2-2018

Sensory, Motor and Process Skills as Compared to Symptom Severity in Adult Patients with Schizophrenia

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February, 2018

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SENSORY, MOTOR AND PROCESS SKILLS

AS COMPARED TO SYMPTOM SEVERITY

IN ADULT PATIENTS WITH SCHIZOPHRENIA

by

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Date ______February 14, 2018________

Submitted in partial fulfillment of the
requirements for the Degree of Doctor of Education in
Teachers College, Columbia University

2018

ABSTRACT

SENSORY, MOTOR, AND PROCESS SKILLS

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Schizophrenia is a serious mental illness affecting millions of Americans. It is characterized by positive and negative symptoms; cognitive impairments; and sensory, motor, and process skill deficits; as well as compromised motor learning, functional difficulties, and diminished quality of life. Neuroscientists attribute the above deficits to abnormal brain development, exaggerated synaptic pruning, and neurodegenerative processes, causing disrupted connectivity and diminished plasticity in the brain, neurotransmitter dysfunction, and impaired sensory processing.

Presently, there is no cure for schizophrenia. Numerous medications and rehabilitation modalities exist; however, many of the affected individuals continue to struggle daily. Recovery of these individuals implies symptom management and environmental supports to foster integration into the society and improved quality of life.

Occupational therapists (OTs) utilize occupation-based assessments and interventions to evaluate and treat functional impairments in clients with various

conditions, including schizophrenia, and provide their clients with environmental adaptations/modifications to enhance function. An improved understanding of the skill deficits and their relationship with schizophrenia symptomatology is necessary to refine treatment and rehabilitation for this client population, and so far, several OT scholars have attempted to research this topic.

This study employed the Adolescent/Adult Sensory Profile (AASP), Assessment of Motor and Process Skills (AMPS), and Brief Psychiatric Rating Scale (BPRS) to examine the sensory, motor, and process skills of stabilized adult patients with schizophrenia spectrum disorders in relation to their symptoms. It was hypothesized that the participants would present with deficient sensory, motor, and process skills, and significant relationships would be revealed between these skill deficits and the severity of psychiatric symptoms.

Analysis of the data confirmed sensory, motor, and process skill deficits in the participants. It discovered correlations between low registration and sensory sensitivity, and anxiety/depression. Relationships were also found between sensory avoidance and motor and process skill deficits. Additional findings included correlations between sensory sensitivity and sensory avoidance, between motor and process skill deficits, and between different categories of psychiatric symptoms.

Study findings support the idea that schizophrenia rehabilitation necessitates addressing the skill deficits with which it comes. The concept of impaired sensory processing underlying schizophrenia symptomatology and skill deficits needs further investigation.

DEDICATION

This paper is dedicated to the memory of my maternal and paternal grandparents,

all of whom were Holocaust survivors.

The personal, professional, and academic challenges I have encountered so far

appear minuscule next to the atrocities they had encountered.

Their subsequent lives and accomplishments are my epiphany of human resilience

and will never cease to inspire me.

ACKNOWLEDGMENTS

I would like to express my sincere gratitude to Dr. Janet Falk-Kessler, my sponsor, and Dr. Glen Gillen, my advisor, for inspiring my research project and for supporting me throughout it.

Dr. Falk-Kessler spent countless hours helping me brainstorm ideas for my research and assisted me with integrating the knowledge I gained from the literature I reviewed. She also worked relentlessly guiding me through my data analysis.

Dr. Gillen introduced me to the Assessment of Motor and Process Skills (AMPS, one of the measurements used in this study) and helped me formulate the goals of my research. He has also shown endless patience in advising my doctoral course selection over the years.

Above all, I appreciate my mentors' incredible sense humor, which made this challenging journey more manageable for me. Without them, my research project would not have thrived, and I am forever grateful for the opportunity to work with these two outstanding scholars.

Additionally, I am very appreciative of the feedback provided by Dr. Stephen Silverman on my data analysis. Dr. Silverman kindly agreed to serve on my proposal and dissertation defense committees, and has been a positive influence in this research project.

I would like to sincerely thank Dr. Laudan Jahromi for serving on my dissertation defense committee and for reviewing my thesis.

I would also like to acknowledge Dr. Dawn M. Nilsen, Dr. Katherine Dimitropoulou, Dr. Emily Raphael-Greenfield, and Dr. Lenin C. Grajo, as well as my

fellow doctoral students, for challenging me with thought-provoking questions and comments, and for equipping me with valuable information while I was working on my research and preparing to defend my dissertation.

A special thank you to the St. Vincent’s Behavioral Health Center (SVBHC) faculty and staff. Dr. Stewart Levine, former Chair of Psychiatry and the co-investigator in this study, provided essential guidance regarding the study procedures and trained the participating nursing staff in conducting the Brief Psychiatric Rating Scale (BPRS, another measurement used in this research).

Dennis Burch, Shannon Crabb, Belinda Seak, and Jessica Werdmann, the registered nurses who participated in this research, have been tremendously helpful with subject recruitment and the BPRS administration.

Young Oh and Jennifer DiDonato, who were in charge of the SVBHC psychosocial rehabilitation department at the time this study was initiated, offered valuable feedback on subject recruitment and safety procedures. Dr. Andre Newfield, current Chair of Psychiatry, also provided ongoing support for this research.

Thank you also to Dr. Heather Miller-Kuhaneck, Associate Professor at the Graduate Program in Occupational Therapy, Sacred Heart University, for providing comments in regards to the Adolescent/Adult Sensory Profile (AASP, another assessment utilized in this study).

Finally, I would like to mention that my doctoral journey would not have been possible without the unconditional love of my mom and dad; and my husband, Dr. Igor Halperin, the ultimately passionate and dedicated scientist I continuously look up to.

L.H.

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Chapter I

INTRODUCTION

Problem Statement

Schizophrenia is a serious mental illness that affects 2.4 million Americans over the age of 18. The hallmark symptoms of this disease include *psychosis* (loss of contact with reality), *positive symptoms*, such as hallucinations (false perceptions) and delusions (false beliefs); *negative symptoms*, such as flat affect, lack of motivation and spontaneity, and social/emotional withdrawal; *cognitive* deficits, such as impaired information processing, reasoning and problem solving, and disorganized speech and behavior; and *occupational* and *social* dysfunction (American Psychiatric Association [APA], 2013; Javitt, 2010; Lieberman et al., 2008).

The literature also suggests that patients with schizophrenia spectrum disorders often demonstrate poor cognitive, sensory, motor, and process skills as well as a diminished sense of coherence and control. This results in functional impairments, such as difficulties with self-care and household management, unemployment, decreased academic performance, social isolation, and limited engagement in leisure, which ultimately lead to diminished quality of life among this client population.

The etiology of schizophrenia is not well understood, although in recent years attention has been drawn to brain impairment. Neuroscientists attribute skill deficits seen

in schizophrenia to neuropathology, such as abnormal brain development followed by exaggerated synaptic pruning and neurodegenerative processes, causing disrupted connectivity and diminished plasticity in the brain, neurotransmitter dysfunction and impaired sensory stimuli transmission. These abnormalities eventually result in poor motor planning/coordination/learning, abnormal reflexes, compromised cognition, and behavioral disorganization, in addition to delusions, hallucinations, flat affect, and diminished volition frequently exhibited by people with schizophrenia (Lesh, Niendam, Minzenberg, & Carter, 2011; Lieberman et al., 2008; McGlashan & Hoffman, 2000; Murray & Dazzan, 2002; Pettersson-Yeo, Allen, Benetti, McGuire, & Mechelli, 2011).

Treatment of schizophrenia continues to evolve because there is no current cure. The concept of recovery undergirds most treatment models, and implies symptom management and environmental supports to foster the integration of chronically mentally ill individuals into society and improvement of their quality of life (Lieberman et al., 2008). Numerous medications and rehabilitation treatment modalities have been developed to address the treatment and recovery of people with schizophrenia; however, many individuals carrying this diagnosis continue to exhibit functional deficits (Silverstein, 2000).

Occupational therapy (OT) practitioners, utilizing occupation-based assessment and treatment tools to evaluate and treat functional impairments and the underlying skill deficits in clients with mental health conditions, can assist this client population with environmental modifications and adaptations that enhance occupational engagement, thereby fostering recovery (American Occupational Therapy Association [AOTA], 2010).

Symptom severity and impaired cognition have been linked to poor functional outcomes among people with schizophrenia spectrum disorders. However, more understanding of the relationship between sensory, motor, and process skills, and function, which is the OT approach, has received limited attention in schizophrenia research. As compromised sensory, motor, and process skills result in functional deficits for many populations, it is important to explore this relationship in schizophrenia spectrum disorders.

Sensory, Motor, Cognitive, and Process Skills: Definitions

The second edition of the Occupational Therapy Practice Framework (OTPF) issued by the AOTA in 2008 defined *sensory-perceptual skills* as "actions or behaviors a person uses to recognize and respond to visual, auditory, proprioceptive, tactile, olfactory, gustatory, and vestibular sensations" (p. 640). Examples of sensory skills included *hearing* (sounds), *locating* (by touch), *discerning* (flavors), and so on (AOTA, 2008, p. 640). Sensory skills are no longer described under the category of Performance Skills in the 3rd edition of the OTPF. However, *sensory functions* are still included in it under Client Factors (AOTA, 2014).

Motor skills are defined in the OTPF (3rd edition) as "Occupational performance skills observed as the person interacts with and moves task objects and self around the task environment" (p. S25). Examples of motor skills include *bending* and *reaching* (for an object), *coordinating* (body parts), and so on (AOTA, 2014, p. S25).

Cognitive skills were defined in the 2nd edition of the OTPF as "actions and behaviors a client uses to plan and manage the performance of an activity" (p. 640). The

examples of cognitive skills included *selecting* (tools and supplies), *sequencing* (tasks), *organizing* (activities), *prioritizing* (steps), and so on (AOTA, 2008, p. 640). Similar to sensory skills, cognitive skills have been re-conceptualized in the 3rd edition of the OTPF and are now called *mental functions* under Client Factors (AOTA, 2014).

It is useful to note that *process skills* measured by the Assessment of Motor and Process Skills (AMPS) used in this study, are now defined by the AOTA similarly to how they were defined in the past: "Process skills are occupational performance skills… observed as a person selects, interacts with, and uses task tools and materials; carries out individual actions and steps; and modifies performance when problems are encountered" (p. S25). Examples of specific process skills include *attending* (to a task), *choosing* (tools and materials), *organizing* (workspace), and so on (AOTA, 2014, p. S25).

Since the AMPS used in this study refers to *process* rather than *cognitive* skills, research findings on the process skills of people with schizophrenia are discussed throughout this study in addition to the findings on the sensory, motor, and cognitive skills of this client population.

Purpose of the Study

This descriptive study aimed to examine the sensory, motor, and process skills of adult patients receiving inpatient treatment for schizophrenia spectrum disorders and exhibiting symptom stabilization and medication adjustment. An improved understanding of the sensory, motor, and process skills and their relationship with the symptomology in schizophrenia may be necessary to develop refined treatment and rehabilitation models for this client population.

Research Questions and Hypotheses

The research questions for this study were as follows:

1. What are the motor and process skills deficits in patients with schizophrenia spectrum disorders?
2. What are the sensory skill deficits in patients with schizophrenia spectrum disorders?
3. What is the relationship between the sensory and the motor and process skills of patients with schizophrenia spectrum disorders?
4. What is the relationship between the skill deficits found in patients with schizophrenia spectrum disorders and the severity of their psychiatric symptoms?

It was hypothesized in this study that:

1. The study participants would demonstrate sensory skill deficits as measured by the Adolescent/Adult Sensory Profile (AASP).
2. The study participants would demonstrate motor and process skills deficits as measured by the motor and the process subscale scores of the Assessment of Motor and Process Skills (AMPS).
3. Statistically significant relationships would be found between the sensory skills of the study participants as measured by the AASP, and their motor and process skills as measured by the AMPS.
4. Statistically significant relationships would be observed between the sensory skills of the study participants as measured by the AASP, their motor and

process skills as measured by the AMPS, and the severity of their psychiatric symptoms as measured by the Brief Psychiatric Rating Scale (BPRS).

Chapter II

LITERATURE REVIEW

Background

Schizophrenia is a serious mental illness that affects 2.4 million Americans and up to 1% of the population worldwide (Javitt, 2010; National Alliance of Mental Illness [NAMI], 2017). Schizophrenia is characterized by *psychosis* (loss of contact with reality), *positive symptoms,* such as hallucinations (false perceptions) and delusions (false beliefs); *negative* symptoms, such as flat affect, lack of motivation and spontaneity, and social/emotional withdrawal; *cognitive* deficits, such as impaired information processing, reasoning and problem solving, and disorganized speech and behavior; and *occupational* and *social* dysfunction (American Psychiatric Association [APA], 2000; Javitt, 2010; Lieberman et al., 2008).

Social, affective, motor, and cognitive dysfunctions and mild physical anomalies as well as attenuated symptoms (e.g., illusions, magical thinking, obsessive behaviors, etc.) during childhood and adolescence precede the acute stages of schizophrenia. These features are usually mild and may have low predictive value (since they do not always turn into schizophrenia symptoms). Among other risk factors for schizophrenia are genetics, prenatal or birth complications, altered brain morphology present early in life, subtle motor abnormalities during infancy, and a history of trauma and substance abuse.

In individuals who eventually develop schizophrenia, the prodromal stage is followed by a first episode of psychosis, which may be followed by one or more psychotic relapses, and later on by residual cognitive deficits and a functional impairment. In terms of the changes occurring in the brain, schizophrenia is a disorder of synaptic connectivity (in the cortex, thalamus, hippocampus, cerebellum, etc.), which evolves over three stages: premorbid *neurodevelopmental*; *neuroplastic* (evident during the prodromal phase, at and after the onset, when abnormal synaptic pruning and myelination occurring during puberty "unmask" the pre-existing deficits); and *neurodegenerative* (occurring during the residual chronic stage).

Progressive changes in the brain morphology (such as brain volume loss, ventricular enlargement, and grey matter reduction) correlate with poor treatment outcomes, but antipsychotic medications and cognitive training can decrease illness progression and prevent relapses. Atypical drugs, or the newer generation of the antipsychotics (such as clozapine, etc.), are based not only on the dopamine-, but also on the glutamate-, serotonin-, cholinergic-, noradrenergic-, and histamine-receptor systems, and produce neuroprotective effects (such as enhancing neurogenesis and brain connectivity); cause fewer side effects; and have a better impact on the cognition, function, and quality of life in individuals with schizophrenia (Jarskog, Miyamoto, & Lieberman, 2007; Lieberman et al., 2001; Lieberman, et al., 2008). Moreover, the earlier the treatment begins, the better the outcomes may be (Cuesta et al., 2012). For this reason, early identification of the prodromal phase of schizophrenia and psychosis prevention are being targeted worldwide. Increasing public awareness/decreasing stigma

in society and developing community outreach programs can be important steps towards improving treatment outcomes in people with schizophrenia (Lieberman et al., 2001).

Hans, Auerbach, Asarnow, Styr, and Marcus (2000) and Hans, Auerbach, Auerbach, and Marcus (2005) conducted a prospective longitudinal study to describe the development from infancy through adolescence of a sample of Israeli young people with a parent who had schizophrenia, as compared to young people with a parent who had a non-schizophrenia psychiatric diagnosis or no mental health issues. Infants born to parents with schizophrenia repeatedly demonstrated motor and sensory-motor delays. Neuromotor and neurocognitive deficits (such as poor motor coordination and difficulties with visuo-motor tasks) were evident in these individuals at the school-age follow-up and during adolescence, while attentional deficits and physical anomalies were also present during adolescence. Poor social adjustment in the offspring of parents with schizophrenia, as exhibited by immaturity, social awkwardness, and a tendency to be rejected by peers, was found as well. While poor social adjustment in schizophrenia offspring may have resulted from environmental factors, such as poor modeling by parents or stigmatization by peers, it was also possible that the social impairment profile demonstrated by these subjects provided a vulnerability marker for schizophrenia.

Tsuang, Stone, and Auster (2010) conducted a literature review to describe the risk factors for schizophrenia and the abnormalities that create schizophrenia *endo-phenotype* (measurable associated features, yet not direct symptoms of the illness). In these authors' view, schizophrenia endo-phenotype can serve as a basis for early intervention and prevention. Family history is the strongest risk indicator for schizophrenia, and first-degree relatives of schizophrenia patients often exhibit

cognitive, motor, emotional, and social abnormalities. These individuals also show psychophysiological deficits, such as difficulty inhibiting startle responses and impaired ability to follow a moving object with their eyes. Decreased amygdala and hippocampal volumes, compromised white matter integrity, increased activity in the prefrontal cortex (PFC) and right parietal cortex, and differences in the amount of N-acetyl aspartate characterize the brain structure of these individuals. Maternal pregnancy and delivery complications are also more common among people with schizophrenia as well as their first-degree relatives. Mild or short-lasting positive symptoms, recent functional decline, and a diagnosis of a schizotypal personality disorder are considered risk factors as well. Therefore, s*chizotaxia* (initially described by Meehl, 1962, 1989, as cited in Tsuang et al., 2010) as a neural integrative defect predisposing to schizophrenia can be reformulated into a vulnerability syndrome to include physiological, cognitive, and social abnormalities and negative symptoms in relatives of schizophrenia patients.

According to Tsuang et al. (2010), an early intervention approach promotes education to schizophrenia high-risk populations regarding the early signs of mental illness and its potential triggers, such as substance abuse, pregnancy complications, and childhood trauma. Goal setting, problem solving, and cognitive reconstruction can also be taught to this population, and case management may be required at times. In addition, antidepressants, mood stabilizers, and anti-anxiety medications have been successfully used with at-risk groups. These interventions are more effective if initiated early in the process, and media outreach can help reduce social stigma and encourage individuals at risk to seek treatment when their symptoms can be still addressed effectively. More

research involving brain function, metabolism, and molecular biology is needed to advance the field of early intervention for schizophrenia spectrum disorders.

Since presently there is no cure for schizophrenia, the concept of *recovery* from it becomes essential. This concept implies developing ways to manage one's illness, improving one's quality of life, and achieving personally meaningful existence in the community (Lieberman et al., 2008). Lieberman et al. (2008) proposed using "standard qualifiers" to describe specific areas of recovery, such as "recovery of cognitive functioning" or "recovery of vocational functioning" (p. 488). According to these authors, clinical and functional outcomes vary greatly among people with schizophrenia. First-episode psychosis usually responds well to treatment, and with age, positive symptoms also tend to decrease on their own. However, negative symptoms and cognitive deficits may continue throughout one's life. Cognitive and functional outcomes may be improved by continued pharmacological treatment, cognitive training, and supportive psychotherapy. These outcomes can also be positively affected by environmental factors, such as level of stimulation, vocational opportunities, and supports available to the person in the community; they can be negatively affected by social stigma, comorbid medical conditions, and substance abuse. In the United States, people with schizophrenia live much shorter-than-average lives, are usually unable to reside independently, and report worse quality of life when compared to the general population and people with physical illnesses (Lieberman et al., 2008).

Individuals with schizophrenia often struggle with integrating into the community and establishing and maintaining employment and social relationships. These difficulties often result from cognitive deficits; problems with social cognition/perception, verbal

communication; and impaired coping skills. Therefore, they cannot be addressed by medications only, but rather require a rehabilitative approach (Silverstein, 2000).

Moreover, growing evidence exists in the literature to support the idea that patients with schizophrenia frequently demonstrate poor sensory, motor, and process skills. These impaired skills are often referred to as "neurological soft signs" and include problems with sensory integration, motor coordination, and motor planning (Thomann et al., 2009).

Rehabilitation for individuals with schizophrenia includes skills training, cognitive and behavioral techniques, vocational training, treatment of comorbid substance abuse conditions, and so on, and focuses on relapse prevention as well as acquisition, maintenance, and generalization of appropriate living skills (Silverstein, 2000). Despite these strategies, "far too many people with schizophrenia remain unable to fulfill their potential" (Silverstein, 2000, p. 241). However, when proper supports are provided to people with schizophrenia and their families, and certain environmental adaptations are in place, independent living, education, and employment may still be realistic goals for this population, especially when addressed early in the course of illness (Lieberman et al., 2008).

Neuroscience Perspective

In 1919, Kraepelin[1] used the metaphor of "an orchestra without a conductor" when referring to a mind of a patient suffering from what was back then called *dementia praecox* (relabeled later on as schizophrenia) (Kraepelin, 1919, 1971, as cited in Lesh

[1] Emil Kraepelin (1856-1926), a German psychiatrist, founder of modern scientific psychiatry.

et al., 2011, p.317). For decades, various researchers have attempted to develop a neuroanatomical model to explain the diverse symptoms of this disease.

Jaynes[2] (1986, 1990) viewed the appearance of auditory hallucinations in schizophrenia as a regression to what he called a “bicameral mind,” a mind that operated in ancient people who were acting non-consciously and were driven by what they believed were the voices of the “gods.” According to Jaynes, the bicameral mind was divided into two hemispheres: the right hemisphere transmitted the hallucinatory verbal instructions from the gods to the left hemisphere, which was the site for language and rational behavior. The widespread use of writing caused the end of the bicameral mind-based mentality and facilitated the development of contemporary consciousness (Jaynes, 1986, 1990, as cited in Cavanna, Trimble, Cinti, & Monaco, 2007). Even though functional neuroimaging studies have confirmed that the right temporal lobe represents the source of auditory hallucinations in some schizophrenia patients, the diversity of hallucinatory phenomena in healthy individuals and in individuals with various psychiatric disorders suggests that Jaynes’ hypothesis may lack the complexity needed to explain the appearance of auditory hallucinations in schizophrenia (Cavanna et al., 2007).

Schizophrenia as a Neurodevelopmental Disorder Resulting From Synaptic Dysconnectivity

Feinberg (1982) was among the first researchers to propose that schizophrenia was a neurodevelopmental disorder (as cited by Lesh et al., 2011). Frith et al. (1995, as

[2] Julian Jaynes (1920-1997), an American psychologist best known for his theory about human consciousness.

cited in Pettersson-Yeo et al., 2011) suggested that schizophrenia was the result of an abnormal functional integration between distinct brain regions.

McGlashan and Hoffman (2000) described a computer-simulated elimination of synaptic connections that modeled normal cognitive development and psychotic symptom formation. They enlisted diminished emotional expressivity, anxiety, withdrawal and passivity, social maladjustments, and poor peer relationships, along with minor physical anomalies, poor coordination and perceptual-motor integration, abnormal speech, poor attention and concentration, lower IQ and poor educational achievements, as well as disruptive and aggressive behavior (most often exhibited in males) as vulnerability factors or risk markers for psychosis occurring in childhood and early adolescence. However, the authors also argued that these deficits were present only in some prodromal patients and were mild and did not necessarily predict schizophrenia. McGlashan and Hoffman claimed, “While the role of neurodevelopmental deficits may be substantial, they are seldom (if ever) sufficient to account for the disorder. A second "hit" is also necessary. This hit is developmentally driven synaptic pruning” (p. 641).

Murray and Dazzan (2002) assumed that studying neurological soft signs (NSS) in individuals experiencing early stages of schizophrenia could potentially help clarify whether a neurological dysfunction or a degenerative process underlay this disease. In addition, the authors aimed to explore whether the presence of NSS in patients with schizophrenia could be explained as the side effects of the pharmacological treatment these patients were receiving. Murray and Dazzan reviewed several studies that clinically examined neurological function in patients with first-episode schizophrenia or psychosis. The reviewed studies reported excessive NSS (specifically, poor motor coordination and

sequencing, impaired sensory integration, and abnormal reflexes) in these patients and high-risk individuals (such as patients' relatives). The suggested deficits appeared to be more common among male participants, subjects with lower education, and possibly those experiencing more severe symptoms. In addition, an excessive prevalence of mixed-hand dominance and abnormal body laterality among participants were reported, possibly suggesting lack of cerebral asymmetry in individuals with schizophrenia. Two of the studies correlated the NSS with the premorbid social dysfunction and the length of hospitalizations in the participants. In addition, most studies had failed to reveal any association between the pharmacological treatment and the NSS. In fact, some studies had proposed a hypothetical protective effect of the medications on the subjects' neurological function. One of the reviewed studies had reported an association between the NSS and structural abnormalities, such as smaller brain volume, excessive cerebrospinal fluid on the brain surface, and so on, in subjects with schizophrenia, suggesting cortical rather than subcortical deficits in this illness. Murray and Dazzan concluded that the reported NSS in patients with schizophrenia indicated a genetic vulnerability resulting in a neurological dysfunction that was evident at the early stages of the illness and prior to the exposure to psychiatric medications in these individuals. The authors implicated that neurological dysfunction could serve as a vulnerability marker while identifying individuals at risk for developing schizophrenia and providing early intervention to them.

Pettersson-Yeo et al. (2011) systematically reviewed the structural and functional connectivity literature concerning schizophrenia. They concluded that reduced connectivity in the brain and frequent involvement of its frontal regions were the most

common trends reported. These two trends were reported across all stages of the disorder and were independent of the neuroimaging methodology employed.

More recent studies have supported the idea of disrupted brain connectivity in schizophrenia. For instance, Zhang et al. (2014) used brain imagery to investigate structural and functional abnormalities in 28 first-admission patients with schizophrenia, as compared to 26 healthy controls. The authors also examined the relationship between brain connectivity and length of illness in subjects with schizophrenia. Multiple structural and functional brain abnormalities were discovered among the study participants with schizophrenia, and the severity of these abnormalities was more pronounced in subjects with longer duration of illness. Therefore, the study results confirmed the progressive nature of this disease.

Sensory Deficits in Schizophrenia

Sensation in schizophrenia has been another area of interest for neuroscientists. In 1961, McGhie and Chapman documented sensory distortions as spontaneously reported by individuals experiencing early symptoms of this illness. They speculated that these individuals experienced difficulty differentiating body sensations from environmental sensory cues, which in turn led to delusions and functional difficulties (Javitt, 2009; McGhie & Chapman, as cited in Dunn, 2001). Subsequent studies reported impaired *sensory gating*, or poor ability to habituate to repeated sensory stimuli, causing sensory overload and impaired response to sensory input within the central nervous system of patients with schizophrenia (Braff, as cited in Brown, Cromwell, Filion, Dunn, & Tollefson, 2002). Some theorists associate the positive and negative symptoms along

with the impaired cognition seen in this disorder with the sensory gating abnormalities (Potter, Summerfelt, Gold, & Buchanan, 2006).

Javitt (1993, 2009, 2010) has researched event-related potentials (ERP) in schizophrenia patients to describe information-processing mechanisms associated with this disorder. Specifically, Javitt has paid attention to the *mismatch negativity* (MMN), negative polarity ERP components within primary auditory cortex evoked by early (occurring prior to information processing) events elicited when a deviant stimulus is interjected into a series of repetitive standard stimuli. Javitt, Doneshka, Zylberman, Ritter, and Vaughan (1993) found that patients with schizophrenia demonstrated a significant reduction in MMN amplitude when compared to healthy controls, especially on the left side of the brain. Javitt (2010) suggested that the MMN deficits may be more severe in chronic patients who exhibit prominent negative symptoms, and these deficits form a specific profile of auditory ERP dysfunction in schizophrenia.

The issue of impaired MMN in schizophrenia has been further studied by Jahshan et al. (2012). These authors examined three types of event-related potentials evoked by a duration-deviant auditory stimulus (MMN, P3a,[3] and RON[4]) in 118 participants across four groups: individuals at risk for psychosis, participants with early stages of schizophrenia, chronically ill schizophrenia patients, and healthy controls. The study results suggested MMN and P3a deficits in at-risk individuals; and MMN, P3a, and RON deficits in schizophrenia patients (both early stage and chronic groups). Moreover, the

[3] P3a is a frontocentral positive wave representing a shift in attention when attending to sensory stimuli (Friedman et al., 2001, in Jahshan et al., 2012).

[4] RON (reorienting negativity) is an ERP "automatically elicited during active auditory and visual discriminations tasks" (Jahshan et al., 2012, p. 3).

MMN, P3, and RON amplitudes associated with psychosocial functioning among the chronically ill (as measured by the Modified Global Assessment of Functioning), while P3a and RON associated with the severity of negative symptoms (as measured by the Scales for the Assessment of Negative Symptoms) among the at-risk participants. The authors concluded that sensory discrimination, and the orienting and reorienting of attention in response to auditory stimuli were impaired in schizophrenia and worsened over time.

Leavitt (2009) postulated that the sensory deficits observed in individuals with schizophrenia represented evidence that the brains of these individuals may be malfunctioning at subcortical, not just cortical levels. She conducted a series of experiments in which the middle latency evoked potentials,[5] ventral (“what?”) versus dorsal (“where?”) auditory pathways distinction, and effects of monocular deprivation[6] were studied in six subjects with schizophrenia. The results of these experiments confirmed the presence of subcortical deficits and revealed more significant impairments in the ventral auditory pathway, as compared to the dorsal auditory pathway in the participants’ brains. This finding opposed the researcher’s hypothesis that the dorsal auditory pathway was found to be more impaired, yet this could have resulted from the methodological issues. In addition, the study participants failed to exhibit the monocular

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[5] “Auditory evoked potentials (AEP) represent the response of the auditory pathway to an auditory stimulus, typically a click presented through headphones. The electroencephalogram (EEG) is recorded using surface electrodes placed on the scalp and the response of the auditory pathway is derived by computer averaging. The AEP is categorized on the basis of the latency of the response following the auditory stimulus” (Bell, Smith, Allen, & Lutman, 2004, p. 442). The middle-latency response represents the transition from brainstem-level processing to late-latency cortical processes (Leavitt, 2009).

[6] The covering of one eye for several hours in healthy subjects significantly increases the amplitude of the visually evoked potential (VEP) from the subjects’ uncovered eye. When the VEPs of each eye resulting from monocular viewing of stimuli are added up, they sum to a greater value than the VEP resulting from binocular viewing of the same stimuli. To accommodate for attention deficits in participants with schizophrenia, Leavitt (2009) limited monocular deprivation to 30 minutes in her study.

effect. Leavitt concluded that impairments across sensory modalities were indicative of non-dopamine-energic pathology “in the very foundations of the brain” present in individuals with schizophrenia and contributed to higher-order (cognitive) deficits. The researcher speculated that the auditory and visual impairments provided a profile common to patients with schizophrenia, which in turn represented a strategy for identifying prodromal population and confirmed the NMDA (N-Methyl-D-aspartic acid) and GABA (gamma-aminobutyric acid) receptors dysfunction in this disease.

Javitt (2010) supported the idea of a widespread cortical and subcortical dysfunction in schizophrenia. This researcher claimed that, even though the dopamine model had served as the primary etiological model for schizophrenia for decades, it only accounts well for the positive symptoms of this disease. In contrast, glutamatergic models, such as the one based on the NMDA receptors dysfunction, better explain both the negative and the cognitive symptoms of schizophrenia, and, therefore, provide a more comprehensive etiological model for this illness.

Shergill, Samson, Bays, Frith, and Wolpert (2005) used a force-matching task[7] to study the *sensory attenuation*[8] of the self-produced stimuli in patients with schizophrenia, as compared to healthy adults. They found that self-generated forces were less attenuated among subjects with schizophrenia. The authors concluded that participants with schizophrenia had demonstrated diminished ability to predict the sensory consequences

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[7] In a force-matching task, target force is applied to the subject’s left index finger by a torque motor. Participants are asked to reproduce the force they just experienced by either pressing with their right index finger or by using a joystick controlling the torque motor (Shergill et al., 2005, p. 2384).

[8] Sensory attenuation allows for self-generated forces to be perceived as weaker than the externally-generated forces of the same magnitude, which assists with distinguishing between the self-produced movement and the movement generated by an external cause (Shergill et al., 2005, p. 2384.)

of their actions, which could explain the misattribution of self-produced actions to external forces (delusions of control) seen in this illness.

A related study was conducted by Thakkar, Nichols, McIntosh, and Park (2011), who investigated *body ownership* (one's ability to perceive body sensations as unique to self) in patients with schizophrenia while using the rubber hand illusion (RHI),[9] and observing the proprioceptive drift (difference between the means of perceived index finger locations before and after tactile stimulation) as well as the changes in hand temperature caused by the RHI in the participants with schizophrenia and in healthy controls. The study results indicated that the RHI was quantitatively and qualitatively stronger in participants with schizophrenia. The RHI experiment used in the study had also caused an out-of-body experience in one of the subjects with schizophrenia. The investigators concluded that individuals with schizophrenia had a weakened sense of body ownership, which was indicative of potential abnormalities in temporo-parietal networks in the brain. The authors also speculated that the weakened body ownership explained the occurrence of delusions of passivity in this disorder.

Findings on sensation in schizophrenia have supported the idea that "deficits in early sensory processing may contribute greatly to deficits in higher-order cognition" in this condition (Leitman et al., as cited in Champagne & Frederick, 2011). For instance, it is speculated that dysfunctional auditory and visual processing may explain impaired social cognition (recognition of facial expressions and tone of voice) in individuals carrying this diagnosis (Javitt, 2009), and that impaired object recognition in particular

[9] "Watching a rubber hand being stroked while one's unseen hand is stroked synchronously can lead to a sense of ownership over the rubber hand, a shift in perceived position of the real hand, and a limb-specific drop in stimulated hand temperature" (Thakkar et al., 2011, p. 1).

may contribute to the schizophrenia negative symptoms, such as lack of interest in the environment (Doniger, Silipo, Rabinowicz, Snodgrass, & Javitt, 2001). Facial emotion recognition deficits were associated with poorer occupational and social functioning at baseline in patients with schizophrenia (Behere et al., 2011).

Motor Learning and Motor Performance Deficits in Schizophrenia

In addition, several of the research projects pertaining to schizophrenia have paid special attention to motor learning and motor performance deficits among schizophrenia patients, and have offered insights into the brain pathology underlying these phenomena. For instance, Schwartz, Rosse, Veazey, and Deutsch (1996) assessed motor learning skills in schizophrenia patients while using a rotary pursuit task.[10] Based on the results of their study, the researchers speculated that impaired motor performance in schizophrenia patients was associated with a "disrupted neural system underlying motor skill acquisition" (p. 246), including cortical, subcortical, and cerebellar structures.

Silver, Shlomo, Schwartz, and Hocherman (2002) conducted a study in which they measured the visuomotor function of patients with schizophrenia, as compared to healthy controls. Schizophrenia patients demonstrated visuomotor function deficits, such as impaired ability to control movement direction during pattern-tracing and target-tracking tasks. These deficits had not resulted from extrapyramidal side effects,[11] as

[10] In rotary pursuit task, "subjects hold a stylus on a target that is rotating on a top of turntable. Skill learning is demonstrated when subjects are able to keep the stylus on the target for longer periods of time with practice" (Schwartz et al., 1996, p. 242).

[11] Extrapyramidal side effects often result from lack of dopamine caused by antipsychotic medications and include Acute Dyskinesia/Dystonic Reaction (e.g., muscle spasm and postural abnormalities), Tardive Dyskinesia (stereotypic movements of oral/fascial areas, extremities, and trunk), Parkinsonism (e.g., movement rigidity, tremors, and drooling), Neuroleptic Malignant Syndrome (e.g., tachycardia, mental status changes, muscle rigidity, tremors, and dystonic posturing), Akinesia (e.g., diminished motor spontaneity, reduced gesturing, and increased sense of drowsiness), and Akathisia (restlessness and motor agitation) (Blair & Dauner, 1992).

subjects with schizophrenia were on atypical anti-psychotic medication and had not demonstrated extrapyramidal symptoms prior to the beginning of the study. The visuomotor deficits did not appear to be dependent on specific illness variables, such as length of illness. Silver et al. speculated that visuomotor deficits were a "trait-like characteristic of schizophrenia, similar to eye movement abnormalities" (p. 75). They also speculated that reduced cortical connectivity underlay the visuomotor deficits of schizophrenia.

Other studies pertaining to motor performance in schizophrenia have reported difficulties with rapid hand movement and reduced hand movement amplitude, peak velocity,[12] and regularity (Putzhammer et al., 2005), as well as decreased movement fluency due to deficient motor sequence planning (Delewoye-Turrell et al., 2007). Moreover, evidence suggests that antipsychotic medications used to treat schizophrenia (especially the conventional ones) negatively affect hand function (Nowak, Connemann, Alan, & Spitzer, 2006; Putzhammer et al., 2005).

Exner, Weniger, Schmidt-Samoa, and Irle (2006) used a three-dimensional structural magnetic resonance imaging (MRI) test to research the anterior supplementary motor area (pre-SMA) in the cortex of schizophrenia patients, who were also observed while performing a computer-based task involving motor planning. The findings showed that reduced volume of the left pre-SMA in these patients was related to the impaired implicit learning of a motor sequence. Specifically, subjects with schizophrenia were able to improve the accuracy and speed of their motor responses to the visual stimuli, but

[12] Peak velocity is a "maximal instantaneous velocity during a movement. A higher peak velocity means greater force generation" (Lin et al., 2008, in Wang et al., 2014, p. 232).

failed to reproduce stimuli sequence from memory, “suggesting a cognitive rather than a motor execution deficit in these subjects” (p. 393).

Frantseva et al. (2008) reported that poor motor learning in schizophrenia was linked to dysfunctional brain plasticity. Thomann et al. (2008) reported that cerebellum volume was significantly reduced in schizophrenia patients, and neurological soft signs in schizophrenia patients were significantly associated with the volume of the right cerebellar hemisphere.

The study conducted by Bolbecker and associates (2009) confirmed the cerebellar pathology contribution to schizophrenia-related deficits and provided evidence that secretin, a hormonal agonist released in the cerebellum, affected its ability to coordinate neural signals in time. In addition, different studies have reported structural pathology in the cerebellar vermis, decreased linear density and size in Purkinje cells, decreased blood flow, deficient metabolism and other abnormalities in the cerebellum (Andreasen et al., Heath et al., Daskalakis et al., Muller et al., Picard et al., Shenton et al., Volkow et al., as cited by Andreasen and Pierson, 2008).

The works of Nancy C. Andreasen in this field are of special interest because she has attempted to integrate the existing evidence into a comprehensive neuroanatomical model to explain the cognitive and motor deficits exhibited in schizophrenia. Similar to the subsequent claims made by Leavitt (2009) and Javitt (2010), Andreasen, Paradiso, and O’Leary (1998) and Andreasen and Pierson (2008) had challenged the previously accepted idea that specific symptoms of schizophrenia resulted from a malfunction of specific cortical regions (such as frontal and temporal cortex). Instead, these researchers

suggested that the interaction between multiple components in distributed brain circuit underlay this disease.

Initially, Andreasen et al. (1998) proposed a view of schizophrenia as a neurodevelopmental brain disorder, in which the neuro-connections between the prefrontal, frontal, thalamic (basal ganglia in particular), cerebellar, and brainstem regions were disrupted, causing what these authors referred to as an "impairment in mental coordination…an abnormality in cognition as well as motor activity," or a "cognitive dysmetria" (p. 204). In 2008, Andreasen and Pierson proposed a "cerebellar cognitive theory" (p. 1) and speculated that the cerebellum had a crucial role in the cortico-cerebellar-thalamic-cortical circuit (CCTCC). It also coordinated and modulated different aspects of cortical activity in addition to being in charge of motor coordination and motor learning. These researchers assumed that the existence of the "well-programmed" Purkinje cells within the cerebellum enabled it to perform fine-tuned pattern perception, error detection, rapid modulation, and coordination of the neuro-activity; to provide adaptive feedback to the cerebral cortex; and to facilitate cognition by serving as a "timekeeper" of mental events and coordinating associative learning, speech, facial recognition, emotion attribution, directed attention, and many types of memory. Instead of modulating and coordinating, the impaired cerebellum in schizophrenia misconnected the information arriving from the cerebral cortex.

The impact of antipsychotic medication on motor control and motor learning in schizophrenia is of an importance as well. Jahn et al. (2006) used a Brief Motor Scale (BMS), consisting of Motor Coordination and Motor Sequencing subscales, to assess motor NSS in schizophrenia patients who had exhibited psychosis but were in a sub-acute

phase of illness. The NSS scores correlated significantly with severity of illness, negative symptoms, and lower social functioning in these patients. A modest correlation was found between the NSS scores and the side effects from the psychiatric medications the subjects had been receiving. The authors also reported that the NSS scores had eventually decreased in patients who either remained stable or improved in terms of their psychiatric symptoms, but not in patients who got worse over time.

A statistically significant negative correlation between implicit motor learning (as measured by the Serial Reaction Time Task) and neurological soft signs (as measured by the Neurological Evaluation Scale) in schizophrenia has been reported by Chrobak et al. (2016), who examined 20 schizophrenia patients receiving antipsychotic medications and compared them with 20 healthy subjects.

Keedy, Reilly, Bishop, Weiden, and Sweeney (2015) used functional imaging to investigate brain function in first-episode schizophrenia patients performing visual attention and motor learning tasks before and after receiving antipsychotic medication (21 patients were assessed prior to receiving medication, of which 14 were assessed after the 4-6 weeks of treatment). Matched healthy subjects were studied as well. Subjects with schizophrenia exhibited reduced activation in the neocortical visual attention network during the visual attention task. Activation of this network increased significantly as a result of the antipsychotic treatment, with higher dosages eliciting a stronger response. However, the antipsychotic medication had a negative impact on the motor learning task because it caused a reduced activation of the dorsolateral PFC, which had been unimpaired prior to the initiation of the treatment. The authors concluded that, while

antipsychotic medications had a positive effect on attention, they compromised motor learning in schizophrenia.

Effects of Cognitive Deficits on Functional Outcomes in Schizophrenia

Schizophrenia often presents with delusions, impaired decision-making and problem-solving, and disorganized speech and behavior. Cognitive deficits in schizophrenia are typically present at first episode (often during adolescence), decline during the 3-4 years immediately preceding the onset, and remain relatively constant over the remaining course of the illness (Javitt, 2010). An abundance of literature has been published aiming to describe the cognitive deficits present in schizophrenia in more depth and to explain the neuro-anatomy behind it (Lesh et al., 2011). A large portion of this literature further supports the idea that schizophrenia is a neurodevelopmental disease.

Green, Kern, Braff, and Mintz (2000) reviewed literature on the functional consequences of the neurocognitive deficits present in schizophrenia. They discovered significant associations between neurocognitive functions such as memory, executive function and vigilance (sustained attention), and functional domains, such as community outcome, social problem solving, and psychosocial skill acquisition, in this population, as reported by the original studies. Green et al. proposed that both learning potential and social cognition could be viewed as mediators, through which cognition affected skills acquisition and functional outcomes in persons with schizophrenia.

Various researchers have reported impairments in visual information processing (specifically, contour integration or linking of the visual features that create a coherent whole), attention, memory, verbal memory, executive functioning, context processing (ability to process task-related information), skill acquisition, learning potential, and

social perception/cognition among people with schizophrenia. The use of cognitive assessments while planning interventions for schizophrenia patients has been problematic, because these tests often fail to distinguish between a generalized performance deficit and a specific cognitive dysfunction (Silverstein, 2000).

Brekke, Kohrt, and Green (2001) studied the relationship between the executive functioning as measured by the Wisconsin Card Sorting Test; psychosocial functioning as established by the Global Assessment Scale, DSM-4; and the subjective experience represented by measures of satisfaction with life and self-esteem in adult patients with schizophrenia. A positive and statistically significant association between psychosocial functioning and subjective experience was observed in subjects with impaired executive functioning. However, among patients with intact executive functioning, psychosocial variables were negatively associated with self-esteem and satisfaction with life. The authors concluded that executive functioning played a major role in moderating the relationship between subjective experience and psychosocial performance.

A study by MacDonald et al. (2005), which employed an MRI scanner, confirmed context-processing deficits and revealed prefrontal cortical hypofrontality (lower levels of activity) related to these deficits among never-medicated, first-episode schizophrenia patients. Prefrontal cortical dysfunction also correlated with subjects' disorganization symptoms. The authors speculated that during a continuous performance task (pushing corresponding buttons when presented with a series of single letters on the scanner screen), subjects with schizophrenia used episodic memory instead of context processing to encode and retrieve information (an inefficient strategy), and this pattern accounted for slower reaction times and more errors observed among these subjects. Prefrontal cortical

dysfunction was not present either in patients with non-schizophrenia psychosis or in healthy individuals, who served as comparison groups in this study.

Milev, Ho, Arndt, and Andreasen (2005) conducted a battery of cognitive and clinical assessments with subjects who were in their first episode of schizophrenia, schizophreniform disorder, or schizoaffective disorder. The neuropsychological test battery included the domains of verbal memory, processing speed and attention, language skills, visuospatial skills, and problem solving. Clinical assessment tools used in the study looked at the severity of psychotic and negative symptoms and disorganization among the subjects. In addition, participants' global psychosocial functioning, relationship impairment, participation and enjoyment of recreational activities, and work impairment were measured after an average follow-up period of 7 years. The results of the study indicated that verbal memory, processing speed, and attention as well as the severity of negative symptoms at intake predicted the subsequent functional outcome in the participants. Moreover, cognitive deficits and negative symptoms overlapped in explaining the variance in the functional outcome. The authors concluded that verbal memory, processing speed, and attention were potential targets for psychosocial treatment aimed at improving functional outcomes in schizophrenia. In addition, the authors speculated that the shared variance between negative symptoms and cognitive deficits in schizophrenia were indicative of an underlying neurobiological cause.

Some studies have looked at cognitive and academic performance of children and adolescents who were later on diagnosed with schizophrenia as adults. Fuller et al. (2002) examined performance on standardized educational testing (Iowa test) in children and adolescents who subsequently developed schizophrenia. Compared with the general

population, the subjects showed only modest deficits when assessed during 4th and 8th grade, yet exhibited a markedly decreased performance between 8th and 11th grade. The authors concluded that scholastic performance declined during puberty in schizophrenia and, therefore, scholastic decline during puberty could be an early sign of schizophrenia.

A longitudinal study performed by Reichenberg et al. (2010) on 1,037 subjects over 30 years in New Zealand demonstrated that participants who were later diagnosed with schizophrenia as adults had exhibited developmental deficits (such as static impairments in verbal and visual knowledge acquisition, reasoning, and conceptualization, as well as developmental lags, including slower developing processing speed, attention, visual-spatial problem solving, and working memory) as children. These developmental deficits and lags had not been observed in children who later suffered from recurrent depression (Reichenberg et al., 2010).

Lesh et al. (2011) summarized the existing evidence from the neuroimaging and pharmacological data, animal models and human subjects, and proposed a *model of cognitive control deficits* in schizophrenia, a unifying theory that describes neural and cognitive abnormalities resulting in higher cognitive dysfunction present in this illness. Lesh et al. emphasized the role of the PFC in providing cognitive control by integrating and processing incoming information and coordinating appropriate behavioral responses in humans. According to these authors, early brain injury, genetics, and environmental factors can all cause an abnormal rate of synaptic pruning (elimination) during adolescence, which in turn can lead to a disrupted neuro-circularity in the PFC and other brain areas (such as frontal, parietal and occipital regions, hippocampus, thalamus, cerebellum, etc.) of the affected individuals. The resulting altered inter-regional

connectivity in the brain can cause hallucinations; impaired memory, attention, processing speed, language and executive function; and general disorganization. Poor social and vocational functioning frequently seen in patients with schizophrenia can be attributed to these deficits.

Some investigators have been researching ways to improve cognition in schizophrenia. Cuesta et al. (2012) conducted a study on 77 drug-naïve first-episode schizophrenia patients to compare cognitive outcomes between patients with a short duration of untreated psychosis (DUP) and a long duration of untreated psychosis. The study found that participants with a shorter duration of untreated positive and negative symptoms performed better than participants with a longer duration of untreated symptoms on memory and pre-attentional visual tasks, but not on executive function tests, when presented with a battery of neuropsychological assessments during the initial stage of hospitalization, and when tested again 1 and 6 months later. The investigators concluded that early pharmacological intervention served as a protective factor in terms of memory and attention in first-episode schizophrenia.

In addition, some evidence exists to support the idea that cognitive rehabilitation programs improve information processing in schizophrenia (Lieberman et al., 2008).

Occupational Therapy Perspective

Occupational therapy (OT) helps to improve clients' ability to participate in the activities they want and need to engage in during the day (daily occupations). These daily occupations include self-care, instrumental activities of daily living, sleep/rest, work, education, leisure, and social participation. Since sensory, motor, cognitive, social, and

emotional abilities of people affect their participation in daily occupations, occupational therapists assist their clients with fostering these abilities through the use of meaningful activities. Because environmental factors are believed to either support or interfere with occupational performance, adapting one's environment to his/her occupational needs has been another area of expertise of occupational therapists.

Occupational Therapy Research on Sensory Integration/Processing, Movement, Cognition, and Functional Outcomes in Schizophrenia, and Other Mental Health Disorders

Historically, occupational therapists have paid a lot of attention to the skill deficits exhibited in the chronically mentally ill, and have attempted activity-based evaluations and interventions in order to assess and remediate these deficits, and to improve the occupational performance and overall well-being of this population.

For instance, Falk-Kessler and Quittman (1990) examined the relationship between the neuropsychological test performance, demographic characteristics, and ability to function in social, vocational, and leisure spheres among people with chronic mental illness. In this study, findings from the Wechsler Adult Intelligence Scale (WAIS), Southern California Sensory Integration Test (SCSIT), and Luria Nebraska Neuropsychological Battery (LNNB) were compared to the findings collected through a structured chart review and by a survey of a first-degree relative, as well as to each patient's diagnosis and average level of social, vocational, leisure, and general functioning over the preceding year, as established by the DSM-3, Axis 5. Of all the subtests, Localization of Tactile Stimuli included in the SCSIT correlated with vocational, leisure, and social functioning. No other significant correlations were found. Very few demographic characteristics correlated with functional ability. The LNNB-

impaired subgroup had lower academic rank and more difficulty learning than the non-impaired subgroup. Schizophrenia patients had more hospitalizations and worse vocational functioning than the non-schizophrenia subgroup. The authors concluded that assessing neurological performance out of the context of functioning was not relevant, and that decisions about treatment needed to be made on an individual basis and not be driven by generalizations about specific client populations.

Intriguingly, a similar study was conducted several years later outside of the field of occupational therapy. Brekke, Raine, Ansel, Lencz, and Bird (1997) investigated the relationship between the neuropsychological variables, psychophysiological findings, and psychosocial characteristics (such as symptomatology, independent living, work, and social functioning) among patients diagnosed with schizophrenia or schizoaffective disorder. The neuropsychological variables were measured through the use of the Stroop Test, the Controlled Oral Word Association Test, and the Wechsler Adult Intelligence Scale-Revised. The psychophysiological variables were established based on the electro-dermal responses, such as skin conductance and reactivity to stimuli and stress. Finally, the symptomatology was assessed while utilizing the Brief Psychiatric Rating Scale, and the psychosocial functioning level was established through the use of the Strauss and Carpenter Outcome Scale and the Role Functioning Scale. The study results indicated that symptomatology severity correlated with electro-dermal responses, verbal fluency, and visuomotor performance, while social functioning correlated with electro-dermal responses, and independent living correlated with visuomotor and verbal processing.

Falk-Kessler and Bear-Lehman (2003) have advocated for increasing OT practitioners' awareness of the sensory-motor deficits among the mentally ill, including

clients with schizophrenia. These authors reported on hand function in the chronic psychiatric population and asserted there was convincing evidence that people with schizophrenia frequently demonstrated poor manual coordination, weak hand grasp, and altered tactile processing in their hands. Falk-Kessler and Bear-Lehman concluded that, since hand function was essential to performing daily tasks, occupational therapy had to address hand function-related limitations in addition to the interpersonal, social, and cognitive skills in clients with mental illness.

Wang et al. (2014) examined the speed, forcefulness, and coordination of movement in schizophrenia patients with no extrapyramidal side effects from medications, as compared to healthy controls, during a bimanual assembly activity similar to a typical work task. Subjects with schizophrenia demonstrated slower and less forceful unimanual, and less coordinated bimanual movements than the healthy subjects. An increase in the object size facilitated a faster, more forceful, and better coordinated movement among both subject groups (individuals with schizophrenia and healthy controls). The researchers suggested that movement rehabilitation incorporating manipulation of the object size was important in the treatment of schizophrenia patients.

Lin et al. (2015) compared hand dexterity in a single task (Purdue Pegboard Test, PPT) and a dual task (PPT and Serial Sevens Subtraction Test combined) in participants with schizophrenia with that of healthy controls. They also investigated how hand dexterity discrepancy between the single and dual tasks related to functional outcomes in subjects with schizophrenia. The authors discovered that participants with schizophrenia exhibited much worse than the healthy controls hand dexterity in the dual task, and that their attentional effort increased gradually when they changed from performing the task

with preferred hand to performing it with both hands, as opposed to the healthy subjects who were able to control attentional effort better in order to meet the task demands and, therefore, exhibited a decrease in dexterity discrepancy while engaging in a bimanual task. Moreover, subjects with schizophrenia whose hand dexterity declined more during the dual task demonstrated worse functional outcomes, as measured by the University of California, San Diego, Performance-Based Skills Assessment, Brief Version, and the Activities of Daily Living Rating Scale III. Lin et al. speculated that dual task performance could become a behavioral marker while addressing functional deficits in people with schizophrenia, and that occupational therapists working with clients affected by this condition should consider both incorporating hand dexterity-based and dual tasks into treatment to foster ADL activities, as well as simplifying tasks and contexts for these clients to accommodate for attentional and dexterity deficits.

Sensory processing is an area that has been of interest to occupational therapists across their professional evolution (Dunn, 2001). Lorna Jean King was one of the most prominent OT scholars who addressed the cognitive and sensory-motor aspects of the diagnosis and treatment of the mentally ill. Specifically, King (1974, 1990) had described what she believed were the typical posture and movement patterns among schizophrenia patients: forward dropping head, internally rotated and adducted upper extremities; “flat” hand and limited fine-motor skills; lumbar lordosis and forward tilted pelvis; knee hyperextension and rolled-in knees; limited range of motions and low muscle tone, shuffling gate; poor head-eye dissociation and limited eye tracking; difficulty crossing body midline, impaired spatial perception, motor planning and praxis; and disturbed arousal levels (either psychomotor retardation to the point of immobility, or purposeless

movement). King (1990) referred to schizophrenia as a neurodevelopmental disorder. She postulated that neurophysiological deficits (specifically in the thalamus area) underlay both physical and cognitive disabilities present in schizophrenia, and that brain plasticity would allow for these dysfunctions to be relieved by appropriate interventions. She explained, “Movements of the body affect biochemistry, which in turn affects the process of behavior and emotion” (p.12). King had adapted Ayres’s sensory integration theory[13] to use movement as a therapeutic tool with schizophrenia patients who exhibited negative symptoms. Her interventions aimed to help clients achieve the state of “calm alertness” (the level of arousal at which an individual can function successfully); to improve their body concept and motor planning; and to foster clients’ affect, interest, and motivation in order to allow for their successful reintegration into the community.

Other occupational therapists of King’s generation also promoted the use of sensory-motor treatment modalities with patients with schizophrenia. For instance, Jorstad, Wilbert, and Wirrer (1977), Rider (1978), and Bailey (1978) reported improved sensory function, posture, gait, and body concept among schizophrenia patients who had received a course of treatment consisting of sensory-motor activities, such as jumping, marching, parachute games, tossing beanbags, and so on. In addition, these activities had increased clients’ psychosocial functioning, as demonstrated by improved affect, socialization and self-esteem (Jorstad et al., 1977), diminished psychotic behavior (Rider, 1978), and improved quality of language (Bailey, 1978).

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[13] A. J. Ayres defined sensory integration as “the neurological process that organizes sensations from one’s body and from the environment and makes it possible to use the body effectively in the environment” (Ayres, as cited in Champagne & Frederick, 2011, p. 7). Recently, the term *sensory integration* has been replaced with “sensory processing” and “sensory modulation” in the occupational therapy literature (Champagne & Frederick, 2011; Olson, 2011).

Interestingly, the utilization of treatment modalities that incorporate movement has been supported by the literature outside of the occupational therapy discipline. For instance, Duraiswamy, Thirthalli, Nagendra, and Gangadhar (2007) and Behere et al. (2011) have reported improvements in positive and negative symptoms, emotion recognition ability, and social and vocational functioning in schizophrenia patients as a result of using yoga therapy combined with antipsychotic medications to treat these patients.

Over the years, the interest of OT practitioners in addressing the sensory-motor deficits of the chronic psychiatrically ill clients has diminished (Falk-Kessler & Bear-Lehman, 2003). Additionally, according to Parham et al. (2007), "validity of sensory integration treatment outcomes studies has been threatened by weak fidelity regarding therapeutic principles" (p. 216).

Fortunately, after over a 25-year gap, OT scholars are paying attention to King's ideas again, and more statistically refined research that examines sensory processing in patients with schizophrenia is being carried out by some OT researchers. For example, Brown et al. (2002) measured sensory processing in patients with schizophrenia and bipolar illness while using the Adolescent/Adult Sensory Profile (AASP). The study showed that both the schizophrenia and the bipolar disorder groups scored unusually high when compared to most people on sensation avoiding and unusually low on sensation seeking, while the schizophrenia group also scored unusually high on low registration. The investigators concluded, "Individuals with schizophrenia tend to miss available sensory stimuli. When stimuli are indeed detected, they are often avoided" (p. 187). The coexistence of the low registration and sensory-avoiding patterns in individuals with

schizophrenia “may reflect the small range within which these persons can receive sensory input and use it to participate successfully” (Dunn, 2001, p. 617). In addition, sensory processing is believed to provide a basis for cognitive mechanisms (such as attention, organization, memory, and problem solving) and possibly for one’s temperament and personality traits. Sensory processing challenges are linked to the cognitive deficits present in schizophrenia, and knowledge of the sensory processing patterns among the individuals carrying this diagnosis is necessary to plan effective interventions for them (Dunn, 2001).

Olson (2011) examined the relationship between the symptoms of sensory modulation disorder (SMD) and schizophrenia. She utilized the AASP to establish patterns of sensory modulation, and the Positive and Negative Syndrome Scale (PANSS) to assess positive and negative symptoms in subjects with schizophrenia. Demographic data of the participants were also collected and analyzed. No correlation was found between the negative symptoms of schizophrenia and the SMD. However, positive symptoms did correlate with low registration and high sensitivity, as measured by the AASP. In addition, positive symptoms in African American males best predicted higher sensory sensitivity. Olson speculated that psychosis and not necessarily schizophrenia predicted the SMD. The author also concluded that the relationship between the positive symptoms and the SMD in mentally ill called for a revision of the currently existing in U.S. healthcare patient management procedures. Since isolation and sensory deprivation may increase psychosis, Olson questioned the use of seclusion and restraints with psychotic, acting out-of-control individuals, and advocated for the implementation of sensory treatment modalities, such as deep pressure and multi-sensory rooms. Additional

research addressing sensory processing in people with schizophrenia is required to better plan treatment interventions for this client population (Champagne & Frederick, 2011).

It may be important to note that sensory processing deficits have been reported by OT scholars and their colleagues in studies performed on subjects with psychiatric conditions other than schizophrenia. For instance, Lane, Young, Baker, and Angley (2009) reviewed the literature on sensory processing in autism and other pervasive developmental disorders and concluded there was strong evidence to support the idea that the majority of children with these disorders exhibited either low registration, high sensitivity, avoidance, or stimuli seeking across all sensory modalities. Moreover, this multisensory disturbance was associated with specific maladaptive behaviors observed in these children. The above authors also investigated sensory processing patterns and adaptive behaviors in 54 children with autistic disorder and concluded that sensory processing subtypes present in the study participants (sensory-based inattentive seeking, sensory modulation with movement sensitivity, and sensory modulation with taste/smell sensitivity) predicted communication deficits and maladaptive behaviors among these subjects.

Lane, Reynolds, and Thacker (2010) aimed to understand the relationship between anxiety, sensory over-responsivity, and Attention Deficit Hyperactivity Disorder (ADHD). They used a Sensory Challenge Protocol (a series of sensory stimuli), electro-dermal, and cortisol level measurements along with behavioral questionnaires to assess neuroendocrine, electro-dermal, and behavioral characteristics (such as sensory over-responsivity and anxiety) in 84 6- to 12-year-old children with or without ADHD. Forty-six percent of the study participants with ADHD were identified as having sensory over-

responsivity, while only 20% of the children without ADHD included in the study showed sensory over-responsivity. Children with ADHD scored higher on anxiety and had higher cortisol levels when presented with the Sensory Challenge Protocol and significantly higher electro-dermal responses when recovering from it. The study established links between sensory over-responsivity and anxiety in participants with and without ADHD. The investigators concluded that ADHD, sensory over-responsivity, and anxiety "overlapped consistently in ways that influenced the behavioral presentation of the child" (Lane et al., 2010, p. 8) and speculated that these deficits could be attributed to the prefrontal cortex/hippocampal synaptic gating deficits in the affected population.

Rieke and Anderson (2009) demonstrated, while comparing the AASP results of 51 adults with Obsessive-Compulsive Disorder (OCD) with the means of the adult group in the AASP standardization study, that the subjects with OCD scored higher on sensory sensitivity and sensation avoiding than the general population. This study also confirmed the discriminant validity of the AASP because its results were in agreement with the OCD literature suggesting that adults with OCD exhibited inefficient stimuli inhibition processes (Rieke & Anderson, 2009).

Finally, Brown, Shankar, and Smith (2009), who used the AASP to assess 20 individuals with various psychiatric conditions (including schizophrenia, but excluding OCD), were able to demonstrate that subjects with Borderline Personality Disorder (BPD) scored higher on sensory sensitivity and sensation avoiding than other study participants. In addition, therapy utilizing sensory processing principles was reported by the subjects with BPD to be helpful in decreasing both psychiatric symptoms and

dependence on acute care services. The authors suggested that BPD and sensory-processing disorder shared common neurobiological mechanisms.

The findings described above may indicate that further, more vigorous research is needed to investigate and describe the sensory processing profiles that accompany different psychiatric diagnoses and the neurodevelopmental mechanisms behind these profiles.

A manuscript published by Koziol, Budding, and Chidekel (2011) both validates and challenges the OT research regarding sensory deficits across various populations. Koziol et al. noted that sensory integration/sensory processing/sensory modulation disorders have not been included in the medical or psychiatric diagnostic nomenclatures, yet can be significant and important to address. Moreover, Koziol et al. agreed that these conditions may accompany autism spectrum disorders, attention deficit-hyperactivity disorders, other developmental delays, cerebral palsy, Parkinson’s disease, and schizophrenia. These authors claimed that, even though OT scholars have attempted to explain sensory processing conditions, they have not operationally defined the symptoms of these conditions or addressed their neuroanatomic underpinnings. Moreover, the OT and non-OT studies that attempted to research these conditions while using behavioral observations, electro-dermal reactivity measures, EEG, magneto-encephalography, and MRI have provided inconsistent and contradictory results.

Koziol et al. (2011) asserted the importance of describing the neuroanatomy behind the deficits in the noticing and modulation of sensory stimuli and the resulting behavioral responses, or what they call a “continuous sensory-motor interaction between an individual and his/her environment” (p. 771). In these authors’ view, the parietal

cortex and premotor regions in the frontal lobe make decisions about the required movements and actions based on the spatial attributes of the objects found in the environment. The basal ganglia and PFC predict the possible outcomes of these movements and actions. Therefore, cognition and sensory-motor control are connected. In addition, dynamic interactions exist between the neo-cortex (outer layer of the cerebral cortex), the basal ganglia, and the cerebellum. While the motor cortices, the basal ganglia, and the cerebellum assure automatic behavioral responses, a higher-order control is needed to adapt to a changing environment (by modifying behavior and learning new responses). This adaptation is made possible by the PFC, the supplementary motor area (SMA) in the cortex, and the subcortical structures. Therefore, the *duel-tiered model of cognition* reviewed by Koziol et al. (2011) emphasizes adaptation to the environment through alternating automatic behaviors with conscious cognitive control as needed. Young children *react* to the environment as opposed to being *proactive* in choosing the right behavioral response to it. As children grow, their motor control increases. Motor control is a prerequisite for ultimately developing cognitive control, metacognition, and self-control (including goal setting, planning, etc.).

Moreover, the cortex responds to environmental stimuli by excitation, while the basal ganglia serve as a major inhibitory force (specifically, by releasing inhibition on the thalamus) and, by doing so, allow for the sensory gating. Basal ganglia interfaces between the cortical and subcortical regions and systems. By supporting response selection and decision making, temporal organization (timing), and binding of new motor sequences, basal ganglia play a central role in instrumental learning.

The cerebellum, according to Koziol et al. (2011), plays a major role as well: it is responsible for postural adjustments to vestibular stimulation and adapting motor programs to varying conditions; it maintains muscle tone, coordination, and balance, and assists with learning new sensory-motor skills as well as with modulation of cognitive and affective processing. In addition, it regulates “the rate, rhythm and force of sensation and behavior” necessary for automatic, procedural learning, cortical working memory, and construction of sensory-motor programs or models for motor activities (Koziol et al., 2011, p. 776). The cerebellum accomplishes these tasks by connecting with other brain regions, such as neo-cortex, temporal lobes, basal ganglia, thalamus, limbic system, and brainstem as well as spinal cord. These connections are made possible by the Purkinje cells found in the cerebellum and are most likely modulated by the noradrenergic and serotonergic neurotransmitters.

The behaviors described as “sensation-seeking” and “hyper- and hypo-sensitivities” by the OT literature are seen by Koziol et al. (2011) as a result of insufficient inhibitory influence in the brain, or “a disturbance in gating mechanisms of the frontal-striatal-pallidal-thalamic-cortical modulatory loop” and of the impaired “prefrontal system-hippocampal interactions” (responsible for retrieving action-appropriate information from memory) (pp. 779-780). These neuroanatomic deficits can also explain difficulties in reasoning and abstract thinking in pediatric populations. Since the development of the inhibitory control is needed to establish the working memory, and the subcortical areas mature prior to the cortical regions of the brain, sensory deficits usually become evident before diagnosis of the executive dysfunction is made. According to Koziol et al. (2011), in some cases, sensory deficits may be transient and brain

maturity-dependent. However, similar to many OT scholars, these authors asserted that early detection of sensory deficits in children may contribute to the design of treatment modalities that enhance cognitive, emotional, social, and academic functioning in this population and make use of an interdisciplinary collaboration.

Occupational Engagement in Schizophrenia

Some OT researchers have studied factors affecting *occupational engagement* (“the extent to which a person has a balanced rhythm of activity and rest, a variety of meaningful occupations and routines, and the ability to move around in society and interact socially…over time” [Bejerholm & Eklund, 2007, p. 21) in persons with schizophrenia. Chugg and Craik (2002) interviewed people with schizophrenia to inquire about how the subjects spent their time, what they believed had influenced their occupational engagement, what were their occupational routines, and whether they were able to experience a “flow” (a subjective psychological state characterized by positive mood, high motivation, high cognitive efficiency, and increased activity level, which occurs when one is consumed by a task). Subjects reported that physical and mental illnesses as well as medications had impacted their engagement in occupations, yet some participants used “doing things” as a means of managing symptoms. Subjects also generally recognized that they functioned differently at different times of the day and week. For many participants, having someone supportive (such as a community worker) with them was an important external factor when engaging in occupations. Certain routines, such as drinking coffee, showering, and caring for pets, were described as motivating. Lack of employment and feeling unable to work were reported as important issues by the participants. Poor self-concept in several participants seemed to lead to

performing fewer occupations during the day. While some participants stated that being challenged was a positive factor for them, others saw it as unnecessary pressure which needed to be avoided. Finally, several subjects were able to identify occupations that evoked “flaw”-like experiences for them. Chugg and Craik suggested that the findings of their study should be considered when planning OT interventions for clients with schizophrenia.

Bejerholm and Eklund (2007) used several assessment tools to explore relationships between occupational engagement, self-related variables (such as locus of control, mastery, sense of coherence), and quality of life as well as psychiatric symptoms (as measured by the BPRS) in schizophrenia. They found that a higher level of occupational engagement correlated with higher ratings of self-related variables, fewer psychiatric symptoms, and higher ratings of quality of life, and that severity of negative symptoms as well as little sense of coherence and external locus of control contributed significantly to the lack of occupational engagement. The authors concluded that limited engagement in daily occupations demonstrated by people with schizophrenia resulted not just from their illness and environmental influences, but also from their personal factors. In addition, this study confirmed the importance of well-balanced occupational engagement in the rehabilitation of schizophrenia patients.

Lipskaya-Velikovsky, Jarus, and Kotler (2016) investigated the potential of a holistic functional assessment performed during acute hospitalization to predict participation in daily activities 6 months after discharge in people with schizophrenia. One hundred four patients with schizophrenia participated in this study initially. The functional assessment consisted of the Neurobehavioral Status Examination (Cognistat),

Kitchen Task Assessment, Positive and Negative Syndrome Scale (PANSS), and Observed Tasks of Daily Living-Revised (OTDL-R). In addition, demographic data and illness-related information were collected from the patients' charts. Six months following discharge, 70 participants agreed to be interviewed using the Adults Subjective Assessment of Participation. Statistical analysis conducted in this study showed that higher *participation diversity* (a number of activities engaged in on a daily basis) of the research subjects 6 months post-discharge was predicted by a better performance on cognitive tasks (specifically, constructional ability) and less severe negative symptoms during hospitalization as well as a lower number of previous hospitalizations. An additional variable that highly associated with participation diversity was the capacity to perform instrumental daily activities, as measured by the OTDL-R. The authors concluded that participation diversity in the community could be predicted during acute hospitalization while relying on the measures of executive function and symptomatology, as well as personal and environmental factors and previous hospitalization history.

Theoretical Underpinnings: Chaos Theory as a Common Ground

From the literature reviewed above, one may notice that, although the terminology used by occupational therapists to describe the sensory, motor, and process skill deficits exhibited in schizophrenia is different from the one utilized by neuroscientists (e.g., “sensory processing” versus “sensory gating,” “mismatch negativity,” “impaired motor skill acquisition,” “cognitive dysmetria,” and “cognitive control”), both disciplines are concerned with the same phenomena: skill deficits resulting from the developmental brain pathology that accompanies this complex disease.

In addition to the linguistic differences, what may be setting OT and neuroscience apart is the difference in approach: occupational therapists are primarily interested in relieving the performance deficits with which their clients present, while considering the brain pathophysiology of these clients as a contributing factor only; neuroscientists focus most of their attention on the pathophysiology, noting the skill deficits as a resulting factor. This discrepancy is not surprising, given that occupational therapists spend most of their professional time actively interacting with their clients, while neuroscientists perform most of their work in lab settings, equipped with sophisticated technology such as neuroimaging tools. In fact, this kind of a difference in approach has been documented in the OT literature and has been referred to by Wilding and Whiteford (2007) as a "top-down versus bottom-up reasoning" (p.189).

Despite these differences in approach and terminology, OT and neuroscience do share a common ground. Both disciplines acknowledge that schizophrenia is a complex disorder resulting from an interaction between multiple disruptions in the brain and affecting different aspects of human behavior, which also interact with each other and the environment, and ultimately cause functional deficits. This view of schizophrenia is in agreement with the principles of chaos theory and its applications to what Royeen (2003) described as the "dynamics of neuro-occupation": interactive, interdependent development or symbiosis between the human nervous system and engagement in occupation, where the nervous system affects human performance and purposeful human activity affects health (p. 615). Royeen proposed that *chaos theory* (also known as *dynamic* or *non-linear systems* theory) can help integrate the profession and science of occupational therapy. According to Royeen, chaos theory has five key assumptions

(complex, non-linear relationships among the variables existing in a system; these variables' correlation and interdependency; existence of forever-changing chaotic systems; self-guided, self-organized, non-hierarchical and emergent nature of chaos systems and their underlying order) that are relevant to OT practice: intervention-outcome relationship is never linear; therapist and client exist in an interdependent, co-effecting manner; human condition is forever changing; genetic predisposition, environment, occupational participation, and emotional tone create a unique person. In other words, many variables or processes influence or co-effect one another within the many contexts in which occupation occurs, and the interaction of multiple variables within a system as well as the dynamic interaction of multiple systems (such as occupational process, occupational performance, and occupational context) undergird occupation within a given person (Royeen, 2003, p. 615).

Interestingly, dynamic systems theory is also considered one of the contemporary motor learning theories. It views movement as a result of an ongoing interaction between the subsystems within the person, the task, and the environment, and emphasizes the role of practice and experience in the production of new movement patterns (Zwicker & Harris, 2009). This notion is important in understanding schizophrenia because impaired motor skill acquisition might be negatively impacting the functional outcomes in people affected by this disease, and motor learning principles may assist with preventing disability in this client population.

The literature review presented in this paper demonstrates the complexity of the symptoms, skill deficits and functional outcomes in schizophrenia spectrum disorders. While the majority of the studies clearly identify sensory, process skill, or motor

deficits in this population, these deficits have the potential to impact one’s ability to function in everyday life. These deficits can, for example, interfere with one’s ability to manipulate objects, be comfortable in situations with either limited or excessive sensory stimuli, and may also contribute to maladaptive behaviors. What has not been explored is the relationship between psychiatric symptomotology, sensory deficits, process skill deficits, and motor deficits. Understanding the relationship between these symptoms and deficits is important as it may provide more focused motor learning and occupational therapy avenues for intervention, which can result in improved occupational performance. The study described below begins to address these goals.

Chapter III

METHODOLOGY

This study examined the sensory, motor, and process skills of 18 adult patients receiving inpatient treatment for schizophrenia spectrum disorders at the St. Vincent's Behavioral Health Services Center and exhibiting symptom stabilization and medication adjustment. The Adolescent/Adult Sensory Profile (AASP) and the Assessment of Motor and Process Skills (AMPS) were used in the study, and the findings were compared to the subjects' psychiatric symptoms severity as measured by the Brief Psychiatric Rating Scale (BPRS).

Population

Approvals were obtained from the Institutional Review Boards (IRBs) of both Teachers College, Columbia University and St. Vincent's Medical Center prior to beginning this study. A sample of 18 subjects was recruited at the St. Vincent's Behavioral Health Center, Adult Inpatient units located in Westport, Connecticut. Every patient of either gender who was receiving inpatient treatment for schizophrenia spectrum disorder at the above facility was asked to consent, if they met the inclusion and exclusion criteria. Inclusion and exclusion criteria had been established to assure the subjects' ability to participate fully in all assessments. The criteria were confirmed based

on personal communication with the hospital treatment team and the documentation that it provided.

Criteria for inclusion were: minimum age of 18; minimum of 5-year-long psychiatric history; schizophrenia spectrum diagnosis; symptom stabilization and no major side effects at the time of the study.

Criteria for exclusion were: non-English speakers; a history of neurological conditions, recent substance abuse, or intellectual disability/developmental disorders; presence of acute symptoms (such as active hallucinating, catatonia, episodes of extreme disorganization, as well as extreme fatigue or physical discomfort, etc.) and severe side effects (such as dizziness, tremor, drowsiness, etc.).

Patients with a history of neurological conditions, substance abuse, and intellectual disability/developmental disorders, or subjects who had not met the criteria for symptom stabilization and/or medication adjustment were excluded from the study to avoid discomfort among study participants as well as confounding factors.[1]

Only individuals who understood and spoke English were included in the study. This was necessary because the facility utilizes the Language Line (telephone interpreters) to assist with interpretation during evaluation and treatment of the clients who are not fluent in English, while the Assessment of Motor and Process Skills (AMPS; observation-based evaluation used in this study to collect data) requires the subjects to be observed when performing daily tasks under natural conditions.

[1] Acute symptoms (such as hallucinating, paranoia, catatonia, episodes of extreme disorganization, etc.), severe side effects from medications (such as dizziness, tremor, drowsiness, etc.), as well as extreme fatigue or physical discomfort could have affected subjects' performance during the testing process and, therefore, confounded the study results. In addition, it would have been in the participants' best interest to stop participation in the study if they were experiencing acute symptoms, physical discomfort/fatigue, or side effects.

Instrumentation

Three assessments were used in this study: Adolescent/Adult Sensory Profile (AASP), Assessment of Motor and Process Skills (AMPS), and Brief Psychiatric Rating Scale (BPRS).

Adolescent/Adult Sensory Profile (AASP)

The AASP is a standardized self-report measure designed to evaluate behavioral responses to everyday sensory experiences in clients who are 18 to 65 years old. This assessment consists of 60 items and takes approximately 10 to 15 minutes to complete. The 60 items represent Low Registration, Sensation Seeking, Sensory Sensitivity, and Sensation Avoiding responses to visual, auditory, touch, taste/smell, and movement stimuli, and a general category of activity level. The behavioral responses to sensory experiences are measured on a five-point scale ranging from “Almost Never” to “Almost Always.” The Pattern Grids are included in the assessment to provide a non-numerical method to examine how an individual’s scores cluster along the sensory threshold (low/high) and behavioral response (avoiding/seeking) categories. This classification system describes the individual’s responses as compared to most people and places the individual along a continuum of distributed scores rather than indicating whether an individual’s responses substantiate a concern (AASP, Technical Report, 2008).

Brown, Tollefson, Dunn, Cromwell, and Filion (2001) conducted a series of studies (such as an expert panel, item reliability and factor analysis, skin conductance study, item revision and reliability reexamination) aimed to evaluate the reliability and validity of the AASP. Following item revision and reliability reexamination, the values of

the coefficient alpha (internal consistency) for the various age groups and quadrant scores ranged from 0.6 to 0.78, and the authors concluded that the AASP was a reliable and valid tool to use in practice settings (Brown et al., 2001).

In 2002, Brown et al. demonstrated while using the AASP that “Individuals with schizophrenia tend to miss available sensory stimuli. When stimuli are indeed detected, they are often avoided” (p. 187). In this study, individuals with schizophrenia were also compared to individuals with bipolar illness. The results indicated that both the schizophrenia and the bipolar disorder group had higher scores on sensation avoiding than the control group.

Olson (2011) used the AASP in conjunction with the Positive and Negative Syndrome Scale (PANSS) to assess patients with schizophrenia. She found a relationship between positive symptoms of schizophrenia and either low registration or high sensitivity as revealed by the AASP. No relationship was found between the negative symptoms and the patterns of Sensory Modulation Disorder (SMD). The researcher concluded, “The relationship may actually be between psychosis and SMD and not schizophrenia” (p. 1).

Assessment of Motor and Process Skills (AMPS)

The AMPS is an observation-based measure of the effort, efficiency, safety, and independence exhibited by a person performing chosen and familiar Activities of Daily Living (ADL). Sixteen motor and 20 process skill items are scored on a four-point ordinal scale, with “1” being equivalent to a deficient skill and “4” being equivalent to a competent performance. Rater training and calibration are required to administer the AMPS. The ADL motor and ADL process skills are

> analogous to the goal-directed actions defined under the Activities and Participation domains of the International Classification of Functioning, Disability and Health (World Health Organization [WHO], 2001), and are thus the small units of performance that when carried out, one by one, result in the overall task being completed (Center for Innovative OT Solutions, 2013, n.p.)

Once the evaluation is complete, the OT rater enters the person's raw scores for each ADL task observed into the AMPS software. The AMPS software is then used to perform statistical analysis of the raw scores, considering the challenges of the observed ADL tasks and the severity of the rater. The many-faceted Rasch methodology used by the AMPS allows for the raw scores to be converted into logits, with a 2.0 logit cut-off for motor ability (effort) and a 1.0 logit cut-off for process ability (efficiency) (Fisher & Jones, 2010).

Research on the AMPS indicates good reliability and validity, including validity for use with males and females of different ages, across various cultures and diagnostic groups (Dickerson & Fisher, 1997; Duran & Fisher, 1996; Goldman & Fisher, 1997; Goto et al, 1996, as cited in Fisher & Bernspång, 2007). When different methods were employed to estimate the reliability coefficient of the motor and process ability scores as measured by the AMPS, the results ranged between 0.85 and 0.92 (Fisher & Jones, 2010). Moreover, a recent study by Merritt (2011) evaluated the validity of using the AMPS as evidence of the need for assistance in the community. Existing data of 64,466 subjects was analyzed, retrospectively. Motor and process skills measures had fair and good discriminative values, respectively, especially when matched motor and process decisions occurred. The author concluded that the AMPS was a valid tool to use when evaluating the need for assistance in the community, yet noted that the validity and reliability of the global functioning as measured by the AMPS still lacked evidence.

Even though limited evidence for its application in mental health practice has been collected (Hitch, 2007a), the AMPS may be of a special interest to occupational therapists practicing in mental health settings because the ADL process scale included in it reflects the efficiency (time and space organization) of ADL task performance, a problem that is common to mentally ill (Fisher & Bernspång, 2007). A few studies have been conducted while utilizing the AMPS with schizophrenia patients. Girard, Fisher, Short, and Duran (1999) used the AMPS to compare the occupational performance of non-disabled people, people with depression, and people with schizophrenia, and concluded that these three groups performed on a continuum of decreasing ability, with schizophrenia patients performing the least well.

On the contrary, when Moore, Merritt, and Doble (2010) attempted to use the AMPS to determine whether there were significant differences in ADL ability and ADL skill profiles between samples of individuals with depressive bipolar disorder, manic bipolar disorder, and schizophrenia, no clinically significant differences were found in the mean ADL ability among the study participants. The findings failed to support the idea that psychiatric diagnosis was a valid predictor of skill performance.

Fossey, Harvey, Plant, and Pantelis (2006) used the AMPS in conjunction with structured interviews and the Life Skills Profile (an informant-report measure of disability) to compare the occupational performance in ADL of people diagnosed with schizophrenia in two types of settings in urban Australia: residential rehabilitation facilities and home settings where patients received intensive outreach support. Mean ADL process ability, based on the AMPS process skills subscale, indicated that

regardless of the type of the setting the participants were in, the majority of them required some assistance to reside in the community.

Haslam, Pépin, Bourbonnais, and Grignon (2010) combined the AMPS with the Positive and Negative Syndrome Scale (PANSS), the Addiction Severity Index (ASI), and the Worker Role Interview (WRI) to determine whether the process skills as measured by the AMPS would discriminate between the employment levels of adults with schizophrenia engaged in either competitive employment, supported employment, prevocational training, or non-vocational activities. Moderate correlation was found between the level of employment and the global scores of the process skills scale on the AMPS. The authors concluded that process skills could be one of the predictors of work-related outcomes for this population.

Brief Psychiatric Rating Scale (BPRS)

The BPRS is widely used to assess the positive, negative, and affective symptoms of individuals with schizophrenia. It assesses an individual's behavior during the interview and over the previous 2-3 days (this can be reported by the patient's family). The assessment employs a Likert scale ranging from 1 (not present) to 7 (extremely severe) to describe symptom severity. Depending on the version used, the BPRS consists of 18 or 24 items (the 24-item version was used in this study). The total score is the sum of the scores from the 18-24 items reflecting the current clinical picture the patient presents with, and can be compared from one evaluation to the next as the measure of response to treatment (Kopelowicz, Ventura, Liberman, & Mintz, 2008). The 24-item BPRS was chosen for this study since it includes symptoms that may be relevant to this

investigation, such as *bizarre behavior, self-neglect, distractibility,* and *motor hyperactivity.*

Kopelowicz et al. (2008) conducted a study aiming to establish discriminant validity of the 24-item BPRS based on a sample of 565 subjects with schizophrenia. As a result of this research, the investigators concluded that the 24-item version of the BPRS could be divided into four symptom categories: Positive Symptoms consisting of *grandiosity, suspiciousness, hallucinations, unusual thought content, bizarre behavior, disorientation,* and *conceptual disorganization*; Agitation/Mania Symptoms consisting of *uncooperativeness, tension, excitement, distractibility, motor hyperactivity,* and *mannerisms;* Negative Symptoms consisting of *blunted affect, emotional withdrawal,* and *motor retardation*; and Depression/Anxiety Symptoms consisting of *anxiety, depression, suicidality,* and *guilt* (Kopelowicz et al., 2008). Moreover, according to Kopelowicz et al., when the entire study sample was considered, *hostility, self-neglect,* and *somatic concern* loaded predominately on the Positive Symptoms factor, and *elevated mood* loaded predominately on the Agitation/Mania factor; thus, these variables could be "dropped" onto the corresponding subcategories when deriving sub-scores for each symptom category in addition to the total BPRS score (A. Kopelowicz, personal communication, July 31, 2013).

The BPRS has been recognized as a psychometrically adequate instrument (Thomas, Donnell, & Young, 2004), and its four-factor structure is supported as stable and reliable by the correlation coefficients and coefficient of congruence ranging from 0.91 to 0.98. (Kopelowicz et al., 2008).

To the best of the principal investigator's knowledge, none of the previous studies have employed the AASP in conjunction with both the AMPS and the BPRS to study the sensory, motor, and process skills as compared to psychiatric symptoms severity in adult patients with schizophrenia.

Research Procedures

Potential subjects were approached by one of the nurses participating in this research and were given a letter informing them about the study. Each potential subject was re-approached the next day by one of the nurses involved in the study to see if she/he had questions about the letter or the study and/or was interested in participating.

The principal investigator (PI) only met with a potential study participant if she/he had expressed her/his interest to participate in it. The PI met with the patient for approximately 10-15 minutes to discuss the study and its potential risks and benefits. If the patient agreed to participate, she/he was offered to read the consent form and ask questions about the study. Once the potential participant stated that she/he had no more questions about the study, she/he was asked to repeat in her/his own words what she/he had learned about the study. This process was repeated until the potential participant demonstrated that she/he understood the study and what it involved. Once the potential participant demonstrated understanding of the study, she/he was offered to sign the consent form. When a potential candidate chose to decline participation in the study, she/he was thanked for her/his time and dismissed. When a participant signed the consent form, there were opportunities to discontinue participation or take a break from participating.

Data collection for each subject began after the consent form was signed. The PI asked each participant to provide answers to the questions listed in the AASP. To assure accuracy, the PI read the questions out loud for the participant and recorded her/his responses. However, if the subject asked to complete the questionnaire independently, she/he was allowed to do so. If requested, the PI provided answers to the subject's questions about the results of the assessment. This part of the testing procedure took approximately 15-20 minutes to complete with each client. The PI used the Sensory Profile Select Scoring Assistant to score, interpret, and store the results of this assessment. Participants' numbers, diagnoses, age, gender and raw scores only were submitted for the analysis to protect participants' identity.

Upon completion of the AASP, the participant and the PI proceeded with the AMPS (the PI had completed the AMPS training and rater calibration process and obtained the AMPS rater certification prior to beginning the study). Each subject was evaluated while performing two personal or domestic ADL tasks that she/he reported having prior experience and at least some difficulty with. The tasks were chosen from the following list: *making a bed; polishing shoes; setting a table; making an instant drink/ an instant drink and toast; making cold cereal and a beverage; making a sandwich/a sandwich and a beverage; making instant noodles; loading and starting a washing machine; hand washing laundry; folding a basket of laundry; watering plants and removing dead leaves; repotting a small houseplant; cleaning windows; sweeping the floor; mopping the floor.*

No tasks that could potentially harm subjects, such lifting heavy items or handling sharp instruments, were offered. The tasks were performed in parts of the facility that

best allowed for the observation of ADL skills (patient room, dining room, laundry room, etc.). If the participant expressed interest in the results of the assessment, the PI provided her/him with a brief feedback on her/his performance. This part of the testing procedure took approximately 30-40 minutes to complete with each subject.

The PI scored the subject's performance of the observed AMPS tasks according to the criteria outlined in the AMPS manual.[2] These scores were then submitted to the Center for Innovative OT Solutions for further analysis. Only participants' numbers, diagnoses, age, gender, and raw scores were submitted for the analysis to protect participants' identity.

Following the completion of the AASP and AMPS, registered psychiatric nurses employed at the St. Vincent's Behavioral Health Center, who had volunteered and had been selected to assist with this study, conducted the BPRS with each participant (the co-investigator provided BPRS training to the nurses, and inter-rater reliability had been established with an intraclass correlation coefficient (ICC) of 0.938 prior to beginning of the study). The PI was blind to the results of the BPRS during the interpretation of the AASP and AMPS results. Once the AASP and AMPS results were processed for all the participants, the PI obtained and recorded each subject's BPRS scores and conducted statistical analysis to compare them to the AASP and AMPS data.

[2] *Assessment of Motor and Process Skills*, Volume 2: *User Manual* (Fisher, 2010).

Data Storage and Confidentiality Procedures

Each subject was assigned a participant number. The PI/staff involved in the study used each subject’s participant number, diagnosis, gender, age, and scores only when documenting the results of the assessments employed in the study and conducting a statistical analysis of these results.

Individual findings of the assessments were discussed with each study participant and the treatment team only. The PI passed on only clinically concerning findings (such as psychiatric symptoms or significant difficulties with performing basic self-care tasks observed among the participants during the study) to the treatment team.

Information collected during this study was stored in locked file cabinets at the hospital with access only by the following individuals: the researchers; Teachers College, Columbia University faculty who served as advisors for this study; and St. Vincent’s Medical Center and Teachers College, Columbia University IRB members. In addition, dis-identified raw scores of the AMPS assessment for each subject were submitted for further analysis to the Center for Innovative OT Solutions (formerly called AMPS Project International). Study results will be reported in the aggregate only in all publications and reports.

Data Analysis

Statistical analysis was conducted in this study using the IBM SPSS Statistics 24 software. Pearson Product Moment-Correlation and Spearman Rho tests were utilized to investigate the relationships between the study variables.

AASP quadrant total scores for Low Registration, Sensory Sensitivity, Sensory Avoidance, and Sensation Seeking were analyzed in relation to the AMPS data (overall motor and process ADL ability logits and their functional interpretations, as well as levels of assistance required in the community), and in relation to the total scores in four categories of psychiatric symptoms as established by the BPRS (Positive Symptoms, Negative Symptoms, Anxiety/Depression, and Agitation/Mania).

Due to the nature of the AMPS,[3] only overall functional ratings and not individual motor and process skill items could have been used in the analysis. Additionally, to simplify the statistical analysis, participants' overall BPRS scores in the main four symptom categories and not individual raw scores for each symptom were compared to the skill deficits in this study.

[3] Only overall functional ratings and not individual raw scores in the AMPS have been adjusted for the task difficulty and rater severity (Fisher & Jones, 2010).

Chapter IV

STUDY RESULTS

Participants

Eighteen subjects ages 22-56 were recruited for this study: 10 males and eight females. Mean participant age was 36. No statistical differences were discovered between the male and female ages. Thirteen subjects had been diagnosed with schizophrenia, and four subjects (all females) had been diagnosed with schizoaffective disorder. Subjects with both schizophrenia and schizoaffective disorder were included in the study to simplify the recruitment process. The sample of those with schizoaffective disorder was too small to be analyzed in any distinct manner.

One of the male subjects (Subject #4) withdrew from the study prematurely for unclear reasons. Therefore, his data were incomplete and are not presented here. The demographics of the remaining 17 subjects are summarized in Table 1 and Figures 1 and 2 below.

Table 1

Demographics of the Study Participants

Participant Number	Gender	Age	Diagnosis
1	Female	31	Schizoaffective Disorder
2	Female	42	Schizoaffective Disorder
3	Male	45	Schizophrenia
4	**Withdrew from the study**		
5	Female	28	Schizophrenia
6	Female	47	Schizophrenia
7	Female	24	Schizoaffective Disorder
8	Male	22	Schizophrenia
9	Female	36	Schizoaffective Disorder
10	Female	56	Schizophrenia
11	Male	33	Schizophrenia
12	Male	37	Schizophrenia
13	Female	44	Schizophrenia
14	Male	24	Schizophrenia
15	Male	34	Schizophrenia
16	Male	27	Schizophrenia
17	Male	39	Schizophrenia
18	Male	52	Schizophrenia

Figure 1

Study Participants' Gender

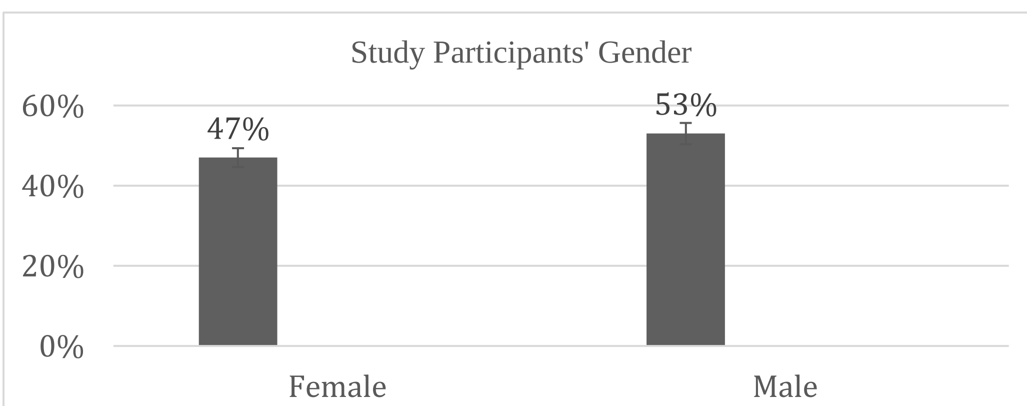
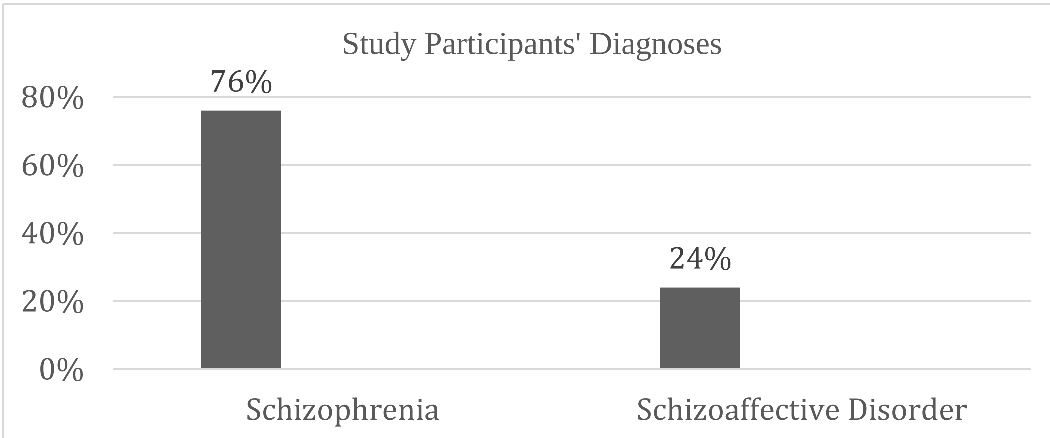


Figure 2

Study Participants' Diagnoses



Sensory Skill Deficits of the Study Participants

One of the aims of this study was to describe the sensory skill deficits in patients with schizophrenia spectrum disorders. Twelve of the study participants presented with different than most people low registration patterns. Eleven subjects presented with different than most people sensation-seeking patterns. Ten subjects demonstrated different than most people sensory-sensitivity patterns, and 10 subjects exhibited different than most people sensory-avoidance patterns. The sensory skills of the study participants are summarized in Table 2 and Figure 3 below.

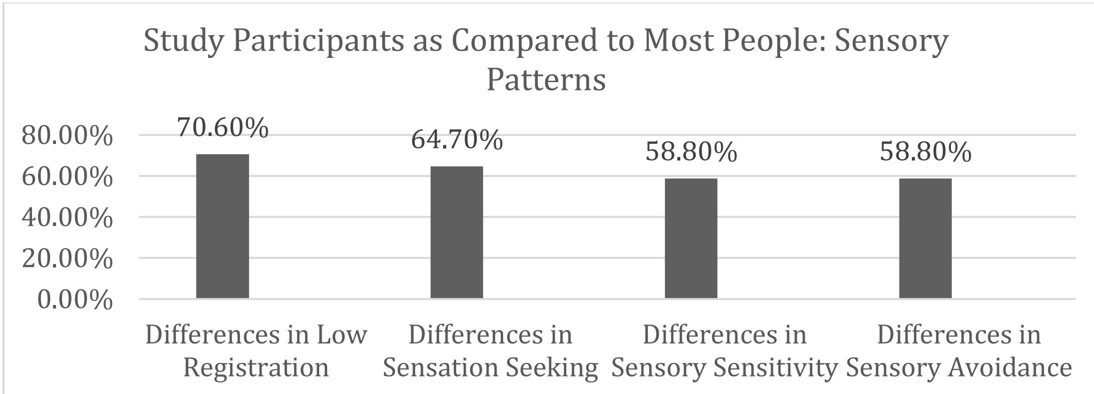
Table 2

AASP Quadrant Raw Scores/Classifications

Participant Number	Low Registration	Sensation Seeking	Sensory Sensitivity	Sensation Avoiding
1	49 (Much More Than Most People)	56 (Similar to Most People)	45 (More Than Most People)	38 (Similar to Most People)
2	42 (More Than Most People)	51 (Similar to Most People)	38 (Similar to Most People)	54 (Much More Than Most People)
3	19 (Less Than Most People)	58 (More Than Most People)	24 (Less Than Most People)	31 (Similar to Most People)
5	33 (Similar to Most People)	34 (Much Less Than Most People)	40 (Similar to Most People)	53 (Much More Than Most People)
6	40 (More Than Most People)	36 (Less Than Most People)	58 (Much More Than Most People)	53 (Much More Than Most People)
7	46 (Much More Than Most People)	40 (Less Than Most People)	43 (More Than Most People)	49 (More Than Most People)
8	33 (Similar to Most People)	37 (Less Than Most People)	37 (Similar to Most People)	55 (Much More Than Most People)
9	51 (Much More Than Most People)	31 (Much Less Than Most People)	36 (Similar to Most People)	37 (Similar to Most People)
10	55 (Much More Than Most People)	57 (More Than Most People)	60 (Much More Than Most People)	55 (Much More Than Most People)
11	27 (Similar to Most People)	49 (Similar to Most People)	39 (Similar to Most People)	35 (Similar to Most People)
12	32 (Similar to Most People)	34 (Much Less Than Most People)	42 (More Than Most People)	44 (More Than Most People)
13	20 (Less Than Most People)	59 (More Than Most People)	46 (More Than Most People)	33 (Similar to Most People)
14	N/A	41 (Less Than Most People)	29 (Similar to Most People)	31 (Similar to Most People)
15	34 (Similar to Most People)	46 (Similar to Most People)	34 (Similar to Most People)	63 (Much More Than Most People)
16	38 (More Than Most People)	45 (Similar to Most People)	21 (Less Than Most People)	33 (Similar to Most People)
17	47 (Much More Than Most People)	60 (More Than Most People)	51 (Much More Than Most People)	53 (Much More Than Most People)
18	36 (More Than Most People)	49 (Similar to Most People)	24 (Less Than Most People)	25 (Less Than Most People)

Figure 3

Study Participants as Compared to Most People: Sensory Patterns



Motor and Process Skill Deficits of the Study Participants

The second aim of the study was to describe the motor and process skills deficits in patients with schizophrenia spectrum disorders. In this study, six subjects demonstrated minimal effort performing ADL tasks, and nine subjects demonstrated moderate effort. Six subjects exhibited minimal inefficiency performing ADL tasks, four subjects showed moderate inefficiency, and one subject exhibited marked inefficiency. Additionally, eight subjects performed ADL tasks in a manner that suggested at least minimal level of assistance in the community, and three subjects appeared to require moderate to maximal level of assistance. For six subjects, the level of assistance was established as minimal due to the symptom severity leading to the hospitalization and despite the relatively high ADL performance as measured by the AMPS.[4] The motor and process skills of the study participants are summarized in Table 3 and Figure 4 below.

[4] As per the AMPS manual, the level of assistance in the community is to be determined based on the client's overall status and not just motor and process skill scores.

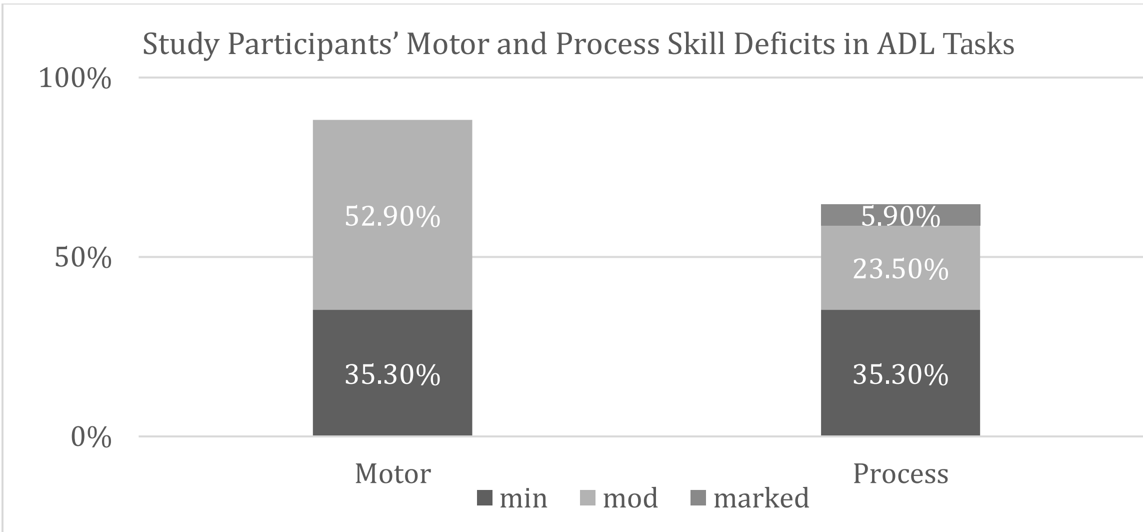
Table 3

AMPS ADL Ability Logits/Level of Assistance

Participant Number	ADL Motor Ability	ADL Process Ability	Level of Assistance
1	0.58 (Moderately effortful)	0.21 (Markedly inefficient)	Moderate to maximal
2	1.79 (Minimally effortful)	0.46 (Moderately inefficient)	Minimal
3	1.58 (Moderately effortful)	0.8 (Minimally inefficient)	Minimal
5	1.59 (Moderately effortful)	1 (Questionable inefficiency)	Minimal
6	0.9 (Moderately effortful)	1.2 (Questionable inefficiency)	Minimal
7	1.3 (Moderately effortful)	0.9 (Minimally inefficient)	Minimal
8	2.1 (Questionable effort)	1.4 (Efficient)	Minimal
9	-0.2 (Moderate effort)	0.0 (Moderately inefficient)	Moderate to maximal
10	1.6 (Minimally effortful)	0.7 (Minimally inefficient)	Minimal
11	0.5 (Moderately effortful)	0.5 (Moderately inefficient)	Moderate to maximal
12	0.4 (Moderately effortful)	0.8 (Minimally inefficient)	Minimal
13	1.9 (Minimally effortful)	1 (Questionable inefficiency)	Minimal
14	2.1 (Questionable effort)	0.7 (Minimally inefficient)	Minimal
15	1.9 (Minimally effortful)	1 (Questionable inefficiency)	Minimal
16	1.7 (Minimally effortful)	0.6 (Moderately inefficient)	Minimal
17	1.9 (Minimally effortful)	1.4 (Efficient)	Minimal
18	1 (Moderate effortful)	0.8 (Minimally inefficient)	Minimal

Figure 4

Study Participants' Motor and Process Skill Deficits in ADL Tasks



Relationship Between the Sensory, Motor, and Process Skill Deficits of the Participants

In order to examine the relationship between the sensory, motor, and process skills of the study participants, the Pearson Product Moment-Correlation (Pearson's r) and Spearman Rho tests were conducted. These tests revealed the following relationships:

- Pearson's r revealed a potential correlation between *sensory avoidance* and *motor skill deficits* (r = .591, p = .072), with a moderate effect size (r^2 = 0.35).
- Spearman Rho test revealed that *process skills deficits* were in relationship with *sensory avoidance interpretation* (r = .514, p = .035), and that *process skills interpretation* was in an inverse relationship with s*ensory avoidance interpretation* (r = - .547, p = .023).

Relationship Between Skill Deficits and Severity of Psychiatric Symptoms Among the Study Participants

This research also examined the relationship between the skill deficits found in patients with schizophrenia spectrum disorders and the severity of their psychiatric symptoms. The Brief Psychiatric Rating Scale (BPRS) was used in this study to assess the psychiatric symptoms of the participants. The BPRS was not completed with two of the participants due to an earlier-than-planned discharge. All remaining subjects exhibited psychiatric symptoms as revealed by the BPRS. Total BPRS scores are provided in Table 4 below.

Table 4

Total BPRS Scores

Subject Number	Positive Symptoms Total	Agitation/ Mania Total	Negative Symptoms Total	Depression/ Anxiety Total	Total BPRS Score
1	22	22	9	18	71
2	28	7	7	16	58
3	17	14	6	4	41
4	Withdrew from study				
5	21	9	11	12	53
6	17	9	9	13	48
7	14	10	3	8	35
8	20	7	6	9	42
9	14	11	4	9	38
10	17	7	4	17	45
11	BPRS not completed				
12					
13	14	9	3	7	33
14	11	9	3	7	30
15	10	10	3	7	30
16	16	14	3	9	42
17	16	12	3	13	44
18	12	7	3	5	27

The Pearson Product Moment-Correlation, employed in this study to examine the relationship between the skill deficits and the severity of psychiatric symptoms among the participants, revealed a strong correlation between *depression/anxiety* and *sensory sensitivity* (r = .719, p = .029; with a large effect size: r^2 = .52); as well as a correlation between *depression/anxiety* and *low registration* (r = .689, p = .019; with a moderate effect size: r^2 = .47).

Additional Findings

In addition to the findings described above, the statistical analysis employed in this study revealed the following relationships:

- *Sensory sensitivity* strongly correlated with *sensory avoidance* as revealed by Pearson's r (r = .949, p = .004), with a large effect size (r^2 = .90).
- *Motor skill deficits* strongly correlated with *process skill deficits* as revealed by Pearson's r (r = .606, p = .010), with a moderate effect size (r^2 = .37).
- *Depression/anxiety* strongly correlated with *positive symptoms* (r = .675, p = .006, with a moderate effect size: r^2 = .46) as revealed by Pearson's r.
- *Positive symptoms* correlated with *negative symptoms* (r = .699, p = .004, with a moderate effect size; r^2 = .49) as revealed by Pearson's r.

Chapter V

DISCUSSION

This study aimed to examine the sensory, motor, and process skills of adult patients receiving inpatient treatment for schizophrenia spectrum disorders and exhibiting symptom stabilization and medication adjustment. It was hypothesized in this study that the participants would demonstrate sensory as well as motor and process skill deficits, and that statistically significant relationships would be found between these skill deficits. Moreover, a statistically significant relationship was expected to be found between the skill deficits and the severity of psychiatric symptoms of the study participants.

The descriptive analysis employed in this study discovered sensory processing differences among the participants in terms of low registration, sensation seeking, sensory sensitivity, and sensory avoidance. The sensory processing differences revealed among the study participants resemble the differences demonstrated by other psychiatric populations, such as children with autism (Lane et al., 2009), adults with OCD (Rieke & Anderson, 2009), and individuals affected by Borderline Personality Disorder (Brown et al., 2009). Moreover, the study results are in agreement with findings related to low registration and sensation avoiding in people with schizophrenia, as previously reported by Brown et al. (2002).

The study also discovered correlations between anxiety/depression and sensory sensitivity and low registration among the participants. These findings are parallel to the relationship between anxiety and sensory over-responsiveness in children with ADHD, as reported by Lane et al. (2010), and may provide additional insight into the relationship between sensory processing deficits and psychiatric symptoms.

No evidence was obtained in this research to confirm the claim by Olson (2011) that positive symptoms correlate with low registration and high sensitivity in people with schizophrenia. However, it may be important to note that Olson utilized a different psychiatric assessment (Positive and Negative Syndrome Scale, PANSS). The PANSS combines BPRS items with items of the Psychopathology Rating Scale (Singh & Kay, 1975, in Lyne, Kinsella, & O'Donoghue, 2012). According to Lyne et al. (2012), "positive and negative scale total scores highly correlate between the BPRS and the PANSS, even though the items and subscales in these assessments may not be interchangeable" (p. 238). Therefore, it is unclear at this point whether the fact that the current study did not confirm Olson's (2011) findings can be attributed to the differences between the BPRS and the PANSS. Thus, more studies utilizing the AASP in conjunction with psychiatric symptom measurements may be needed to explore further the relationship between sensory processing deficits and psychiatric symptomatology.

Additionally, the strong correlation between sensory sensitivity and sensation avoidance revealed by this study appears to be logical, since it would make sense for someone who is overly sensitive to a certain type of sensory stimuli to avoid at least some of those stimuli as they encounter them in daily life. However, this topic may need further investigation.

Another important finding of this research is the potential relationship between the sensory patterns and the motor and process skill deficits, since a potential correlation between sensory avoidance and motor skill deficits was revealed by Pearson's r. Moreover, Spearman Rho test revealed that *process skills deficits* were in relationship with *sensory avoidance interpretation*, while *process skills interpretation* was in an inverse relationship with s*ensory avoidance interpretation.* These findings are parallel to the results of the study by White, Mulligan, Merril, and Wright (2007), in which children with atypical sensory profiles demonstrated increased motor and process skill deficits.

The link between sensory sensitivity, sensory avoidance, ADL skill deficits, and depression/anxiety is especially intriguing, as the relationships between these variables may provide insight into the mechanism behind the functional difficulties and impaired quality of life among people with schizophrenia. For instance, it may be reasonable to assume that increased sensory sensitivity in this population frequently results in avoidance of tasks that are rich in sensory input and/or a deficient task performance. The above assumption may be illustrated by the example of an individual with schizophrenia who might be avoiding showering due to excessive sensitivity to a running water. In a different example a person with schizophrenia may be refraining from independent meal preparation because of the difficulty with holding utensils as a result of the impaired ability to notice the tactile and proprioceptive cues they provide. Ultimately, these sensitivities may lead to underdeveloped functional skills, feelings of inadequacy/low self-esteem, external locus of control, decreased energy, low motivation to participate in daily activities and increased social isolation, which in turn might perpetuate feelings of depression and anxiety frequently present in schizophrenia.

Additional findings of this study, such as the correlation between motor and process skill deficits, and relationships between different categories of psychiatric symptoms (depression/anxiety strongly correlated with positive symptoms, and positive symptoms also correlated with negative symptoms), may require further research.

All subjects in this study demonstrated ADL skill deficits that suggested a need for at least a minimal level of assistance in the community. This finding resembles the results of the study by Fossey et al. (2006), where the majority of the participants (all of whom had schizophrenia) performed on the AMPS at the level suggesting a need for at least some assistance in the community.

The skill deficits revealed in this study through the utilization of the Adolescent Adult Sensory Profile (AASP) and the Assessment of Motor and Process Skills (AMPS), and the fact these deficits were in relationship with psychiatric symptoms, confirmed the utility of OT assessments in the process of treatment and discharge planning for people with schizophrenia. Lipskaya-Velikovsky et al. (2016) argued that participation in the community among people with schizophrenia could be predicted during acute hospitalization, while relying on a holistic functional assessment composed of measures of executive function and psychiatric symptoms, as well as personal and environmental factors, including previous hospitalization history. The current study results indicate that utilization of occupation-based assessments with a focus on motor and process skills (such as the AMPS), as well as measures of sensory processing (such as the AASP), may add to the validity of the inpatient functional assessment aimed at predicting function in the community, when considered in conjunction with the symptomatology, cognitive abilities, and personal and environmental factors.

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The relationships between sensory, motor, and process skills, and the severity of schizophrenia symptoms discovered in this study may have several other implications. The main implication is that rehabilitation of clients with schizophrenia spectrum disorders must take into consideration the unique sensory differences (such as low registration or high sensitivity), and motor and process skill deficits (such as difficulty with transporting objects or organizing workspace) of each such client.

Moreover, because sensory processing patterns and motor skills develop early in life, it might also be essential to address the sensory and motor delays in children who have not yet been diagnosed with any psychiatric conditions, to maximize their present and future functional outcomes. This conclusion emphasizes the importance of early intervention services (including occupational therapy) provision.

Finally, the findings of this study combined with the literature review that preceded it may offer further insight into the unique mechanism behind the functional impairments manifested by individuals with schizophrenia spectrum disorders. More specifically, it might be reasonable to propose that the genetically-propelled neurodevelopmental and neurodegenerative pathology of schizophrenia causes disrupted sensory registration and processing, leading to perceptual, motor, cognitive, social, and emotional impairments, which in turn result in difficulties with performing daily activities. The graphic: Dynamic Systems of Occupational Performance in Individuals with Schizophrenia (see Appendix C), illustrates how the components within each module of the proposed dynamic system, if impaired, can build towards functional and participation deficits.

Study Limitations and Future Research

There are several limitations to this study, which should be taken into consideration in future research pertaining to skill deficits in schizophrenia spectrum disorders. The main limitation is the fact that the stringent subject recruitment protocol employed in this study (as requested by the IRBs because the study examined a vulnerable subject population) had resulted in a small sample size.

To minimize potential safety issues, the IRB requirements also limited the tasks that could be performed as a part of the AMPS in this study. This resulted in a limited list from which the participants could select tasks; this may have potentially confounded the AMPS data.

To simplify the recruitment process, individuals with both schizophrenia and schizoaffective disorder were included in the study. The sample of those with schizoaffective disorder turned out to be too small to be analyzed in a distinct manner. Should future studies recruit larger samples of participants with schizophrenia and schizoaffective disorder, it may be useful to compare the skill deficits between these two subgroups on the schizophrenia spectrum.

One subject withdrew from the study for unknown reasons, and the BPRS was not completed on two additional subjects due to an earlier-than-planned discharge. As a result, the data in this research may have further weakened.

Since the AASP is based on self-report, one could argue that it may have impeded the reliability of the study results. However, the AASP has been recognized as a psychometrically valid tool and has been widely used in research, making the above issue unlikely.

The analysis employed in this study used the AASP scores representing participants' sensory thresholds (Low Registration/Sensory Sensitivity) and behavioral responses (Sensation Avoiding/Sensation Seeking), rather than the sensory processing categories of Taste/Smell, Movement, Visual, Touch, Activity Level, and Auditory. It may be valuable for future research on sensory processing in schizophrenia to address specific sensory categories in addition to sensory thresholds and behavioral responses.

Finally, an additional limitation of this study is the fact that only relatively stable, ready-for-discharge subjects participated in it, making the study findings potentially relevant to near-remission schizophrenia patients only.

Summary and Conclusions

This research project employed the Adolescent/Adult Sensory Profile (AASP), Assessment of Motor and Process Skills (AMPS), and Brief Psychiatric Rating Scale (BPRS) to examine the sensory, motor and process skills of stabilized adult patients with schizophrenia spectrum disorders in relation to their symptom severity. It was hypothesized in this study that the subjects would present with deficient sensory, motor, and process skills, and that statistical analysis would reveal significant relationships between these skill deficits and the severity of the participants' psychiatric symptoms.

The analysis of the data confirmed that the subjects in the study demonstrated sensory skill differences as measured by the AASP, and motor and process skill deficits as measured by the AMPS. The study also discovered correlations between low registration and sensory sensitivity as measured by the AASP, and anxiety/ depression as measured by the BPRS. Additional relationships were found between sensory avoidance

as measured by the AASP, and motor and process skill deficits as measured by the AMPS.

Therefore, the hypotheses of this study pertaining to the existence of skill deficits in patients with schizophrenia were confirmed, while the hypotheses about the relationships between the skill deficits and the severity of psychiatric symptoms were supported, but not across all domains.

Additional findings of this study include correlations between sensory sensitivity and sensory avoidance, between motor and process skill deficits, and between different categories of psychiatric symptoms. These findings require further investigation.

This study highlights the link between sensory differences, skill deficits and symptoms of schizophrenia spectrum disorders as a part of the mechanism behind the functional difficulties in the affected individuals, and supports the idea that most of them may need some level of assistance in the community. Additionally, it provides evidence for the use of occupation-based assessments and interventions in mental health practice.

Sensory aspects of schizophrenia, their relation to symptomatology, and impact on performance skills and functional outcomes in people affected by this disease is an intriguing topic, which necessitates further exploration, as an improved understanding of it may lead to discovering new treatment modalities for this client population.

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Appendix A

Recruitment Letter

Teachers College, Columbia University
525 West 120th Street
New York, NY 10027
212 678 3000
www.tc.edu

SENSORY, MOTOR AND PROCESS SKILLS AS COMPARED TO SYMPTOM SEVERITY IN ADULT PATIENTS WITH SCHIZOPHRENIA: STUDY DESCRIPTION TO POTENTIAL PARTICIPANTS

Dear Madam/Sir,

You are invited to participate in a research about how people with schizophrenia respond to what they see, hear, touch, smell or taste, and to when their body moves in space. The research will also look at how people with schizophrenia perform some of their daily tasks, such as fixing a simple meal or making a bed, and more. If you agree to participate, the researcher primarily responsible for this study will meet with you to ask you some questions and to watch you perform a couple of tasks. You will choose the tasks yourself from the list the researcher will offer. One of the nurses will also meet with you to ask you more about your symptoms.

After you are done participating in this study the researcher will use a computer program to enter all of the information in and to see if there is a connection between your symptoms, how you respond to things around you, and how you perform daily tasks. Your name will not be documented or entered into the computer, and a participant's number (along with your age, gender and diagnosis) will be used instead. Nobody, but you, your treatment team members, and the researchers, will ever find out about how you personally did during the assessments.

Participation in this research is voluntary. This research may help us lean more about your illness, and how to better care for people who have it. There are no unusual risks involved in this study, but you can stop your participation at any time. If you choose not to participate in this research, or if you stop your participation after you have agreed to it, it will not affect how you will be treated at, or when/where you will be discharged from the hospital. Please let the nursing staff on the unit know if you have any questions about this research or are considering participating in it, and the nurses involved in this study will arrange for the primary researcher to meet with you to discuss it further.

Thank you for taking the time to read this letter.

Sincerely,

The research team.

Appendix B

Consent Form

Sensory, Motor and Process Skills as Compared to Symptom Severity in Adult Patients with Schizophrenia, July 31st, 2014

Teachers College, Columbia University
525 West 120th Street
New York NY 10027
212 678 3000
www.tc.edu

INFORMED CONSENT

RESEARCH TITLE: Sensory, Motor and Process Skills as Compared to Symptom Severity in Adult Patients with Schizophrenia

RESEARCH SITE: St. Vincent's Behavioral Health Center, Adult Inpatient units; Westport, Connecticut

RESEARCHERS: Lolia Halperin, MA, OTR/L, Doctoral Student, Teachers College, Columbia University; Dr. Stewart Levine, MD, Chair, Department of Psychiatry, St. Vincent's Medical Center

DESCRIPTION OF THE RESEARCH:

You are invited to participate in a research about how people with schizophrenia respond to what they see, hear, touch, smell/taste, and when their body moves in space. The research will also look at how people with schizophrenia perform some of their daily tasks.

If you agree to participate, you will be asked to answer some questions about your daily activities. You will be also asked to perform two tasks that are familiar to you, and that you may find difficult. You will choose these tasks yourself from the following list: *making a bed; polishing shoes; setting a table; making an instant drink/ an instant drink and toast; making cold cereal and a beverage; making a sandwich/a sandwich and a beverage; making instant noodles; loading and starting a washing machine; hand washing laundry; folding a basket of laundry; watering plants and removing dead leaves; repotting a small houseplant; cleaning windows; sweeping the floor; mopping the floor.*

In addition, a staff member from the hospital will meet with you to ask you more about your symptoms.

TIME INVOLVEMENT:

Your participation will take approximately an hour and half to two hours. You can choose to complete the assessments the research involves in either two or three sessions.

RISKS AND BENEFITS:

This research has the same amount of risk you would encounter during a usual course of evaluation and treatment, or, while performing daily domestic tasks. You may experience some temporary emotional discomfort when or after answering some of the questions you will be asked. In addition, you may feel temporarily fatigued during or after completing the tasks you will choose to perform during the assessment. Please also note that, as hot water may be accidentally spilled when making an instant drink or instant noodles, it will be up to you to decide whether you are interested in performing these tasks, or would rather choose to perform other tasks included in the assessment.

No tasks that can potentially physically harm you (such as carrying unusually heavy objects or handling sharp instruments, etc.) will be required of you during this study.

Should you experience any unexpected worsening in your psychiatric or medical condition during the study, the investigator will make sure that the treatment team present at the hospital provides the necessary care to you.

There are no direct benefits for participation in the study. There is no financial cost to you for participating in the study, and you will not be paid for participating in the study. You can choose to stop your participation at any time. If you stop your participation, it will not affect how you will be treated, or when you will be discharged from the hospital. Please tell the investigator that you have decided to stop. Also, the investigator may choose to have you stop if he or she thinks it is in your best interest.

DATA STORAGE TO PROTECT CONFIDENTIALITY:

Your participant number along with your age, gender and diagnosis, but not your name will be used in this study to protect your identity. Consent forms will be collected into a separate envelope and kept separate from the assessment results. Nobody, but you, your treatment team members, and the researchers involved in this study will ever find out about how you personally performed during the assessments.

Information collected during this study will be stored in locked file cabinets at the hospital with access only by the following individuals: the researchers; Teachers College (TC), Columbia University faculty, who serve as advisors for this study; St. Vincent's Medical Center and TC, Columbia University Institutional Review Boards (IRB-s) (independent committees whose purpose is to protect human subjects involved in clinical research) members; and the Center for Innovative OT Solutions(an agency that provides data analysis for one of the assessments used in this study) associates.

While it is unlikely, there may be times when state or federal law requires disclosure. In that event the St. Vincent's Medical Center and/or TC, Columbia University will make every effort to protect your personal information.

HOW THE RESULTS WILL BE USED:

Information from this study will be used for one of the researcher's dissertation. In addition, it may be presented at professional meetings/conferences, used to educate students, and published in the press for people with schizophrenia and those who provide care to them. Every effort will be made to ensure anonymity. Study results will be reported in the aggregate only in all publications and reports.

EXCHANGE OF PROTECTED HEALTH INFORMATION PRIVACY STANDARDS FOR RESEARCH

Effective April 14, 2003, you must be told of your right to permit or deny the sharing or exchange of your protected health information (PHI) from your enrollment in this

research study. This right is found under a federal law called the Health Insurance Portability and Accountability Act (HIPAA) of 1996.

Protected health information (PHI) is any information about you, including such information as your age, gender, address, etc., that is created or received by a health care provider, health plan, employer, or health care clearinghouse (an organization that processes your insurance claim). This information has to do with your past, present, or future physical or mental health or condition, health care given to you, or the past, present, or future payment for health care given to you. The information specifically identifies you as an individual or may reasonably lead to your identification.

Health care providers and other persons who are not health care providers but are involved in the study will have access to your PHI until the time that the entire study is finished. Your consent to have your PHI shared with those persons involved with this research protocol is necessary in order for them to 1) perform the study and determine its value and outcome and 2) for treatment, payment of services and health care operation necessary to conduct the research.

You agree that you cannot see or get your PHI that was created or obtained during the research study by the researcher or health care provider, covered under HIPAA, while the research study is in progress. You will be able to see or get your PHI created or obtained during the research study when the research is finished.

If you decide that you do not want your PHI exchanged or shared or that you do not want to waive your right to your PHI while you are involved in the study, you must inform your doctor or the research coordinator of the study now. Your decision regarding your protected health information may determine your eligibility to participate in this study.

CONTACT INFORMATION FOR THE STUDY

If at any time you have any questions regarding this research or your participation in it, you can contact the researchers, who will answer your questions. The 24–hour

Teachers College, Columbia University
Institutional Review Board
Protocol Number: 14-279
Consent Form Approved Until: 04/27/2017

IRB APPROVED
DATE: 5|16|16 SIGN OFF:

contact person for this study is Dr. Levine, MD, Chair, Department of Psychiatry, St. Vincent's Medical Center (phone number 203-221-8801).

If at any time you have comments, or concerns regarding the conduct of the research or questions about your rights as a research subject, please contact Dr. Robert Brown, Chairman of the IRB at St. Vincent's Medical Center (phone number: 203-576-5711). In addition, you can contact the TC, Columbia University IRB (phone number: 212-678-4105).

I have read and discussed the study description with the researcher. I have had the opportunity to ask questions about the purposes and procedures regarding this study. I am 18 years of age or older, and my signature means that I agree to participate in this study. The researcher may withdraw me from the research at his/her professional discretion. I will receive a copy of this document.

Participant's signature: ______________________________ Date: ___/____/____

Printed name of participant: ______________________________

Signature of witness: ________________________________Date: ____/____/___

Printed name of witness________________________________

Researcher's signature: ______________________________ Date: ____/____/___

Printed name of researcher: ______________________________

Teachers College, Columbia University
Institutional Review Board
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Consent Form Approved Until: 04/27/2017

IRB APPROVED
DATE: 5/16/16 SIGN OFF:

Appendix C

Dynamic Systems of Occupational Performance in Individuals with Schizophrenia