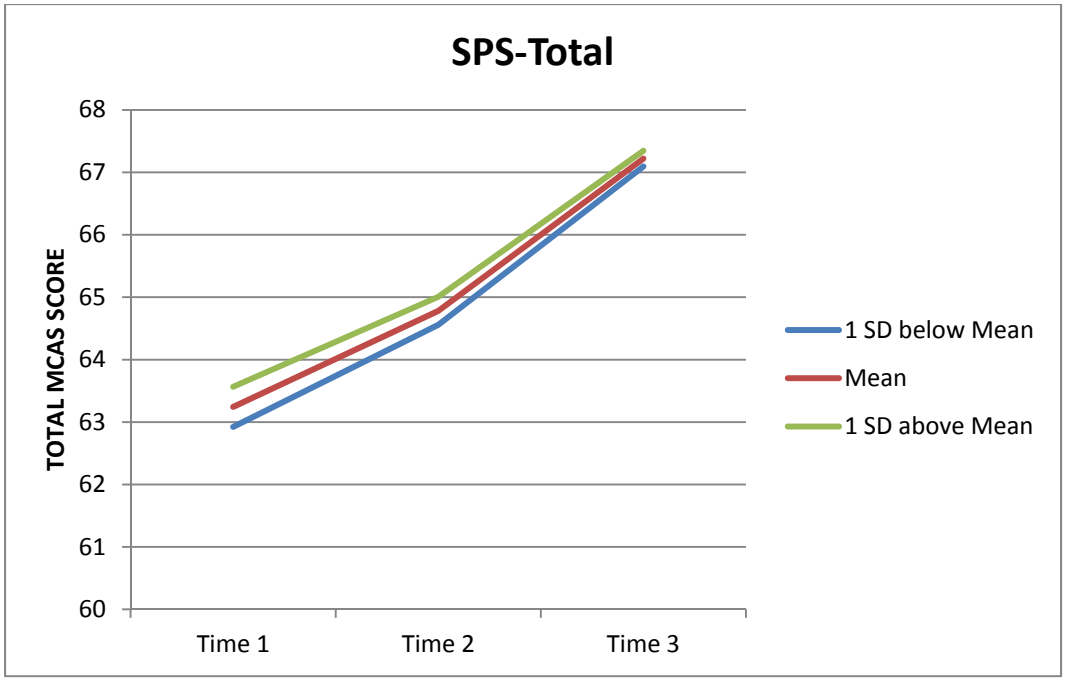


Figure 11: MCAS-Total by Baseline SPS-Total (Controlling for Group)

The Facial Emotion Identification Task (FEIT) was added to the MCAS-Total unstructured piecewise model as a baseline social cognitive predictor. The time-invariant FEIT score represents the number of correctly identified facial emotions, out of a total of 19 possible points. It was centered at its overall mean for Time 1 (N = 40) of 11.44(SD=3.14; Min=2; Max=17).The centered FEIT predictor was added to the unstructured piecewise MCAS model, controlling for group, as a main effect and

interaction with the slopes. According to p-value significance testing, the time-invariant FEIT did have a significant main effect such that for each point increase on FEIT scores (better performance) were associated with an average increase of 1.41 points on the MCAS Total score (p = .0325). There was also a significant interaction between the FEIT and Slope12 such that higher scores on the FEIT were associated with a less positive rate of change from Time 1 to Time 2 (p = .018). This is the same trend as observed on the neurocognitive predictors- higher baseline performance predicts less improvement during the first time period.

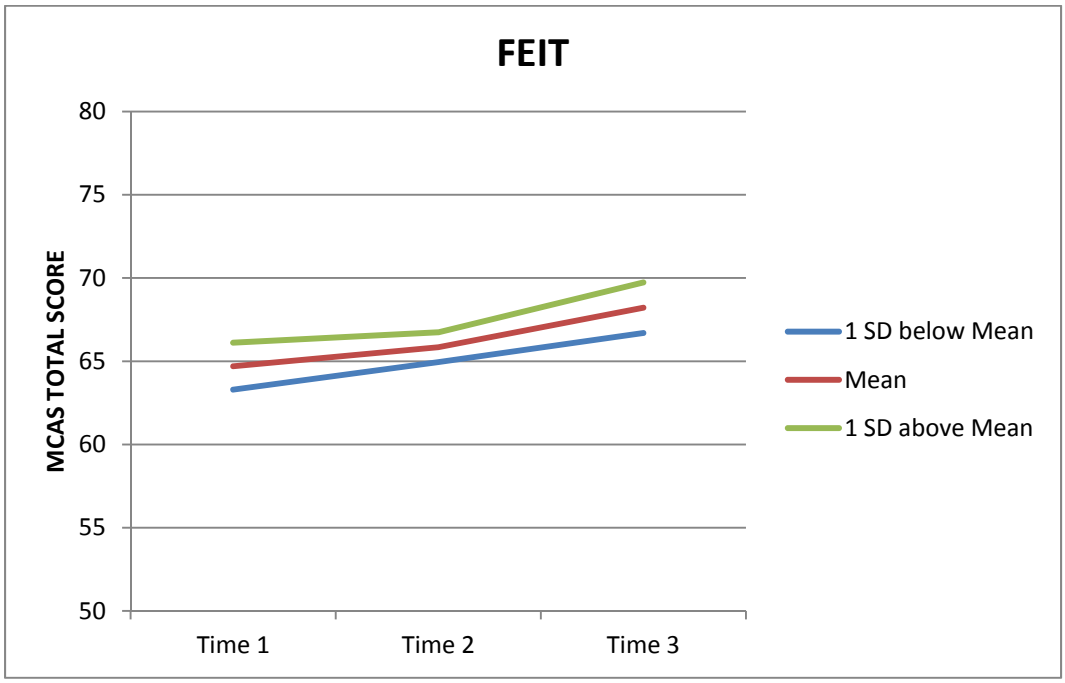


Figure 12: MCAS-Total by Baseline FEIT (Controlling for Group)

The Vocal Emotion Identification Task (VEIT) was added to the MCAS-Total unstructured piecewise model as a baseline social cognitive predictor. The time-invariant VEIT score represents the number of correctly identified facial emotions, out of a total of 21 possible points. It was centered at its overall mean for Time 1 (N = 41) of 9.93 (SD=3; Min=3; Max=16).The centered VEIT predictor was added to the unstructured piecewise

MCAS model, controlling for group, as a main effect and interaction with the slopes. According to p-value significance testing, the time-invariant VEIT did have a significant main effect such that a 1-point increase above the mean on the VEIT (better performance) was associated with an average increase of 1.54 points on the MCAS-Total score (p = .0193). There was also a significant interaction between the VEIT and Slope12 such that higher scores on the VEIT were associated with a less positive rate of change from Time 1 to Time 2 (p = .0392). This is the same pattern as that observed on previous social cognitive measures- higher scores predicted less positive change during the first time.

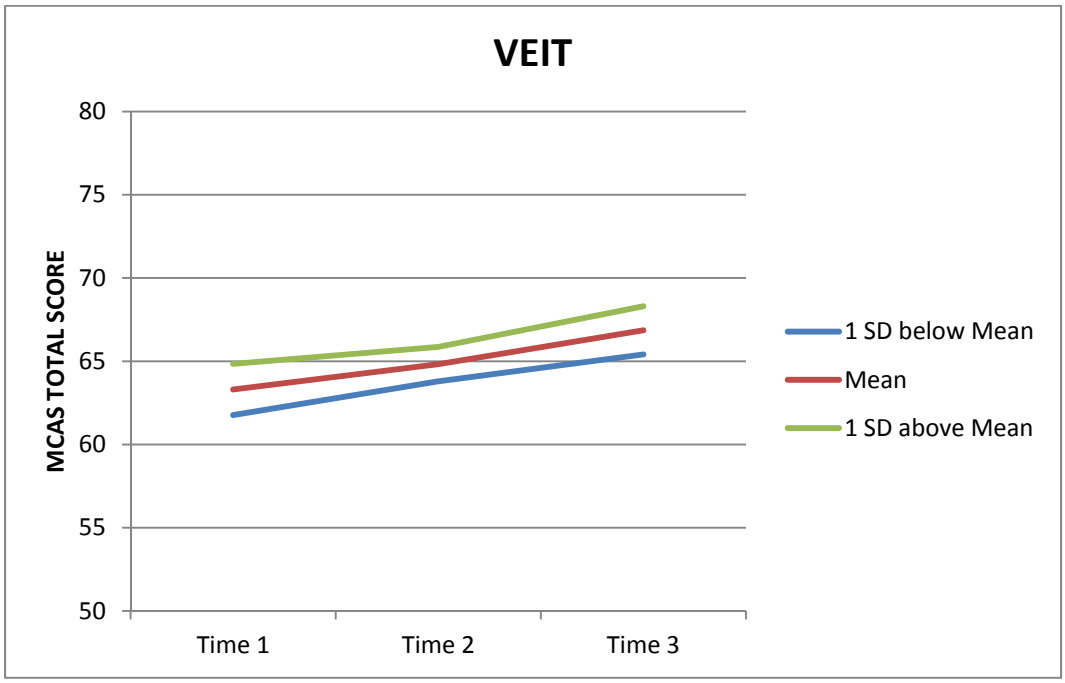


Figure 13: MCAS-Total by Baseline VEIT (Controlling for Group)

The Hinting Task was the next social cognitive predictor added to the MCAS-Total unstructured piecewise model. The Hinting Task score represents the number of correctly interpreted vignettes, out of a maximum of 20 possible points. The Hinting Task score was centered at its overall mean for Time 1 (N = 41) of 15(SD=4; Min=4; Max=20).The centered Hinting Task predictor was added to the unstructured piecewise

model, controlling for group, as a main effect and interaction with the slopes. According to p-value significance testing, the time-invariant Hinting Task did have a significant main effect such that each additional point on the Hinting Task score(better performance) predicted the baseline MCAS Total score to increase by 1.56 points (*p*= .0003). There were no significant interactions between scores on the Hinting Task at baseline and either slope. Although the Hinting Task was a significant predictor of baseline MCAS Total scores, it did not have the same mediating effect as the previous social cognitive predictors during the first time period.

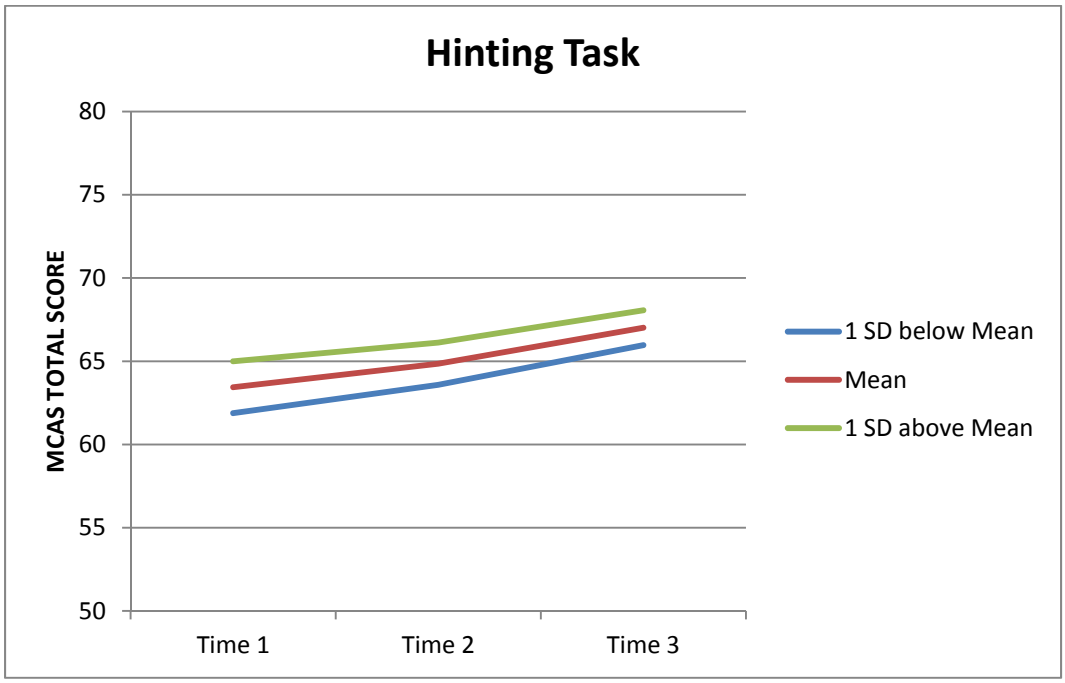


Figure 14: MCAS-Total by Baseline Hinting Task (Controlling for Group)

The Benton Facial Recognition Task (BFRT) requires participants to notice details in photographs of facial expressions and correctly match corresponding faces; the number of correctly matched faces is summed as the total score for the task. The BFRT time-invariant Time 1 variable was centered around its mean (N = 41) of 40.57 (SD=5.53; Min=29; Max=51) before being added to the unstructured piecewise model for

MCAS-Total, controlled for group. The BFRT score did not have a main effect on the unstructured piecewise model for MCAS; however, it did have a significant interaction with the first slope such that higher scores on the BFRT at baseline (better performance) were associated with a less positive rate of change than between Time 1 and Time 2, compared with persons with lower scores on the BFRT (p = .0228). The BFRT did not have a main effect at baseline but it did show the same pattern during the first time period in which higher scores (better performance) at baseline predicted less positive change.

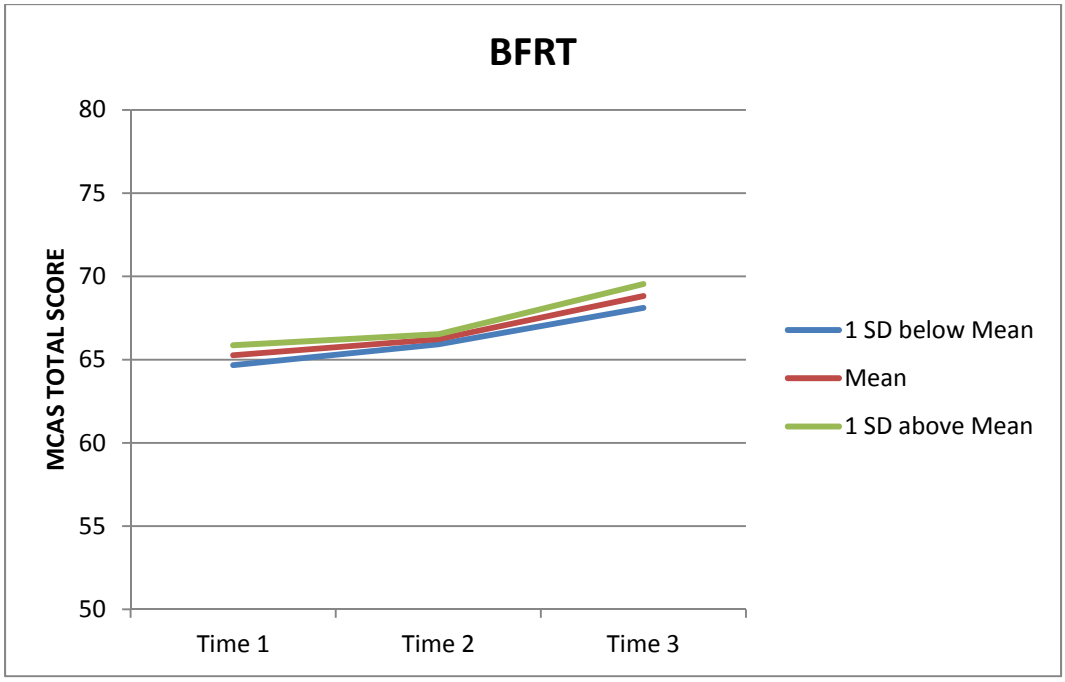


Figure 15: MCAS-Total by Baseline BFRT (Controlling for Group)

In summary, the analyses associated with the first hypothesis, using the MCAS as the criterion variable, show that social functioning did improve over the course of the study, although most of this improvement was associated with one group in one time period. All but one of the cognitive measures (the exception is the Hinting Task) predicts overall social functioning in the expected direction. In addition, all but one of the sociocognitive measures (the exception is the Social Perception Scale) predict at baseline

the MCAS rate of change over the first treatment period. The direction of prediction is unexpected but not counterintuitive; poorer performance at baseline predicts a steeper rate of positive change over the following 6 weeks. However, the pattern of change over time does not support the hypothesis that the link between the baseline cognitive variables and rate of MCAS change represents moderation of the SCIT treatment effect.

Criterion variable 2: *Social Functioning Scale (SFS)*

The intra-class correlation from the unconditional means model for SFS (i.e. empty model, intercept only) was calculated as .65, indicating that 65% of the variance in SFS-Total scores over time can be attributed to between-person differences. Spaghetti plots of individual trajectories and group means on the SFS social functioning measure can be seen in Figures 16-18. Figures 16 and 17 show the two groups modeled separately and Figure 18 represents all study participants over the three time points. The unstructured saturated means model with both groups included indicates that there was significant change across the three time points in SFS-Total scores ($p < .05$). Examination of Figure 18 shows that there was a significant decrease at Time 2, followed by a significant increase at Time 3. The SFS shows a pattern different from the MCAS. Observation of the figures suggests that Group 1 contributes mostly to the overall effect of time; however the effect is in the opposite direction as the expected treatment effect (i.e., Group 1 decreases in performance during the first time period), Also, there is no significant effect of group in the SFS models, likely due to a power problem.

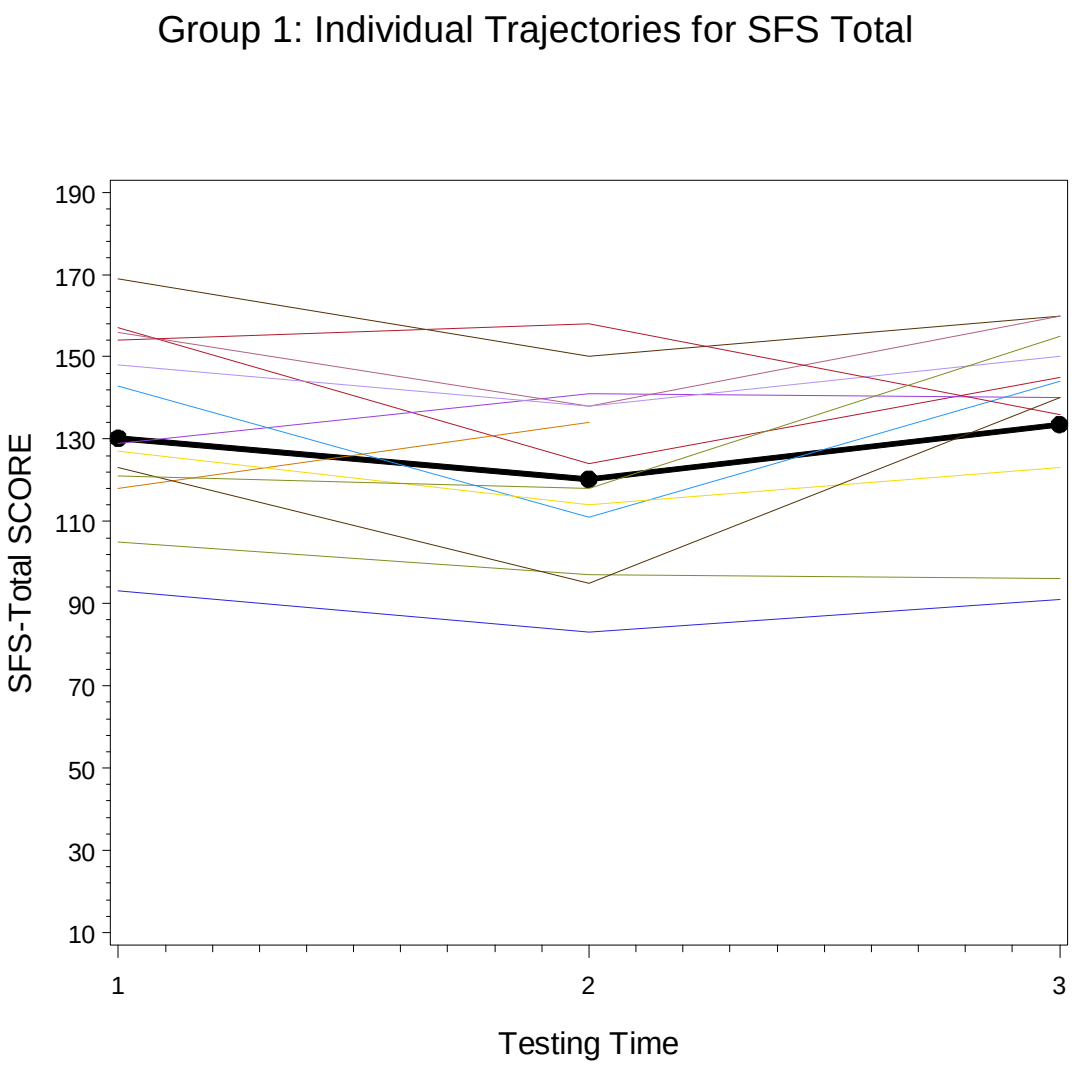


Figure 16: Group 1 SFS-Total

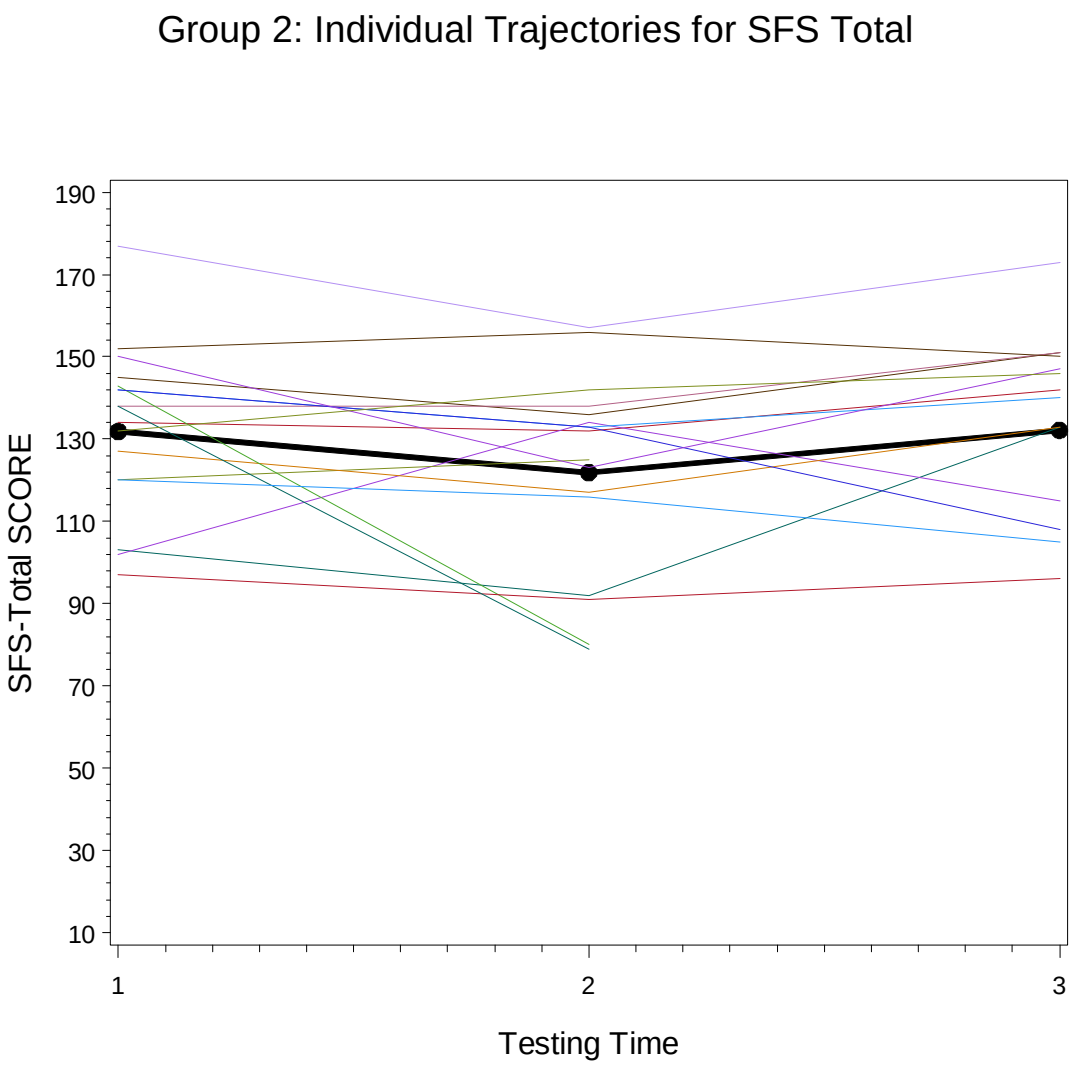


Figure 17: Group 2 SFS-Total

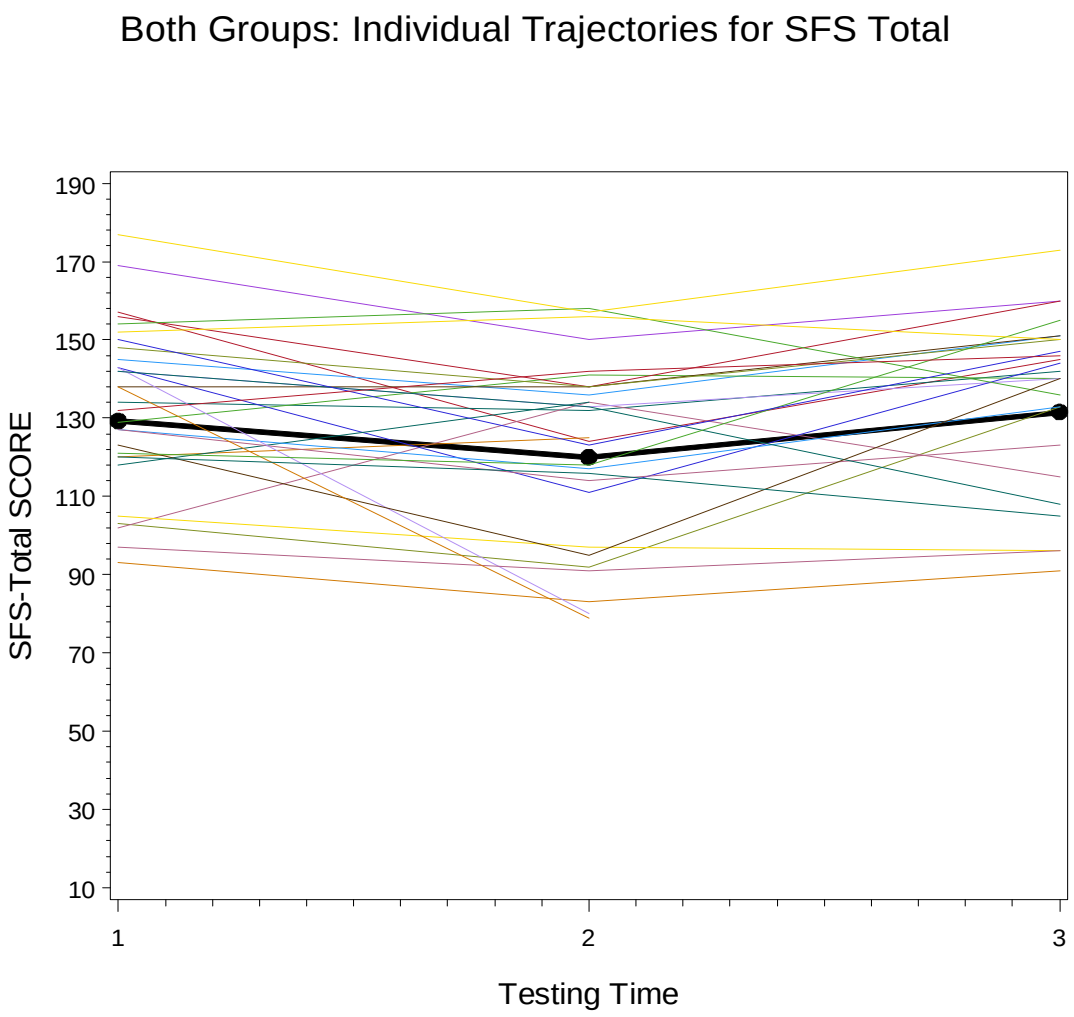


Figure 18: Both Groups SFS-Total

1. *Unconditional Models*

An unstructured piecewise model for SFS, controlling for group, was then evaluated, in which all the variances and covariances are allowed to vary. The unstructured piecewise model evinced there was significant change across the three time points in SFS-Total scores; there was a significant Slope12 indicating Time 2 scores were 9.3 points lower (worse performance) than Time 1 scores (p =.014), and Time 3 scores were 11.8 points higher than Time 2 scores (p =.008). Both groups showed the same

pattern on this measure although Group 1 scores were slightly higher at the three time points than were Group 2 scores.

The model parameters from the unstructured unconditional two-piece model (i.e. without predictors) for SFS-Total, controlling for group, are given in Table 4. The mean predicted SFS-Total score for the sample at Time 1, according to the unconditional unstructured piecewise model, when controlling for group, was 130.14. The mean instantaneous linear rate of change from Time 1 to Time 2, controlling for group, was a 9.3 point decrease on the SFS Total score, and the mean rate of change from time 2-3 was an 11.82 point increase.

Table 4
Parameter Estimates & Model Fit Statistics for Unstructured Piecewise Linear Model Controlled for Group; Dependent Variable: SFS Total

Parameter	Piecewise Model		
	Estimate	SE	p-value
Fixed Effects:			
Intercept	130.14	4.99	<.0001
SLOPE12	- 9.26	3.57	.0145
SLOPE23	11.82	4.03	.0084
Variance Components:			
Intercept Variance	489.05	113.26	<.0001
Intercept-Session 1-2 Covariance	328.52	110.63	.0030
Session 1-2 Variance	561.91	149.11	<.0001
Intercept-Session 2-3 Covariance	376.15	106.43	.0004
Session 1-2, 2-3 Covariance	286.86	116.50	.0138
Session 2-3 Variance	472.69	125.06	< .0001
Model Fit:			
REML Deviance	799.1		
AIC	811.1		
BIC	821.1		
Total Number of Parameters	6		

2. *Conditional Models*

To test the first hypothesis that baseline neurocognition and social cognitive functioning would predict change in social functioning, conditional piecewise models for SFS-Total were estimated with the neurocognitive and social cognitive predictors. However, although the slopes were significant in many of the models (directionally identical to the unconditional model), none of the predictors had significant main effects or interactions with the slopes in the SFS unstructured piecewise model. Thus piecewise model statistics will not be reported for each predictor. Examination of the plots of the majority of SFS conditional models resemble the patterns observed when Trails-B was included as the independent variable (see Figure 19); the baseline predictors did not predict baseline SFS scores or change in SFS scores over time.

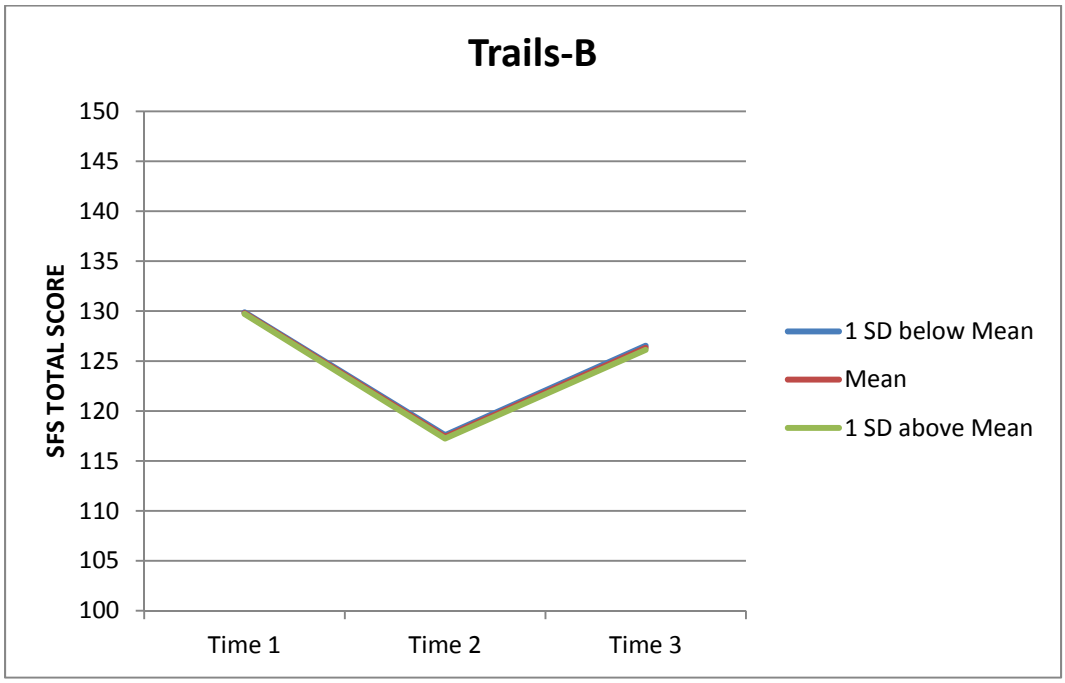


Figure 19: SFS-Total by Baseline Trails-B (Controlling for Group)

To summarize the evaluation of the first hypothesis using the SFS as the criterion variable, the SFS showed change over time very different from that of the MCAS. While

the MCAS showed gradual improvement, the SFS showed a pronounced decrease during the first treatment period and a partial recovery during the second period. As with the MCAS, Group 1 appears to contribute disproportionately to this pattern. The cognitive and social cognitive measures at baseline do not predict baseline SFS or rate of change. The SFS is a self-report measure, unlike the MCAS which is assessed and scored by a mental health technician, thus it is likely that the observed decrease at Time 2 in social functioning is a product of involvement in the study and participants' heightened awareness to functional deficits.

Hypothesis 2

The second hypothesis states that treatment effects are maintained over the passage of time, in the absence of treatment. It was expected that recency of SCIT participation is a significant factor in predicting the maintenance of treatment gains.

Analysis of this hypothesis cannot be straightforward since neither of the groups had unequivocal gains while in SCIT treatment. Contrary to hypothesis, some of the gains were made during TAU; additionally, the SFS results suggest decreases in social functioning, during SCIT treatment. Furthermore, the group by time interaction was not significant, indicating there were no clear group differences during either of the time periods. Thus, there is not sufficient rationale to compare Time 3 to Time 2 for Group 1 (i.e., TAU following SCIT) to explore for maintenance or loss of treatment gains since treatment gains were arguably not present, or inconsistently present. A more useful analysis appears to be overall patterns of change across measures and across groups, which can be addressed through hypotheses three and four.

Hypothesis 3

The third hypothesis sought to assess whether some assessment measures are more sensitive to change over time than others. In order to test this hypothesis, each of the neurocognitive and social cognitive measures (previously used as predictors) were computed into a format to be modeled as criterion variables in unstructured piecewise longitudinal models. When the neurocognitive and social cognitive measures were modeled as predictors, the baseline scores, centered at the group mean were added to the models (i.e., Hypothesis 1). In order for the predictors to act as dependent variables (i.e., Hypothesis 3), a third version of each variable was computed that was time-variant and not centered, such that each person's score at each of the three occasions on each measure is used as the outcome variable for the model. A model was analyzed for each dependent variable. The subscales of the multi-scalar measures (MCAS, SFS, and SPS) were each modeled independently. Of the 31 measures, ten measures did show significant change over time (see Table 5). Trends for each measure with means estimated separately for the two groups can be viewed in Figures 20-30. In this study, statistical significance is not the focal point and general patterns and trends over time can be observed in the relevant variables.

Table 5
Predicted slopes for variables that change over time

		Group 1 (SCIT 1st)		Group 2 (TAU 1st)	
Measure	ICC	Slope 12	Slope 23	Slope 12	Slope 23
MCAS-Total	.86	+1.20	+2.34	+3.51**	+1.50
MCAS-Health	.80	+0.28	+0.45	+2.00**	+0.002
MCAS-Behavior	.71	+0.37	-0.07	+ 0.77*	-0.74
SFS-Recreation	.54	-2.80	+5.03**	-0.03	+2.42
SFS-Prosocial	.51	-6.07*	+4.43	-4.31	+5.06
SPS-Total	.54	-9.32**	+6.69	+0.30	+5.57
SPS-Details	.60	-10.32**	+6.81*	+0.34	+4.91
Hinting	.60	-0.54	+1.97	0.14	+1.74*
FEIT	.43	+0.72	-1.02	-1.42	+2.29**
NAB-S	.91	-3.32	+16.37*	-0.26	14.78

*p<.05; **p<.01

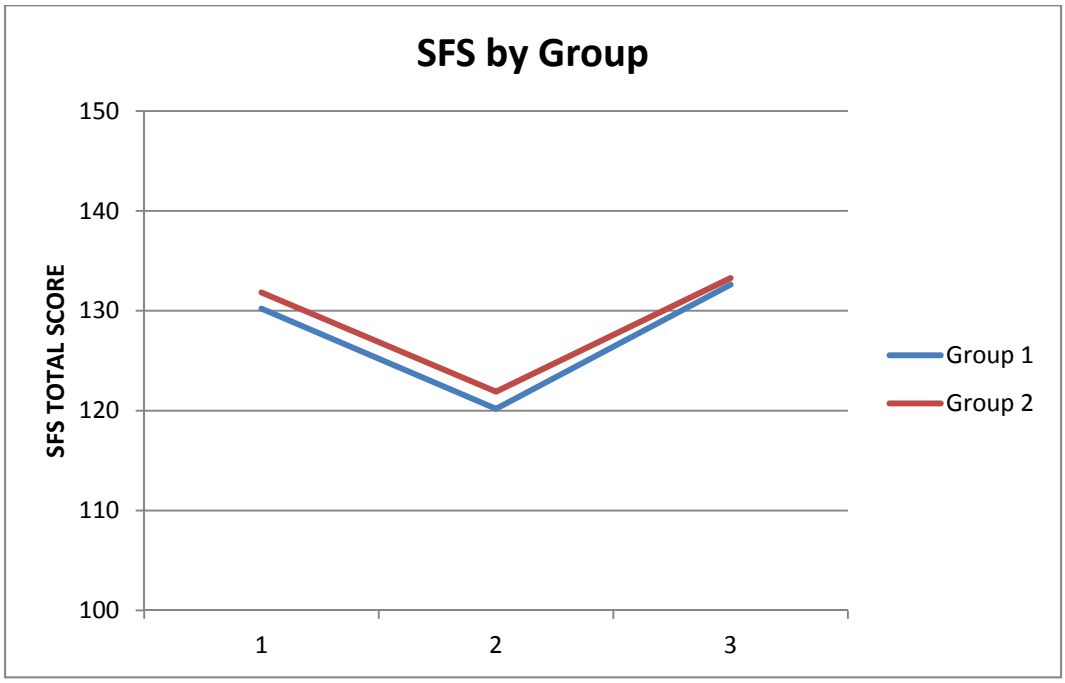


Figure 20: SFS-Total: Means Estimated from Unstructured Piecewise Model

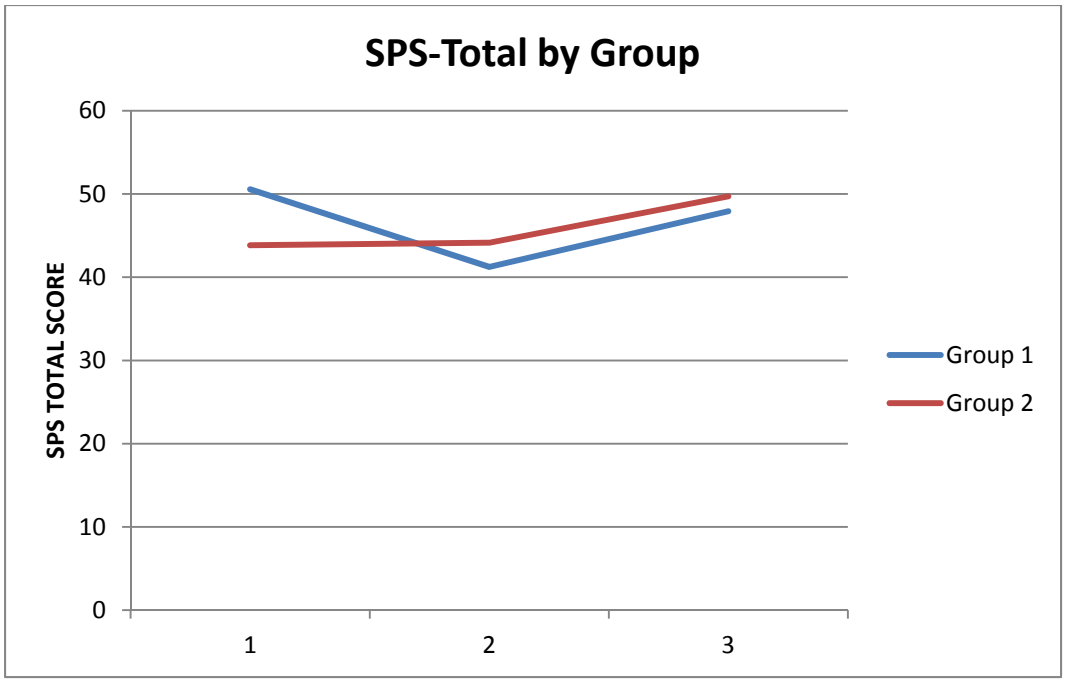


Figure 21: SPS-Total: Means Estimated from Unstructured Piecewise Model

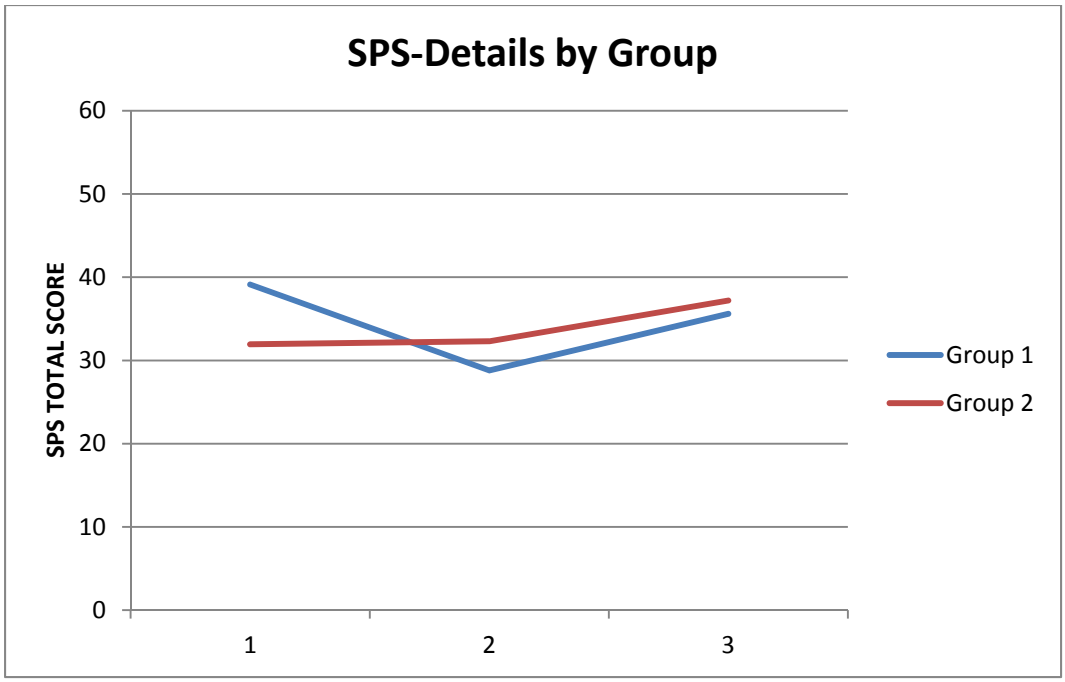


Figure 22: SPS-Details: Means Estimated from Unstructured Piecewise Model

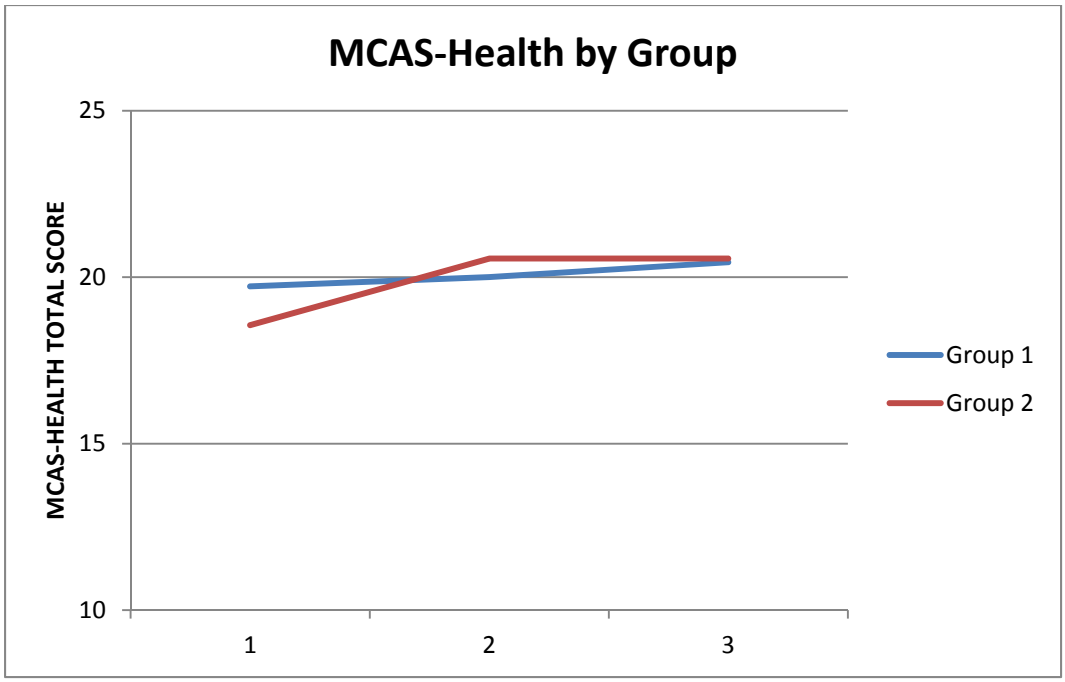


Figure 23: MCAS-Health: Means Estimated from Unstructured Piecewise Model

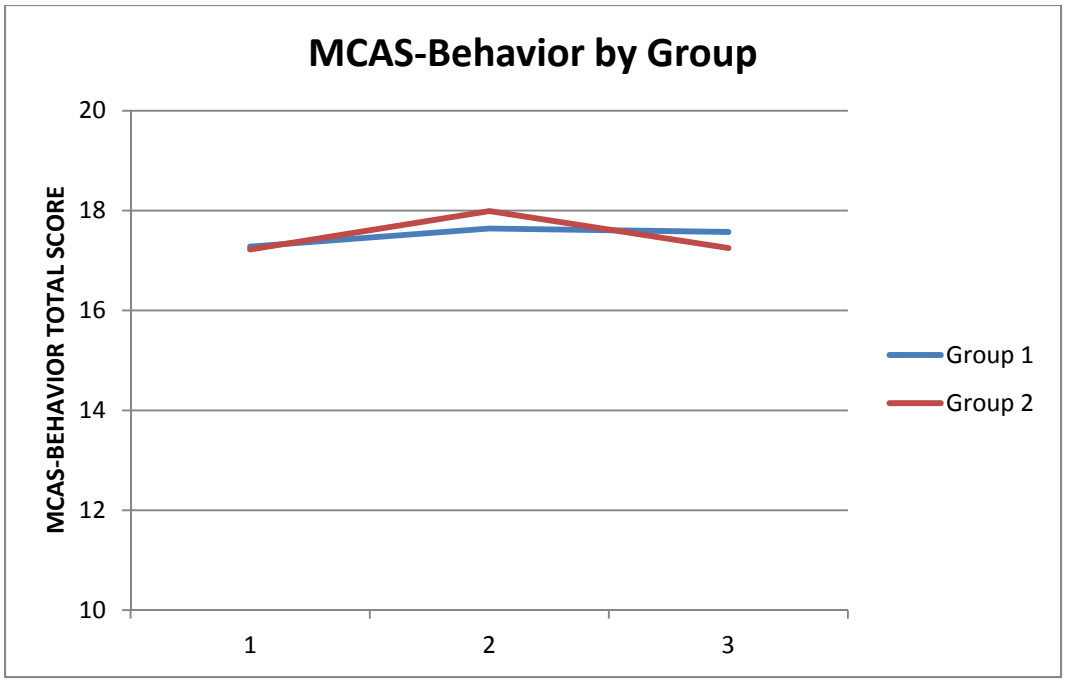


Figure 24: MCAS-Behavior: Means Estimated from Unstructured Piecewise Model

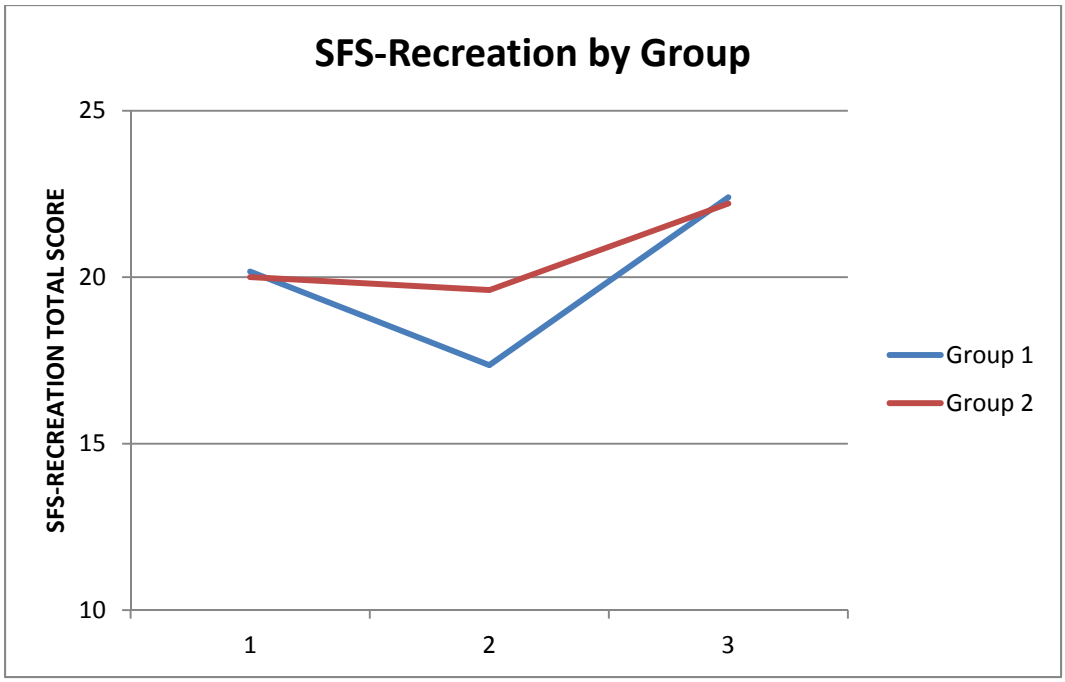


*Figure 25:*SFS-Recreation: Means Estimated from Unstructured Piecewise Model

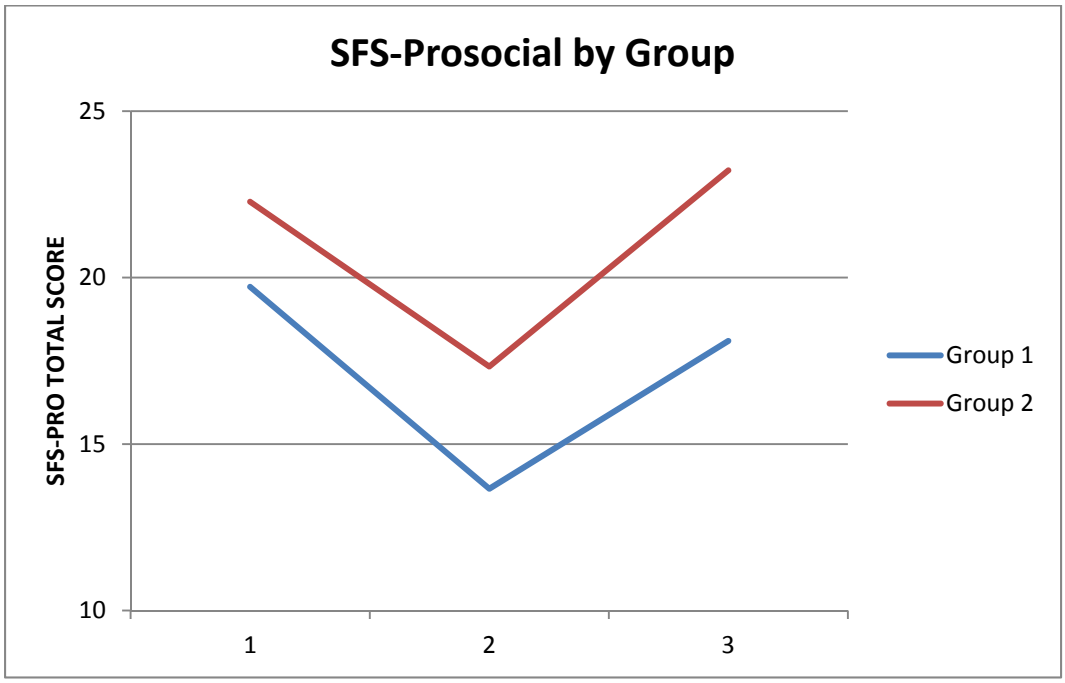


*Figure 26:*SFS-Prosocial: Means Estimated from Unstructured Piecewise Model

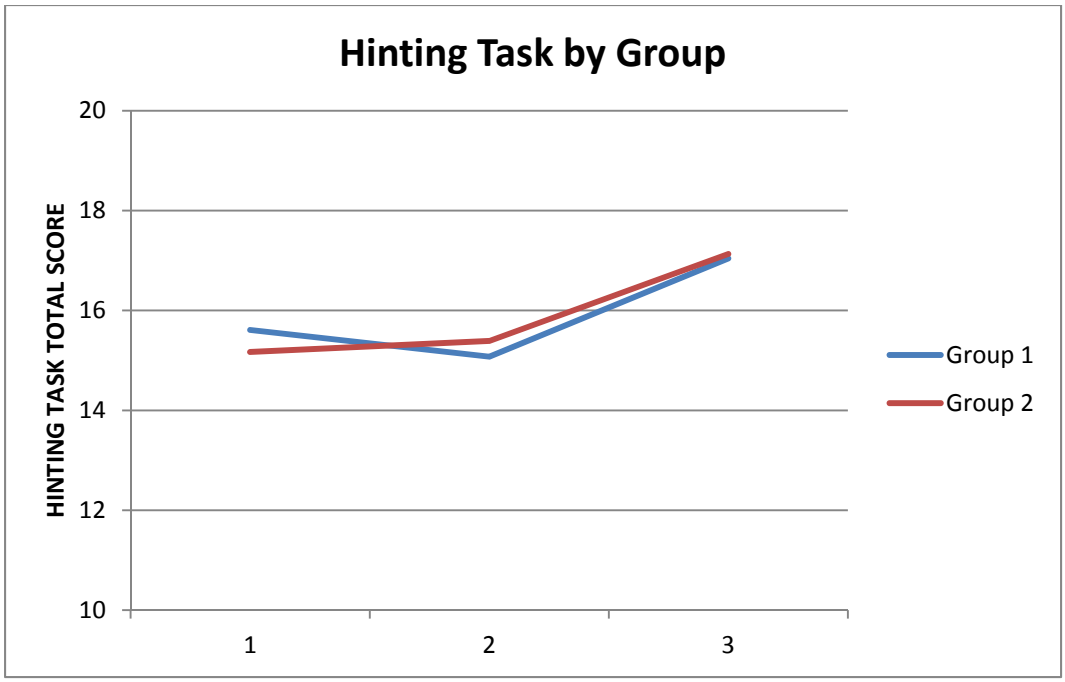


*Figure 27:*Hinting Task: Means Estimated from Unstructured Piecewise Model

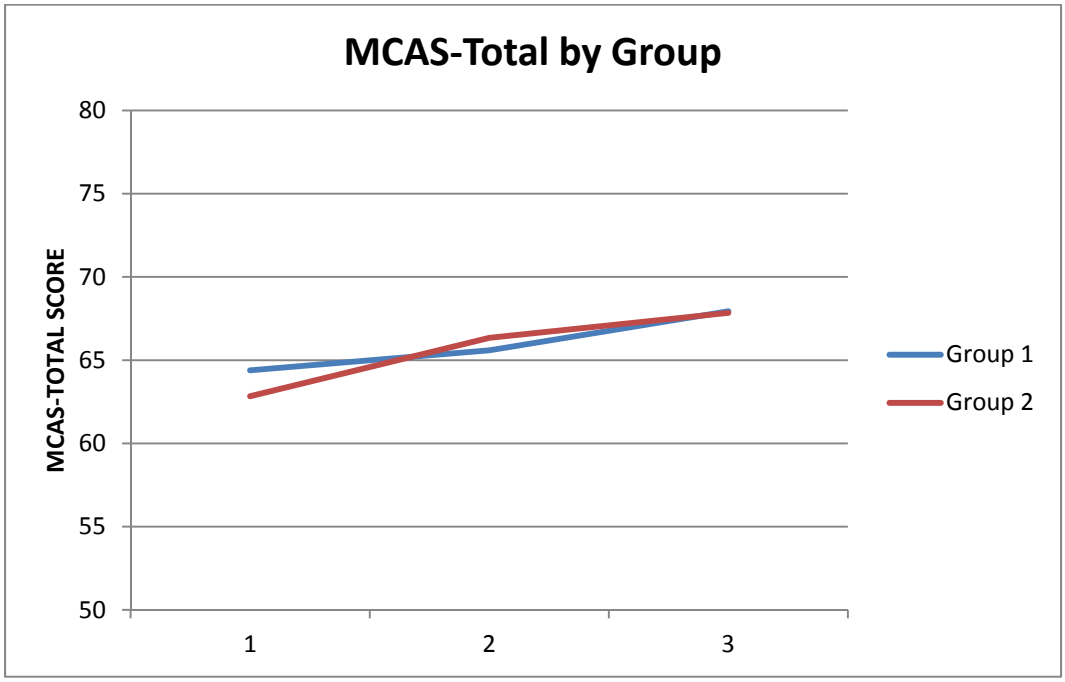


Figure 28: MCAS-Total: Means Estimated from Unstructured Piecewise Model

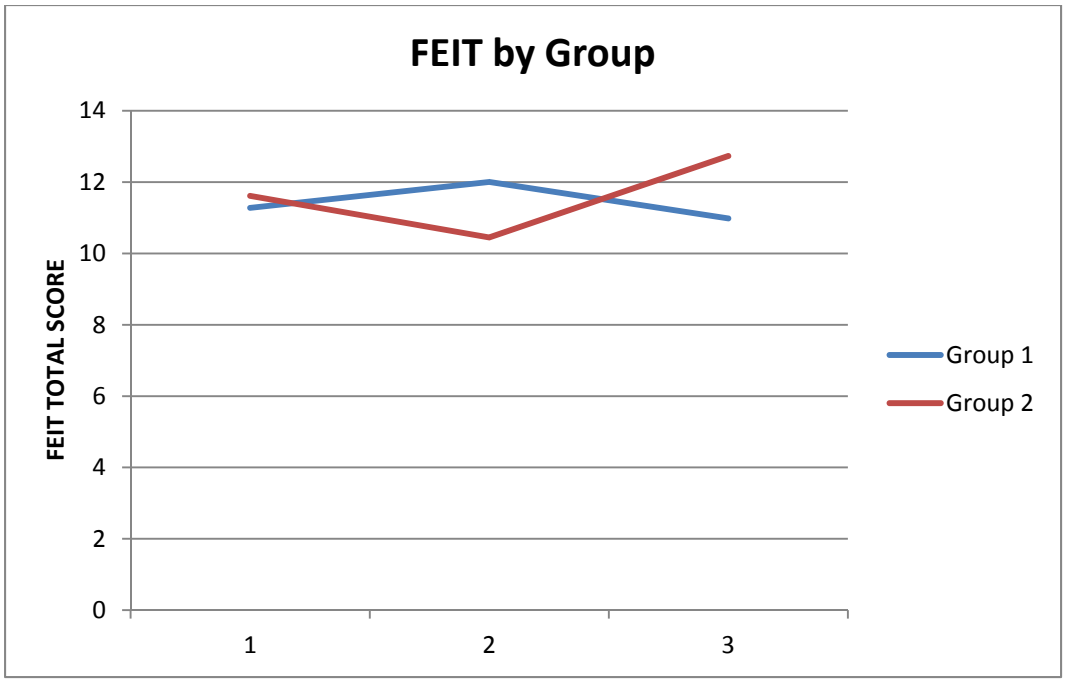


Figure 29: FEIT: Means Estimated from Unstructured Piecewise Model

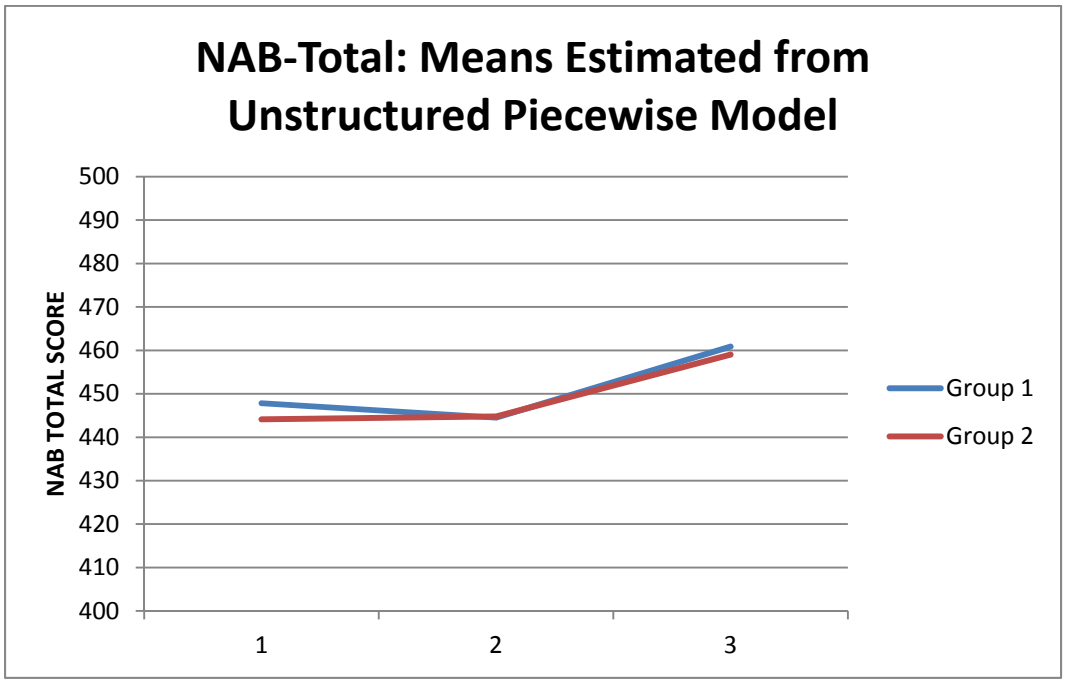


Figure 30: NAB-Total: Means Estimated from Unstructured Piecewise Model

In summary, ten of the 31 measures showed significant change over time. Three of these are clinician observation measures of social functioning, two are self-report measures of social functioning, one is a neurocognitive measure and four are social cognitive measures. Not a single measure detected significant change for both groups during both time periods, despite trends that suggest complex bidirectional changes. Qualitative change patterns suggest that only MCAS-Health and MCAS-Total showed continuous improvement over the course of the study. Only one measure, the Facial Emotion Identification Test (FEIT) showed a qualitative pattern of change consistent with the waiting-list control experimental design for evaluating SCIT, with Group 1 showing improvement in the first treatment period and Group 2 showing improvement in the second. Both groups showed a decrease in FEIT during TAU. Five measures showed a net improvement over time (NAB Total, Hinting, SFS Recreation, MCAS Health and MCAS Total). Overall, the results suggest that the question of what measures are most sensitive to change does not have a single answer. The different instruments appear to be measuring different kinds of change over time.

Hypothesis 4

The fourth hypothesis proposes that there are separable and meaningfully different domains that change over time among persons with chronic SMI, and that these domains of functioning respond to SCIT differentially. Embedded within this exploratory hypothesis is an empirical question as to which of the variety of commonly used and theoretically-warranted assessment measures are empirically useful, for this population and in this context. Thus the analysis for this hypothesis was multi-faceted and sought to answer more than one level of inquiry.

The measures that showed change over time in Hypothesis 3 were identified as sensitive enough to detect change over time, both during SCIT, and over a longitudinal period in which many factors may contribute to changed scores and variances, including specific and nonspecific treatment effects, repeated measure and practice effects, spontaneous recovery, and other error. The aim of this study was not to define the various potential causes of change over time, but rather to isolate the measures that do indeed show significant change over time. After isolating the relevant measures (statistical and clinical significance is important with such a small sample size), principle components analysis (PCA) was conducted in order to construct empirically-based groups of the relevant variables, reduce the data, and form a groundwork from which to apply theory to understand the components that change over time.

The PCA is a data reduction technique that reduces the number of measured variables (in this case, variables that show change over time) into a smaller set of composite variables that carries as much of the originally measured variables' information as possible. The PCA was conducted in SAS 9.2 for each of the three time points for the relevant social cognitive, neurocognitive, and social functioning variables. To construct the PCA, first a correlation matrix of the z-scores for all the variables is computed, then based on the total variance accounted for, the variable communalities, and the interpretability of the solution, a determination is made regarding the total number of components to keep. The components are then "rotated" (either orthogonally or obliquely, based on theory and common convention) and the rotated components are interpreted based on loadings (a cutoff for loading is decided by the researcher). In this case, in order to find the most interpretable and replicable component solution, numerous

rotations were computed, with a goal of finding the most parsimonious and sensitive structure. Oblique rotations (Direct Oblimin) were computed first based on the fact that the various variables were presumed to be correlated, however, the results indicated very little correlation among the components, thus orthogonal rotations (Varimax) were conducted as well. All rotations were conducted with eigenvalue greater than 1; a cutoff point of 0.4 was implemented in all component structures in order to find components with highly loaded factors (share at least 16% of variance with the component), and to minimize the number of multivocal variables. The number of components to interpret was based on examination of the scree plot, the Kaiser criterion, cumulative variance accounted for, and interpretability of the solution.

The component structures were different across the three time points. Initial analyses were conducted using the Time 1 Varimax rotation. The Kaiser criterion test and examination of the scree plot converged to indicate that two components were meaningful and therefore retained for rotation. For Time 1, the two components accounted for 60.4% of the total variance. The relevant variables and corresponding factor loadings for the three time points are presented in Table 6. Using the .40 factor loading cutoff, 7 variables loaded on the first component and 2 variables loaded on the second component. The first component included NAB-Total, FEIT, MCAS-Total, MCAS-Health, MCAS-Behavior, SPS-Details, and Hinting; the second component included SFS-Recreation, SFS-Prosocial.

The Time 2 Varimax rotation, based on the Kaiser criterion test and examination of the scree plot, produced three components that were meaningful and interpretable. For Time 2, the three components accounted for 71.3% of the total variance. Using the .40

factor loading cutoff, four variables loaded on the first and second components, and three variables loaded on the third component, with two variables being multivocal (NAB-Total and Hinting). The first component included NAB-Total, MCAS-Total, MCAS-Health, and MCAS-Behavior; the second component included NAB-Total, FEIT, SPS-Details, and Hinting; and the third component included SFS-Recreation, SFS-Prosocial, and Hinting.

The Time 3 Varimax rotation, based on the Kaiser criterion test and examination of the scree plot, also produced three components that were meaningful and interpretable. For Time 3, the three components accounted for 72.2% of the total variance. Using the .40 factor loading cutoff, four variables loaded on the first and second components, and three variables loaded on the third component, with two variables being multivocal (NAB-Total and SPS-Details). The first component included NAB-Total, MCAS-Total, MCAS-Health, MCAS-Behavior; the second component included NAB-Total, FEIT, SPS-Details, and Hinting; and the third component included SFS-Recreation, SFS-Prosocial, and SPS-Details.

Table 6
Principle Component Analysis of Empirically-Selected Variables (Varimax Rotation)

Time 1			
Total Variance = 60.4%	Component 1	Component 2	Component 3
NAB-Total	**.80**	.10	
MCAS-Total	**.92**	-.07	
MCAS-Health	**.87**	-.18	
MCAS-Behavior	**.84**	-.03	
SFS-Recreation	.06	**.89**	
SFS-Prosocial	-.08	**.75**	
FEIT	**.48**	-.27	
SPS-Details	**.51**	.14	
Hinting	**.69**	-.08	
Time 2			
Total Variance = 71.3%			
NAB-Total	**.42**	**.60**	.25
MCAS-Total	**.95**	.06	.18
MCAS-Health	**.95**	.11	.09
MCAS-Behavior	**.91**	.02	.14
SFS-Recreation	.14	.32	**.81**
SFS-Prosocial	.13	-.30	**.79**
FEIT	-.05	**.72**	-.14
SPS-Details	.05	**.73**	.15
Hinting	.20	**.44**	**.53**
Time 3			
Total Variance = 72.2%			
NAB-Total	**.67**	**.55**	.07
MCAS-Total	**.96**	.04	.05
MCAS-Health	**.93**	-.08	.01
MCAS-Behavior	**.93**	.08	-.02
SFS-Recreation	.12	.19	**.84**
SFS-Prosocial	-.04	-.14	**.81**
FEIT	-.01	**.56**	-.27
SPS-Details	-.09	**.65**	**.43**
Hinting	.13	**.77**	.08

Following the PCA, factor-based scores which are linear composites of the variables determined to be meaningful within the components, were derived for each participant for each component in order to analyze change over time in the piecewise models. Examination of the component structures from the initial PCA, across the three

time points suggests that there are three components and they are relatively stable across the three time points. It appears that at Time 1 the first two components, reflecting separation of MCAS and cognitive variables, are collapsed into a single factor. The separate social functioning component is evident at all 3 times. The reason factor-based scores were used instead of weighted component scores is that there were different factor structures for the different time points and true PCA components can only be derived from time-invariant data. In order to derive the factor-based scores, the z-scores for each of the variables in the components were averaged and 3 factor based scores were used in subsequent modeling. The components were interpreted (named) as follows: Self-perceived Social Functioning (SFS-Recreation, SFS-Prosocial, NAB-Total); Observed Social Functioning (MCAS-Total, MCAS-Health, MCAS-Behavior, NAB-Total); and Social Perception (FEIT, SPS-Details, Hinting). The NAB-Total score was the only multivocal variable included in the components and in the factor-based score calculations.

The means and individual trajectories (spaghetti) plots for the three factors are shown in Figures 31 - 33. The Self-perceived Social Functioning Factor had an ICC of 65%, and examination of the means plot showed a pattern over time very similar to that observed on all the SFS scales, in which there was an overall decrease from Time 1 to Time 2 and an increase at Time 3. The unstructured piecewise model for the this factor, controlling for group, showed a significant second slope such that for persons in the first group the Time 3 factor scores were .42 z-score points higher than the Time 2 scores (p = .0017); the intercept was negative and the Time 3 mean value was slightly positive, with a value of 0.12.

The Observed Social Functioning Factor had an ICC of 88%, and examination of the means plot showed relatively little change over time, with a slight positive increase from Time 1 to Time 3. The unstructured piecewise model, controlling for group, showed a significant Slope12 such that for persons in Group 1, the scores at Time 2 were .21 z-score points above Time 1 (p = .0003). The intercept was negative and the Time 3 score was slightly positive on the z-score scale (z = .018).

The Social Perception Factor had an ICC of 74%; examination of the means plot showed a slight, although not statistically significant, decrease at Time 2, followed by a significant increase of .38 z-score points at Time 3 (p = .0006). The intercept was just barely positive, Time 2 mean was negative and Time 3 mean was .25 on the z-score scale.

Individual Trajectories for Self-Perceived Social Functioning Factor

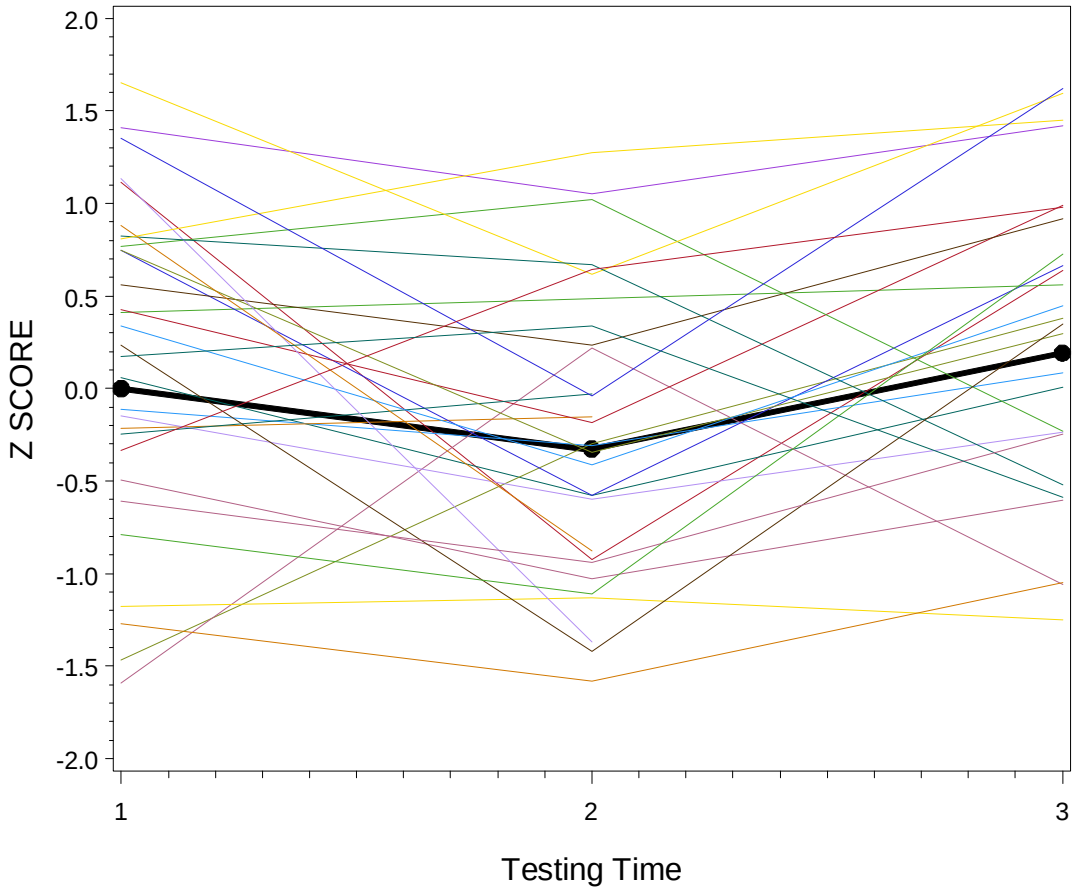


Figure 31: Self-Perceived Social Functioning Factor

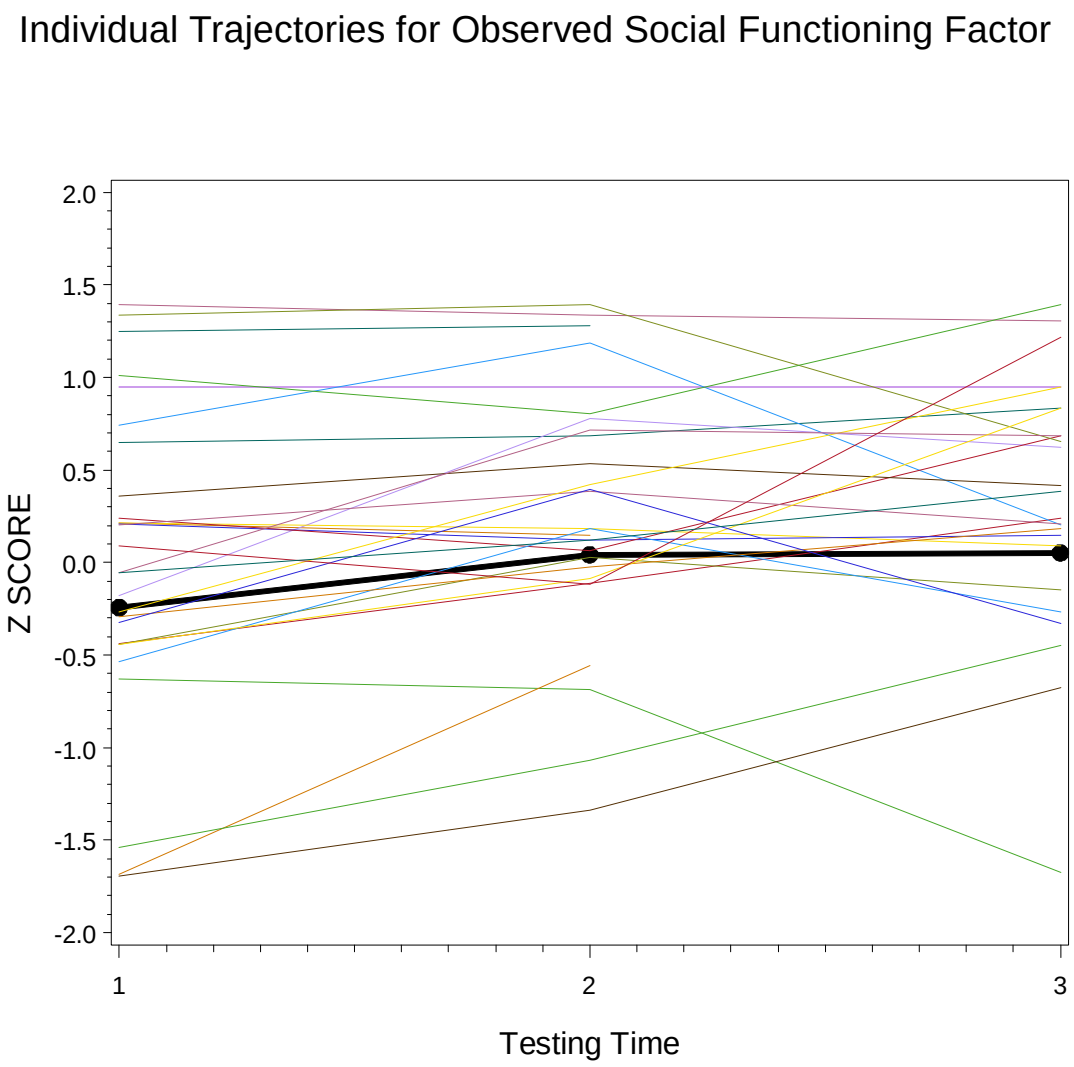


Figure 32: Observed Social Functioning Factor

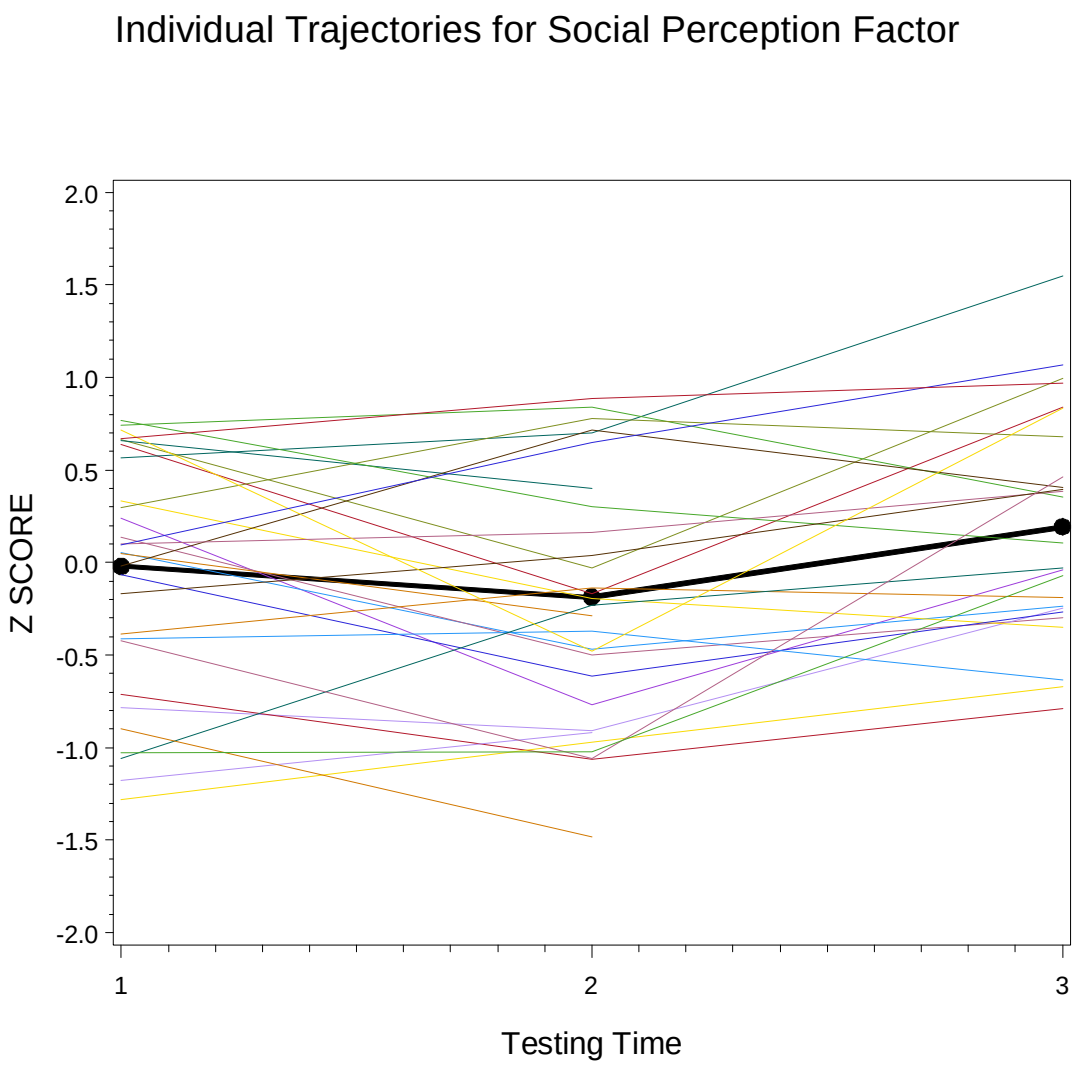


Figure 33: Social Perception Factor

In order to examine the conceptual question of whether there are particular factors that change when participants are in SCIT treatment, time was re-aligned statistically such that all participants were in SCIT at the same time. The groups were combined to provide another perspective on changes specific to SCIT, with the hope that the larger sample would reduce idiosyncratic uncontrolled effects in Group 1 and provide an alternative picture of the changes. In this model, both groups were in SCIT from time 2-3

and the TAU periods for each group are not examined (i.e., for the "during SCIT" analyses for Group 1, Time 1 became Time 2 and Time 2 became Time 3; for Group 2, Time 2 – Time 3 still represented time during SCIT).

In general, the lagged models for all three factors during the time that the sample was in SCIT (Figures 34-36), appear to be relatively stable and show nonsignificant change over time.

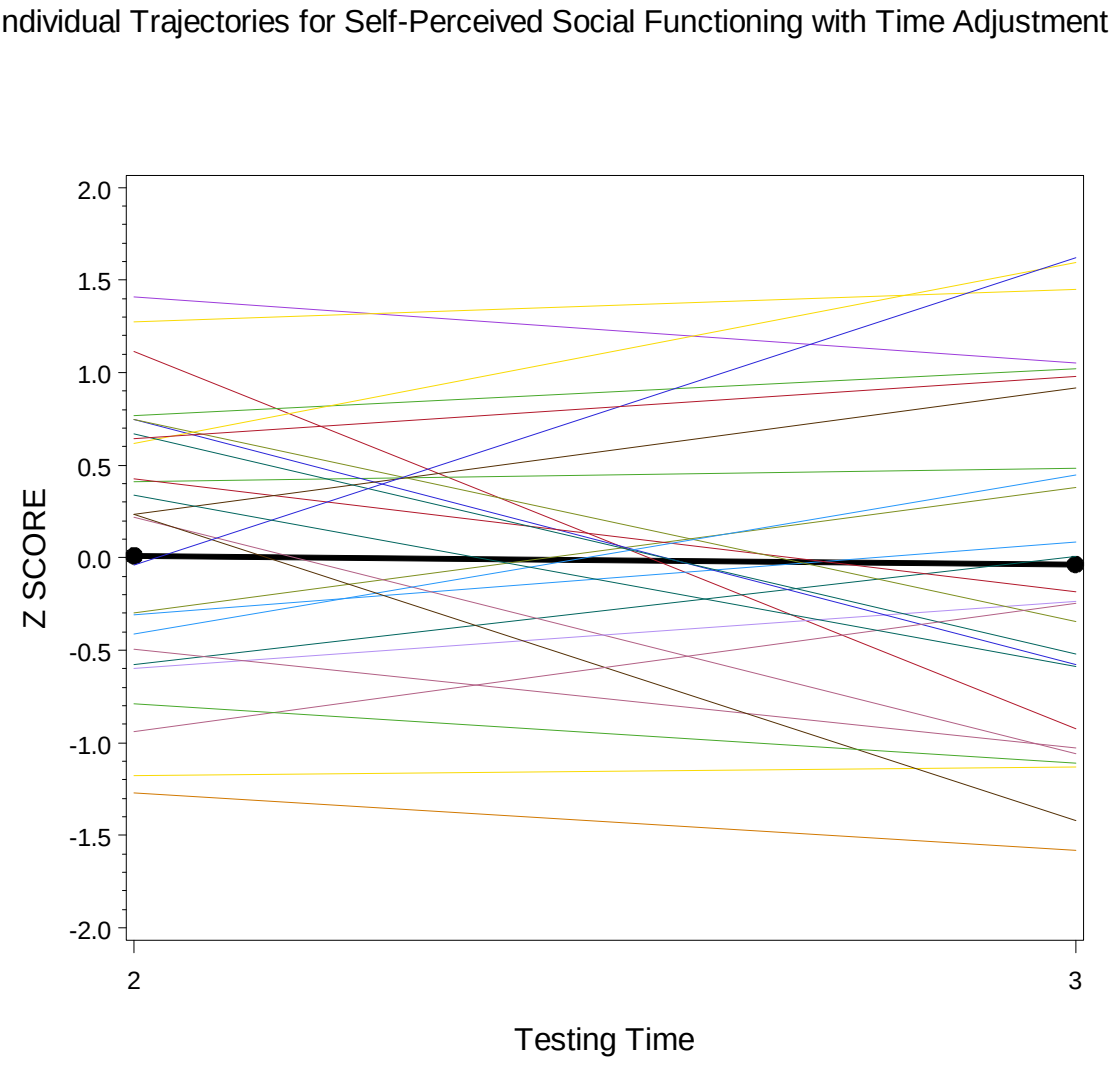


Figure 34: Self-Perceived Social Functioning Factor with Time Adjustment

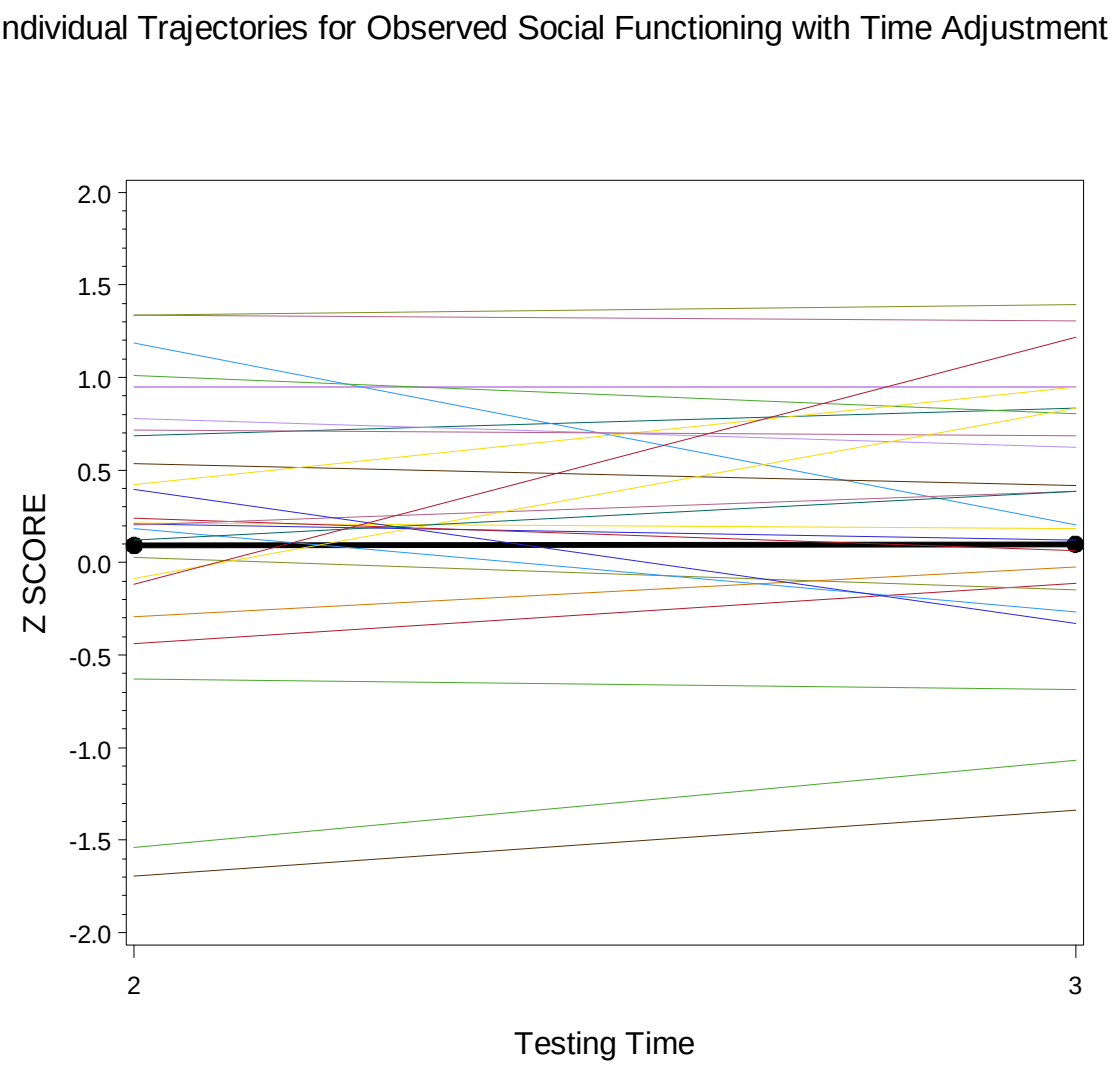


Figure 35: Observed Social Functioning Factor with Time Adjustment

Individual Trajectories for Social Perception Factor with Time Adjustment

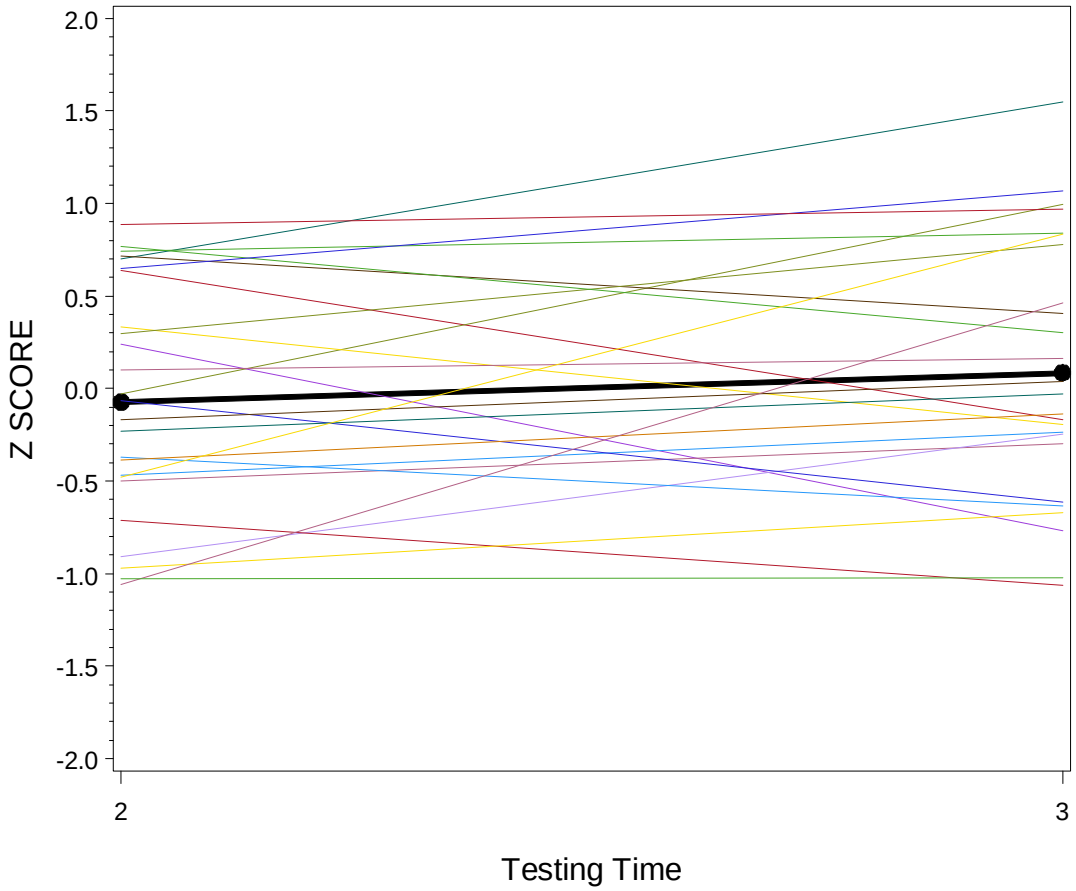


Figure 36: Social Perception Factor with Time Adjustment

In summary, evaluation of the fourth hypothesis is complementary to the qualitative analysis of change patterns pertinent to the third hypothesis. The self-report instrument and the clinician observation instrument appear to measure two separate domains of functioning, with neurocognition providing a secondary influence on each. Measures of social functioning represent a third domain, separate from both measures of social functioning and from neurocognitive functioning. None of these appear to be sensitive to SCIT treatment effects, however.

Hypothesis 5

The fifth hypothesis predicted that person-level characteristics would moderate treatment effects for each piece in the model. For all analyses, the two piecewise slopes were coded such that Time 1 represents the intercept. Individual characteristics were included as main effects and interactions with the slopes in models predicting social functioning criterion (i.e., MCAS Total and SFS Total) (Figures 37-55). Although preliminary analyses discussed above assessed demographic variables, this hypothesis examined the moderation effect of Level 2 (between-person effects) variables on change over time. The unstructured piecewise models were tested with the various characteristics included as main effects and as interactions with the two slope pieces.

Day Program

For all analyses, Midtown is the reference group and Southville is the comparison program. There was a significant difference in MCAS-Total at baseline based on program such that persons at Southville scored 14.6 points lower at baseline than did persons at Midtown ($p < .0001$) (see Figure 37). There was a significant interaction between the effect of program and the slope between Time 2 and Time 3 such that participants at Southville's scores increased by an average of 5.95 points between Time 2 and Time 3 ($p = .0335$), while Midtown scores stayed relatively stable. It should be kept in mind that at both locations half the people were in SCIT and half were in TAU during the two time periods (i.e. Time 1 to Time 2, and Time 2 to Time 3).

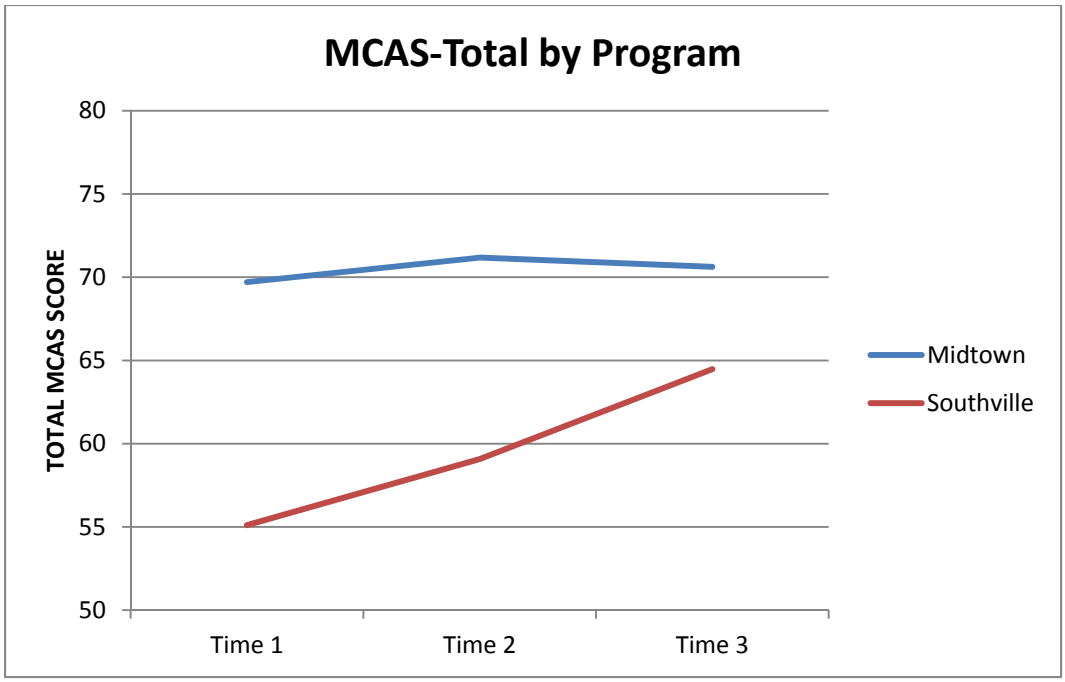


Figure 37: MCAS-Total by Program

The effect of program was then included as a main effect and interaction with the slopes in the unstructured piecewise model with SFS-Total as the dependent variable. In this model, there was no effect of program on SFS-Total scores over time and there were no interactions between program and the slopes in the model. Examination of the figure suggests that although Program did not have a significant effect, persons in both programs showed the same pattern of decrease followed by increase on SFS Total.

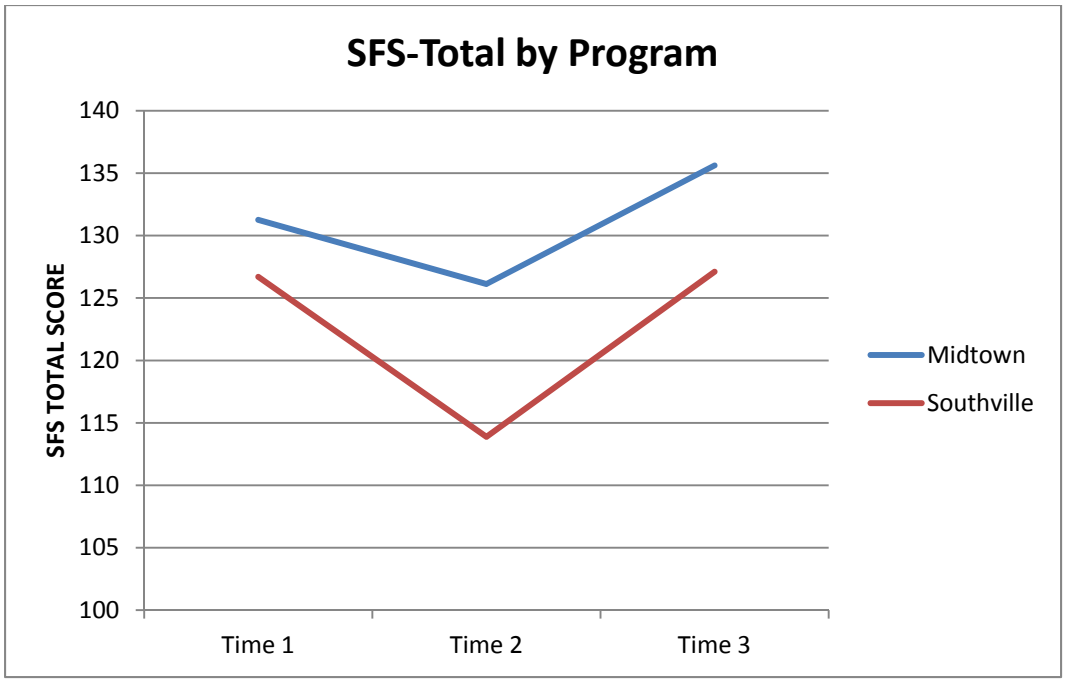


Figure 38: SFS-Total by Program

Group

For all analyses, the SCIT 1st group is the reference group, coded as 0, and the TAU 1st group is the comparison group, coded as 1. There was no main effect on MCAS-Total or interaction between group and slope in the initial model (Figure 39). Examination of the figure indicates that both groups increased over time on MCAS-Total and Group 2 increased more positively from Time 1 to Time 2 than Group 1.

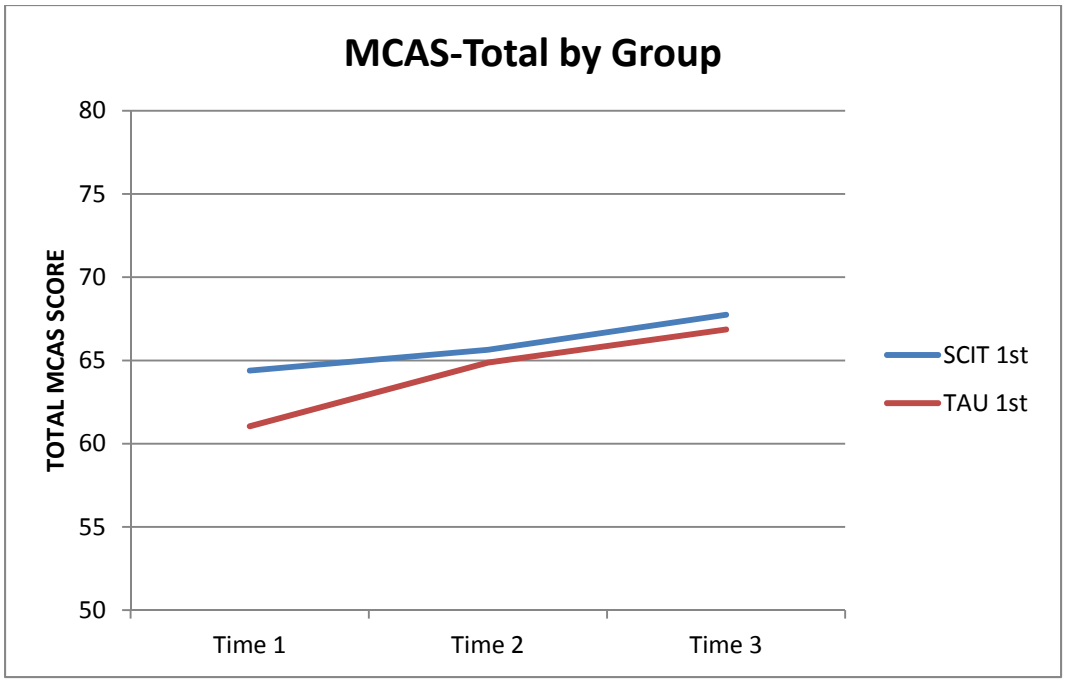


Figure 39: MCAS-Total by Group

Group was included as a main effect and interaction with slopes in the unstructured piecewise model for SFS-Total score (Figure 40). There was no main effect of group on SFS Total or interaction between group and slope in model; the two groups showed the same general trend on SFS Total.

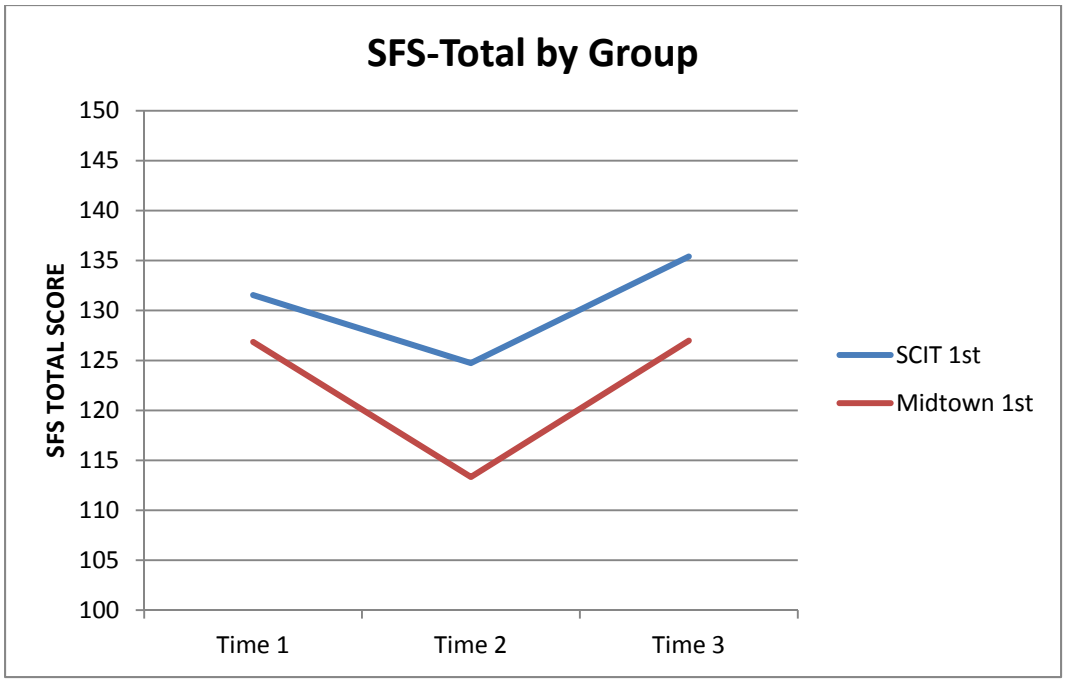


Figure 40: SFS-Total by Group

Completion Status

It was hypothesized that persons who completed the SCIT study and attended all three assessment sessions may be fundamentally different from persons that dropped out after the first or second assessment session. Thus, a completion variable was derived to represent persons who completed all three assessments (n = 28), compared to those who dropped out after the first (n = 4) or second assessment session (n = 9). There was not a significant main effect of completion status on MCAS-Total at baseline; however, there was a significant slope from Time 1 to Time 2 for the group that completed the study such that MCAS Total scores increased by an average of 2.19 points (p = .011). The time period from assessment sessions 2-3 cannot be estimated since the majority of the comparison group was not involved in session 2 and none were involved in session 3.

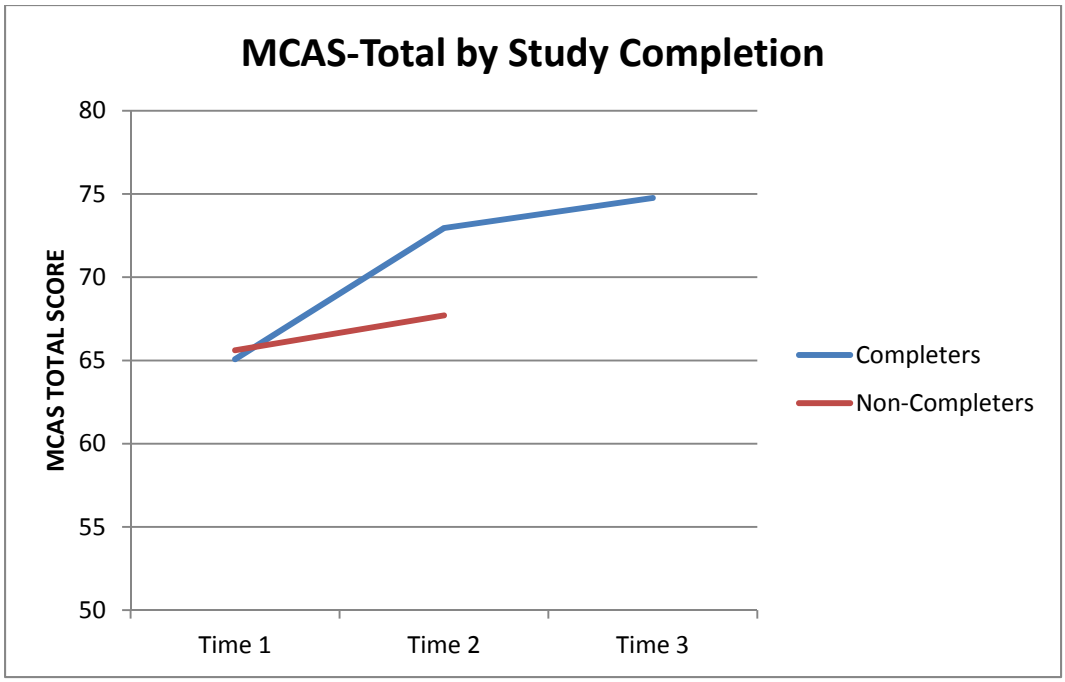


Figure 41: MCAS-Total by Study Completion

Study completion was then included as a main effect and interaction with time in the model with SFS-Total as the outcome variable. There was no main effect of Completion status on SFS-Total at baseline and there was no interaction between completing the study and rate of change during the first time period.

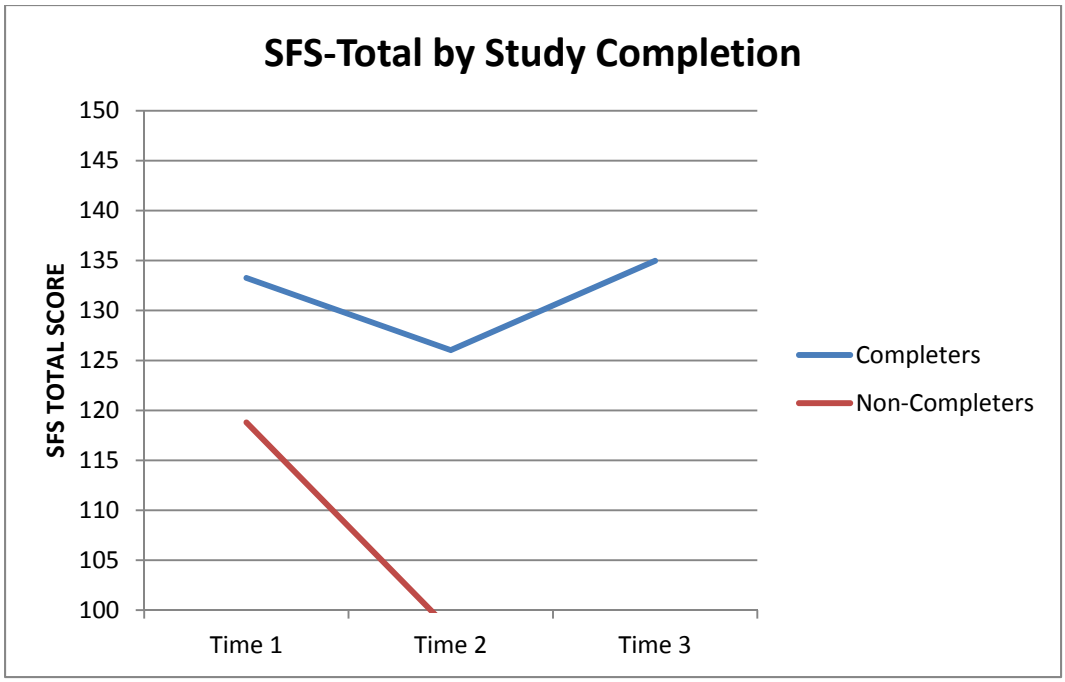


Figure 42: SFS-Total by Study Completion

Age

In the unstructured piecewise model to test for effect of age, age was centered around its mean of 42 (SD=13) before being included as a main effect and interaction in the unstructured piecewise model for MCAS-Total. There was no main effect of age but there was a significant interaction between age and second slope such that older persons increase at a rate of 0.286 points less positive from Time 2 to Time 3 than younger persons (p = .031).

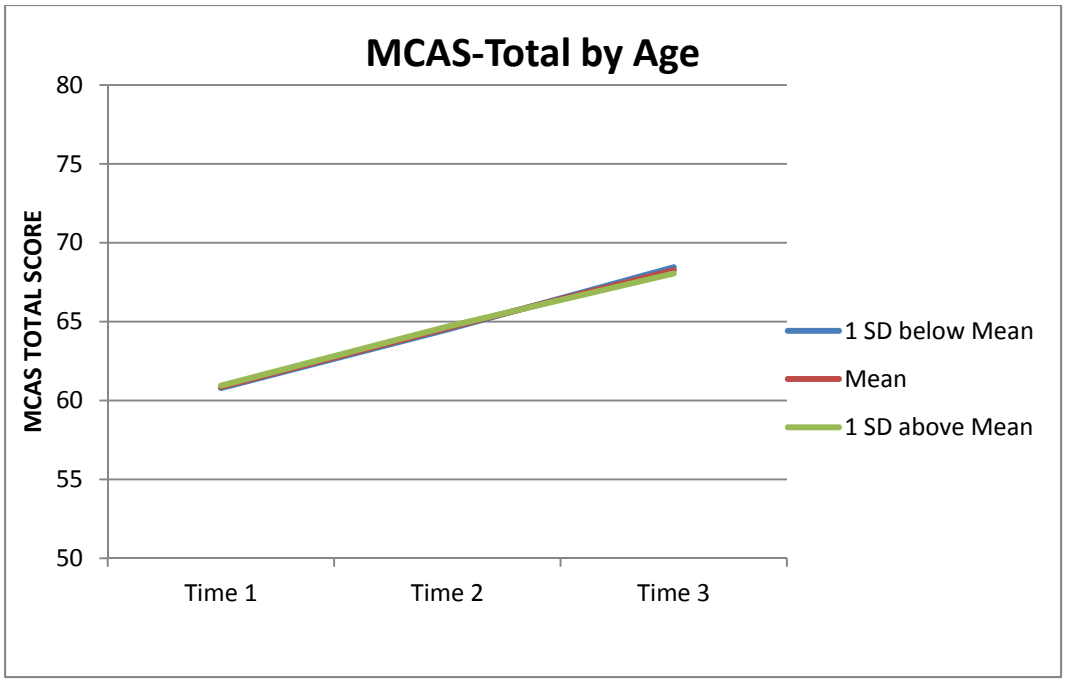


Figure 43: MCAS-Total by Age

There was no main effect of age on SFS Total score and there were no interactions between age and either of the two slopes.

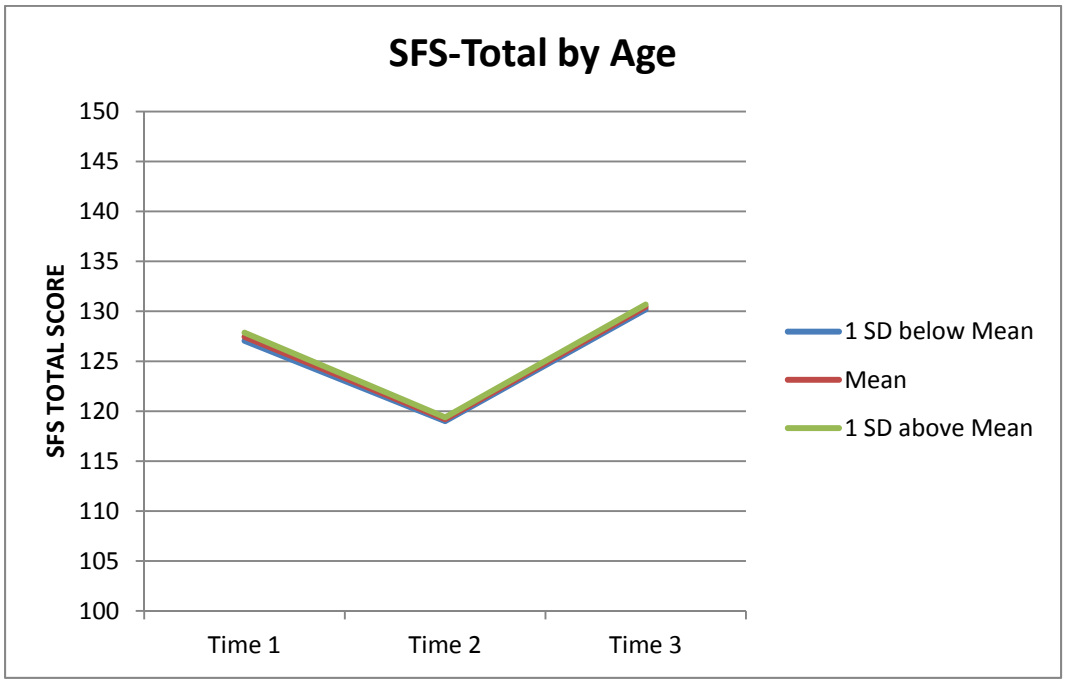


Figure 44: SFS-Total by Age

Gender

Gender was coded such that males are the reference group, coded as 0 and females are the comparison group, coded as 1. In the MCAS-Total model, there was no significant main effect of gender or interactions with time, indicating that although MCAS-Total scores were observed to increase somewhat over time, there was not a difference in baseline scores or rate of change in scores between males and females.

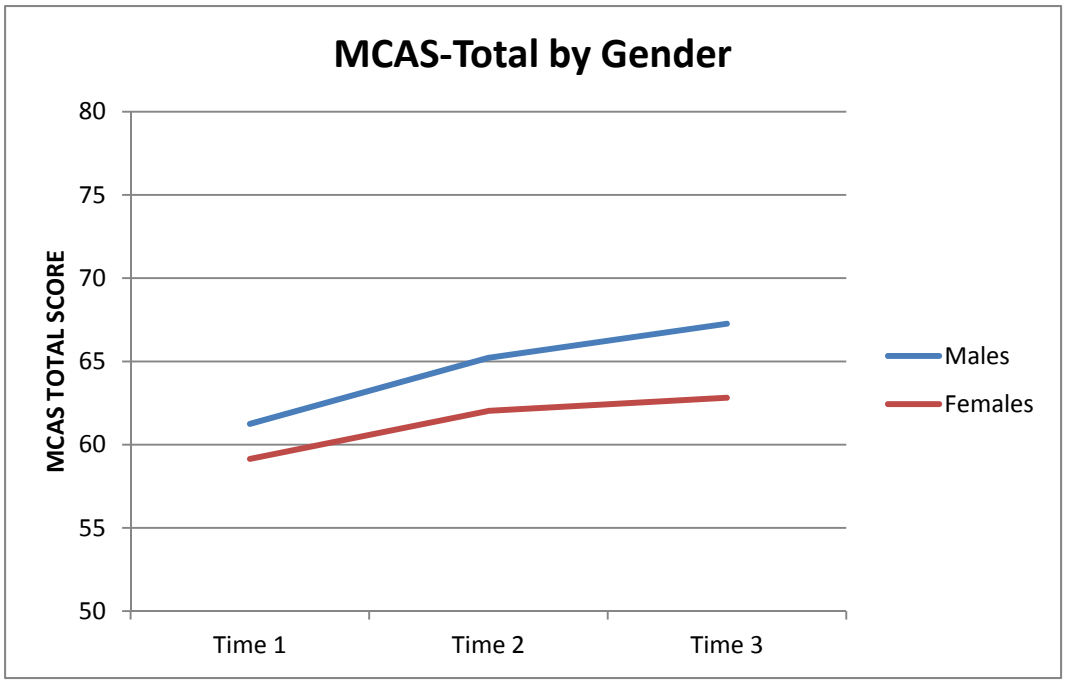


Figure 45: MCAS-Total by Gender

In the SFS Total model, there was no significant main effect of gender and there were no significant interactions between gender and either slope. However, the qualitative pattern shown in fig 46 suggests that if there is a negative effect on self-reported functioning, it is stronger in men than women. Women tend to have more accurate self-appraisals in clinical studies; the current findings may suggest that men are more susceptible to the treatment effect such that self-ratings plummeted after the first segment of the study, before returning to a level comparable to female peers.

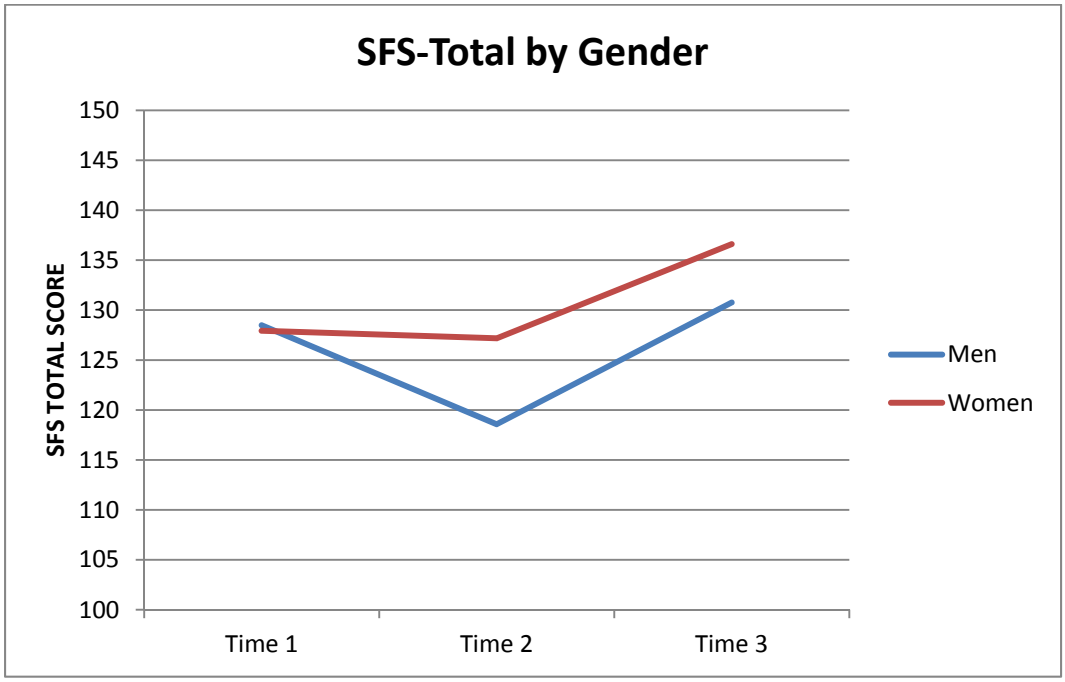


Figure 46: SFS-Total by Gender

Clinical Symptoms

For all tests of symptom profiles, group was controlled for in the unstructured piecewise models. The baseline BPRS-Affect factor score was centered around its mean at Time 1 of 2.315 (SD=0.847). There was a significant main effect of Affect at baseline such that persons who scored 1 point higher than the mean on the Affect factor (more severe symptoms) had MCAS-Total scores 4.65 points lower than those who scored at the mean at baseline (p = .039). There was a significant interaction between Affect and Slope12 such that persons who scored above the mean on Affect (more severe symptoms) had MCAS-Total scores that increased by an average of 3.72 points from Time 1 to Time 2 (p = .005). This is consistent with the pattern observed with social cognitive predictors- lower functioning at baseline predicted more improvement on the MCAS during the first time period.

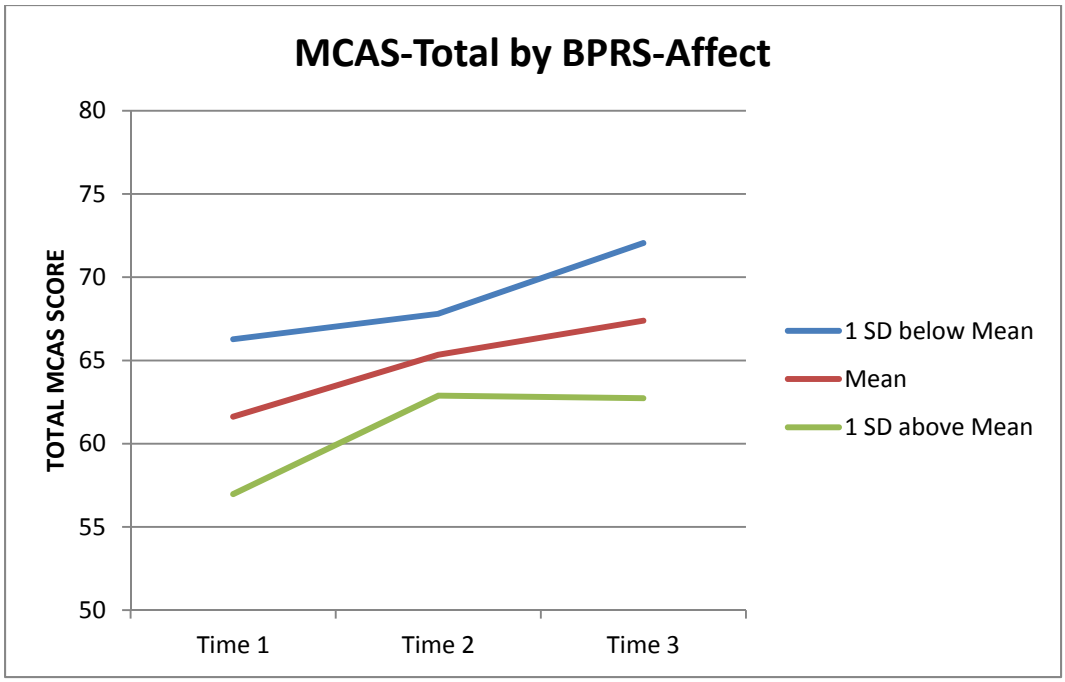


Figure 47: MCAS-Total by BPRS-Affect

In the SFS-Total unstructured piecewise model with the centered BPRS-Affect baseline score included as a predictor, there was no main effect of Affect score on SFS-Total and there were no significant interactions between Affect and either slope.

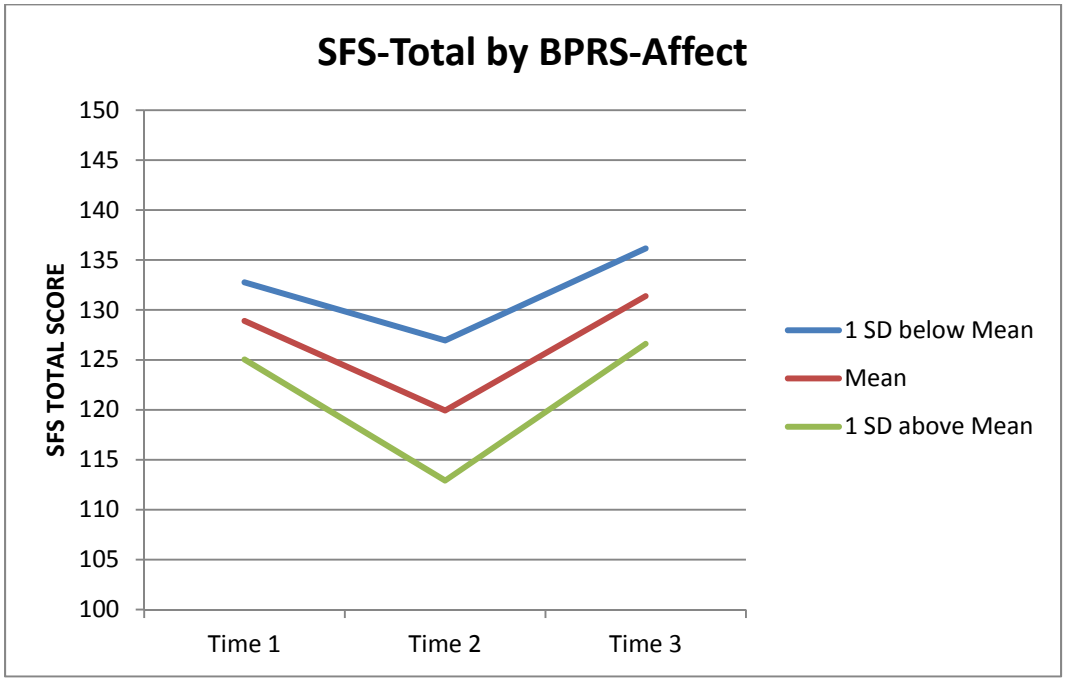


Figure 48: SFS-Total by BPRS-Affect

For the BPRS-Thought Disturbance factor, group was controlled for in the unstructured piecewise model. The baseline Thought Disturbance factor score was centered around its mean at time 1 of 1.687 (SD=0.833). There was no main effect of Thought Disturbance on MCAS-Total scores. There was not a significant interaction between BPRS-Thought Disturbance scores and MCAS-Total; persons with all levels of Thought Disturbance scores increased at a faster rate from Time 1 to Time 2 than from Time 2 to Time 3 (p = .0003).

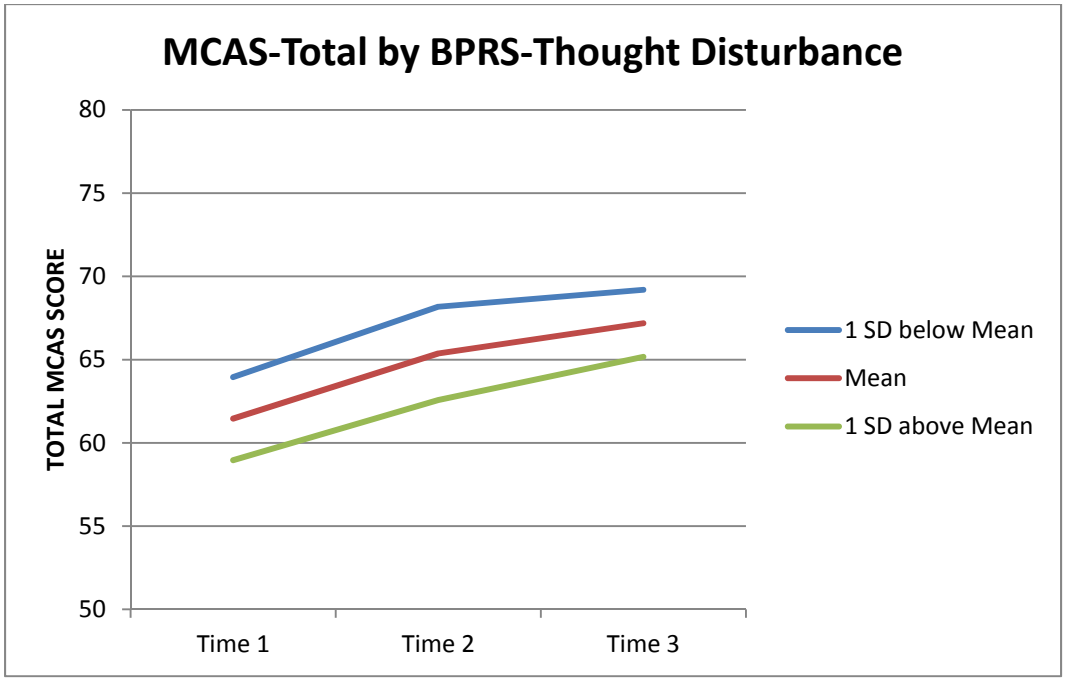


Figure 49: MCAS-Total by BPRS-Thought Disturbance

In order to test the effect of the BPRS-Thought Disturbance factor on SFS-Total score, group was controlled for in the unstructured piecewise model. There was no main effect of Thought Disturbance score on SFS-Total and there were no significant interactions between Thought Disturbance and either slope. However, examination of the graph (see Figure 50) suggests that persons who scored 1 SD below the mean (less impaired) on Thought Disturbance have higher SFS-Total scores and show less change

over time. There is trend-level statistical significance to support these observations; persons with higher Thought Disturbance scores (more impaired) have a decrease in SFS-Total scores of 7.98 points from Time 1 to Time 2, compared to persons with lower Thought Disturbance factor scores (p = .0627, ns). It appears that persons at the mean or above on Thought Disorder scores showed an exaggerated effect of decreased self-rated social functioning scores, but then had scores comparable to the group mean at Time 3.

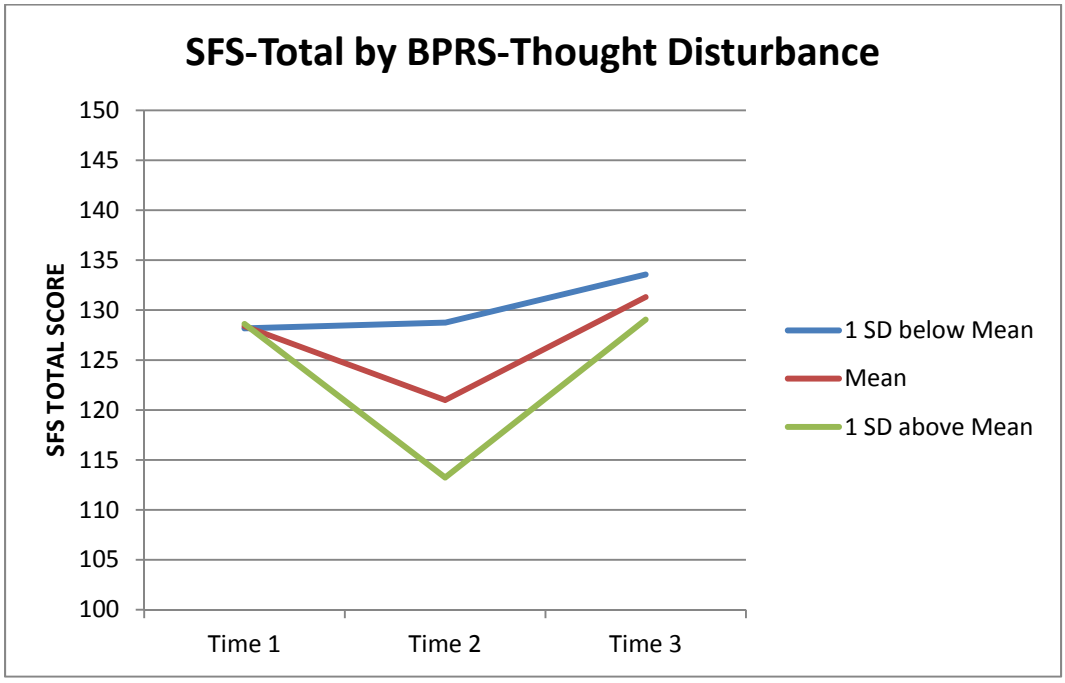


Figure 50: SFS-Total by BPRS-Thought Disturbance

For the BPRS-Disorganization factor, group was controlled for in the unstructured piecewise model. The baseline Disorganization factor score was centered around its mean at Time 1 of 1.442 (SD=0.497). There was a significant main effect of Disorganization such that persons with 1 point higher than the mean score on the Disorganization factor (more impaired) had MCAS-Total scores at baseline that were 8.63 points below those who scored at the mean at baseline (p = 0.025). There was an interaction between the Disorganization factor score and Slope12 such that persons with higher scores on the

Disorganization factor (more impaired) increased more on MCAS Total scores by 3.38 from Time1 to Time2 (p = 0.015).

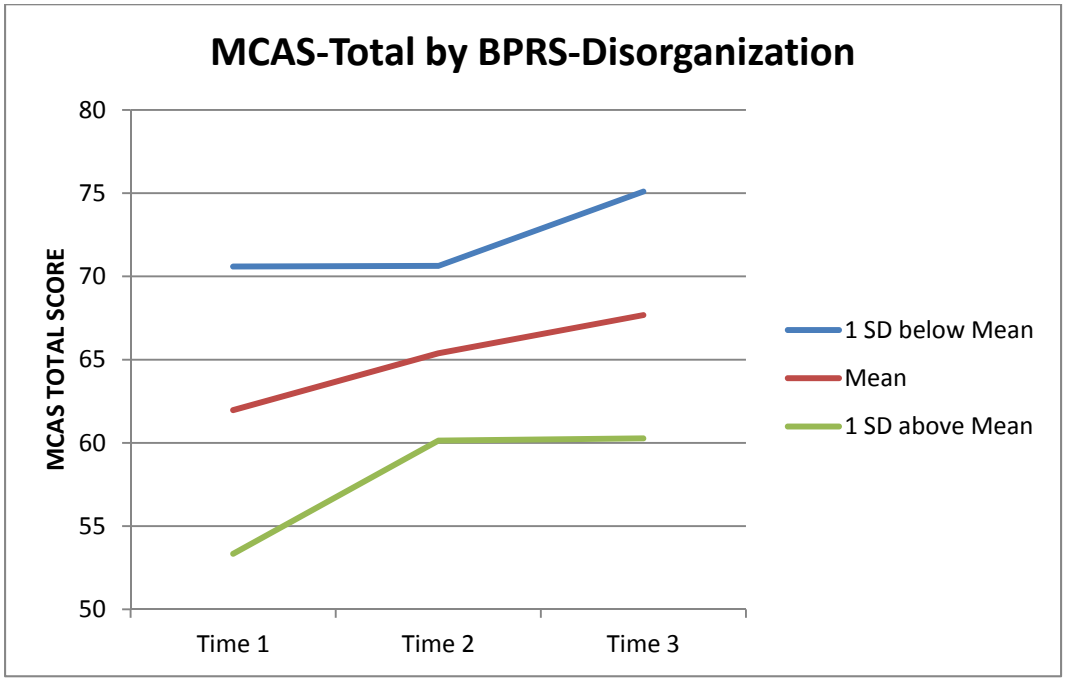


Figure 51: MCAS-Total by BPRS-Disorganization

In order to test the effect of the BPRS-Disorganization factor on SFS-Total score, group was controlled for in the unstructured piecewise model. There was no main effect of Disorganization score on SFS-Total and there were no statistically significant interactions between Disorganization and either slope. However, examination of the plot indicates that the second slope and the Disorganization factor likely had a nonsignificant interaction such that persons who scored higher on the Disorganization factor (more impaired) had more positive increases from Time 2 to Time 3; the statistical results support this observed trend, persons with higher Disorganization scores increased 15.2 more points on SFS-Total than persons with lower Disorganization scores from Time 2 to Time 3 (p = .082, ns). This is similar to previously observed trends in that more impaired persons improved more on the outcome measure, however, this is different than previous

predictors in that that the pattern was observed during the second rather than the first time period. Similar to the pattern observed on the Thought Disturbance Factor, persons at the mean or lower rated themselves much lower at Time 2 and then had a dramatic regression to the mean at Time 3.

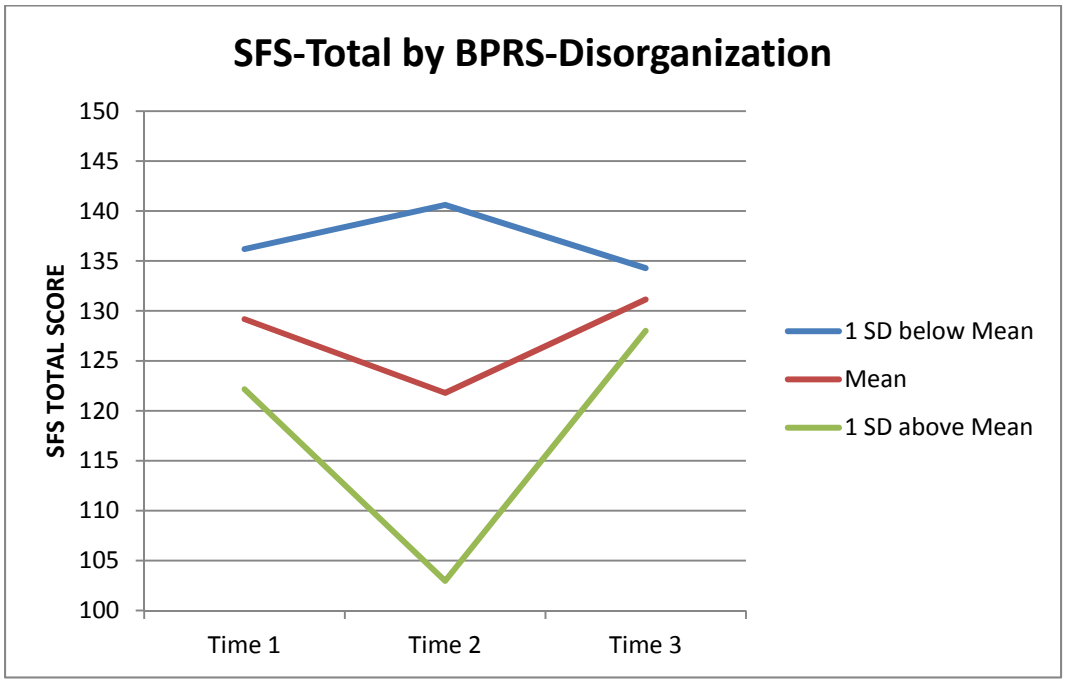


Figure 52: SFS-Total by BPRS-Disorganization

For the BPRS-Anergia factor, group was controlled for in the unstructured piecewise model. The Anergia baseline factor score was centered around its mean at time 1 of 1.625 (SD=0.720). There was a significant main effect of Anergia such that persons with higher than the mean score on the Anergia factor (more impaired) had MCAS Total scores averaging 7.02 below those who scored at the mean at baseline (p = 0.008). There was an interaction between the Anergia factor score and Slope12 such that persons with higher scores on the Anergia factor increased in MCAS Total scores by 2.676 (p = 0.006) from Time1 to Time2 but did not significantly change during the second time period.

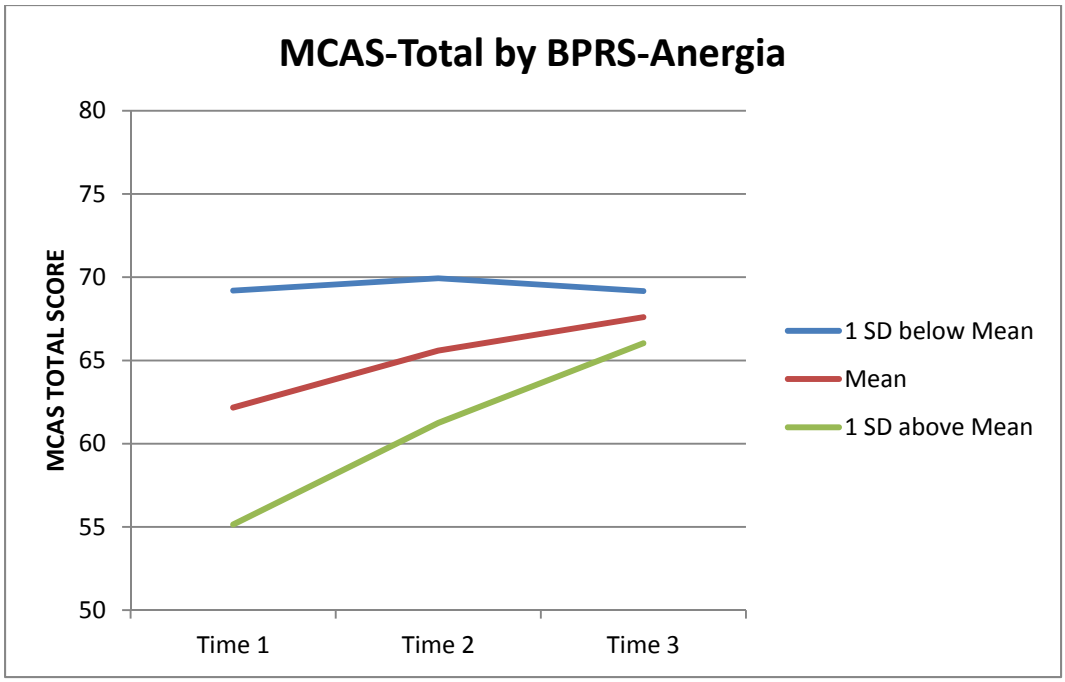


Figure 53: MCAS-Total by BPRS-Anergia

In order to test the effect of the BPRS-Anergia factor on SFS-Total score, group was controlled for in the unstructured piecewise model for SFS-Total. There was no main effect of Anergia score on SFS-Total and there were no significant interactions between Anergia and either slope. Again, persons with more impairment on the Anergia Factor (at the mean or above) showed a large decrease in self-rated social functioning at Time 2 and then a large reversal to in direction of self-ratings at Time 3.

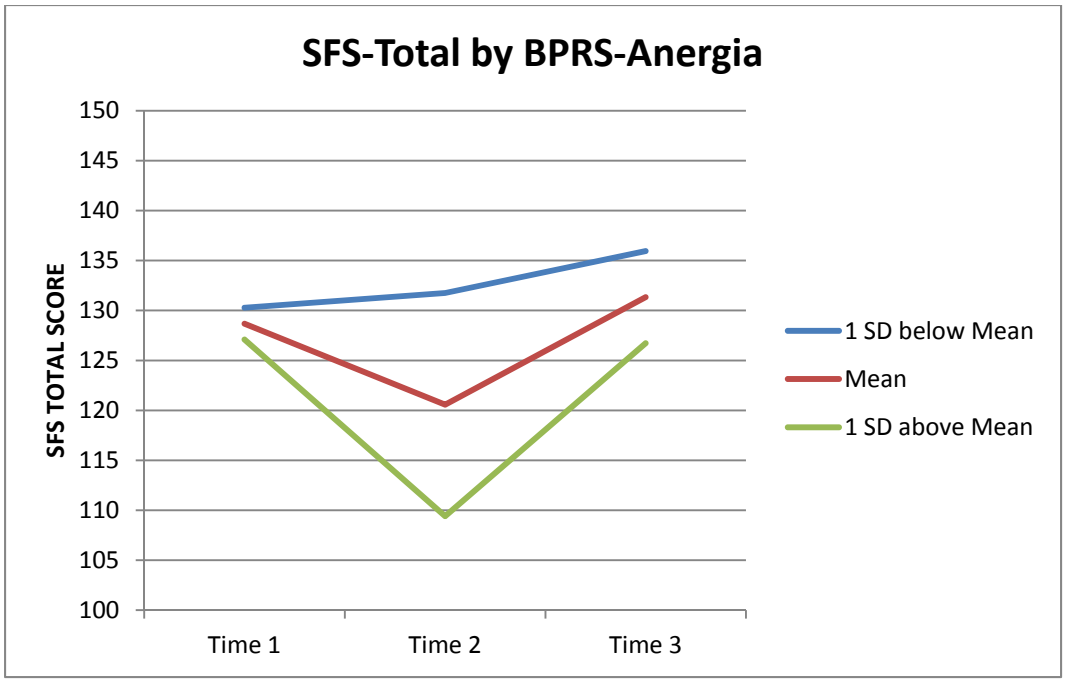


Figure 54: SFS-Total by BPRS-Anergia

In sum, program and group were both significant predictors of MCAS-Total scores at baseline, with persons at Midtown and in Group 1 having higher MCAS Total scores. However, persons at Midtown and in Group 1 had less positive change over time than did the other categories. Persons who completed the study had a more positive rate of change over time, as did younger participants and persons who scored at the mean or lower on the four BPRS psychiatric symptom factors.

Chapter 4: Discussion

The symptoms and functional deficits of SMI are understood as potentially creating a disability (Liberman, 2008). Just like physical disabilities, mental disabilities can severely impair quality of life; however, also like physical disabilities, they are responsive to rehabilitation and in the majority of cases recovery is possible. Recovery from disability enables persons to actualize goals and live a rewarding and fulfilling life. The rehabilitation process in SMI involves numerous targeted domains of functioning, including symptom-related disturbances, dysregulated physiological and emotional systems, disproportional responsivity to environmental and internal stimuli, deficits in motivation, and difficulty performing self-care or other activities that may be beneficial in social, financial, occupational, or personal goal-achievement. Frequently, the course of the disorder is such that skills and abilities were not adequately learned during crucial developmental years because of premorbid conditions. Furthermore, the cognitive disorganization and/or neurological dysregulation that accompany a psychotic episode can interfere with the knowledge and skills to function independently (Spaulding, Sullivan, & Poland, 2003). In rehabilitation approaches, both neurocognition and social cognition are theoretically and clinically implicated in functional improvements. Improvements in these areas can change the ways in which people interpret and understand the behaviors and intentions of other people. Improved interpersonal functioning has the potential to positively impact almost every other domain of everyday life.

The primary objective of this study was to examine change over time in a variety of domains among individuals with SMI. Social functioning, social cognition and neurocognition were the domains of interest and were assessed using multiple measures.

Not only is social cognition consistently impaired in people with SMI (Addington et al., 2006a; Corrigan 1997; Johnston, Stonajov, Devir, & Schall, 2005), the SCIT treatment provided an ideal avenue in which to examine change in response to a targeted intervention. The study took place in the context of an ongoing research laboratory in which constructing large databases, informing treatment decisions with empirical data, and conducting optimally specific and sensitive assessments are the primary goals. Thus, comprehensive and in-depth understanding of the data collected in relation to the SCIT study was of high importance for future studies within the laboratory, using a similar outpatient chronic SMI population. Beyond examining the SCIT outcome data with advanced multilevel models, the longitudinal analyses were ideal for examining change over time in general, and in relation to person characteristics and assessment measure sensitivity. In addition to treatment response which is expected to explain some of the variance, this study provides empirical and theoretical foundations for the selection of measures and study-design for the next major grant-funded trials composed in the lab.

The data provided at least marginal support for the majority of the hypotheses and, importantly, highlighted potential fundamental differences between the domains and between individual measures. Interestingly, contrary to the first hypothesis, persons with lower neurocognitive and social cognitive functioning tended to improve more during SCIT than persons with better performance at baseline. The results are preliminary due to the small sample size and inherent heterogeneity in a sample of adults with SMI, yet they are useful in the analysis of individual differences and quantitatively understanding the wide range of variability that is seen in similar populations. Importantly, the advanced statistical methods used in this study allow for the inclusion of within-person and

between-person variance. Although it is not possible to quantify the variance due to error from that due to individual differences with only three time points, understanding the amount of change that was within-person over time is of utmost importance and was assessed with the analyses herein. Overall, neurocognition changed significantly less within-person than did social cognition and social functioning. This is consistent with expectations as neurocognitive remediation programs would be necessary to incur significant changes in neurocognitive functioning. This study did not analyze the unique domains of neurocognition separately but future studies would be advised to do so with a larger sample, especially over the course of rigorous rehabilitation and social cognitive interventions.

The first hypothesis predicts that baseline neurocognition and social cognition would predict responsivity to SCIT. It is of utmost importance to understand whether there is a specific level of cognitive ability that someone must possess to respond optimally to the SCIT techniques, whether there is a baseline level of social cognitive abilities optimal for the SCIT model, and whether individual differences in baseline functioning, learning style, and cognitive profile determine SCIT outcomes. The results supported the hypothesis that baseline neurocognition would moderate change in social functioning during SCIT, and over time in general. Specifically, higher functioning on the measures of executive functioning and neurocognition in general (included memory, attention, language and spatial abilities) all predicted higher social functioning. Additionally, higher neurocognitive functioning predicted less of an increase in social functioning over time; even though the majority of people showed improvement on the social functioning measure, people with lower neurocognitive scores at baseline showed a

faster rate of improvement in social functioning than the people with higher neurocognitive abilities. This pattern was observed in both groups, but was only significant during the first time period.

Also consistent with the first hypothesis, several domains of social cognition were significant predictors of social functioning change over time. Specifically, higher abilities in social perception, emotion perception and theory of mind (ToM) tasks predicted higher levels of social functioning as measured by the MCAS. Significantly, the emotion perception measures appeared to have moderating effects such that persons with better emotion perception abilities had a less positive rate of increase in social functioning over time. This may be due to ceiling effects (the persons with better emotion perception had significantly higher social functioning at baseline), or it may be that persons with lower levels of emotion perception responded more positively to the SCIT intervention and showed more improvements over time.

The results for the Social Functioning Scale (SFS) show a drastically different pattern than that observed on the MCAS, a pattern contrary to expected treatment effects. However, they are similar in pattern of change over time to the Social Perception Scale (SPS). For both the SFS and the SPS, examination of the figures suggests that Group 1 had significant decreases in average scores at Time 2 and then showed substantial gains in average scores at Time 3. One theory to explain the difference in social functioning outcomes measured by the MCAS from those reflected on the SFS is methodological. The SFS is a self-report instrument while the MCAS is completed by the participant's paired staff (mental health technician). Thus it is possible that individuals involved in the study rated themselves lower at Time 2 because participation in the data collection itself

added emphasis on skills or abilities that were previously not carefully assessed, or, self-assessment at Time 1 was over-rated and regressed toward the mean at Time 2. Group 2 did not tend to show the same drastic decrease at Time 2 compared to Time 1, which further suggests it was involvement in the study itself affected self-ratings at Time 2.Additional studies with this measure need to be conducted with similar samples to evaluate validity and reliability over time with this particular population, and in the presence of active participation in a research study. A strength of the current study is that two alternative methods for evaluating social functioning were implemented, decreasing error and allowing for a more accurate interpretation of the results.

The second hypothesis states that time spent in TAU following SCIT should either predict maintenance or reduction in treatment effects. This hypothesis was based on the expectation that clear treatment effects would be apparent. However, because of the inconsistencies and variability across measures and between groups, it was not possible to fit the data to any of the hypothesized piecewise models (see Figures 1-3), or even any semblance of these models. Remarkably, many of the expected “treatment gains,” or improvements on measures of social cognition and social functioning, occurred during TAU. This phenomenon can be observed in both groups on a substantial number of the measures. Thus, rather than explore the originally posited hypothesis, qualitative analyses were utilized in order to gain an understanding of the changes that took place during SCIT and those that took place afterwards, and the individual differences involved in all rehabilitative change over time.

In order to use mixed methods to further explore the clinical significance and rehabilitative change that occurred within the study, informal interviews were conducted

with staff members and past participants, in conjunction with examination of archival progress notes from the SCIT groups. In general staff and participants that were present at the day centers remember very few specific details about what they learned in the groups, although they do recall some of the recurring characters' names and visual diagrams used to explain the relationship between feelings, thoughts, and behaviors. Although past participants primarily recall only that they enjoyed SCIT groups, it has been noted by successive skills-training group facilitators that persons who participated in the original SCIT groups are more skilled in tasks that require the differentiation between *facts* and *guesses* for social perception and interpretation. Furthermore, in a newsletter article published in the months following the SCIT study in the Midtown Center News (2009), one participant wrote about his experience in SCIT:

> We are practicing how not to jump to conclusions in a given situation or set of circumstances. By coming to a conclusion before we have all the information, we could be setting ourselves up to have feelings or opinions not based on fact. Learning not to jump to conclusions can also keep your stress level down and give people the benefit of the doubt in certain situations. Changing our thinking changes our feelings, which in turn changes the way we behave. (p. 4)

Thus, although the second hypothesis was not explored quantitatively, it appears that participants mostly enjoyed the SCIT groups, and still show some benefit from the skills they practiced. Although the evidence for this is primarily anecdotal, the staff at the day centers share very positive feelings about the SCIT groups and acknowledge the importance of conducting assessments prior to and following skills-training groups. However, the staff and participants alike share the sentiment that the assessment battery for the SCIT study was overwhelming and unmanageable for some participants. They express a desire that future studies include a more expeditious assessment battery.

The third hypothesis was designed to use empirical analysis to compare the various assessment measures to inform the selection of a battery of tests that are the most sensitive and reliable with the sample population. The conclusions from these analyses are designed to augment future research and clinical work within the SMI laboratory at UNL. A major advantage of using these results for future assessment decisions is that it will enable the battery to be shortened so as not to be perceived as overwhelming and redundant but still include tests necessary to detect significant change.

Several of the measures showed significant change over time. The social functioning measures and social perception measure showed improvement among persons in Group 1 by Time 3. Although it would have been expected that the improvements would be detected at Time 2, the observed changes are possibly attributable to delayed treatment effects or spontaneous improvement. However, it is unlikely the significant improvements are due solely to practice effects since similar gains were not observed on all measures at Time 3 and were not observed on these same measures for Group 2.

Group 2, in general, started lower and improved more during both time segments on the majority of measures with the exception of some nonsignificant decreases in scores on the SFS and FEIT during the first time period. Two measures of relevant noteworthiness are the Hinting Task and FEIT; these tests of ToM and emotion perception, respectively, showed improvements in the expected directions and during the expected time periods (while each group was in SCIT), suggesting they are detecting meaningful change. Further support for this conclusion is given by the ICC's for these two measures, both indicated that near 50% of the variance was within-person (ICC = .60

and .43 for Hinting Task and FEIT, respectively), meaning that participants showed intraindividual change on these measures.

It must be noted that if an outcome measure did not show significant change over time, one cannot necessarily conclude that the measure is not substantially sensitive or valid. It is possible that there was in fact no real change for the measure to detect. Conversely, it is possible that change occurred but was not detectable by the questions asked on the given measure, that other factors related to the administration or analysis of the measure obviated detection of substantial change over time, or that the measure is highly sensitive to power problems. Finally, floor and ceiling effects are an ongoing concern in studies that involve highly heterogeneous populations. Future studies would be advised to increase the sample and number of measurement occasions in order to use multivariate methods to answer this question.

Regarding the fact that Group 1 scored higher on baseline than Group2, on the majority of measures, it is possible that the method for assigning participants to treatment groups was not ideal. The small sample size skews true statistical comparison of the two groups because a few very high or very low individuals may alter the composition of the group and resulting group means. Thus it is necessary to consider the highly heterogeneous population and large variability observed within individuals and between individuals as just one of the many facets that makes controlled clinical research in this field highly difficult and necessitates numerous replications in order to form any firm conclusions.

It should be emphasized that the purpose of these analyses was to identify measures that detected not only treatment effects, but more broadly, change over time.

That said, “treatment effects” per se are not an objective construct given the established overlap and contagion among the numerous domains of functioning. This study supports previous research that has found gains in social cognition are related to personal hygiene, appearance, and neatness (Penn et al, 1996; Poole et al., 2000). Specifically, the MCAS Behavior and MCAS Health scores showed significant improvement by Time 3 for Group 1. Although we cannot make causal interpretations about these findings, they are noteworthy and attempts to replicate them should be made in future studies. Arguably, increased attention to social perception and social knowledge may benefit personal habits related to health and grooming behaviors. Not only can these habits benefit social relationships, individuals that increasingly attend to social cues and interpersonal interactions may also increase attention to personal appearance, thereby affecting social impression management.

Finally, in the aim of identifying measures and accumulating empirical evidence for a specific battery of tests, it should be noted that some measures should be included in future batteries despite the fact that they are not sensitive outcome measures. Of particular note are the Trails-B test and other tests of executive functioning. These measures showed substantial moderating effects on social functioning outcome over time but did not change uniquely when modeled as dependent variables. Similarly, the NAB-S (general neurocognitive functioning) had an ICC of 91% indicating that individual participants did not show growth or change in neurocognitive functioning, although neurocognitive abilities at baseline were a significant predictor of growth over time in the social functioning domain.

The fourth hypothesis built on the third hypothesis and further aimed to simplify and delineate the measures that showed significant change and the domains into which these measures can be usefully categorized. The Principle Components Analysis (PCA) was not designed to reduce or quantify specific sources of variance but it did provide meaningful categories of measures that showed similar patterns over time. Significantly, the NAB-S was the only neurocognitive measure included in these analyses as it was the only measure that showed significant change over time as an outcome measure. However, because it was multivocal and somewhat inconsistent in its component loading across time points, it is likely a component of its own. This offers further support for the differentiation of neurocognition and social cognition (Green et al., 2008; Fett et al., 2011). Two of the three social cognitive components (i.e., Self-Perceived Social Functioning and Social Perception) showed similar patterns over time in which scores decreased at Time 2 and increased at Time 3. The Observed Social Functioning component showed a gradual increase over time. It is theoretically consistent that the Self-Perceived Social Functioning and Social Perception components were similar in pattern as they can be assumed to be functionally related in the real world. However, when the groups were combined such that all participants were modeled together for the time period they were in SCIT, decreases in scores on these two factors can be observed. Further investigation with a larger sample and more time points would be necessary to understand these findings and establish the reliability of this trend. It is more important to attempt to replicate the component structures than to decipher the absence of clear treatment effects in the case of a small sample size and a short duration of active treatment.

Supporting the findings of the fourth hypothesis, recent research indicates that the social cognitive assessments used most frequently in work with SMI populations actually measure a cluster of separable factors (Manusco et al., 2011).In a study designed to empirically clarify the factor structure of social cognition and determine whether there are differential domains within the construct in the context of SMI, Manusco and colleagues (2011) found three separable social cognitive factors, two of which predicted functional capacity and functional outcome above and beyond non-social neurocognition and symptoms. To date, the Manusco study was the first known study to conduct an exploratory factor analysis on the domains possibly embedded within the social cognition construct within SMI, and this study is the first PCA with a similar goal. Future studies should further seek to identify the meaningfully separable domains in order to understand variations in change over time and differentiate between state and trait-like deficits. Additionally, further work to quantitatively differentiate neurocognition and psychiatric symptoms from performance on social cognitive measures and potential for improvement in social cognitive domains will help with targeted treatment interventions and recommendations.

Consistent with the fifth hypothesis, individual characteristics did have a moderating effect on change over time as measured by the MCAS Total. Persons who completed the study had a more positive rate of change over time but were not significantly different at baseline from those who did not complete the study. There were originally 40 people recruited for the study that completed informed consent forms and attended the initial assessment session. Of these 40 people, 3 people dropped out before the first SCIT implementation began, thus they did not participate in either group

although their assessment data was retained for inclusion in the baseline analyses. Of the 37 remaining participants (19 in Group 1 and 18 in Group 2), six did not attend the second or third assessment sessions (5 from Group 1 and 1 from Group 2), and five attended the first two but not the third assessment sessions (2 from Group 1 and 3 from Group 2). Additionally, of the 14 persons that did not complete the entire study, four were from Midtown and 10 were from Southville. Although these numbers are too small to conduct significance testing, it is theorized that Southvillle and Midtown have fundamentally different populations, different therapeutic climates, or different external events at the time of the study.

Gender did not have a significant effect on social functioning at baseline and did not moderate progress over time; however, examination of the figures suggests that men scored slightly higher over time than did women. This trend is apparent on the social functioning measure rated by staff, as well we the self-report measure. A larger and more balanced sample would be useful in determining any gender-related effects. At baseline, age was not a significant predictor of social functioning, but over time younger participants had more positive change than older participants, significantly so during the second time period. Also significant, persons who scored at the sample mean or lower on the four BPRS psychiatric symptom factors had lower social functioning scores at baseline and this difference maintained over time, compared to persons with lower levels of psychiatric symptoms. Examination of the separate BPRS factors indicated some differences based on qualitative type of symptomatology. Specifically, persons with more negative affect and more disorganization showed more increase in social functioning from Time 1 to Time 2 than did persons without elevated symptom levels on these two

factors. This may be explained in a manner similar to that for persons of low functioning on the neurocognitive and social cognitive measures, that is, higher functioning at baseline predicts less rapid improvement in the first time period and a possible ceiling effect. Importantly, research suggests that different symptom profiles may differentially relate to particular neural network activation systems and unique deficits in the processing of social stimuli (Pinkham et al, 2008). In the current study, persons with higher levels of Anergia improved more on social functioning from Time 1 to Time 2 than persons with lower Anergia. Although social functioning is only thought to be proximal to the processing of social stimuli, it is plausible that different symptoms relate to different processing areas and an exploration of the symptom factors in relation to emotion perception, social perception, and ToM may be warranted in future studies. Future studies should also explore the relationship between psychiatric symptoms and rehabilitative change over time; the majority of research suggests they are minimally related which may be an explanation for the inconsistent findings across symptom factors, in combination with the small sample size and general low-level of reported psychiatric symptomatology across participants (see Table 1). Program and group were both significant predictors of MCAS Total scores at baseline, with persons at Midtown and in Group 1 having higher MCAS Total scores. However, persons at Midtown and in Group 1 had less positive change over time than did the other categories. Although participants were not randomly assigned to treatment groups, they were assigned with the intention of balancing the groups by age and gender and level of functioning. However, in addition to significant effects of the person-level variables, treatment group proved to have a moderating effect on change over time as well such that persons in Group 1 (SCIT

1st) had higher scores at baseline and less positive change during the first time period, as compared to Group 2. The only way to resolve the ambiguity raised by finding group differences in baseline functioning and in rate of change over time is to replicate the study with a larger, randomly assigned sample. Group was controlled for in all analyses, given the reliance on time intervals. Although having only three occasions prevented quantitative differentiation between the variance due to individual differences from that due to error, the person-level moderation analyses are necessary and useful to identify the specific individual characteristics which are significant moderators, and affect treatment effects. Age, program, group, completion status, and psychiatric symptomatology each contributed a significant amount of variance. With five measurement occasions it would be possible to quantify the amount of variance attributable to individual differences, and with four occasions it would be possibly to model two random slopes (allowing each person to have their own variance and covariance for both slopes within the same model).

A major finding of this study is not directly addressed by the hypotheses. Surprisingly, there is a robust effect of being in the study such that self-reported social functioning is reduced six weeks after the initial assessment, regardless of participation in SCIT. This finding is mediated by neuro- and socio-cognitive impairments and symptomatology. Participants in both groups tended to have decreased self-ratings on the social functioning measure at Time 2 compared to Time 1. Also surprising, there was a large consistent rebound effect such that persons with decreased self-ratings at Time 2 tended to show large increases in social functioning self-ratings at Time 3. The mediating effect of cognitive impairments and symptom severity was negligible at Time 3. Worthy of further investigation is whether gender also mediates, or exaggerates, this effect.

Examination of the figures suggests that only men showed the decrease in self-rated social functioning as a product of being involved in the study for the first 6 weeks; women tended to have higher and more stable self-ratings. Men's self-ratings may have decreased as a product of increased self-awareness and attention to social abilities; simultaneously women's self-perception may be somewhat immune to study participation. However, it is not possible to draw any conclusions about a possible gender interaction from the present study because of the small sample size and uneven distribution of men and women.

Cultural variations such as nationality, language-based standardizations, norms, belief systems, shared cognitive models and customary emotional expression practices can influence an individual's social cognition, however, these constructs do not determine an invariable bundle of traits that are universal or innate (Vogeley & Roepstorff, 2009). Indeed, social cognition within an SMI population should be understood in terms of the relevant cultural and social norms and expectations, as well as the more molecular deficits that result from impaired neurodevelopment and a dearth of "normal" social experiences and developmental milestones during adolescence and early adulthood. Although many of the social cognitive deficits known to be prevalent in SMI have been found across cultures (within the US and internationally), there are also likely more subtle nuances that are particular to persons with SMI that are also members of particular geographical regions, SES groups, etc. Although it is important to understand the competences (i.e. language), practices, and beliefs of any group in which social cognition is going to be studied, it is likely that differentiating between individualism and collectivism is only secondary to the individual's capacity to correctly interpret emotions

or social inferences and the appropriate response in interpersonal situations in a manner consistent with social norms and adaptive functioning.

Cultural neuroscience may be a future domain of research to be translated to the neuroanatomical and imaging research being done in the SMI area. Studies have found different brain regions activated during self-representation (Zhu et al., 2007), theory of mind tasks (Kobayashi et al., 2007), emotion perception and self-awareness (Lin et al., 2008) among children and adults from different cultures ("eastern" vs "western"), and subsequent to culturally-related independent or interdependent self-construal priming (Kobayashi et al., 2007; Sui & Han, 2007), but these studies have been faulted for assuming nationality can operationalize cultural variations. In the same vein, it is important to explore the biological and developmental influence on social cognitive deficits. In one of the only studies to examine social functioning in persons at clinical high risk for schizophrenia, the researchers found the high-risk sample to have deficits in social engagement and interpersonal communication equal to those among persons with multi-episode chronic schizophrenia, and to be significantly more impaired than the non-psychiatric controls, as measured with the SFS (Addington et al., 2008).

A fundamental theme in the results discussed herein revolves around the small sample size and the limited interpretability, reliability, and generalizability of the current results. Furthermore, the heterogeneity of this sample is significant, albeit realistic of actual outpatients with chronic SMI. Intrinsic to interpretation of the present findings, and using them to inform future studies, is clarification and acknowledgment of the difference between statistical significance and clinical significance. In this study, real, replicable statistical significance cannot be assumed; however, a continuum of clinical

significance that is sensitive to heterogeneity between people and fluctuations within people is relevant and can be assumed. Frequently, the concept of clinical significance is cited in the literature in the presence of ambiguity about what certain measures mean, or in discussions of therapeutic change. The reason for this is simple: it is not frequently possible or optimal to rely solely on statistical significance testing to understand the real-world impact of therapeutic interventions or results yielded on a given assessment. Clinical significance refers to whether the intervention makes a real difference in the life of the client and in their daily interactions (Kazdin, 1999). The concepts and constructs that are targeted by SCIT and the range of assessment measures implemented in this study are relevant to clinical significance. The clinically significant questions include whether participants have an easier time perceiving peers' and relatives' emotions; whether participants experience a decrease in the frequency of interpersonal misunderstandings; and whether participants can initiate and maintain social relationships with increased ease. Clinical significance implies that in addition to improvements in skills and abilities, actual behaviors also change as a result of the intervention.

Clinical significance often overlaps with statistical significance, and furthermore, we seek both clinical and statistical significance based on evidence that they have been achieved in the past. Recently, studies have found both types of significance in relation to efforts to improve the social cognitive abilities of adults with SMI. Not only are the numbers promising, the real-life impact of successful treatments allows people to take on responsibilities and fulfill new goals. The ongoing debate about proximity to functional outcomes appears to support the notion that social cognition is more proximal and neurocognition more distal to social functioning, and that emotion and social perception

account for unique variance in functional outcome, above and beyond neurocognition (Manusco et al., 2011).

Although neurocognition is consistently found to be related to impaired social functioning in schizophrenia, it only explains 20-40% of the variance in functional outcome(Choi, Kim, Lee, & Green, 2009) and is attributed to effect sizes of 20-60% in functional outcome (Green, Kern, Braff, & Mintz, 2000). There is an ongoing discussion in the field as to whether social cognition is an important mediator of the relationship between neurocognition and social competence (Green et al., 2000). More recently, research has explored whether specific aspects of social cognition are linked with specific forms of neurocognition (Lancaster, Evans, Bond, & Lysaker, 2003). Lancaster and colleagues (2003) found that executive functioning is related to the ability to recognize actual and suggested social cues and that memory is related to the recognition of concrete social cues; however, contrary to this trend, they found controlling for intelligence and hospitalization history nullified the relationship between neurocognition and social problem solving. Arguably, because social cognition is the cognitive process of perceiving and processing social cues from the environment, which underlies social behavior, prerequisite neurocognitive abilities must be intact for smooth processing in the social arena (Yager & Ehmann, 2006).

In a discussion of particular social cognitive domains, emotion perception is inevitably isolated as central to social cognition, closely related with specific domains of neurocognition, and relatively accessible in both assessment and treatment. Emotion perception has been found to be significantly correlated with work functioning and independent living (this relationship is also predictive, such that higher emotion

perception predicted better work functioning and independent living one year later) (Kee,Green, Mintz, & Brekke,2003). Mueser et al. (1996) found emotion perception to be related to personal appearance and hygiene and others have found it related to neatness (Penn et al 1996) and appropriate appearance (Poole et al, 2000). Emotion perception requires attention to detail and assimilation of relevant cues to accurate response behaviors. This, arguably, translates to the skills involved in grooming and hygiene and other mundane task performance. Emotion perception has also been found to be related to conversational skills (Ihnen, et al., 1998) and interpersonal relationships (Poole, 2000); these may be true correlations, or there may be intervening variables for which emotion perception is somewhat of a proxy.

Consistent with the present study, which suggests emotion perception shows the most robust gains over time, previous social cognition intervention implementations have found that of the four targeted social cognition domains, persons in the social cognition treatment condition made significant gains only in facial affect perception, compared to persons in the control condition (Horan et al., 2009). The facial affect perception improvements were independent of basic neurocognitive functioning. Confirming that affect perception abilities are responsive to therapeutic techniques is useful, but understanding the ways which these abilities generalize to real-life is equally important. Interestingly, emotion perception is a significant predictor of work functioning and successful independent living; however, it has not been found to relate to social functioning or family relationships (Kee et al., 2003).These differential relationships between emotion perception abilities and real-world outcomes are possibly attributable to issues with measurement or, as suggested by Kee and colleagues, family and social

relationships might be more amenable, and therefore less impacted by, emotion perception deficits, in comparison with work settings and independent living tasks. Frequently, when people with SMI have repeated failures in the vocational arena, it is often because of interpersonal functioning deficits, rather than an inability to perform the tasks. The importance of emotion perception and its relation to different domains of functioning suggests that in addition to social cognitive abilities, persons with SMI benefit from social support, familial relationships, and compensatory strategies, just like persons without SMI. The ambiguity that surrounds individual response to rehabilitation and the heterogeneous nature of the disorder makes it difficult to prescribe a regimen of treatment and environmental structure that will support optimal functioning in each person with SMI.

In addition to the ongoing debate regarding social cognition's proximity to social functioning, there is also disagreement regarding the degree to which social cognitive abilities may spontaneously recover, or improve during non-targeted treatment, or as a result of nonspecific treatment effects. The current study does support the argument that realms of social cognition may improve during TAU, or in a delayed fashion in relation to a targeted intervention. In a well-designed randomized controlled trial of a social cognitive intervention, persons in the control condition improved in several areas of social cognition; the control participants improved in more domains than persons in the experimental condition (Horan et al., 2009). However, in the present study, a confounding factor is that the total elapsed time was approximately three months, thus it is difficult to say whether abilities were gained that had not been present prior, and equally difficult to assume permanent changes. In a longer study, Addington et al.

(2006b) found that in the absence of active social cognition treatment, there were no changes over a one-year period in social cognitive abilities or neurocognitive abilities among a sample of outpatient program adult attendees with multi-episode chronic schizophrenia. This study indicated that deficits in both social knowledge and social perception were stable over time in the absence of treatment. However, Addington and colleagues measured social functioning using the Quality of Life Scale and a laboratory-based measure of social problem solving, and although these two measures may not be the best indicators of true social functioning, the researchers did find different mediational relationships between neurocognition and social cognition based on the two different outcome measures, which is consistent with the current study. Thus, other clinical factors and more nuanced aspects of social functioning and cognition may contribute to the outcomes and a multitude of assessments may be necessary for the most comprehensive and accurate assessment of functioning. The current study is an improvement over recent studies that assessed a restricted number of domains of functioning and failed to detect subtle differences. The current study aimed to detect differences in the measures' sensitivity and to allow for models that control for multiple potentially confounding factors while delineating real effects.

Limitations

This study achieved several goals that will lay groundwork in the field of SMI and in future work conducted in the UNL SMI laboratory. Significantly, it provides one of the first empirical components analysis of a large number of social cognitive assessments which will enable researchers to have both theoretical and empirical information in the selection of measures to assess rehabilitation. Simultaneously, this study utilized advanced multilevel statistical models in order to understand social cognitive and

neurocognitive change over time among adults with chronic mental illness involved in day treatment programs. Despite the utility to the UNL SMI lab of being provided a thorough and complete analysis of the existing data, there are several important limitations.

The primary limitation in this dissertation is the small sample size and the short duration of time in which the data was collected. The sample started out with 40 participants; however, by the third assessment occasion there were only 26 participants that completed the assessments. The study lasted for a period of approximately three months, in which there were three assessments conducted, although this allows for multilevel analyses to be conducted, extending the study to include five assessments and a longer follow-up period would enable analyses to quantitatively assess the various sources of variance and the true impact of individual differences (random effects) as well as lasting treatment effects. The study should be replicated in a design that allows for at least five assessment occasions. However, given the limitations inherent in the database, the extensive analytic methods applied capitalize on available resources and provide important insight into any trends and patterns that do exist within the limited dataset.

Implications for Future Studies

Future studies would also be advised to incorporate additional assessment methods and measures not included in the original study. Given the relevance of emotion perception to both social cognition and social functioning, concurrent eye-tracking analysis could determine facial visual scanning abnormalities, EEG physiological monitoring and fMRI technology may further elucidate trends related to regional neural activation related to emotion perception and social cue detection and processing. Recent

neuroimaging studies suggest there is emotion perception hemispheric specialization depending on the valence (i.e. right hemisphere perceives negative facial emotions and left hemisphere perceives positive facial emotions) (Kirsch, 2006). The current study did not analyze the results according to the valence of the social stimuli being perceived, it may be included in future studies in conjunction with symptom profile subgroups or specific neurocognitive deficit subgroups, if specific neuroanatomical regions are hypothesized to be related to the observed profiles and deficits.

In this study, social functioning was measured using the MCAS and SFS. While this is an improvement over past studies that do not directly assess community functioning or do not use both staff-report *and* self-report measures, further work needs to be done to understand the degree to which these measures map on to success in social settings and occupational settings. The current study used the total scores of the MCAS and SFS, as well as subscale scores; future studies with larger samples should focus exclusively on the subscale scores to avoid limiting sensitivity to unique domains of social functioning that may be subsumed within the wide scope of functioning included in the summary scores for the two measures. Future studies would be advised to devise a priori domain-specific hypotheses for different aspects of social functioning. A specific measure that is recommended to be added to the assessment battery in future similar studies is the Social Cue Recognition Test (SCRT; Corrigan, 1997). The SCRT requires individuals to use social cues to make inferences about social situations; it assess the participant’s ability to observe and comprehend concrete cues (i.e. what the actor said and did) and abstract cues (i.e. inferences about the rules, affect and goals guiding the

actors' behaviors) – these skills are specifically taught and practiced within the course of SCIT.

In addition to the heterogeneous nature of schizophrenia, community outpatients that attend day programs represent a wide range of abilities, clinical profiles, and social abilities. Thus, the inclusion in a bi-weekly hour-long skills-training intervention may not be a robust enough factor to predict change on measures of specific social cognitive abilities or overall social functioning. Likely, a more controlled environment with more intense psychosocial rehabilitation would allow researchers to accurately control for and predict domain-specific improvements. However, the purpose of the present study was such that efficacy assessment was the goal, and the intervention administered in a real-world setting was ideal for measuring whether any change took place, for whom, and at what rate. Midtown Center, the program that showed more promising outcomes in the current study, is in fact the site of future research and clinical interventions for the SMI laboratory. Additionally, since the time the data was collected, Midtown Center has transformed into a more concentrated rehabilitative setting with numerous ongoing skills training modalities, including SCIT. Thus, future studies have an increased chance in detecting real change resulting from participation in rehabilitative techniques.

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