ASSOCIATIONS AMONG DOMAINS OF SELF-DISTURBANCES IN SCHIZOPHRENIA

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Abstract

Self-disturbances are being increasingly recognized as important, possibly even central, features of schizophrenia spectrum disorders; however, little is known about the associations among different manifestations of self-disturbances. The aims of the current study replicate previous findings of self-disturbances in schizophrenia, compare domains of self-disturbances in schizophrenia and in a control sample, and compare self-disturbances with other symptoms and deficits in schizophrenia. The three domains of self-experience included somatosensation and body perception, phenomenological self-experiences, and dialogical self. Participants included 48 individuals with schizophrenia and 36 non-psychiatric controls. The results of this study replicate previous findings of deficits in phenomenological self-experiences and dialogical self, as well as bottom-up somatosensation. The results also indicated consistent associations between the domains of phenomenological self-experience and dialogical self, but not somatosensation. Somatosensation was associated with more negative symptoms of schizophrenia, while phenomenological self-experience and dialogical self were associated with higher levels of positive symptoms.

Associations among Domains of Self-Disturbance in Schizophrenia

Self-disturbances have been identified as prominent yet perplexing features of schizophrenia-spectrum disorders (Henriksen and Parnas, 2012; Sass, 2014). Self-disturbances include a wide array of symptoms, such as misattribution of agency, disrupted sense of body ownership, perceived changes in body size or shape, and impaired self-other distinction. The first models of schizophrenia characterized disturbances in self-processing as a basic feature of the disorder (Bleuler, 1950; Kraepelin 1919). Other models of schizophrenia symptoms have been more predominant since the 1980s, such as the common symptom grouping of positive and negative (Andreasen, 1985; Crow, 1998) or positive, negative, and disorganized symptoms (Liddle 1993). In the past ten years, the field of schizophrenia has seen a reemergence of interest in self-disturbances as an important feature of the disorder, with some even positing self-disturbances as the core dysfunction in schizophrenia (Stenghellini & Rossi, 2014). Self-disturbances may be a parsimonious and accurate explanation for the symptoms of schizophrenia, yet the structure and manifestations of these symptoms are not yet well understood.

Evidence for the importance of self-disturbances comes from several sources. Researchers have noted that self-disturbances are among the first symptoms to emerge in the schizophrenia prodrome, a period of time before the onset of schizophrenia in which individuals experience attenuated psychotic symptoms (Brent et al., 2014; Hartman et al., 1984; Hauser et al., 2011; Parnas, 2000; Sass, 2014). As well, some have found self-disturbances to be predictive of conversion to psychosis in individuals at high risk for developing schizophrenia (Nelson, Thompson, & Yung, 2012). Due to the early

emergence of self-disturbances, a better understanding of these symptoms could improve the prediction of frank psychosis and aid in intervention strategies.

Although self-disturbances have been identified as an important feature of many recent conceptualizations of schizophrenia, very few studies have explored the relation between different manifestations of self-disturbance. Self-disturbances in schizophrenia have been documented in at least three domains or levels of experience, including: Domain 1) somatosensation and body perception, which includes sense of touch, proprioception, and general perceptions of one's own body; Domain 2) phenomenological self-experiences, which are first-person experiences of body ownership and integrity; and Domain 3) dialogical self, which is the ability to converge the many aspects of self-concept into a coherent identity. As few studies have simultaneously assessed these individual domains within a single sample, it is unclear if these are separate or related processes.

These three domains of self-disturbances likely have one of three general structures. Self-disturbance domains could hold a hierarchical structure (Figure 1), in which each domain is part of the umbrella category of self-disturbances, but branch off into separate group of processes, each subserved by smaller component parts. Self-disturbance domains may also form a causal model (Figure 2), in which disturbances in the more basic processes of Domain 1 lead to disturbances in the intermediate level processes of Domain 2, which in turn lead to disturbances at the highest level of cognitive process, Domain 3. Finally, a third possible model for self-disturbances is simply no cohesive structure, in which processes are largely independent from each other.

Thus, the current study had three main goals. This study aimed to replicate previous research showing that people with schizophrenia have higher levels of self-disturbances in each of the three domains compared to non-psychiatric control participants. The second, and most important, goal of the current proposal was to clarify the relations among these domains of self-disturbances in people with schizophrenia. The third goal was to examine the association between self-disturbances, positive and negative symptoms of schizophrenia, social and role functioning, and cognitive functioning.

Domain 1: Somatosensation and Body Perception in Schizophrenia

The somatosensory system is the portion of the peripheral and central nervous system that processes touch and pain. Body perception is the general domain of perceiving and monitoring corporeal functions. Although disruptions of basic sensory and perceptual processes in the visual and auditory modalities have been strongly implicated in the pathogenesis of schizophrenia (Javitt, 2009), considerably less research has focused on the integrity of somatosensation and bodily perception. Existing studies indicate that people with schizophrenia are impaired on measures of pain perception (Levesque et al., 2012), perception of body position (Arnfred, 2012; Arnfred, Raballo, Morup, & Parnas, 2015), perception of internal bodily sensation (Roehricht & Priebe, 2006), and temperature sensitivity (Boettger, Grossmann, & Baer, 2013). As well, somatosensory and bodily perceptual abnormalities may be markers of early psychosis (Hauser et al., 2011; Stanghellini, Ballerini, Fusar Poli, & Cutting, 2012).

This study included measures of three subdomains of somatosensory function: haptic perception, proprioception, and perceptual action prediction. Within the first two of these subdomains, both bottom-up and top-down processes were assessed. Bottom-up processes originate in peripheral sensory receptors (Gibson, 1966). Information in bottom-up processes moves from the peripheral nervous system to the central nervous system. Top-down processes originate in the central nervous system, specifically the cerebral cortex (Gregory, 1970). In top-down perceptual processes, information derived from cognition influences sensation and perception. While most sensory, perceptual, and cognitive functions have both bottom-up and top-down components, many are predominantly reliant on one direction of information flow (Javitt, 2009).

Haptic perception: Bottom-up and top-down processes. Haptic perception is the sense of touch. As with all sensory modalities, haptic perception involves both bottom-up and top-down processes (Intraub, Morelli, & Gagnier, 2015).

Bottom-up haptic processing. The current study employed a two-point discrimination task to assess bottom-up haptic processes. Two-point discrimination is a test of tactile spatial acuity in which individuals must distinguish whether a tactile stimulus has one point or two, using no visual input. Distances between the two-point stimuli are of varying length, affording the ability to calculate a two-point discrimination threshold (the inter-point distance at which an individual is able to distinguish two points from one at more than 50% accuracy). There is only one existing study comparing two-point discrimination in individuals with schizophrenia and non-psychiatric controls. Broekma and Rosenbaum (1975) found a higher threshold in schizophrenia patients as

compared to controls, indicating impaired tactile spatial. Relatively high two-point discrimination thresholds have also been found in individuals with schizophrenia-like symptoms (Lenzenweger, 2000), as well as first-degree relatives of individuals with schizophrenia (Chang & Lenzenweger, 2001; Chang & Lenzenweger, 2005).

Top-down haptic processing. This study employed a haptic version of the classic visual Mueller-Lyer Illusion to assess function of top-down somatosensory processes in schizophrenia. In the visual Mueller-Lyer Illusion (Mueller-Lyer, 1889), individuals are presented with two simple horizontal line figures, one flanked by wings pointed outward (Figure 3a), and the other flanked with wings pointed inward (Figure 3b). The examinee is asked to judge the length of each horizontal line. While the line segments are identical in length, the examinee will typically perceive the line segment with wings pointed outward as incorrectly longer than the line segment with wings pointing inward. The process by which the visual Mueller-Lyer Illusion works is believed to be based on contextual information that would typically be allowing the perceiver to maintain size constancy in objects at varying distances (Foster, Klienholdermann, Leifheit, & Franz, 2012).

Evidence for the underlying processes of the haptic Mueller-Lyer Illusion comes in part from research with the visual Mueller-Lyer Illusion, as the two illusion modalities appear to share some top-down processes and the haptic version is less widely studied. Evidence strongly suggests that the visual Mueller Lyer Illusion relies on top-down neural processes, based on brain imaging studies indicating involvement of the right inferior and superior parietal cortex, areas implicated in top-down processing (Wiedner &

Fink, 2007). The haptic Mueller-Lyer Illusion appears to have both shared and separate processes compared to the visual version of the illusion, suggesting that the haptic version relies on top-down processes as well, though at least some of these top-down processes are likely specific to the haptic modality. Evidence for this comes from several sources. First, the haptic Mueller-Lyer Illusion creates an effect comparable to the well-established visual estimation of the horizontal line (Dewar & Carey 2006; Foster, Klienholdermann, Leifheit, & Franz., 2012; Loomis, Klatzky, & Lederman, 1991; Suzuki & Arashida, 1992). As well, methodological variations in illusion administration (e.g., stimulus administration) affect the visual and haptic version of the illusion in similar ways (Gentaz & Hatwell, 2004). These findings indicate that the visual and haptic versions of the Mueller-Lyer Illusion likely result from some shared top-down processes (Gentaz & Hatwell, 2004), with explicit egocentric reference (processing of spatial cues relative to oneself) being a suggested shared process (Miller & Al-Attar, 2002). However, the haptic version of the Mueller-Lyer Illusion does not appear to be a generalization of learned visual context cues that drive the visual version of the illusion. This is evidenced by the finding that individuals who become blind very early in life still show haptic Mueller-Lyer Illusion effects equal to sighted individuals (Heller et al., 2002), which would not be the case if the illusion were dependent on learned visual context cues. Thus, in addition to the top-down processes shared with the visual version of the task, the haptic Mueller-Lyer Illusion also appears to rely on top-down, haptic-specific processes.

Previous research has shown differences in susceptibility to the Mueller-Lyer Illusion between people with schizophrenia and non-psychiatric controls, with people with schizophrenia judging the length of the two horizontal line segments as closer in length than non-psychiatric controls (Letourneau 1974; (Pessoa, Monge-Fuentes, Simon, Suganuma, & Tavares, 2008). In the case of individuals with schizophrenia, the contextual cues of the wings do not interact with the perceived length of the horizontal line segment, presumably due to dysfunction in top-down visual processes (Pessoa, Monge-Fuentes, Simon, Suganuma, & Tavares, 2008).

The current study used a haptic version of this task in order to assess the integrity of top-down haptic processes in schizophrenia. In the haptic version of the Mueller-Lyer Illusion, the line figures in Figure 3 are presented as relief drawings, from which the participant judges the length of the horizontal lines based solely on his or her sense of touch. As mentioned, previous studies have found a similar illusion with the haptic version of the task as with the visual version (Cizewski, Wichowicz, & Zuk, 2015). This illusion has not been explored in the haptic modality in individuals with schizophrenia. If individuals with schizophrenia are impaired in the haptic Mueller-Lyer illusion, this could be indicative of improper top-down haptic processes (Pessoa, Monge-Fuentes, Simon, Suganuma, & Tavares, 2008).

Proprioception: Bottom-up and top-down processes. The proprioceptive system is responsible for ascertaining body position, motion, and balance. Proprioception has been suggested as a prominent deficit in schizophrenia by several researchers (Chapin et al., 1996; Gapenne, 2010; Rado, 1953; Rosenbaum 1971). In his Multiple Deficit

Theory of schizophrenia, Rosenbaum (1980) described proprioception as one of four major deficits in schizophrenia, along with attention, affect, and thought disorder. Abnormalities in the proprioceptive system may underlie more explicit symptoms, such as distortion in the perception of body shape (Rosenbaum, Cohen, Luby, Gottlieb, & Yelen, 1959). Although few recent studies have examined proprioceptive functioning in individuals with schizophrenia, a recent study found an association between self-disturbances and abnormalities in an electroencephalographic (EEG) index of proprioception (Arnfred, Raballo, Morup, & Parnas, 2015).

Bottom-up proprioception. This study assessed bottom-up proprioceptive processes using a weight discrimination task. Previous research has found increased errors in weight discrimination in people with schizophrenia compared to non-psychiatric controls (Tanno, Shiihara, & Machiyama, 1999), and deficits in weight discrimination have been linked to body image disturbances in people with schizophrenia (Erwin & Rosenbaum, 1979; Rosenbaum, Flenning, & Rosen, 1965). More recent work has found a less sensitive weight discrimination threshold in relatives of people with schizophrenia, which may indicate a link between bottom-up proprioceptive dysfunction and genetic liability for schizophrenia (Chang & Lenzenweger, 2005). Chang and Lenzenweger (2005) also found a significant association between poor weight discrimination performance and increased negative symptoms and cognitive-perceptual dysfunction in people with schizophrenia-like symptoms in the general population. Taken together, these findings provide preliminary evidence that bottom-up proprioception, as measured with weight discrimination tasks, may be disrupted in schizophrenia spectrum disorders.

Top-down proprioception. This study measured top-down integrity of the proprioceptive system with an illusion called the "Pinocchio Illusion", in which vibration induced to the bicep while a person is touching his or her nose will often lead to the perception of a lengthening nose. The Pinocchio Illusion is actually comprised of two related illusory experiences. First, the application of vibration to the bicep of a blindfolded individual's bent arm has been shown to create the sensation that the arm is extending, or unbending (Jones, 1988). Second, if an individual touches his or her nose during this illusory arm extension, the individual may experience the additional illusion that the nose is growing in length as the arm extends (Lackner, 1988). In this illusion, the proprioceptive system is tricked into misattributing the stimulation of the bicep to an arm extension, and in turn arm extension to a lengthening of the nose.

Increased susceptibility to corporeal illusions such as the Pinocchio Illusion may be an indication of impaired sensory integration, a top-down sensory process (Tsarkiris & Haggard, 2005). Several studies have found increased susceptibility to the Pinocchio Illusion in schizophrenia (Graham et al., 2014; Thakkar, Nichols, McIntosh, & Park, 2011), individuals at risk for the development of schizophrenia (Asai et al., 2011), and individuals with subclinical hallucinatory experiences (Burrack et al., 2005).

Action perception: The Efference Copy Model and intentional binding.

The Efference Copy Model of perceptual action prediction. This study measured prediction of the sensory consequences of action in the schizophrenia participants. Perceptual action prediction occurs when one prepares to make an intentional action and the brain simultaneously predicts what the sensory consequences might be to this action

(Feinberg, 1978). The brain does this by creating a neural copy of the motor plan, called an efference copy, and sending it to the primary sensory cortices, the main areas of the brain responsible for processing sensory feedback (Haggard, Clark, & Kalogeras, 2002). When the brain is functioning properly, the efference copy allows the sensory cortices to expect the sensory consequences of the action performed, and therefore not respond to these self-generated stimuli. For example, if an individual intentionally presses a piano key, an efference copy of this motor plan is sent to the sensory cortices. The sensory cortices are then primed to expect the sensory consequences that typically result when one presses a piano key (i.e. a tone). Expecting this tone, the auditory cortex fires fewer neurons in response, indicating to other parts of the brain that the tone is not an unexpected or particularly salient stimulus. This model of action prediction is known as the Efference Copy Model (Figure 4), and is an integral part of the subjective sense of having caused an action (Frank, Posada, Pichon, & Haggard, 2005). If the efference copy of an intentional action is not properly sent to the somatosensory cortex, the sensory consequences come as a surprise to the brain, and may not be labeled as having resulted from the intentional action (Frank, Posada, Pichon, & Haggard, 2005). In addition, attribution of agency to an action appears to be at least partially reliant on this attenuation of the somatosensory cortex, and a lack of attenuation could cause an action to be judged as caused either unintentionally or by an outside source (Bulot, Thomas, & Delevoye-Turrell, 2007).

Due to the importance of the Efference Copy Model in determining whether an action is self- or other-generated, several researchers have proposed disruption of the

Efference Copy Model as a central deficit in schizophrenia (Feinberg, 1978; Ford & Mathalon, 2005; Frith, Blakemore, & Wolpert, 2000a). In the Disrupted Efference Copy Model of schizophrenia, the efference copy of an intentional motor plan is not consistently sent to the somatosensory cortex (Ford & Matholon, 2012). As a result, the brain sometimes does not expect the sensory consequences of an intentional action, and that action may be attributed to sources outside of the acting individual (Ford & Mathalon, 2005).

Measurement of the Efference Copy Model using an Intentional Binding Task.

Measurement of the Efference Copy Model can be challenging due to the pre-attentive nature of perceptual action prediction. Many researchers have used the phenomenon of intentional binding as a proxy for measuring integrity of the Efference Copy Model, as this phenomenon is believed to be heavily reliant on proper functioning of the efference copy (Fourneret, Franck, Slachevsky, & Jeannerod, 2001). Intentional binding is a perceptual heuristic in which two events that are causally related and self-caused are perceived as being closer together in time, as compared to two events that are causally related but not self-caused (Cravo et al., 2009). For example, when one is asked to judge the time period between the pressing of a button and a resultant tone, this person will typically judge the time between the button press and the tone as shorter if he or she is pressing the button, as opposed to another person pressing the button (see Figure 5). The phenomenon of intentional binding is believed to be a shortcut for the brain to assist in determining whether an action is self-caused or other-caused (Cravo et al., 2009). For

this reason, intentional binding is likely one of the main processes underlying our experience of intention (Engbert, Wohlschläger, & Haggard, 2008; Wegner, 2003).

Several studies have shown that intentional binding may be impaired in individuals with schizophrenia (Franck, Posada, Pichon, & Haggard, 2005; Frith, Blakemore, & Wolpert, 2000b; Maeda et al., 2012; Martin, Giersch, Huron & van Wassenhove, 2013; Renes et al., 2012; Voss et al., 2010) and in individuals at risk for developing schizophrenia (Hauser et al., 2011). Results have been mixed as to whether individuals with schizophrenia experience a greater or lesser effect of intentional binding as compared to non-psychiatric control subjects. It may be the case that schizophrenia is associated with a general imprecision in predictive mechanisms, rather than consistent impairment in too much or too little intentional binding (Haggard, Clark, & Kalogeras, 2002). A general lack of temporal precision in the action prediction mechanisms could cause ambiguity, which may be dealt with by over- or under-attributing events to one's own intentions.

Some researchers have suggested that impaired action prediction could explain self-disturbances in schizophrenia, such as feelings of being controlled by others and dissociative experiences (Gray 2014; Thakkar, Nichols, McIntosh, & Park, 2011; Whitford, Ford, Mathalon, Kubicki, & Shenton, 2012). Impaired action prediction could lead to self-disturbances in that the feeling of having caused an action is a component of the feeling of body ownership as well as a coherent sense of self-inhabitance (Sass, 2003) Consistent with this theory, abnormal intentional binding has been found to be correlated with positive symptoms of schizophrenia (Voss et al., 2010) and with anomalous self-

experiences such as self-demarcation, and abnormal body experience in individuals at risk for schizophrenia (Hauser et al., 2011). However, no study has directly compared a measure of intentional action prediction and other measures of self-disturbances in individuals with schizophrenia. This study will assess intentional action prediction in order to directly compare this process with other measures of self-disturbances in schizophrenia.

Domain 2: Phenomenological Self-Experience

Phenomenological self-experience is the subjective, first-person experience of oneself. It is the in-the-moment sense of owning one's own body, having control of one's own actions, and being an active participant in one's own environment. People with schizophrenia often report symptoms of anomalous self-experiences (ASEs). These include symptoms such as derealization, unusual bodily sensations, difficulty distinguishing oneself from others, disturbances in stream of consciousness, and lack of feeling of authorship over one's own thoughts (Raballo and Parnas, 2012), as well as loss of a sense of agency and ownership of experience (Nelson, Whitford, Lavoie, & Sass, 2014). ASEs have been conceptualized as a hyper-reflexivity of self-experience, in which first-person-ness that would usually be tacit becomes the focal point of attention (Parnas, Jansson, Sass, & Handest, 1998; Sass, 2003; Sass & Parnas, 2003). This hyper-awareness may lead to a number of unusual experiences such as the feeling that one is losing oneself, a loss of connection with life experiences, dampening of the emotions, and feelings of derealization (Cicero et al., 2016b)

ASEs may be unique to the schizophrenia spectrum, with higher levels of ASEs found in schizophrenia as compared with psychotic bipolar disorder (Haug et al., 2014), obsessive-compulsive disorder and non-psychotic mood disorders (Raballo & Maggini, 2005), and a general sample of first-admission patients in a psychiatric hospital (Norgaard & Parnas, 2014). ASEs may be associated with other prominent features of schizophrenia, including positive symptoms (Kim et al., 2010; Sass & Parnas, 2003), lack of insight (Bedford & David, 2014), depression (Haug et al., 2012a), suicidality (Haug et al., 2012b; Skodlar & Parnas, 2010; Skodlar, Tomori, & Parnas, 2008), and social cognition and function (Ebisch et al., 2014; Fisher, McCoy, Poole, & Vinogradov, 2008; Haug et al., 2014).

Some researchers posit that ASEs may actually underlie symptoms such as delusions and hallucinations (Haug et al., 2014; Sass, 2003; Sass and Parnas, 2003). For example, if the implicit sensation of inhabiting one's own body is not present in an individual suffering from schizophrenia, this may provide a starting point from which delusional beliefs about alien control may develop. As well, one prominent model of hallucinations posits auditory hallucinations as misattributions of inner speech (Ford & Mathalon, 2005). These misattributions may be a result of the loss of an intrinsic sense of ownership over one's own thoughts.

Domain 3: Dialogical Self

Dialogical self is the ability to form a coherent identity out of the many attributes that make up any one person. Individuals form a unitary concept of themselves by integrating their personal histories, personality characteristics, and other self-descriptions

into a singular dialogical self. The concept of dialogical self has a basis in the philosophical work of Nietzsche and Kierkegaard, in psychological theory (Campbell et al., 1996) and in empirical work (Hermans, 1996). Several researchers suggest that difficulty forming and maintaining a coherent dialogical self may be a prominent feature of schizophrenia (Lysaker & Lysaker, 2010; Meehan & Machlachlan, 2008; Stenghellini & Lysaker, 2007). Instances of disturbed dialogical self in schizophrenia include decreased memory of self-referential information (Harvey, Lee, Horan, Oschsner, & Green, 2011), difficulty attributing meaning to autobiographical memories (Berna et al., 2011a; Berna et al., 2011b), and reduced clarity of self-concept (Cicero et al., 2016a).

This study included a measures of the latter aspect of dialogical self, decreased self-concept clarity. Self-concept clarity (SCC) is the degree to which an individual holds a stable and consistent perception of his or her own attributes (Campbell et al., 1996). Several studies indicate that individuals with schizophrenia appear to have low SCC (Boulanger, Dethier, Gendre, & Blairy, 2013; Noyman-Veksler, Weinberg, Fennig, Davidson, & Shahar, 2013) .

Previous findings of association between self-experience domains

Few studies have directly assessed the relation between different domains of self-disturbances in schizophrenia. Only one published study has empirically examined the possible association between somatosensory/body perception self-disturbances and ASEs in schizophrenia. Weight discrimination deficits were associated with body perception disturbances in individuals with schizophrenia (Rosenbaum, Flenning, & Rosen, 1965). However, several authors have suggested conceptual evidence for an association between

these two domains of self-disturbances in schizophrenia. Sass, Peinkos, and Nelson (2013) posit that aberrations in bodily sensations could be explained by hyper-reflexivity, the excessive attention allocated to otherwise implicit self-experience. The authors describe how paying close attention to the sensations in a part of one's body can create the impression that the body part is no long a part of oneself. In this way, deficits in somatosensory processing may be associated with abnormal phenomenological self-experience.

Aims

The current study had three main aims. The first aim was to replicate the results of past studies indicating that individuals with schizophrenia have higher levels of self-disturbances as compared to the general population. The second aim was to explore the relations between three a priori domains of self-experience, clarifying whether a hierarchical model of self-disturbances in schizophrenia is supported by the data, and whether a casual model can be ruled out or should be further investigated. This was the main aim of the current work. The third aim was to examine the relation between self-disturbances and the positive and negative symptoms of schizophrenia, social and role functioning, and cognitive functioning. The hypotheses of this study are as follow:

H1: The schizophrenia group will be significantly impaired on all measures of self-disturbances as compared to non-psychiatric controls.

H2: Data will support the hierarchical model, but fail to rule out the causal model. To support the hierarchical model, the three domains of self-disturbances will be

positively correlated with each other. To support the causal model, Domain 2 will mediate the association between Domain 1 and Domain 3.

H3: High levels of self-disturbances will be associated with higher levels of positive and negative symptoms of schizophrenia, lower levels of social and role functioning, and lower cognitive functioning.

Methods

Participants

Participants included 48 individuals with schizophrenia or schizoaffective affective disorder and 36 non-psychiatric controls. The schizophrenia group was recruited via fliers and brief presentations in outpatient mental health facilities. Recruitment facilities included: Diamond Head Health Center, West Honolulu Health Center, Windward Community Health Center, Safe Haven Homeless Shelter, and Helping Hands Hawai‘i Case Management Services. The control group was recruited via the Craigslist online job posting forum, and by posting flyers in community areas, including the Honolulu Public Library system and the University of Hawai‘i Mānoa Campus. The flyers instructed participants to call the Hawai‘i Early Assessment Lab in the Psychology Department on the University of Hawai‘i at Mānoa campus to complete a five-minute phone screen to confirm their eligibility. One schizophrenia group participant dropped out of the study soon after signing the consent form, while another was disqualified for failure to meet criteria for schizophrenia. Two control participants were excluded from the study due to presence of sub-clinical levels of psychotic symptoms.

Inclusion criteria for the schizophrenia participants were as follows: current diagnosis of schizophrenia or schizoaffective disorder, IQ greater than 70 as assessed by the Wechsler Abbreviated Scale of Intelligence-II (WASI-II), no history of serious head injury or neurological disorder, and 18-65 years of age. Inclusion criteria for the control participants were: no current or past mental illness (with the exception of past substance abuse), no prominent psychotic symptoms, no current use of psychiatric medication, no first degree relatives with a diagnosis of a psychotic illness or bipolar disorder, IQ greater than 70, no serious head injury or neurological disorder, and 18-65 years of age. Schizophrenia and control participants were matched on age, gender, and parental education. The participants were matched on parental education rather than participant education, as parental education is more indicative of the participants' socioeconomic status throughout their lives (Byrne, 2004). As well, matching on participant education can create either a schizophrenia group with higher education attainment than an average individual with schizophrenia, or a control group with lower education attainment than the average (Miller & Chapman, 2001)

IRB approval was attained for this study. This study was performed in conjunction with two other schizophrenia studies, and thus falls under the IRB study title: "Minor Physical Anomalies, Social Cognition, and Symptoms of Schizophrenia (see Appendix A)." See Appendix B for copies of study materials.

Materials

Diagnostic and Symptom Ratings.

Structured Clinical Interview for the DSM-IV (SCID-I). The Structured Clinical Interview for DSM-IV (SCID; First, Spitzer, Gibbon, & Williams, 1998) is a structured interview designed for diagnosis of major mental illness. The SCID confirmed the diagnosis of the schizophrenia spectrum participants, and ruled out previous mental illness in the control group. Due to time constraints, only the screener, mood, psychosis, and substance use modules were used with all participants. If participants endorsed symptoms from another mental illness category on the screener, additional modules were completed as appropriate. In previous research, the SCID-I has been found to have inter-rater reliability kappa values between 0.61 and 0.83, and validity kappa values between 0.76 - 0.78 for comparisons between SCID diagnosis and diagnosis made with other standard interview methods (Lobbestael, Leurgans, & Arntz, 2011). The current study used the DSM-IV version of the SCID because the DSM-5 version had not yet been released. The diagnostic criteria for schizophrenia and schizoaffective disorder are nearly identical in the DSM-IV and 5, and the few differences that exist can be ascertained from queries on the DSM-IV version.

Positive and Negative Symptom Scale (PANSS). The Positive and Negative Symptom Scale (PANSS; Kay, Fiszbein, & Opler, 1987) is a 30-item 7-point Likert-type scale used to rate schizophrenia symptoms. The PANSS assesses common symptoms of schizophrenia within three symptom cluster scales, including Positive Symptoms, Negative Symptoms, and General Psychopathology. One of the three graduate student experimenters determined PANSS scores for each schizophrenia participant, using the Structured Clinical Interview for the PANSS (SCI-PANSS).

Internal consistencies of the Positive and Negative Symptom scales have been reported at coefficient alphas of 0.73 and 0.83, respectively, while coefficient alpha for the General Psychopathology scale was 0.79 (Kay, Fizbein, & Opler, 1987). The PANSS has adequate construct validity and external validity (Kay, Fizbein, & Opler, 1987). In the current study, interclass correlation coefficient was .776 between raters.

Somatosensory and body perception measures.

Bottom-up haptic processing: 2-point discrimination task. Participants were seated comfortably in a chair, with their dominant hand palm-up on a table (Figure 6). The experimenter explained that they would feel a series of 1 or 2 points on the palm of their hand, and they should verbally report after each stimulus presentation whether there was 1 point or 2. With eyes still open, the participant was provided an example of the largest 2-point stimulus interval (10mm), as well as the 1-point stimulus.

Stimuli were administered using a standard caliper tool. Each participant underwent 50 stimulus trials of a random protocol including 25 1-point, 13 6mm, and 12 10 mm caliper intervals. Stimulus intervals were chosen in accordance with Chang and Lenzenweger (2001). The 10mm interval is considered relatively easy for the average individual, and was included in order to keep participants from becoming frustrated during the task. For each participant, the percentage of time he or she correctly identified the target stimulus of 6mm was calculated. Higher percentage of correctly identified 6mm stimuli was conceptualized as better performance on two-point discrimination.

Two-point discrimination is mediated by both the peripheral and central nervous systems (Bassetti, Bogousslavsky, & Regli, 1993); however, due to the strong input of

the peripheral nervous system on two-point discrimination performance, this task is considered primarily a measure of bottom-up sensory processes (van Nes et al., 2008). Previous studies on healthy control subjects have found two-point discrimination tasks to be a reliable method, with performance remaining consistent between repeated testing sessions (Tamura, Hoshiyama, Inui, & Kakigi, 2003). Responses can be influenced by preceding discrimination intervals, necessitating random order of stimulus presentation (Tamura, Hoshiyama, Inui, & Kakigi, 2003).

Top-down haptic processing: Haptic Mueller-Lyer Illusion. A haptic version of the Mueller-Lyer Illusion was employed to measure top-down haptic perception. In this task, the participant judged the length of horizontal line segments in a series of wire line drawings using only their sense of touch. These line drawings had either a single line segment (Figure 7.A1 and 7.A2) or double line segments (Figure 7.B).

For each line segment, participants were allowed to swipe the index finger of the dominant hand over the entire drawing while closing their eyes (Figure 8). They were then asked to replicate the length of the horizontal line using a slide ruler, based on the methods of Heller et al. (2002). In the case of double line segments (Figure 7.B) the participant estimated each line segment separately.

Each participant estimated 16 separate line segments, including eight single line segments and four sets of double line segments. The line segments were each one of three lengths: 1.50 in., 1.63 in., or 1.75 in. The order of line segments was counterbalanced between participants such that half of the participants started with the single line segments and half started with the double line segments. Participant scores were

calculated by subtracting the actual length of each horizontal line from the length estimation of that line. Susceptibility to the Mueller-Lyer Illusion was defined as greater mean absolute difference between the perceived and actual length of the line segment.

Evidence for the construct validity of the haptic Mueller-Lyer Illusions comes from evidence that the visual Mueller Lyer Illusion relies on top-down neural processes (Macefield, Gandevia, & Burke, 1990), which is reviewed in the introductory section of this paper.

Bottom-up proprioception: Weight discrimination task. The weight discrimination task tested the acuity of the proprioceptive system. In this task, participants were asked to differentiate between objects with slightly different weights. Weight stimuli were plastic egg-shaped containers filled with differing amounts of fishing weights and cotton balls. The weights of the test stimuli ranged from 40g to56g, with weight differences ranging from 2g to 16g. The experimenter briefly explained the task, and allowed the participant one practice trial with 40g and 60g weights. The two differently weighted eggs were presented one after the other in the palm of the participant's dominant hand, for one full second each (Figure 9). The participant was asked to report if the first or second egg felt heavier. If the participant did not accurately identify the heavier weight, the experimenter provided corrective feedback and allowed one additional practice trial.

The experimenter then administered 40 trials of the task. In each trial, the 40g weight was compared with a heavier weight such that the comparison values were: 40-42g, 40-44g, 40-48g, 40-52g, 40-56g. Order of the 40g weight and comparison weight

was counterbalanced and randomized to avoid response bias. The trials were presented in blocks of 10, with an opportunity for the participant to rest between each block. Percent of correct responses was calculated for each participant, with higher percentage of correct responses indicating better bottom-up proprioceptive functioning.

The weight discrimination task in this study is consistent with established psychophysical methodology (Ritzler, 1977). Evidence of construct validity for weight discrimination as a measure of bottom-up proprioceptive functioning comes from several sources. Heroux and Tremblay (2005) found that individuals in outpatient physical therapy for knee injuries had impaired weight discrimination thresholds with their injured legs compared to their uninjured legs. As the injured ligaments are part of the bottom-up proprioceptive system, this indicates that weight discrimination indexes bottom-up proprioceptive function. As well, Anfred (2005) found that an upper-extremity weight discrimination task induced an established proprioceptive event-related potential called the proprioceptive evoked potential. To the best of my knowledge, the reliability of weight discrimination tasks has not been directly assessed.

Top-down proprioception: Pinocchio Illusion

The Pinocchio Illusion tested the degree to which the proprioceptive system is susceptible to manipulation. In the Pinocchio Illusion, vibration was applied to the participant's bicep muscle while eyes closed and his or her index finger on his or her nose.

In this task, the participant was comfortably seated at a table. The participant was told to close his or her eyes, rest the dominant side elbow on the table, and lightly touch

his or her nose with the dominant hand index finger (Figure 10). The experimenter explained that the participant would feel a vibration on their arm for two minutes and instructed the participant to notify the experimenter if and when any changes in the shape or size of any part of the body were felt during the task. The experimenter then applied an 80 Hz neck massage tool to the dominant arm bicep of the participant for two minutes, while tracking if and when the participant felt modulation of the shape or size of any body part. After the two minutes, the participant was asked to fill out a brief questionnaire regarding the presence and location of any perceived changes in the shape or size of body parts, as well as a rating on 1-10 scale of the intensity of any experienced illusion.

This task was completed after the other somatosensory tasks, based on previous findings that manipulation of the proprioceptive systems can influence tactile perception (DeVignemont, Ehrsson, & Haggard, 2005). The main variable of interest for the Pinocchio Illusion was whether the participant experienced the illusion in any part of his or her body. Within this measure, it was compared whether participants experienced the illusion in their arm, nose, or both, with each being an indication of stronger illusion, respectively. The secondary variable of interest was the strength at which the participant reported experiencing any change in the shape or size of a body part. The final variable of interest in the Pinocchio Illusion was the latency at which the participant felt an illusory change in his or her body, with shorter latencies indicating a stronger illusion effect. Greater susceptibility to the Pinocchio Illusion will be conceptualized as poorer

top-down proprioceptive functioning, as this indicates an increased susceptibility to manipulation.

Creation of an illusory arm movement via bicep stimulation has long been observed (Jones, 1988). In previous applications of this task, 30 out of 32 participants experienced the illusion that the arm was passively extending, while 8 out of 32 experienced the additional illusion of the nose growing in length (Burrack & Brugger, 2005). In the same study, susceptibility to the Pinocchio Illusion was positively correlated with high scores on the Perceptual Aberration Scale (Chapman, Chapman, & Raulin, 1978). This indicates a connection between the effects of the illusion and high levels of abnormal perceptual experiences, lending construct validity to the Pinocchio Illusion as a modification of perceptual proprioception. Reliability of the Pinocchio Illusion has not been directly assessed. However, de Vignemont, Ehrsson, and Haggard (2005) found that individuals who experienced an illusory lengthening of one body part were more likely to experience illusory lengthening of another body part, indicating a general underlying susceptibility toward changes in proprioceptive perception.

Sensory-perceptual action prediction: Intentional binding task. The intentional binding task measured sensory-perceptual action prediction processes. Intentional binding is a phenomenon present in normally functioning individuals in which the temporal interval between an action and its effect is perceived as shorter when the action is intentionally caused by the observer, as compared to when the action is observed or unintentionally caused.

In the current study, intentional binding was measured using a Libet-style clock task (Libet, Gleason, Wright, & Pearl, 1983). In this computerized task, the participant was presented with an animated clock, on which there was a rapidly rotating minute hand (Figure 11). The participant was instructed to randomly press a button on the computer, while making note of where the minute hand was located during the button press. The participant was then prompted by the computer to enter the position of the minute hand as perceived at the time of the button press. The participant completed five experimental blocks of this task. In half of the trials, a tone occurred 250 ms after the button press, with no tone occurring in the other half of the trials. Block order was randomized between participants. The trials in which there is both a button press (cause) and tone (effect) were the intentional binding (IB) trials, while the trials in which there were only a button press and no tone were the control (CON) trials.

Calculation of intentional binding scores was based on the recommended methods in Hauser et al. (2011). The difference between the perceived and actual placement of the minute hand was calculated for each trial. The trials were then grouped together into IB vs CON trials, and the average discrepancy between perceived and actual minute placement was compared to determine the degree to which each participant experienced intentional binding between the button press and the tone,

Reliability and validity of the Libet-style clock task has not been directly assessed.

Phenomenological self-experience measure

Inventory of Psychotic-Like Anomalous Self-Experience (IPASE). The Inventory of Psychotic-Like Anomalous Self-Experience (IPASE; Cicero et al., 2016b) is a 57-item self-report measure of five factors of anomalous self-experience commonly reported in individuals with schizophrenia. The factors are: Cognition ("I feel like my thoughts are being generated by someone else"), Self-Awareness and Presence ("I feel that I am not really present in this world"), Consciousness ("I have the experience of being unsure if I have said something out loud or just thought it") Somatization ("I sometimes feel like my legs, arms, or other body parts are not really mine"), and Demarcation/Transitivism ("I wonder whether or not I truly exist").

The IPASE was developed using the conceptual framework of the Examination of Anomalous Self Experience (EASE; Parnas et al., 2005), a semi-structured interview schedule for self-disturbances in schizophrenia. The IPASE has high internal consistency, with a Cronbach's alpha of .98 in a schizophrenia sample and .96 in a non-psychiatric control sample (Cicero et al. 2016b). There is reasonable evidence within ASE's nomological network for construct validity, especially convergent validity in individuals with schizophrenia, individuals with high schizotypy, and non-psychiatric controls. Evidence for discriminant validity was not as clear in initial IPASE research (Cicero et al. 2016b).

Dialogical self measures

Explicit self-concept clarity: Self-Concept Clarity Scale (SCCS). The Self-Concept Clarity Scale (SCCS; Campbell et al., 1996) was used to measure explicit self-concept clarity. The SCCS is a 12-item self-report questionnaire designed to measure the

degree to which one holds a stable and internally-consistent conception of himself or herself. Possible response options range on 5-point Likert scale from 1 = "strongly disagree" to 5 = "strongly agree". Examples of items include, "In general, I have a clear sense of who I am and what I am", and "My beliefs about myself seem to change very frequently". The latter item, along with nine other items on the scale, is reverse-scored.

Evidence for construct validity of the SCCS is derived from expected associations with other constructs in its nomological network. The SCCS shows convergent validity based on correlations between low levels of self-concept clarity and low levels of internal state awareness (Campbell et al., 1996). Evidence for divergent validity comes from correlations between high levels of personality constructs that are theoretically opposite and low levels of self-concept clarity, including neuroticism, self-reflection, and public self-consciousness. The average alpha reliability coefficient of items on the SCCS is 0.86, indicating to high internal consistency of the scale. The test-retest reliability of the SCCS is 0.79 and 0.70 for 4 and 5 month intervals, respectively (Campbell et al., 1996).

Implicit self-concept clarity: Me Not-Me Decision Task (MNMDT)

The Me Not-Me Decision Task (MNMDT) was used to measure implicit self-concept clarity. In the MNMDT, participants decide whether 60 adjectives do or do not describe them. The participant was seated in front of a computer while adjectives were presented in the middle of the screen. The participant was directed to press either the "1" key to indicate "me", or the "0" button to indicate "not me" for each adjective (Figure 12). The participant was instructed to respond as quickly and accurately as possible. After initial instructions, the MNMDT was self-administered by the participant.

Embedded in the 60 adjectives of the target condition were 30 pairs of antonyms (e.g., shy/outgoing). In this task, implicit self-concept clarity was conceptualized as the number of consistent responses to these adjective pairs (e.g., responding "me" to shy and "not me" to outgoing). Percentage of consistent responses was calculated for each participant.

Evidence for the validity of the MNMDT come from convergence with other instances of disturbed dialogical self in schizophrenia including decreased memory of self-referential information (Harvey, Lee, Horan, Oschsner, & Green, 2011), difficulty attributing meaning to autobiographical memories (Berna et al., 2011a; Berna et al., 2011b), and reduced clarity of self-concept (Cicero et al., 2016a). One study reports Cronbach's alpha of the MNMDT at r = -.77 (Cicero et al., 2016a)

Additional Measures

Global Functioning: Role (GF: Role) and Global Functioning: Social (GF: Social). The Global Functioning: Role (GF: Role) and Global Functioning: Social (GF: Social) scales were used to measure role and social functioning. These scales were developed to measure role and social functioning in psychosis. Based on a semi-structured interview and scoring anchor points, the experimenter designated a current functioning score on a scale of 1-10, with 1 being the lowest level of functioning. The GF: Role and GF: Social was administered by trained clinical psychology graduate students.

Evidence for the reliability and validity of the GF: Role and GF: Social comes from studies in psychosis populations. The GF: Role and GF: Social both show high

inter-rater reliability, with intraclass correlation coefficients ranging from 0.93-0.95 and 0.85-0.94, respectively (Cornblatt et al., 2007). Preliminary estimates indicate good construct validity, with the GF: Role scale showing positive correlation with the Straus-Carpenter Outcome Scale (SCOS; Strauss & Carpenter, 1972) Work/School Functioning subscale, and the GF: Social showing positive correlation with the SCOS Social Contacts subscale (Cornblatt et al., 2007).

Mini-Mental Status Exam - 2 (MMSE-2). The Mini-Mental Status Exam - 2 (MMSE-2; Folstein, Folstein, & Hughes, 1975) is a 30-item screening tool for general mental status. It includes screening of the cognitive sub-domains of orientation, registration, attention and calculation, recall, and language. The MMSE-II has high inter-rater reliability, with an intraclass correlation of 0.98 in an elderly sample (Bassuk & Murphy, 2003). Internal consistency estimates of Cronbach's alpha are between 0.36 and 0.57 in non-dementia samples and 0.66 to 0.79 in dementia patients (Mitchell, 2009).

Wechsler Abbreviated Scale of Intelligence - II (WASI-II). The Wechsler Abbreviated Scale of Intelligence - II (WASI-II) was used to assess cognitive functioning and intelligence quotient. The WASI-II is a brief measure of estimated full-scale intelligence quotient (FSIQ). The estimated FSIQ is comprised of four subscales: Block Design, Vocabulary, Matrix Reasoning, and Similarities. The Vocabulary and Similarities subscales combine to form a Verbal Comprehension Index Score, while the Block Design and Matrix Reasoning subscales combine to form a Perceptual Reasoning Index Score.

The four-scale WASI-II has a test-retest reliability of r = 0.92 and a reliability coefficient of 0.92-0.98 (Irby & Floyd, 2013). Convergent validity of the WASI-II, measured by comparing the WASI-II FSIQ to the Wechsler Adult Intelligence Scale - III, is r = 0.92 (Irby & Floyd, 2013)

Demographic Questionnaire. The Demographic Questionnaire provided basic information about the participant, including age, gender, ethnicity, years of education, and years of parental education. This questionnaire was created for the current study and its psychometric properties have not been evaluated.

Medication List. The experimenter filled out a list of the current medications for each participant, based on report of the participant. The list contained the generic and brand names of common psychotropic medications to aid in the proper identification of medication. Names, dosages, and dose frequency of all medications were recorded. If participants were unable to remember the names of any of their medications, they were asked to bring a list of their medications to the next appointment.

Procedure

The tasks of the current study were combined with the tasks of two other schizophrenia studies, amounting to a total protocol length of 7-9 hours per participant. Participants completed the protocol in 2-3 separate sessions, taking place either at an outpatient facility or the Hawai‘i Early Assessment Lab, depending on the participant’s preference. Participants received 25 dollars in cash at the end of each session, totaling 75 dollars for full participation.

During the first three-hour assessment, each participant provided informed consent. Before reading the consent form, the benefits, potential risks, and confidentiality procedures of the study were verbally explained to each participant, in order to underscore these important features of study participation. After consent, the experimenter administered the Mini Mental Status Exam-2 (MMSE-2) to screen for mild dementia-related cognitive impairment. Based on the recommendations of Folstein, Folstein, and Hughes (1975), participants with scores of 23/30 or less were considered to have mild cognitive impairment, and were terminated from the study.

Upon successful completion of the MMSE-2, a clinical psychology graduate student administered the SCID-I, PANSS, WASI-II, GF: Role, and GF: Social. After these tasks were complete, the remaining tasks of both the current study and studies included in the larger schizophrenia study protocol were completed in an order deemed most tolerable for each individual participant. Computer tasks and questionnaires were interleaved between more interactive tasks in order to promote alertness and motivation. Participants were permitted as many breaks as necessary to avoid fatigue.

All diagnostic and symptoms ratings were administered by trained clinical psychology graduate students with a background in schizophrenia research. All experimental tasks, including cognitive tests, somatosensory and perceptual tests, computer tasks, and questionnaires, were administered by both clinical psychology graduate students and trained undergraduate research assistants. All experimenters were trained on each task. Experimenters first observed the task being completed, then

practiced with other trainee experimenters, followed by administration with supervision, and finally independent administration.

Participants completed the questionnaires using MediaLab version 2012 on a Dell laptop computer. The questionnaires were self-administered, but participants were given assistance in reading and understanding the questions on an as-needed basis. Participants completed the intentional binding task and Me Not-Me Decision Task using Direct RT version 2012 on the same laptop computer.

Results

Missing data

Many participants had significant amounts of missing data due to several factors, including: 1) some participants did not return for a second or third appointment, and the self tasks were at the end of the protocol, 2) some participants declined to take part in some of the self tasks, and 3) some of the self tasks were introduced later in the data collection process, thus creating missing data for earlier participants.

To test for randomness of missing data, the Little's Missing Completely at Random (LMCR) test was performed on all experimental variables, including Mueller-Lyer Illusion, two-point discrimination, weight discrimination, intentional binding, PANSS Positive, PANSS Negative, GF: Social, GF: Role, WASI-II Full Scale, WASI-PRI, and WASI-VCI. The LMCR test resulted in a chi-square = 624.334, ($df = 627$; $p = 0.523$) indicating that data were missing completely at random (MCAR). The range of missing data for all participants ranged from 0.0% in GF: Role and WASI-II VCI to 64.1% in weight discrimination ($M = 32.34\%$; $SD = 15.102$).

Removal of 20% or more of the experimental variables and employing multiple imputation (MI) was considered to address the missing data. This would have eliminated 60% of the control sample, leaving 14 remaining control participants, and 35% of the schizophrenia participants, leaving 35 remaining for further analysis. Due to the large number of participants who would be excluded using this technique, it was decided not to exclude participants with missing data, and thus not employ MI. Data were excluded pairwise.

The Pinocchio Illusion was excluded from analysis due to a failure of the task to induce the illusion in any participants. Likely reasons for this failure are detailed in the discussion section below.

Between-groups comparison of self-disturbances

Self-disturbances in the schizophrenia and control groups were compared using independent samples t-tests, with an alpha level of .05 (two-tailed; Table 2). The schizophrenia group performed significantly worse on two-point discrimination. Group differences were not significant for any other self-disturbances in Domain 1, including the Mueller-Lyer Illusion, weight discrimination, and intentional binding. In Domain 2, schizophrenia participants endorsed a significantly higher number of items on the IPASE. In Domain 3, schizophrenia participants showed significantly lower self-concept clarity on both the SCCS and MNMDT.

Associations among three domains of self-disturbances

Zero-order Pearson correlations between self-disturbance measures in the control and schizophrenia groups were calculated separately. The Mueller-Lyer Illusion was

significantly correlated with the SCCS and MNMDT only in the control group. Two-point discrimination was significantly correlated with Weight Discrimination only in the schizophrenia group. The IPASE was significantly correlated with the SCCS in both the control and schizophrenia groups, and correlated with the MNMDT only in the schizophrenia group. The SCCS and MNMDT were correlated in both the control and schizophrenia groups.

Given the lack of consistent associations among all three domains, it was not possible to test a mediation model of self-disturbances.

Associations among self-disturbances and other schizophrenia symptoms, social and role functioning, and cognition, in the schizophrenia group

Zero-order Pearson correlations were performed in the schizophrenia group between all individual self-disturbance tasks, PANSS positive and negative symptom subscales, GF: Social and GF: Role, full scale WASI-II score, and WASI-II Perceptual Reasoning and Verbal Reasoning Index scores. The PANSS positive symptom subscale was significantly correlated with both the IPASE and MNMDT. The PANSS negative symptom subscale was significantly correlated with Weight Discrimination. The GF-Role was correlated with Two-Point Discrimination and MNMDT. Finally, the WASI-II Verbal Comprehension Index was correlated with the MNMDT.

Discussion

Despite recent renewed interest in self-disturbances in schizophrenia, little is understood about how the symptoms in this cluster relate to each other and the rest of the schizophrenia syndrome. The aims of the current study were to replicate past findings of

self-disturbances in schizophrenia, clarify the relations between domains of self-disturbances, and test their association with other deficits in schizophrenia.

The results of the study indicated that only Domain 2, phenomenological self-experience, and Domain 3, self-concept clarity, were consistently related. These two domains were both associated with the positive symptoms of schizophrenia as well. Within Domain 1, somatosensensation and action perception, two sub-domains, bottom-up tactile acuity and bottom-up proprioception, were associated with each other, suggesting that these two functions may have shared processes.

Aim 1: Between groups comparisons of self disturbances

For Aim 1, the hypothesis predicted significant group differences on all measures of self-disturbances. The results indicated that the schizophrenia participants were impaired on some tasks, but not all. Within the somatosensory tasks of Domain 1, somatosensation and body perception, both of the bottom-up somatosensory tasks were significantly or close to significantly impaired in schizophrenia. While no existing literature has examined bottom-up tactile acuity, as measured by the Two-Point Discrimination (TPD) task in schizophrenia, previous research has indicated that individuals with genetic risk for schizophrenia (i.e. first-degree family members of individuals with schizophrenia), as well as those with sub-threshold psychotic symptoms (i.e. schizotypy), are impaired on this task (Chang and Lenzenweger, 2001; Chang & Lenzenweger, 2005; Lenzenweger, 2000).

Several non-significant findings within this aim warrant exploration. Within Domain 1, the Mueller-Lyer Illusion and intentional binding were not impaired in

individuals with schizophrenia as compared to controls. The lack of impairment in weight discrimination may have been due to a smaller sample size in this task as compared to two-point discrimination, as there was a trend towards significance. While no existing literature has reported testing weight discrimination in schizophrenia participants, it has been found to be impaired in individuals with genetic risk for schizophrenia (Chang & Lenzenweger, 2005) and those with sub-threshold psychotic symptoms (Ritzler, 1977), and would be expected to be impaired in schizophrenia. Some studies have reported schizophrenia impairments in tasks which involved input from top-down haptic processes (Ferri et al., 2012; Thakkar, Nichols, McIntosh, & Park, 2011), but these tasks were never tested concurrently with tasks largely dependent on bottom-up haptic processes. This allows for the possibility that previous findings suggesting top-down haptic processes are impaired in schizophrenia may be better accounted for by impairments in the bottom-up processes embedded in the tasks employed.

The finding that intentional binding was not impaired in schizophrenia is inconsistent with most previous research (Franck, Posada, Pichon, & Haggard, 2005; Frith, Blakemore, & Wolpert., 2000b; Maeda et al., 2012; Martin, Giersch, Huron, & van Wassenhove, 2013; Renes, Vermeulen, Kahn, Aarts, & van Haren, 2013; Voss et al., 2010). The apparent lack of intentional binding impairment in our schizophrenia sample could have been from either a true equivalence of performance with controls, or possible methodological issues with both the computer task and task adherence. Intentional binding tasks are methodologically delicate and necessitate a large number of repetitive trials, requiring a substantial amount of effort and motivation on the part of the

participant. As intentional binding takes place in the range of 50-200 milliseconds (Blakemore, Wolpert, & Frith, 2001), lapses in attention on the part of the participant can result in a failure to elicit the phenomenon. Due to the position of the task as late in a long protocol, many participants may not have been exerting adequate attention and effort during the challenging task.

Aim 2: Associations among self-disturbances in schizophrenia and control groups

For Aim 2, the hypothesis predicted correlations between self-disturbance measures such that the hierarchical model of self-disturbances would be supported. The results of this study indicated that the hierarchical model is not entirely appropriate for all domains of self-disturbances. However, one of the most interesting findings of this study is the association between high levels of phenomenological self-disturbances (Domain 2) and low levels of dialogical self (Domain 3) in both the schizophrenia and control groups. This may reflect some shared processes in phenomenological self-disturbances and the theoretically higher-level construct of self-concept clarity. Phenomenological self-disturbances and dialogical self could be processed at the same level in parallel fashion, in which a shared process at this level is disturbed in both constructs. Alternatively, dialogical self might be dependent on the proper processing of phenomenological self, such as in a serial processing pattern, in which case disruptions of the proper processing of phenomenological self cause lower self-concept clarity. Clarifying these possibilities is beyond the scope of the current dataset, but will be important issues to address in future studies.

The schizophrenia and control samples also both showed correlations between the explicit and implicit measures of self-concept clarity within Domain 3, dialogical self. These findings support the construct validity of the two self-concept clarity measures, and suggest that self-concept clarity can be measured both implicitly and explicitly. This replicates the findings of Cicero et al. (2016a), further supporting the concurrent validity of these measures in schizophrenia and control samples.

The schizophrenia and control group self disturbance correlation results diverged in several ways. In the schizophrenia group, the data revealed two additional correlations which were supportive of the hypothesized associations between self-disturbance domains. Performance on two measures of somatosensation in Domain 1, two-point discrimination and weight discrimination, were associated such that poor performance on one correlated with poor performance on the other. These results are supported by previous research indicating that bottom-up tactile acuity and proprioception share common underlying mechanisms (Dijkerman & de Haan, 2007). Non-significant correlations between these measures in the control group may have been due to particularly small sample sizes on these particular tasks.

Interestingly, both measures of self-concept clarity were associated with the haptic Mueller-Lyer Illusion in the control group, such that higher self-concept clarity was associated with lower illusion susceptibility. This is the opposite direction of association that would be expected, as low susceptibility to haptic Mueller-Lyer Illusion is considered an impairment of the adaptive heuristics being exploited by the illusion. It is possible that individuals with high self-concept clarity have stronger top-down

perceptual processes, and therefore a more accurate interpretation of sensory inputs. High self-concept clarity has been associated with high awareness of internal states (Campbell et al., 1996), which is consistent with better fidelity of perception. As the Mueller-Lyer Illusion is a "trick" to the perceptual system, people with high self-concept clarity could be less susceptible to this inaccuracy of perception. Current research on the Mueller-Lyer illusion and self-concept is lacking, therefore more targeted work of the relation between these variables is needed before a clear interpretation can be made.

Aim 3: Associations among self-disturbances, positive and negative symptoms, social and role functioning, and cognition in schizophrenia

For Aim 3, the hypothesis predicted positive associations between self-disturbances, positive and negative schizophrenia symptoms, poor social and role functioning, and cognitive impairment. The results indicated some positive associations among self disturbances, positive and negative symptoms, social and role functioning, and cognition, but not to the expected extent. The correlation patterns of the self tasks with positive and negative symptoms of schizophrenia, social and role functioning, and cognition further suggest Domains 2 and 3 may share processes, while Domain 1 may represent a separate set of processes. Dysfunction in Domains 2 and 3 were both associated with higher levels of positive symptoms in schizophrenia. This finding is comparable to past research linking increased positive symptoms to phenomenological self-disturbances and low self-concept clarity (Cicero et al., 2016a; Noyman-Veksler et al., 2013; Weinberg et al., 2012). In contrast, poor performance on bottom-up proprioception in Domain 1 was associated with a higher level of negative symptoms.

This is consistent with recent findings by Michael and Park (2016) in which a dysfunctional proprioceptive performance was associated with negative symptoms in a schizophrenia sample. Notably, however, Michael and Park (2016) also found their TPD task was associated with negative symptoms, a finding not replicated in the current study.

Limitations and future directions

Several aspects of this study limited the scope of the results. First, several of the self tasks suffered from low sample sizes, particularly in the control group. The self tasks were often last in the protocol, and thus were sometimes were not completed due to time constraints, participant attrition, and participant fatigue. In future work, it may be best to complete the rather strenuous and repetitive self tasks toward the beginning of the research protocol.

The Pinocchio Illusion Task had significant methodological issues. The protocol for the Pinocchio Illusion failed to produce illusory extension of the nose in any participants, though some participants did report unusual feelings in their arm. Two major issues with the task were in the vibration frequency and placement of the vibration tool. Frequency of the tool vibration must approximate the oscillatory activity of muscle spindles at 80 Hz in order to create the illusion of arm extension (Lackner, 1988). The vibration tool was extracted from an inexpensive neck massager, and estimated the Hz value based on information from the instruction manual. Ideally, this task would be performed with an electronic muscle stimulator such as those used in physical therapy. A version of the rubber hand illusion may be a more sensitive and reliable measure of top-down proprioception (Botvinick & Cohen, 1998).

The majority of the schizophrenia sample was taking antipsychotic medication at the time of testing. Antipsychotic medication can have a range of unintended effects on both the central and peripheral nervous systems, including decreased sensitivity to pain, muscle weakness, and peripheral neuropathy (McEnvoy et al., 2006), that could have affected the somatosensory tasks in this study. As well, antipsychotic medications can normalize perceptual processes (Keleman, Kiss, Benedeck, & Keri, 2013). Both the positive and negative effects of medication may endure even after an individual discontinues use (Sohler et al., 2016). These factors combine to confound our ability to determine the effects of antipsychotic medication on somatosensory task performance.

Additional potential medical confounds to the somatosensory tasks include extensive history of alcohol abuse and neuropathy. Individuals with schizophrenia have an increased incidence of alcoholism as compared to the general population (Rasanen et al., 1998), and increased risk for diabetes (Kohen, 2004). Neuropathy can be a consequence of both alcoholism and extended diabetes. Several individuals in the schizophrenia sample had extensive alcohol abuse in their past, and several suffered from diabetes. These two factors were not systematically assessed, and therefore could not account for the possibility that group difference in tactile acuity and weight discrimination may not have been due to schizophrenia, but rather to these related factors.

To address the issue of medication confounds, researchers sometimes test groups of people with high schizotypy, or high levels of psychotic-like symptoms that do not reach the threshold of schizophrenia, and thus do not require medication. Schizotypy samples are gathered from the general population, and therefore are also less likely to be

affected by alcoholism and diabetic neuropathy. The authors of this paper are engaged in an ongoing study of individuals with high schizotypy, which employs many of the same self-disturbance measures as the current schizophrenia study. If the high schizotypy group shows somatosensory deficits comparable to the current schizophrenia sample, this will strengthen the conclusion that somatosensory deficits are part of the pathogenesis of schizophrenia. This works includes additional measures that theoretically measure self-processing. The study in progress measures interoception, the ability to detect internal sensations such as organ functioning, using a heartbeat counting paradigm. In addition, the study measures the ability of our participants to distinguish between a recording of their own voice and that of another person. By examining additional putative measure of self-disturbances, this research may elucidate the associations between constructs within this multifarious symptom cluster.

The current study examined associations between putative measures of self-disturbances, but lacked comparison with established measures of self-disturbances. The Examination of Anomalous Self-Experience (EASE; Parnas et al., 2005) is the gold standard of measuring self-disturbance in schizophrenia, but can be time-intensive and requires extensive training. The IPASE was developed with the intention to facilitate easier measurement of self-disturbances. It is not yet clear if the IPASE measures the same construct as the EASE. Therefore, the authors of the current works are engaged in research to compare these two instruments in a schizophrenia sample.

Future studies may also address the real world implications of self-disturbances. Self-disturbances have been linked to poorer functioning in individuals with

schizophrenia (Weinburg et al, 2012), but the reasons for this are not yet clear. One potential link between decline in function and self-disturbances may be social cognition and behaviors. Michael and Park (2016) found that increased susceptibility to the Pinocchio Illusion and poorer performance on two-point within a sample of individuals with schizophrenia was associated with increased levels of perceived social isolation. The authors put their results in the framework of Hoffman's Social Deafferentation Hypothesis of schizophrenia (Hoffman, 2007), which suggests that the brain of an individual isolated from social inputs may create compensatory activity in the form of hallucination. Michael and Park (2016) point out the connection between social cognition and bodily representations in the temporal parietal junction of the brain, and posit that this brain area may create compensatory activity when socially isolated, creating anomalous bodily experiences. Nelson et al., (2009) also proposed a model of social cognition that was explained by underlying self-disturbances. Other researchers have reported preliminary evidence of links between social functioning or social cognition and self-disturbances. Haug et al. (2014) found phenomenological self-disturbances to be predictive of poor social functioning in the early stages of schizophrenia. Irani, Seligman, Kamath, Kohler, and Gur (2012) found that theory of mind, a component of social cognition, was associated with decreased ability to recognize one's own face in individuals with schizophrenia and their first-degree relatives. Future work in self-disturbances and social cognition may employ a more comprehensive battery of social cognition to better understand the connection between social cognition and self-disturbances.

Future work may also address psychosocial therapies that may target self-disturbances, especially in the early stages of schizophrenia. Stengellini and Lysaker (2007) propose a focus on therapy techniques aimed to help re-integrate bodily selves and life narrative in individuals with schizophrenia. Metacognitive therapy, recently manualized by Van Donkersgoed et al. (2014), is one such technique, though its effectiveness has yet to be vetted beyond case studies and pilot studies.

Conclusion

The past several years of work on self-disturbances in schizophrenia have yielded promising insights into a possible alternative to the mainstream positive/negative symptom dichotomy of schizophrenia. Self-disturbances as a core deficit in schizophrenia fits within the framework of many prominent neurobiological and psychosocial hypotheses of schizophrenia pathogenesis. In the current work adds one small piece to the puzzle of self-disturbances in schizophrenia

Tables

Table 1.
Demographic Information for the Schizophrenia and Control Groups

	Schizophrenia Mean (SD)	Control Mean (SD)	N (SZ, control)	t	df	*d*
Age	48.9 (10.7)	44.6 (13.8)	47/35	-1.59	80	0.348
Gender (F/M)	20/27	16/19	47/35	-	-	-
Ethnicity	-	-	37/30	-	-	-
Caucasian (%)	27.0%	41.7%	-	-	-	-
Pacific Islander	24.3%	4.2%	-	-	-	-
Mixed ethnicity	16.2%	29.2%	-	-	-	-
Japanese	10.8%	8.3%	-	-	-	-
Other	11.7%	14.6%	-	-	-	-
Parental Education (mean)	14.1(2.7)	13.3(4.1)	23/20	-.772	41	0.230
BPRS Total	39.7 (10.5)	22.0 (5.0)	44/32	-9.048***	74	2.152
PANSS Total	64.1 (15.4)	-	47/-	-	-	-
PANSS Negative	15.1 (4.4)	-	47/-	-	-	-
PANSS Positive	17.5 (6.8)	-	47/-	-	-	-
GF-Role	3.4 (2.3)	8.2 (1.0)	44/35	7.537***	77	-2.707
GF-Social	5.5 (2.0)	8.4 (1.2)	45/36	11.432***	79	-1.758

(continued)

Table 1. (continued)
Demographic Information for the Schizophrenia and Control Groups

	Schizophrenia Mean (SD)	Control Mean (SD)	N (SZ, control)	t	df	*d*
MMSE-2	27.6 (1.8)	28.9 (1.5)	48/35	3.618***	81	-0.785
WASI-II Full-Scale IQ	87.4 (14.5)	108.0 (13.6)	46/34	6.998***	79	-1.465
WASI-II VCI	87.3 (13.3)	106.1 (9.6)	47/34	5.005***	79	-1.621
WASI-II PRI	89.8 (18.1)	108.2 (13.6)	47/34	6.990***	78	-1.149
Antipsychotic Medication Status (number medicated)	31	0	40/36	-	-	-

Note: *p<.05, **p<.01, ***p<.001. BPRS = Brief Psychiatric Rating Scale ; PANSS = Positive and Negative Symptom Scale; GF: Social = Global Functioning: Social; GF: Role = Global Functioning: Role; MMSE-2 = Mini Mental Status Exam –II; WASI–II = Wechsler Abbreviated Scale of Intelligence –II; WASI-II PRI = = Wechsler Abbreviated Scale of Intelligence –II, Perceptual Reasoning Index Score; WASI-II VCI = Wechsler Abbreviated Scale of Intelligence –II, Verbal Comprehension Index Score.

Table 2

Between Groups Comparisons of Self Task Performance

	Schizophrenia Mean (SD)	Control Mean (SD)	N (SZ/Control)	t	df	*d*
Mueller-Lyer Illusion Total (inches)	0.262 (0.212)	0.255 (0.216)	37/19	-.114	54	0.033
Mueller-Lyer Illusion "In"	-0.496 (0.370)	-0.459 (0.228)	37/19	.398	54	-0.120
Mueller-Lyer Illusion "Out"	-0.233 (0.347)	-0.203 (0.264)	37/19	.332	54	-0.097
Two-Point Discrimination (6mm % correct)	39.560 (31.208)	26.454 (33.178)	39/18	1.996*	95	0.407
Weight Discrimination (% correct)	75.972 (10.577)	81.447 (6.027)	18/19	1.948	35	-0.636
Intentional Binding (mean time difference)	0.008 (0.538)	-0.038 (0.272)	26/32	-.401	56	0.108
IPASE	132.111 (50.209)	76.968 (22.137)	45/31	-5.734***	74	1.421
Self-Concept Clarity Scale	38.521 (9.561)	47.464 (10.031)	46/28	3.830***	72	-0.913
Me-Not-Me Decision Task (total consistent responses)	27.738 (5.856)	32.032 (4.970)	42/31	3.618***	71	-0.790

Note: *p<.05, **p<.01, ***p<.001. IPASE = Inventory for Psychotic-Like Anomalous Self-Experience.

Table 3

Correlation Matrix of Self Variables, Symptoms, Functioning, and Intelligence Quotient in Schizophrenia Group

	1	2	3	4	5	6	7	8
1. MLI	-							
2. TPD	.127	-						
3. WD	.022	.507*	-					
4. IB	.188	.330	.195	-				
5. IPASE	.240	-.045	-.133	.057	-			
6. SCCS	.009	.132	.149	-.176	-.710***	-		
7. MNMDT	-.199	.096	-.209	-.354	-.348*	.333*	-	
8. PANSS positive	.216	-.091	-.143	-.276	.386*	-.191	-.360*	-
9. PANSS negative	.105	.069	-.501*	-.259	-.070	.208	.015	.116

(continued)

Table 3 (continued)

Correlation Matrix of Self Variables, Symptoms, Functioning, and Intelligence Quotient in Schizophrenia Group

	1	2	3	4	5	6	7	8	9	10	11	12	13
10. GF: Social	-.082	.240	.298	-.186	-.204	.232	.297	-.446**	-.454**	-			
11. GF: Role	.107	.345*	.084	-.110	-.047	.041	.366*	-.200	-.253	.331*	-		
12. WASI-II FS	-.244	.155	-.123	.066	-.172	.060	.137	-.069	.088	.102	.067	-	
13. WASI-II PRI	-.085	.087	.052	.186	-.232	.075	-.024	-.104	-.005	.104	.102	.877***	-
14. WASI-II VCI	-.284	.191	-.290	-.108	-.070	.049	.338*	.000	-.132	.039	,019	.791***	.406**

Note: *p<.05, **p<.01, ***p<.001. IPASE = Inventory for Psychotic-Like Anomalous Self-Experience; PANSS = Positive and Negative Symptom Scale; GF: Social = Global Functioning: Social; GF: Role = Global Functioning: Role; WASI–II = Wechsler Abbreviated Scale of Intelligence –II; WASI-II PRI = = Wechsler Abbreviated Scale of Intelligence –II, Perceptual Reasoning Index Score; WASI-II VCI = Wechsler Abbreviated Scale of Intelligence –II, Verbal Comprehension Index Score.

Table 4

Correlation Matrix of Self Variables in Control Group

	1	2	3	4	5	6
1. Mueller-Lyer Illusion	-					
2. Two-Point Discrimination	-.152	-				
3. Weight Discrimination	-.049	.079	-			
4. Intentional Binding	-.381	.107	.349	-		
5. IPASE	-.221	-.07	.081	.321	-	
6. Self-Concept Clarity Scale	-.565*	.029	.080	-.044	-.687***	-
7. Me-Not-Me Decision Task	-.527*	.138	.015	.043	-.169	.507**

Note: *p<.05, **p<.01, ***p<.001. IPASE = Inventory for Psychotic-Like Anomalous Self-Experience.

Figures

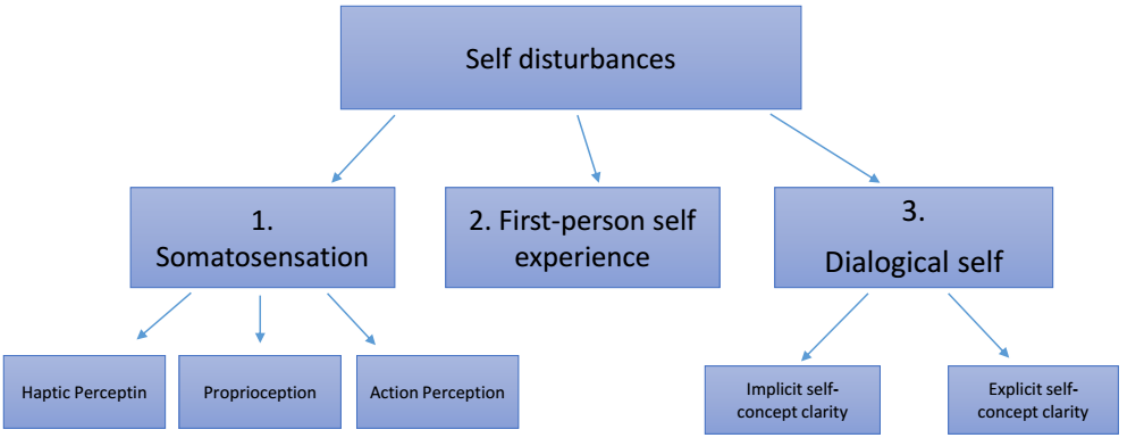

Figure 1. Hierarchical, non-causal model of self-disturbance domains. In this model, the domains are all equal parts of the over-arching construct of self-disturbances. Several subdomains of somatosensation and dialogical self have been hypothesized, but are not exhaustive.

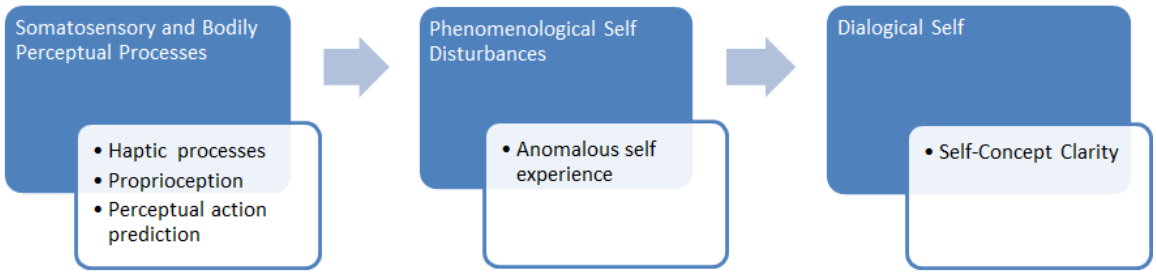

Figure 2. Causal model of self-disturbances. In the causal model, impairment in the somatosensory domain would cause impairment in the phenomenological domains, which in turn would cause impairment in dialogical self.

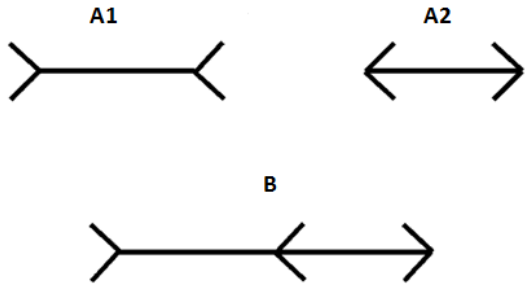

Figure 3: Haptic Mueller-Lyer Illusion. Figure A1) and A2) show single line segments; Figure B shows double-line segments. Participants typically perceive the A1 line segment as longer than the A2 line segment, likely due to perceptual heuristics for depth cues.

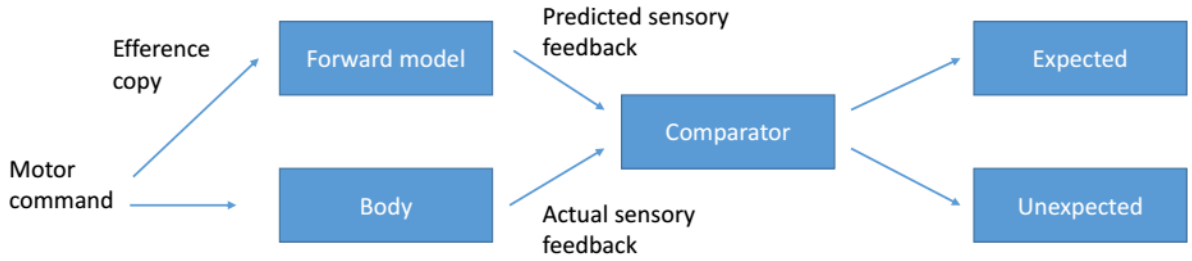

Figure 4: Efference Copy Model of perceptual action prediction. The motor command is sent to the body while the efference copy of the motor command is sent to the forward model in the brain. Predicted sensory feedback from the forward model and actual sensory feedback are compared.

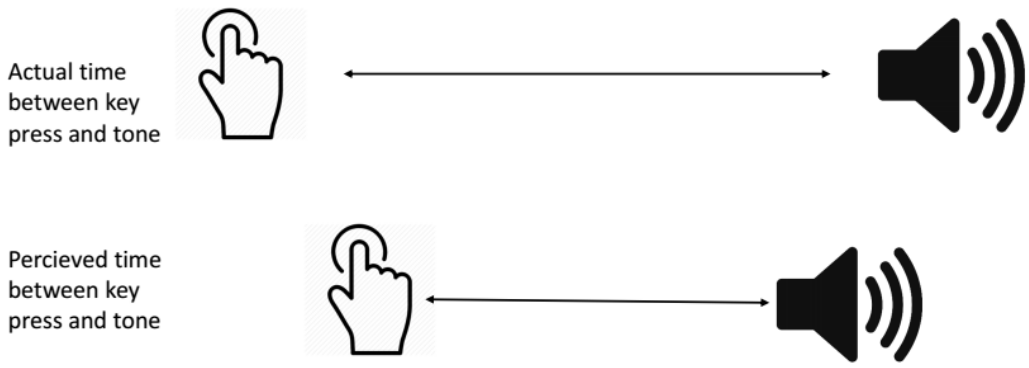

Figure 5: Intentional binding effect. When a voluntary button press is followed by a tone 250 ms later, the distance between the button press and tone are perceptually bound in time.

Figure 6: Two-point discrimination administration. Stimuli at one point, 6 mm, and 10 mm were administered to the palm of the hand.

Figure 7: Haptic Mueller-Lyer Illusion administration. Participants ran the index finger of their dominant hand over raised line drawings of the Mueller-Lyer Illusion stimuli.

Figure 8: Weight Discrimination administration. Participants distinguished between two differently weighted stimuli.

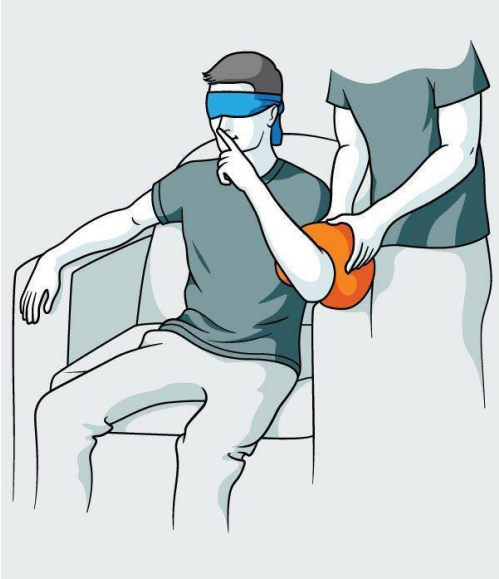

Figure 9: Pinocchio Illusion administration. Participants received stimulation to the bicep while touching the nose.

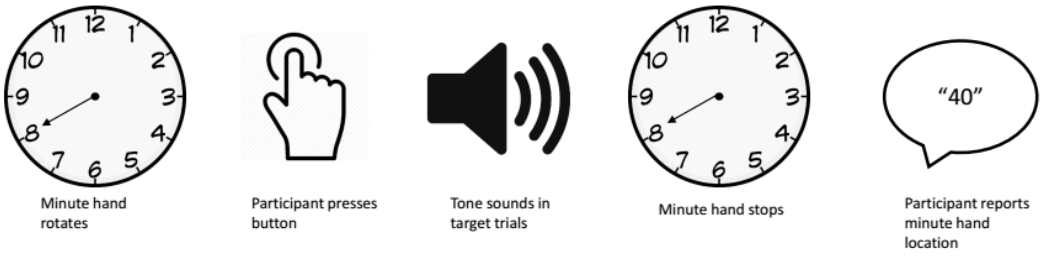

Figure 10: Intentional binding task. Participants pressed a button randomly as the minute hand spun around a clock face. In target trials, a tone sounded; in control trials there was no tone. The minute hand stopped and the participants were prompted to report the perceived location of the minute hand at the time of button press.

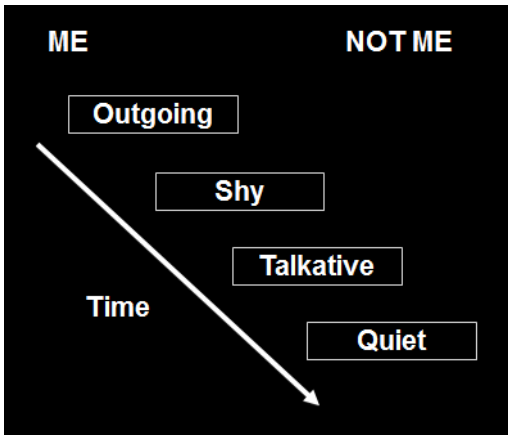

Figure 11: Me Not-Me Decision Task. Participants determined whether a series of adjectives described their personalities or not.

Appendix A: Institutional Review Board (IRB) Document

IRB Letter of Approval

UNIVERSITY of HAWAI'I® MĀNOA

Office of Research Compliance
Human Studies Program

MEMORANDUM
CR

March 23, 2015

TO: Aaron M. Neis
Principal Investigator
Psychology Department

FROM: Denise A. Lin-DeShetler, MPH, MA
Director

SUBJECT: CHS #21716- "Minor Physical Anomalies, Social Cognition, and Symptoms of Schizophrenia"

Your research project identified above, including the informed consent/privacy authorization form, was approved for one year by the University of Hawaii (UH) Human Studies Program at its IRB meeting on March 20, 2015.

This memorandum is your record of the Human Studies Program approval of this study. Please maintain it with your study records.

The Human Studies Program approval for this project will expire on March 19, 2016. If you expect your project to continue beyond this date, you must submit an application for renewal of this Human Studies Program approval. Human Studies Program approval must be maintained for the entire term of your project.

If, during the course of your project, you intend to make changes to this study, you must obtain approval from the Human Studies Program prior to implementing any changes. If an Unanticipated Problem occurs during the course of the study, you must notify the Human Studies Program within 24 hours of knowledge of the problem. A formal report must be submitted to the Human Studies Program within 10 days. The definition of "Unanticipated Problem" may be found at: http://hawaii.edu/irb/download/documents/SOPP_101_UP_Reporting.pdf, and the report form may be downloaded here: http://hawaii.edu/irb/download/forms/App_UP_Report.doc.

You are required to maintain complete records pertaining to the use of humans as participants in your research. This includes all information or materials conveyed to and received from participants as well as signed consent forms, data, analyses, and results. These records must be maintained for at least three years following project completion or termination, and they are subject to inspection and review by the Human Studies Program and other authorized agencies.

Please notify this office when your project is completed. Upon notification, we will close our files pertaining to your project. Reactivation of the Human Studies Program approval will require a new Human Studies Program application.

Please contact this office if you have any questions or require assistance. We appreciate your cooperation, and wish you success with your research.

1960 East-West Road
Biomedical Sciences Building B104
Honolulu, Hawai'i 96822
Telephone: (808) 956-5007
Fax: (808) 956-8683
An Equal Opportunity/Affirmative Action Institution

IRB-Approved Consent Form for Control Participants

University of Hawai'i

Consent to Participate in Research Project:
Physical Features, Social Cognition, and Symptoms of Schizophrenia

My name is David Cicero and I am an assistant professor at the University of Hawai'i at Mānoa (UH), in the Department of Psychology. A graduate student working under my supervision, Aaron Neis, and I are conducting a research study. This study is part of my job and part of Mr. Neis' training to earn a graduate degree in psychology. You are being invited to participate because you are a volunteer from the community without a history of mental illness. The purpose of this study is to answer two questions we have about schizophrenia. Everyone differs in physical features like the size of their heads, shape of their hands, and length of their toes. Most of the time, we don't even notice these differences. Some researchers have found that people with a diagnosis of schizophrenia have certain differences. We want to test whether these differences in physical features are related to symptoms of schizophrenia like hearing voices and having strong beliefs about things that are not necessarily true.

The second question we have is related to people's ability to understand emotion. Some people have found that people with schizophrenia have trouble understanding emotions. We want to test whether this is true, and test whether the ability to understand emotions is related to how people feel about themselves and how they feel about their ethnic background.

Project Description - Activities and Time Commitment: If you choose to participate, you will attend two sessions lasting 2-3 hours each. In session 1, you will complete an interview, some questionnaires, some computer tasks, and some cognitive tasks. In session 2, you will complete the rest of the questionnaires, computer tasks, and cognitive tasks. In an interview, you will be asked a series of questions about your psychological history and the psychological history of your immediate family. The purpose of this assessment is to test whether you have a history of mental illness and to determine whether you may be suffering from psychosis. You will also be asked to take an IQ test, cognitive skills tests, a demographic questionnaire, and allow portions of your head, face, hands and feet to be measured.

The interview portion of the study will be video-recorded and saved. The file will be stored on Professor Cicero's password protected computer in his locked office. The file will be kept for 7 years and then deleted. We keep them for 7 years to be consistent with the ethics code of the American Psychological Association. You have

the option to participate in the study, but decline to be videotaped. The purpose of videotaping the interviews is to make sure we don't miss anything you say.

Benefits and Risks: There are no direct benefits for participation in this study. You may experience minor stress during the interview process, but this stress should not exceed normal daily stress experiences. If you experience increased stress during the interview and it does not subside after 10 minutes, you will be given the option to terminate the session. If you continue to be distressed, you will be referred to Dr. Cicero and /or a mental health care provider.

Confidentiality and Privacy: We will keep all data from the questionnaires in a secure location. Only Professor Cicero and Mr. Neis will have access to the data and video recordings, although legally authorized agencies, including the University of Hawai'i Human Studies Program, have the right to review research records. There are several limits to confidentiality. If you tell us that you plan to hurt yourself, someone else, or that a child has been abused or is in danger, we will break confidentiality and inform your health care provider, child protective services, the police, or another appropriate authority.

Participants in this study will be assigned a participant number. The number will not be linked to your name or other identifying information in any files. Thus, the data will be anonymous and it will not be possible to determine participants' names from the data files. Your name will only be recorded on this consent form. None of your responses will be linked to your name. Moreover, any publications that result from this work will be presented as a whole. This means that I will report how a large group of participants performed on the tasks and will not analyze the data on an individual level. If you would like a summary of the findings from my final report, please contact me at the email listed near the end of this consent form.

Voluntary Participation: Participation in this research project is voluntary. You can choose freely to participate or not to participate. In addition, at any point during this project, you can withdraw your permission without any penalty or loss of benefits.

Compensation: You will be paid $25 for participating in each session. If you have to park at UH or take a bus to UH, you will be reimbursed for this cost.

Questions: If you have any questions about this project, please contact me via phone (808) 956-3695 or e-mail at HEALab@Hawai'i.edu. If you have any questions about your rights as a research participant in this project, you can contact the University of Hawai'i, Human Studies Program, by phone at (808) 956-5007 or by e-mail at uhirb@hawaii.edu.

Please keep the prior portion of this consent form for your records.

If you agree to participate in this project, please sign the following signature portion of this consent form.

Signature(s) for Consent:

I agree to participate in the research project entitled, *Physical Features, Social Cognition, and the Symptoms of Schizophrenia.* I understand that I can change my mind about participating in this project, at any time, by notifying the researcher.

I agree to having my interview video-taped: _____Yes _____No

Your Name:_____

Signature: _____

Date: _____

IRB-Approved Consent form for Schizophrenia Participants

University of Hawai'i

Consent to Participate in Research Project:
Physical Features, Social Cognition, and Symptoms of Schizophrenia

My name is David Cicero and I am an assistant professor at the University of Hawai'i at Mānoa (UH), in the Department of Psychology. A graduate student working under my supervision, Aaron Neis, and I are conducting a research study. This study is part of my job and part of Mr. Neis' training to earn a graduate degree in psychology. You have been invited to participate because you have been diagnosed with a psychotic disorder.

Everyone differs in physical features like the size of their heads, shape of their hands, and length of their toes. Most of the time, we don't even notice these differences. Some researchers have found that people with a diagnosis of schizophrenia have certain differences. The purpose of this study is to answer two questions we have about schizophrenia. We want to test whether these differences in physical features are related to symptoms of schizophrenia like hearing voices and having strong beliefs about things that are not necessarily true.

The second question we have is related to people's ability to understand emotion. Some people have found that people with schizophrenia have trouble understanding emotions. We want to test whether this is true, and test whether the ability to understand emotions is related to how people feel about themselves and how they feel about their ethnic background.

Project Description - Activities and Time Commitment: If you choose to participate, you will attend two to three sessions lasting 2-3 hours each. In session 1, you will complete an interview, some computer tasks, questionnaires, and cognitive task. In session 2, you will complete some more computer tasks, questionnaires, and cognitive tasks. In Session 3, you will finish the questionnaires, computer tasks, and cognitive tasks. In an interview, you will be asked a series of questions about your psychological history and the psychological history of your immediate family. The purpose of this assessment is to test whether you have a history of mental illness and to determine whether you may be suffering from psychosis. You will also be asked to take an IQ test, cognitive skills tests, a demographic questionnaire, and allow portions of your head, face, hands and feet to be measured.

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to participate in the study, but decline to be videotaped. The purpose of videotaping the interviews is to make sure we don't miss anything your say.

Benefits and Risks: There are no direct benefits for participation in this study. You may experience minor stress during the interview process, but this stress should not exceed normal daily stress experiences. If a participant experiences increased stress during the interview and it does not subside after 10 minutes, you will be given the option to terminate the session. If you continue to be distressed, you will be referred to Dr. Cicero and /or a mental health care provider.

Confidentiality and Privacy: We will keep all data from the questionnaires in a secure location. Only Professor Cicero and Mr. Neis will have access to the data and video recordings, although legally authorized agencies, including the University of Hawai'i Human Studies Program, have the right to review research records. There are several limits to confidentiality. If you tell us that you plan to hurt yourself, someone else, or that a child has been abused or is in danger, we will break confidentiality and inform your health care provider, child protective services, the police, or another appropriate authority.

Participants in this study will be assigned a participant number. The number will not be linked to your name or other identifying information in any files. Thus, the data will be anonymous and it will not be possible to determine participants' names from the data files. Your name will only be recorded on this consent form. None of your responses will be linked to your name. Moreover, any publications that result from this work will be presented as a whole. This means that I will report how a large group of participants performed on the tasks and will not analyze the data on an individual level. If you would like a summary of the findings from my final report, please contact me at the email listed near the end of this consent form.

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Questions: If you have any questions about this project, please contact me via phone (808) 956-3695 or e-mail HEALab@hawaii.edu. If you have any questions about your rights as a research participant, in this project, you can contact the University of Hawai'i, Human Studies Program, by phone at (808) 956-5007 or by e-mail at uhirb@hawaii.edu.

Please keep the prior portion of this consent form for your records.

If you agree to participate in this project, please sign the following signature portion of this consent form.

Signature(s) for Consent:

I agree to participate in the research project entitled, *Physical Features, Social Cognition, and the Symptoms of Schizophrenia.* I understand that I can change my mind about participating in this project, at any time, by notifying the researcher.

I agree to having my interview video-taped: _____Yes _____No

Your Name:_____

Signature: _____

Date: _____

Appendix B: Experimental Measures

Somatosensory and Body Perception Task Instructions

->Self task material can be found in the second file drawer from the top, in the file drawer stack in the corner of the lab.

->Materials
Wire drawing task:
- -Task board
- -Occlusion board
- -Sample board
- -Sliding ruler

2-point discrimination
- -Calipers (from MPA tasks)

Weight discrimination
- -Plastic eggs

Pinocchio task:
- -Kitty neck massager
- -Sliding ruler
- -Timer/Stop Watch

And the Self Tasks Recording Sheet

->Please administer self tasks in the order of self task recording sheet.

Wire Drawings Task

1. This is a tactile illusion task. It is important the participant does not SEE the stimulus at any point, as this could interfere with the illusion. It is ok for them to se the sample drawings, but not the task drawings. Please keep the task stimuli flipped upside-down whenever the participant's eyes are open.

2. Randomization: There are 8 stimuli on the board.
If the participant's ID # is:
ODD: start with the "A" row (order A-B)
EVEN: start with the "B" row (order B-A)

3. Place the stimulus board face-up while reading the instructions to the participant. Say:
"For this task, you will be estimating the length of line segments, using your sense of touch. On this board, there there is a small line drawing made of wire. I want you estimate the length of the horizontal line in each drawing. The beginning and end of the horizontal line is marked by these small red wires.
"With your right (or left, if participant is left-handed) **index finger only, please swipe over the drawing, like this (**demonstrate on the sample, how to swipe over the drawing.

It should be back and forth, at whatever speed and pressure they like.). **I want you to touch the entire drawing, but only estimate the length of the horizontal line, between the red wires. Now you try** (let the participant swipe their finger back and forth over the drawing. Provide corrective feedback if they use additional fingers, don't feel the entire drawing, etc).
"Good. That's correct. Now, I want you to estimate the length of the horizontal line, but matching the length with this ruler. Do the best you can."
When they have successfully completed the first sample item, show them the second sample, and say: "**Now look at this wire drawing. It has one horizontal line, divided into two parts. When you come across this type of drawing, I want you to estimate each part of the horizontal line separately"** Allow them to touch this sample, but you don't need to go through the whole process of estimating, etc, unless you feel they don't understand.
4. **"Now you're going to do the same thing with more wire drawing, but this time you will keep your eyes closed. Please do not open your eyes during the task. Are you ready? Ok, close your eyes"**
When their eyes are closed, turn over the board to reveal the stimuli, with the first row (A or B, depending on their randomization assignment) nearest to the participant. Guide their hand to the first stimulus in the row, cover the rest of the stimuli with the occlusion board, and say:
"Feel this wire drawing just like before, and estimate the length using the ruler."
5. Record their response (the number on the ruler) on the self tasks record sheet
6. Continue this with each stimulus on the first row. Do the same on the second row. Remind them of the instruction whenever needed, as many times as needed. Encourage them to complete the task quickly (each drawing need not take more than 30 seconds).

2 Point Discrimination

1 The participant should be seated at a table. Have them place their dominant hand comfortably on the table, with the palm facing upwards.
[photo of this]

2. Tell the participant, **"In this task, I'm going to touch the palm of your hand with either one point of this tool, or two. Here is an example of the one point** (put calipers at 0mm, completely together, and touch the center of the palm for ~2 seconds). **Here is an example of two points** (put the calipers at 10mm, and touch in the same place, with caliper positioned across the palm, perpendicular to the arm). Ask the participant if they have any questions.
[photo of this]

3. Ask the participant to close their eyes. Tell them**, "Now I'm going to touch your hand with either one point or two points, one after another, and I want you to say, "one" or "two" after each time".** Administer each trial, as dictated on the self tasks answer sheet. Write their response after each trial. If there are two trials in a row that are

the same distance, give time between as if you are re-setting the calipers, to avoid giving the participant clues. Try to do this task quickly, and encourage to the participant to make decisions within a few seconds.

Weight Discrimination (eggs) task
Instructions:

1) Explain that they will be comparing the weight of two eggs, and telling you which one is heavier.

2) Ask the participant to place their dominant hand face up and relaxed (cupped). The forearm and bicep should be at a 90 degree angle, and the arm/hand should not be resting on any surface.

3) Show them the purple and the blue eggs. Place the purple egg in their hand for 2 seconds; take it out. Then, place the blue egg in their hand for 2 seconds; take it out. Ask them, "which egg was heavier, the first or the second?" They should respond that the second was heavier. If this is not their response, try it again.

___

4) To start the task, ask the participant to close their eyes. Place the eggs in the palm of their dominant hand in the order listed below. Allow each egg to rest in the palm for 2 full seconds. After removing the second egg, ask, "which egg was heavier?" and the participant should indicate whether the first or second egg was heavier.

5) Between task items, the participant should rest their hand briefly on the table or their lap. Between every trial (10 items; or more often if needed), they may open their eyes and take a brief break.

Key

Weight in grams	**Color of Egg**
40	Purple
42	Teal
44	Orange
48	Red
52	Pink
56	Lime Green
(60)	Blue

Pinocchio Task

1. Show them the cat-shaped neck massager, and say.

" In this next task, I'm going to apply this massage tool to your arm, while you touch your nose. Aside from feeling the vibration on their arm, some people feel other unusual sensations in their face, hands, or body during this task. Some feel changes in the size or length of parts of their body."

2. Ask them to sit with their elbows on the table in front of them, and touch their nose lightly with their dominant hand. Place the center of the kitty massager (the motor- you should be able to feel it vibrating the strongest) against the bicep muscle of the arm touching the nose. Do not let the center of the massager touch any other part of the arm, such as the forearm or triceps.

3. Tell the participant,
"Please close your eyes and I will turn on the massager. If you start to feel any changes in the size or length of any part of your body, say, "NOW", but continue the task. It will last a total of one minute. Try to keep your arms relaxed"

4. Clarify any questions, wait for them to close their eyes, and start the massager (press the power button on the kitty's paw), along with your timer. Note the time that the participant said, "NOW", as the illusion onset latency.

5. After 1 minute, turn off the massager, and tell them they can open their eyes. Ask them the post-illusion questions on the Record Sheet.
Some important considerations:
-The participant should keep their eyes closed continuously during the task
-Avoid explicitly telling the participant that we expect them to feel their nose getting longer. We don't want to lead them too much.
- If the participant does not say "NOW" within 30 second, prompt them, "Do you feel like any parts of your body are bigger or longer than other parts?" If they say yes, just make a note that the latency of illusion onset was unclear.

Somatosensory and Body Perception Tasks Recording Sheet

Ppt ID: _____

Self tasks recording sheet

Wire Drawings (Green board):

Record the participant's length estimate on the sliding ruler for each line segment below. Number should be recorded in terms of 32nd of an inch (top markings on the sliding ruler). For example, a typical response may be, "___1___,___18___", if the participant indicated that the line segment was 1 inch and 18 32nds of an inch on the sliding ruler. Refer to the "task board" for line segment labels.

(single line segments)

A1 _____ ,_____ A2 _____,_____ A3_____,_____

A4_____,_____

(double line segments)

B1L _____,_____ B1R _____,_____ B2L_____,_____

B2R_____,_____

B3L _____,_____B3R _____,_____

B4L_____,_____B4R_____,_____

Two-Point Discrimination:

#	Stimulus	Response (mark "1" or "2")
1	0 mm (1 pt)	
2	10 mm (2 pt)	
3	6 mm (2pt)	
4	0 mm	
5	0 mm	
6	0 mm	
7	10mm	
8	0 mm	
9	6 mm	
10	0 mm	
11	10 mm	
12	0 mm	
13	6mm	
14	10mm	
15	0 mm	
16	0 mm	
17	0 mm	
18	10 mm	
19	6 mm	
20	0 mm	
21	6 mm	
22	6 mm	
23	0 mm	
24	10 mm	
25	6 mm	
26	0 mm	
27	0 mm	
28	6 mm	
29	10 mm	
30	6 mm	
31	0 mm	
32	10 mm	
33	0 mm	
34	6 mm	
35	0 mm	
36	0 mm	
37	6 mm	
38	10 mm	
39	0 mm	
40	10 mm	
41	0 mm	
42	0 mm	
43	6 mm	
44	0 mm	
45	0 mm	
46	0 mm	
47	6 mm	
48	10 mm	
49	0 mm	
50	10 mm	

Pinocchio Task:
1. Illusion response latency
Record to the 1st decimal point.

_____ seconds

Post-Illusion questions:
1. Did you feel anything unusual, like part or parts of your body changing in size of length, during this task? If so, please briefly describe:

2. If participant felt the nose lengthen, ask: **How much longer did you feel your nose became?** (Participant should indicate this using the sliding ruler)
_____,_____ inches
3. Ask: **On a scale of 1-10, how strongly did you feel […]** ("your nose getting longer", etc – use the participants' own words, and record even if they had an illusion other than nose lengthening**)? "0" is no illusion, "5" is a distinct feeling that the body part had changed and "10" is "As clearly as reality"**

0 1 2 3 4 5 6 7 8 9 10
No Illusion Distinct
Clear as reality

Experimenter comments (only if anything notable, such as possible confounds, etc):
_____
_____
_____

GF: Role Scale (GF: Role)
Current:_____
Lowest Past Year: _____
Highest Past Year: _____
Please rate the patient's ''lowest'' level of functioning in occupational, educational, and/or homemaker roles, as appropriate, within specified time frame. For ''current,'' rate most impaired level of functioning for the ''past month.'' Rate actual functioning regardless of etiology of occupational/educational problems.
Note: This scale emphasizes the level of support provided within the individual's environment and the individual's performance given such support. The term ''independently'' as used throughout this instrument implies that an individual is functioning at an ''age appropriate level'' without the assistance of external supports or accommodations. Examples of independent functioning include (1) age-appropriate functioning in a mainstream school without requiring extra help, special classes, or special accommodations for testing; (2) competitive full-time employment without additional guidance, support, job coaching, or other forms of special assistance; and (3) full-time homemaker responsible for generating, organizing, and pacing of household tasks and activities for a family without additional guidance, support, or supervision.
Prompts for GF: Role Scale
Specific questions to aid in rating the GF: Role scale are provided below. Be sure to assess for changes in role functioning over the previous year (to rate highest and lowest) as well as current functioning within the past month. Determine and rate functioning for ''primary role'' setting (work, school, or home) based upon questions below. However, if the subject is engaged in multiple roles, consider total amount of time spent in role-related activities (i.e., part-time school plus part-time work equals full-time role status).

1. How do you spend your time during the day?

2. If currently working:
a. Where do you work? What are your job responsibilities?
b. How many hours a week do you work?
c. How long have you been in your current job? Have you had any recent changes in your job status (e.g., lost job, stopped working, changed position, or workload)?
d. Do you usually need assistance or regular supervision at work? How often do you need extra help? Are there any tasks that you are not able to do alone?
e. Do you ever have trouble keeping up? Are you able to catch up if you fall behind?
f. Have you received any comments (positive or negative) or formal reviews regarding your performance? Have others pointed out things that you have done well or poorly?

3. If currently attending school:
a. What type of school do you attend? (general education, nonpublic school, residential/hospital)
b. Have you ever been in special education classes orother nongeneral education classes?

c. How long have you been at this school? Have you hadany recent changes in your school placement?
d. Do you receive any extra help or accommodations in your classes? Do you receive tutoring or extra help in school or after school? Do you receive extra time to take tests or are you able to leave the classroom to take tests in a quiet place?
e. Do you have trouble keeping up with your coursework? Are you able to catch up if you fall behind?
f. How are your grades? Are you failing any classes?
4. If a homemaker:
a. What are your responsibilities around the house or for the family?
b. How long have you been in charge of the home?
c. How many hours per week do you spend working on household tasks?
d. Are you able to keep up with the demands of your you avoiding any tasks? Do you need regular assistance or supervision for any tasks within the home?

e. Have you received any comments (positive or negative) regarding your performance? Have others pointed out things that you have done well or poorly? household? Do you ever fall behind? If so, are you able to catch up or do you need others' help?

	Superior role functioning
10	Independently maintains superior functioning in demanding roles. Obtains only superior performance evaluations at competitive work placement. Obtains all A's in mainstream school. Generates, organizes, and completes all homemaking tasks with ease.
	Above average role functioning
9	Independently maintains very good functioning in demanding roles. Rarely absent or unable to perform. Obtains good to superior performance evaluations at competitive work placement. Obtains grades in A and B range in all courses in mainstream school. Generates, organizes, and completes all homemaking tasks.
	Good role functioning
8	Independently maintains good role functioning in demanding roles. Occasionally falls behind on tasks but always catches up; obtains satisfactory performance evaluations at competitive work placement; obtains grades of C and above in mainstream school; occasional difficulty generating or organizing homemaking tasks; or maintains above average performance with minimal support (eg, tutoring, reduced academic course load at 4-year university, attends community college, may receive additional guidance at work less than 1–2 times a week). Receives As and Bs, good work/school evaluations, and completes all tasks with this level of support.
	Mild impairment in role functioning
7	Mildly impaired functioning in demanding roles independently. Frequently behind on tasks or unable to perform; frequently obtains poor performance evaluations at competitive work placement or grades of Ds or better in mainstream school; frequent difficulty generating or organizing homemaking tasks; or maintains good performance with minimal support (eg, minimal accommodations in general education classroom, receives additional guidance/support at work 1–2 times a week). Receives Cs or higher, satisfactory work/school evaluations, and completes most homemaking tasks with this level of support.
	Moderate impairment in role functioning
6	Moderate impairment independently. May receive occasional F in mainstream courses, persistently poor performance evaluations at competitive work placement; may change jobs because of poor performance, persistent difficulty generating, or organizing homemaking tasks; or requires partial support (some resource or special education courses, receives guidance/support at work 2+ times per week). May require less demanding or part-time jobs and/or some supervision in home environment but functions well or adequately given these supports (may fall behind but eventually completes assigned tasks, obtains satisfactory evaluations at work or passing grades in school).
	Serious Impairment in Role Functioning
5	Serious impairment independently. Failing multiple courses in mainstream school, may lose job, or unable to complete most homemaking tasks independently; or in entirely special education classes, requires less demanding job/daily support or guidance, may require vocational rehabilitation, and/or some supervision in home environment but maintains "above average" performance—receives As and Bs, good evaluations at work/school, completes all tasks.
	Major impairment in role functioning
4	Very serious impairment independently. All Fs in mainstream school or failing out of school; cannot obtain or hold independent job or unable to complete virtually any homemaking tasks independently, or adequate to good functioning with major support. Requires assisted work environment, entirely special education classes, nonpublic or psychiatric school, home schooling for the purpose of a supportive school environment, and/or supported home environment but functions adequately given these supports (may fall behind but completes assigned tasks, obtains satisfactory performance evaluations at work or passing grades).
	Marginal ability to function
3	Impaired functioning with major support. Requires supported work environment, entirely special education classes, nonpublic or psychiatric school, home schooling for the purpose of a supportive school environment, and/or supported home environment but functions poorly despite these supports (persistently behind on tasks, frequently unable to perform, obtains poor performance evaluations at work or fails courses at school).
	Inability to function
2	Disabled but participates in structured activities. On disability or equivalent nonindependent status. Not working for pay, attending classes for grades, or living independently. Spends 5 or more hours a week in structured role-related activities (eg, residential treatment, volunteering, tutoring, sheltered work programs).
	Extreme role dysfunction
1	Severely disabled. On disability or equivalent nonindependent status. Not working for pay, attending classes for grades, or living independently. Spends fewer than 5 hours a week in structured role-related activities.

Note: This scale has been partially derived from the Social and Occupational Functioning Assessment Scale (SOFAS) from *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (*DSM-IV*) and the GAF as it appears in the Scale of Prodromal Symptoms (SOPS). Item content has been changed to focus specifically on role functioning.

Global Functioning: Social Scale (GF: Social)
Current_____
Lowest Past Year_____
Highest Past Year_____
Please rate the patient's most impaired level of social functioning for the specified time period by selecting the ''lowest'' level which describes his/her functioning within that time frame. For ''current,'' rate most impaired level of functioning in the ''past month.'' Rate actual functioning regardless of etiology of social problems.
Note: The emphasis is on social contact/interactions nwith people other than family members, unless these are the only interpersonal contacts a person has (eg, the lower end of the scale). Also note that ratings of intimate relationships are secondary to the rating of primary friendships and should take into account the age of the individual. For example, older individuals may be expected to have intimate relationships involving steady dating, cohabitation, or marriage, whereas younger individuals may be expected to have only romantic interests (i.e., flirtations or crushes) or close friendships.

GF: Social Scale Prompts
Specific questions to aid in rating the GF: Social scale are provided below. Be sure to assess for changes in social functioning over the previous year (to rate highest and lowest) as well as current functioning in the past month.

1. Tell me about your social life. Do you have friends?
2. Are they casual or close friends? If only casual—are they school or work friends only? If close—how long have you been close friends?
3. How often do you see friends? Do you see them outside of work/school? When was the ''last time'' you saw one of your friends outside of work/ school? (Attempt to determine ''actual'' amount of social contact vs perceived amount of social contact.)
4. Do you usually initiate contact or activities with friends or do they typically call or invite you? Do you ever avoid contact with friends?
5. Do you ever have problems/falling outs with friends? Arguments or fights?
6. Are you dating or interested in dating? (Alter as needed to assess age-appropriate intimate relationships)
7. Do you spend time with family members (at home)? How often do you communicate with them? Do you ever avoid contact with family members?

	Superior social/interpersonal functioning
10	Superior functioning in a wide range of social and interpersonal activities. Frequently seeks out others and has multiple satisfying interpersonal relationships, including multiple close and casual friends. Is sought out by others because of his or her many positive qualities. Age-appropriate involvement in intimate relationships.
	Above average social/interpersonal functioning
9	Good functioning in all social areas, and interpersonally effective. Interested and involved in a wide range of social and interpersonal activities, including both close and casual friends. Age-appropriate involvement in intimate relationships. No more than everyday interpersonal problems or concerns (eg, an occasional argument with spouse, girlfriend/boyfriend, friends, coworkers, or classmates). Able to resolve such conflicts appropriately.
	Good social/interpersonal functioning
8	Some transient mild impairment in social functioning. Mild social impairment is present, but transient and expectable reactions to psychosocial stressors (eg, after minor arguments with spouse, girlfriend/boyfriend, friends, coworkers, or classmates). Has some meaningful interpersonal relationships with peers (casual and close friends), and/or age-appropriate intimate relationships. Infrequent interpersonal conflict with peers.
	Mild problems in social/interpersonal functioning
7	Some persistent mild difficulty in social functioning. Mild impairment present that is NOT just expectable reaction to psychosocial stressors (eg, mild conflicts with peers, coworkers or classmates; difficulty resolving conflicts appropriately). Has some meaningful interpersonal relationships with peers (casual and/or close friends). Some difficulty developing or maintaining age-appropriate intimate relationships (eg, multiple short-term relationships).
	Moderate impairment in social/interpersonal functioning
6	Moderate impairment in social functioning. Moderate impairment present (eg, few close friends; significant but intermittent conflicts with peers, coworkers, or classmates). Moderate difficulty developing age-appropriate intimate relationships (eg, infrequent dating). Occasionally seeks out others but will respond if invited by others to participate in an activity.
	Serious impairment in social/interpersonal functioning
5	Serious impairment in social functioning. No close friends or intimate partner but has some casual social contacts (eg, acquaintances, school/work friends only). Rarely seeks out others. Occasional combative or verbally argumentative behavior with peers. Beginning to withdraw from family members (eg, does not initiate conversation with family, but will respond if addressed).
	Major impairment in social and interpersonal functioning
4	Major impairment in social functioning. Serious impairment in relationships with friends or peers (eg, very few or no friends, frequent conflicts with friends, or frequently avoids friends). Frequent combative or verbally argumentative behavior with peers. Infrequent contact with family members (eg, sometimes does not respond to family or avoids family members).
	Marginal ability to function socially
3	Marginal ability to function socially or maintain interpersonal relationships. Frequently alone and socially isolated. Serious impairment in relationships with all peers, including acquaintances. Few interactions with family members (eg, often alone in room). Serious impairment in communication with others (eg, avoids participating in most social activities).
	Inability to function socially
2	Unable to function socially or to maintain any interpersonal relationships. Typically alone and socially isolated. Rarely leaves home. Rarely answers the phone or the door. Rarely participates in interactions with others at home or in other settings (eg, work, school).
	Extreme social isolation
1	Extreme social isolation. No social or family member contact at all. Does not leave home. Refuses to answer the phone or door.

Note: This scale has been partially derived from the Social and Occupational Functioning Assessment Scale (SOFAS) from *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (*DSM-IV*) and the GAF as it appears in the Scale of Prodromal Symptoms (SOPS). Item content has been changed to focus specifically on social and interpersonal functioning.

Self-Concept Clarity Scale (SCCS)

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1. My beliefs about myself often conflict with one another.	S	A	N	D	SD
2. On one day I might have one opinion of myself and on another day I might have a different opinion.	S	A	N	D	SD
3. I spend a lot of time wondering about what kind of person I really am.	S	A	N	D	SD
4. Sometimes I feel that I am not really the person that I appear to be.	S	A	N	D	SD
5. When I think about the kind of person I have been in the past, I'm not sure what I was really like.	S	A	N	D	SD
6. I seldom experience conflict between the different aspects of my personality	S	A	N	D	SD
7. Sometimes I think I know other people better than I know myself.	S	A	N	D	SD
8. My beliefs about myself seem to change very frequently.	S	A	N	D	SD
9. If I were asked to describe my personality, my description might end up being different from one day to another.	S	A	N	D	SD
10. Even if I wanted to, I don't think I could tell someone what I'm really like.	S	A	N	D	SD
11. In general, I have a clear sense of who I am and what I am.	S	A	N	D	SD
12. It is often hard for me to make up my mind about things because I don't really know what I want.	S	A	N	D	SD

Mini Mental Status Exam - II (MMSE-II)

Mini-Mental State Examination (MMSE)

Patient's Name: _____ Date: _____

Instructions: Score one point for each correct response within each question or activity.

Maximum Score	Patient's Score	Questions
5		"What is the year? Season? Date? Day? Month?"
5		"Where are we now? State? County? Town/city? Hospital? Floor?"
3		The examiner names three unrelated objects clearly and slowly, then the instructor asks the patient to name all three of them. The patient's response is used for scoring. The examiner repeats them until patient learns all of them, if possible.
5		"I would like you to count backward from 100 by sevens." (93, 86, 79, 72, 65, ...) Alternative: "Spell WORLD backwards." (D-L-R-O-W)
3		"Earlier I told you the names of three things. Can you tell me what those were?"
2		Show the patient two simple objects, such as a wristwatch and a pencil, and ask the patient to name them.
1		"Repeat the phrase: 'No ifs, ands, or buts.'"
3		"Take the paper in your right hand, fold it in half, and put it on the floor." (The examiner gives the patient a piece of blank paper.)
1		"Please read this and do what it says." (Written instruction is "Close your eyes.")
1		"Make up and write a sentence about anything." (This sentence must contain a noun and a verb.)
1		"Please copy this picture." (The examiner gives the patient a blank piece of paper and asks him/her to draw the symbol below. All 10 angles must be present and two must intersect.) 
30		TOTAL

Demographic Questionnaire

Demographic Questionnaire

Name:_____ Date of Birth:_____

Sex:_____ Gender:_____

Sexual orientation:_____

Ethnicity:_____

Mothers ethnicity:_____ Father's ethnicity:_____

Mother's mother's ethnicity:_____ Father's mother's ethnicity:_____

Mother's father's ethnicity:_____ Father's father's ethnicity:_____

Mother mental illness:_____ Father mental illness:_____

Current diagnosis:_____(if any)

Last hospitalization:_____(if any)

Length of hospitalization:_____(if any)

Education level (highest):

Grade school:_____(year)

High school:_____(year)

College:_____(years completed)

Graduate school:_____(years)

Degree earned:____(yes)_____(No)

Medication List

Generic Name	Brand Name	Indication	Dose	Frequency
venlafaxine	Effexor	depression		
chlorpromazine	Thorazine	schizophrenia (typical)		
fluphenazine	Prolixin, Prolixin Decanoate	schizophrenia (typical)		
haloperidol	Haldol, Haldol Decanoate	schizophrenia (typical)		
loxapine	Loxitane	schizophrenia (typical)		
mesoridazine	Serentil	schizophrenia (typical)		
molindone	Moban	schizophrenia (typical)		
perphenazine	Trilafon	schizophrenia (typical)		
prochlorperazine	Compazine	schizophrenia (typical)		
thioridazine	Mellaril	schizophrenia (typical)		
thiothixene	Navane	schizophrenia (typical)		
trifluoperazine	Stelazine, Vesprin	schizophrenia (typical)		
ziprasidone	Geodon	schizophrenia (atypical), bipolar		
aripiprazole	Abilify	schizophrenia (atypical)		
clozapine	Clozaril	schizophrenia (atypical)		
olanzapine	Zyprexa	schizophrenia (atypical)		
quetiapine	Seroquel	schizophrenia (atypical)		
risperidone	Risperdal	schizophrenia (atypical)		
amoxapine	Asendin	depression, psychosis		
mirtazapine	Remeron	depression		
nefazodone	Serzone	depression		
phenelzine	Nardil	depression		
tranylcypromine sulfate	Prarnate	depression		
citalopram hydrobromide	Celexa	depression		
escitalopram	Lexapro	depression		
fluoxetine	Prozac	depression		
paroxetine	Paxil	depression		
sertraline	Zoloft	depression		
amitriptyline	Elavil, Endep	depression		
doxepin	Adapin, Sinequan	depression		
maprotiline	Ludiomil	depression		
nortriptyline	Pamelor	depression		

protriptyline	Vivactil	depression		
trazodone	Desyrel	depression		
trimipramine	Surmontil	depression		
desipramine	Norpramin	depression		
imipramine	Tofranil	depression		
buproprion	Wellbutrin	depression		
fluvoxamine	Luvox	depression		
clomipramine	Anafranil	depression		
carbamazepine	Tegretol	bipolar disorder		
divalproex sodium	Depakote	bipolar disorder		
lithium carbonate	Eskalith, Lithobid	bipolar disorder		
lithium citrate	Cibalith S	bipolar disorder		
valproic acid	Depakene	bipolar disorder		
alprazolam	Xanax	anxiety, panic		
buspirone	BuSpar	anxiety		
chloriazepoxide	Librium	anxiety		
clonazepam	Klonopin	anxiety		
clorazepate	Tranxene	anxiety		
diazepam	Valium	anxiety		
lorazepam	Ativan	anxiety		
oxazepam	Serax	anxiety		
prazepam	Centrax	anxiety		
amphetamine	Adderall	ADD		
dextroamphetamine	Adderall, Dexedrine	ADD		
methylphenidate	Ritalin	ADD		
pemoline	Cylert	ADD		

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