“A hidden part of myself”: Examining Felt Presence and Bodily Self Across the Psychosis Spectrum

By

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DEDICATION

For Jagger, my everything.

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1. Introduction

Disruption in one's sense of self is a core feature of schizophrenia. Coined by Dr. Eugen Bleuler in 1911, the term "schizophrenia" combined the Greek words for "splitting" (*schizein*) and "mind" (*phren*) to create a name for a disorder he saw as characterized by a "splitting of the mind" (Bleuler, 1911). Though current diagnostic criteria for schizophrenia (*Diagnostic and statistical manual of mental disorders* [5th ed.]; American Psychiatric Association, 2013) does not include self-disturbance, disordered sense of self was one of the foundational symptoms of schizophrenia described by Kraepelin and Bleuler in the early 20th century (Nordgaard et al., 2021; Kraepelin, 1919; Bleuler, 1911). Indeed, self-disturbance is evident from the early "prodromal" phase – the period marked by a change from premorbid functioning preceding a first psychotic episode – which typically occurs between ages 15 and 30 years (Nelson et al., 2012).

However, in order to understand self-disturbance, it is essential to first understand the components of the self. Phenomenological descriptions identify three levels of selfhood (Parnas, 2003). At the core is the minimal self (ipseity): a pre-reflective selfhood involved in the bottom-up assembly of a sense of self via multisensory processing of external and internal input (Legrand, 2007). The second level is the explicit awareness and monitoring of the self as the invariant subject of experience and action. The third level is the social-narrative self, which encompasses autobiographical memory, personality traits and states, habits, and preferences – the social-narrative self involves mega-cognitive constructs (Northoff et al., 2006).

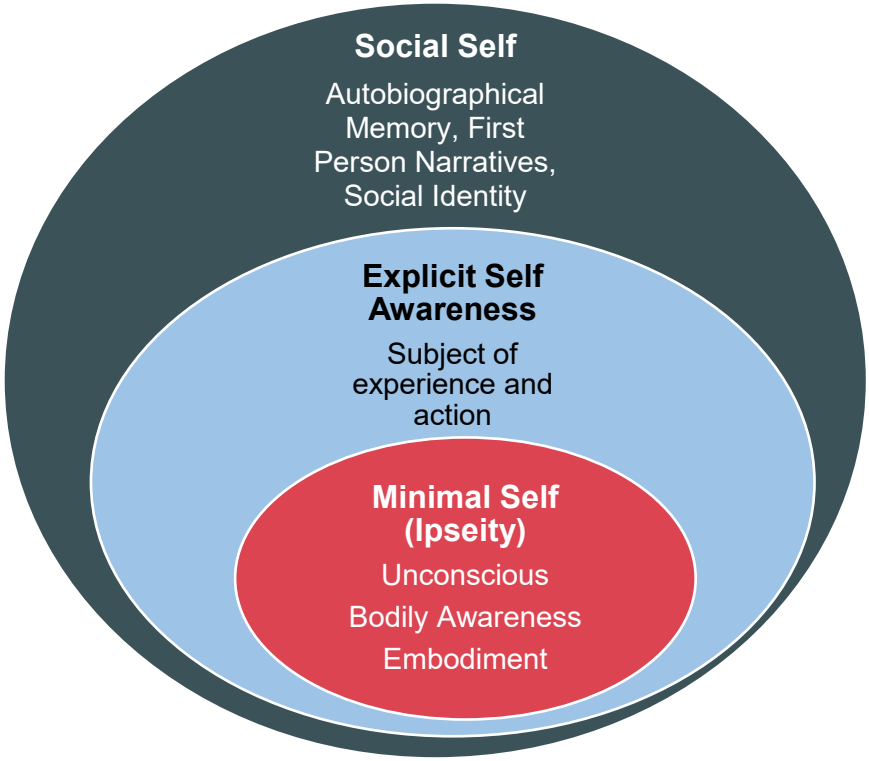


Figure 1. Levels of selfhood

It has been hypothesized that schizophrenia is a disorder of the minimal self with a disrupted sense of embodiment (Zahavi, 2014). Bodily self-consciousness is thought to arise from a continuous integration of bodily signals (Nelson et al., 2015) with at least three defining features: body ownership, self-location (experience of occupying a known physical location in space), and the first-person perspective (Blanke, 2012).

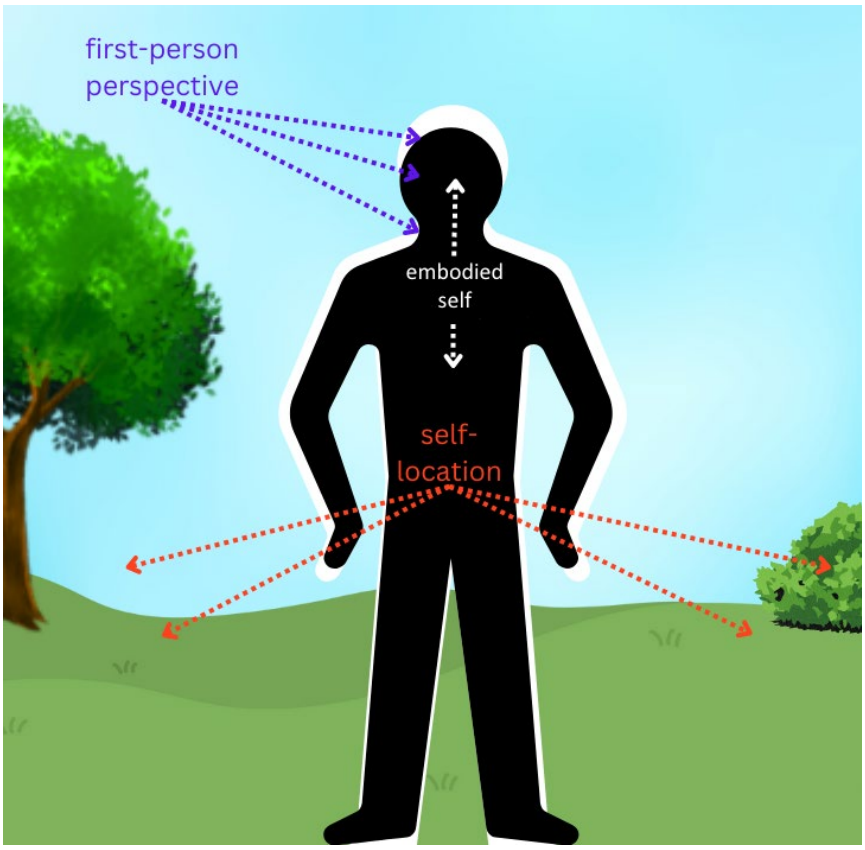


Figure 2. Levels of bodily self-consciousness

Schizophrenia is associated with a flexible or weakened sense of bodily self (Sass & Parnas, 2003; Park & Baxter, 2022; Moe & Docherty, 2014), but what does a weakened bodily self entail? One fundamental feature of self-disturbance in schizophrenia is difficulty distinguishing the self from "other." Difficulty distinguishing the self from other (van der Weiden et al., 2015) indicates a weakened self-other boundary and/or abnormal embodiment. Sense of unitary and coherent body depends on the integrity of the self-other boundary; without a clear sense of the bodily self boundary, it is not possible to distinguish the self from other. Although the body is physically bound by the skeletal structure and the skin, sense of personal body boundary extends into a region of space around the physical body known as the peripersonal space (PPS; Serino, 2019; Rabellino et al., 2020). PPS is defined as the space surrounding the body, where physical interactions take place; in other words, where "I" interact with the world.

The size and precision of the PPS boundary is determined by the receptive fields of multisensory neurons in frontoparietal regions that show facilitated response to stimuli within the PPS. PPS in schizophrenia has been shown to be smaller and less well-defined compared to the PPS of control participants (Lee et al., 2021).

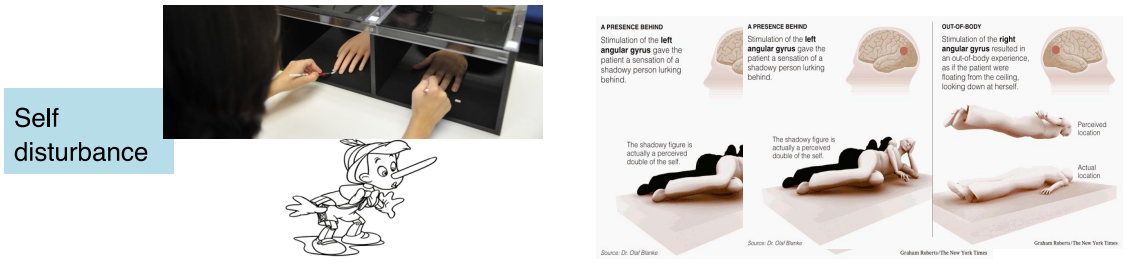
Related to the experience of clear self-boundary is the construct of embodiment. A sense that the self is embodied (i.e., is contained within the physical boundaries of the body) is essential for adaptive interactions with the external world. In addition, there is evidence to indicate that individuals with schizophrenia-spectrum conditions have difficulty with interoception – the detection and integration of internal bodily signals (Torregrossa et al., 2019a; Torregrossa et al., 2019b; Torregrossa et al., 2022; Yao & Thakkar, 2022; Barbato et al., 2021; van't Wout et al., 2004). Interoceptive impairments have been associated with dissociative experiences (i.e., experiences of disconnection between the self and the body) (Shäflein et al., 2018). Individuals with schizophrenia-spectrum conditions are at elevated risk for experiencing disembodiment and dissociations (Benson et al., 2019; Barnby et al., 2023). These experiences are thought to be forms of autoscopic hallucinations (Blanke et al., 2004) such that one's own body imagery is projected to the extrapersonal space and experienced as 'other' (in the case of felt presence experience) and as a disembodied self (in the case of out of body experience).

The felt presence (FP) experience involves the sensation that there is another social agent nearby without any visual evidence to support this notion (Barnby et al., 2023). FP is a relatively common phenomenon and has been documented extensively in psychosis as well as in the general population during a period of loss of 'other,' such as bereavement (Kamp et al., 2020), and within neurological populations for whom self-identification is disrupted, such as individuals with focal epileptic seizures (Picard, 2010) or those with Parkinson's disease (Fénelon et al.,

2011). Out of body experience (OBE) is the sensation that one is perceiving the world from a location outside of their own physical body (Blanke et al., 2004). It is a form of autoscopic hallucination that is also commonly observed in psychotic, neurological, and general population cohorts.

FP and OBE are thought to share similar neuropsychological mechanisms resulting from underlying dysregulation in the cortical network that involves multisensory integration and bodily self-processing, including (and especially) the temporoparietal junction (TPJ), the insula, and the frontoparietal cortex (Blanke et al., 2014; Blanke & Arzy, 2005). This network is associated with three core aspects of bodily self-consciousness: self-identification with the body (also known as body ownership), self-location, and first-person perspective (Blanke, 2012). Thereby, anomalous bodily self-experiences (i.e., FP and OBE) associated with dysregulation of this network inherently involve disrupted embodiment and self-location. To this end, FP and OBE are two sides of the same coin. Neurostimulation studies of healthy humans have demonstrated that FP can be induced via stimulation of the left angular gyrus, whereas OBE can be induced by stimulating the right angular gyrus (Blanke et al., 2014; Blanke & Arzy, 2005). However, despite these overlapping neurological underpinnings, OBE and FP are phenomenologically distinct: FP involves perception of a social 'other' in one's immediate environment without a loss of embodiment, while OBE is a disembodiment experience involving perception of one's own body from an external location with a loss of the first-person perspective. Disrupted bodily self-experience is a salient feature of psychosis and is also observed among those at risk for developing psychosis (Nelson et al., 2012). Moreover, anomalous bodily self-experiences in the general population have been associated with psychosis-risk (Linszen et al., 2022; Larøi et al., 2019). Thus, a careful examination of the

qualities of FP and OBE across the psychosis spectrum is necessary to understand the central role of the bodily self-disturbance in schizophrenia (Braithwaite et al., 2011).



	Body Aberration	Felt Presence	Out of body experience
Embodied self? (Body=Self)	Yes (1PP) Plastic self boundary	Yes (1PP) Intact self boundary	No (2PP) Breached self boundary
Social experience?	No (self is alone)	Yes (self has company)	No (self is alone – even worse self is detached from body)
Psychological Mechanism	Multisensory integration, Tactile-proprioceptive	Disturbed own body imagery	Disturbed own body imagery Self-boundary disintegration
When?	-	Bereavement, social isolation extreme danger	Extreme stress or trauma, isolation
Neurobiol. Correlates	TPJ, Occipitotemporal	TPJ	TPJ, Vestibular disturbance

Figure 3. Properties of anomalous bodily experiences, including FP, OBE, and body aberration; 1PP = first person perspective, 2PP = second person perspective; TPJ = temporoparietal junction.

In addition to the self-disturbance, another core feature of schizophrenia is severe impairment in social functioning. Social impairments constitute the most significant barrier that prevents recovery and rehabilitation in schizophrenia (Green 2016; Green et al., 2015; Green et al., 2008). Importantly, self-disturbance and social impairments are also associated with psychosis-spectrum conditions (Nelson et al., 2009). Experiences of self-disturbance, such as FP and OBE, have been linked to social deficits and elevated distress among those at-risk for developing schizophrenia (Nelson et al., 2012; Benson & Park, 2019; Brent et al., 2014; da Rocha et al., 2018; Gayer-Anderson & Morgan, 2013). Importantly, social isolation and disconnection may be driving bodily self-disturbance (Michael & Park, 2016; Benson et al.,

2019). Reduced social interactions and social isolation have been linked with increased prevalence of psychotic symptoms, including anomalous bodily self-experiences (Michael & Park, 2016) and social hallucinations (Brederoo et al., 2023; Butter et al., 2017; Le et al., 2019). Conversely, social contact has been shown to improve bodily self-consciousness (Arnold et al., 2019; Pellencin et al., 2018; Teneggi et al., 2013). Given the impact of social deafferentation (Hoffman, 2007) and social defeat (Selten et al., 2013) on increased risk for psychosis, these findings are particularly concerning for individuals with schizophrenia as well as those at-risk for psychosis since they report high levels of social isolation and loneliness (Badcock et al., 2020). According to the social deafferentation hypothesis (Hoffman, 2007), similar to the neural reorganization that occurs after an amputation of a limb, a loss of social contact (i.e., social amputation) may lead to a reorganization of the social brain network in efforts to compensate for a lack of social input, resulting in a hallucinatory generation of an 'other' (i.e., FP). Outside of the neuropsychiatric literature, FP is most often construed as an adaptive experience; for example, sensing a deceased family member during bereavement can provide comfort and closure (Barnby et al., 2023), as can the experience of a 'Third Man' that solo mountaineers and voyagers often describe (Alderson-Day et al., 2022; Alderson-Day, 2023).

But is there an adaptive aspect of FP in schizophrenia? A recent study of self-other boundary hints at a potential adaptive function of FP in psychosis. Lee et al. (2021) found that hallucination symptom severity was correlated with a sharper self-other boundary, denoting clearer self-other distinction in those who are clearly more symptomatic. This counterintuitive finding seems to suggest that sensing 'other' in one's proximal environment may be helping to restore the boundary between self and other – the location of the sensed 'other' may demarcate

the border of the PPS. Thus, in this case, the experience of FP may serve an adaptive function of restoring self-other boundary for individuals with schizophrenia-spectrum conditions.

By contrast, there is a breach of the self-boundary in OBE such that the self is perceived to leave the body (disembodiment). Therefore, OBE is a disembodiment experience that could be construed as an extreme case of maladaptive isolation in which the individual is both disconnected from the social world and from their own body. Even in the case of FP, hypothesized benefits may only be temporary (see Figure 4). Chronic loss of social input could lead to increased rate of hallucinations and delusions that further reduce social opportunities starting a maladaptive feedback loop of continual social estrangement and self-disturbance (Park & Baxter, 2022; da Rocha et al., 2018; Gayer-Anderson & Morgan, 2013).

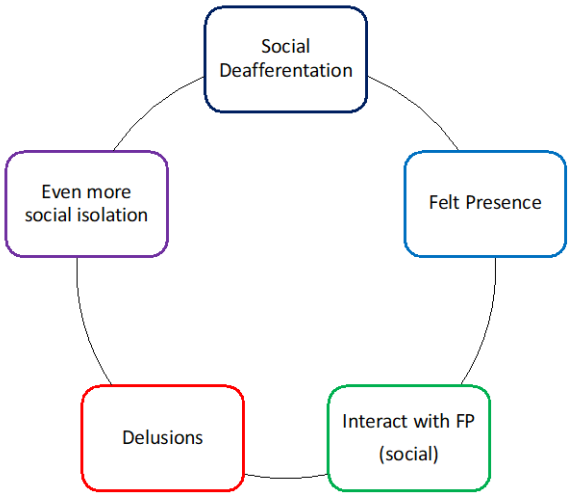


Figure 4. Felt Presence – temporarily adaptive but maladaptive in the long run?

Given the importance of self-disturbance in schizophrenia, why has it not been investigated more extensively? While self-disturbance is central to schizophrenia and a highly salient feature of the prodromal phase, there is scarcity of reliable and valid methods to capture

these problems. Clinical interviews such as the Examination of Anomalous Self-Experience (EASE; Parnas et aal., 2005) and self-report questionnaires such as the Inventory of Psychotic-Like Anomalous Self-Experiences (IPASE; Cicero et al., 2016) have been used to capture phenomenological, qualitative data about self-disturbance, but they are not widely used. Moreover, questions about how the bodily self *is* experienced in psychosis remain (Blatt et al., 1992; Lysaker et al., 2010). It has long been known that body aberration is a core feature of schizophrenia, contributing to the sensation that the body is unfamiliar, unreal, or disintegrating (see Chapman et al., 1978). However, more recently, there has been a wave of empirical studies that demonstrate the feasibility of implementing valid and reliable experimental tasks to objectively assess components of bodily self-disturbances. These studies have demonstrated abnormal sense of time continuity (Giersch & Mishara, 2017), impaired sense of body ownership (Thakkar et al., 2011), disrupted PPS (Lee et al., 2021), and flexibility of the body boundary (Michael & Park, 2016) in schizophrenia-spectrum conditions. In addition, there is strong evidence for impaired interoception and embodiment of emotion (Torregrossa et al., 2019a; Torregrossa et al., 2019b; Torregrossa et al., 2022) in individuals with schizophrenia and those at risk for psychosis. However, none of these studies have specifically examined FP and OBE in relation to psychosis-risk and very little is known about the qualities of these experiences in the general population. Given the high prevalence of FP (Barnby & Bell, 2017; Barnby et al., 2023) and OBE (Pechey & Halligan, 2012) in the general population and their associations with psychosis-risk, it is important to elucidate the nature of this relationship and specify both risk and protective factors.

To specify the role of bodily self-disturbances in psychosis-risk in the general population and expand our understanding of the qualities of these experiences, we conducted three studies:

two online surveys (Studies 1a and 1b) and a laboratory-based experiment to investigate qualities of FP in individuals with schizophrenia (Study 2).

Study 1a aimed to investigate prevalence and qualities of FP and OBE to explore the relationship between FP, OBE, and psychosis risk. We also aimed to identify demographic and psychosocial factors (i.e., loneliness, trauma, resilience) that might contribute to self-disturbance, and to understand the role of self-disturbance in mental health. Study 1b aimed to replicate and expand the scope of Study 1a by examining FP experience and OBE in greater depth. In Study 2, we sought to expand our understanding of the qualities of FP experiences by implementing a novel mapping task. We asked individuals with schizophrenia and healthy control participants to localize sensations of their core self, loneliness, and (if they endorsed past experience of FP) sensed presence. We additionally mapped the locations of biological sensations (headache and hunger) to control for perception of typical physiological functions. Study 2 explored the use of a novel method of mapping self experiences to improve understandings of the bodily self.

Together, these three studies aim to analyze components of bodily self-disturbance in schizophrenia spectrum conditions.

2. STUDY 1a: ANOMALOUS BODILY SELF-EXPERIENCES AND PSYCHOSIS-RISK IN THE GENERAL POPULATION

Felt presence (FP) or sensed presence refers to the feeling that another person or social entity is present in the proximal environment in the absence of any sensory evidence to support this sensation (Barnby et al., 2023). FP has been construed as a form of autoscopic hallucination that may arise due to fundamental disruptions in the bodily self (Brugger et al., 1996; Blanke et al., 2014). FP experiences are not rare in the general population (Linszen et al., 2022; Barnby &

Bell, 2017). FP is often reported by solo mountaineers and voyagers, and during bereavement, sleep paralysis, and spiritual experiences (Barnby et al., 2023). Importantly, FP has also been reported by approximately 50% of early-psychosis patients (Alderson-Day et al., 2022) and there is a strong link between psychosis-proneness and anomalous self-experiences (Davidsen, 2009; Nelson et al., 2019; Benson & Park, 2019; Barbato et al., 2021; Benson et al., 2019; Linszen et al., 2022; Larøi et al., 2019; Blanke, 2004; Blackmore, 1982; Braithewaite et al., 2011). Another form of autoscopic hallucination known as out-of-body experience (OBE) is related to FP but diverges in an important way: OBE is a dissociative experience in which the self is disembodied, whereas in FP, the self is fully embodied. Although both OBE and FP are commonly observed in schizophrenia-spectrum conditions, there is a significant gap in the literature with respect to prevalence, demographic factors, psychosocial correlates, and relationship with mental health. Moreover, very little is known about the phenomenological characteristics of the FP experience. The principal goal of Study 1a was to elucidate the FP experience in the general population in relation with psychosis-risk.

2.1 Methods

2.1.1 Procedure

An anonymous survey was administered online via REDCap (Harris et al., 2009; Harris et al., 2019) and was disseminated to participants through social media (i.e., Twitter, Facebook, Reddit) and mass emailing lists. No identifying information was collected; the study was granted exempt status by the Vanderbilt University Institutional Review Board (IRB #201976). The

survey was available in English and was open to anyone aged 18 or older. On average, the survey took participants between 45 – 60 minutes to complete.

2.1.2 Participants

Two hundred twenty-eight participants completed the survey between October 2020 and June 2021. The final sample size for Study 1a was $N = 211$, after 17 participants were excluded for incomplete responses. A complete summary of the demographics based on the final sample can be found in Table 1.

Table 1. Demographics of participants in Studies 1a and 1b.

	Study 1a *N*=211		**Study 1b** *N*=165	
	Mean (years)	*SD*	*Mean (years)*	*SD*
Age	36.8	17.3	28.52	11.37
Education	16.8	2.8	12.27	2.52
	N	*% of sample*	*N*	*% of sample*
Gender				
Female	126	59.7%	96	58.2%
Male	76	36%	63	38.2
Other or Prefer NA	9	4.3%	6	3.6%
Race/Ethnicity				
White	120	56.9%	90	54.5%
Asian/Pacific Islander	44	20.9%	29	17.6%
Hispanic/Latino	15	7.1%	8	4.8%
Black	11	5.2%	15	9.1%
Multiethnic/multiracial	15	7.1%	16	9.7%
Other	6	2.8%	7	4.2%
Continent of Residence				
North America	172	81.5%	121	73.3%
Europe	27	12.8%	36	21.8%
Asia	6	2.8%	6	3.6%
Latin/Central America	3	1.4%	0	0%
Africa	2	1%	0	0%
Middle East	0	0%	2	1.2%
Endorsement of FP / OBE				
Total Endorsed FP	122	57.8%	79	47.9%
Only FP	*54*	*25.6%*	*32*	*19.4%*
Total Endorsed OBE	91	41.2%	72	43.6%
Only OBE	*24*	*11.4%*	*25*	*15.2%*
Endorsed Both FP and OBE	68	32.2%	47	28.5%
Psychosis-Risk Status				
High-Risk for Psychosis	62	29.3%	55	33.3%
Low Risk for Psychosis	145	68.7%	109	66.1%

Note. The "Other" Race/Ethnicity category includes individuals who identified as Native American or Middle Eastern/North African.

2.1.3 Self-Report Measures

General Demographic Information: Participants self-reported their age, years of education, gender identity, race/ethnicity, and country of residence. Participants also endorsed items indicating whether they had or had never experienced FP and/or OBE. Endorsement of at least one past experience of FP directed respondents to a second part of the survey, where they answered a series of questions about specific qualities of the FP experience (see below).

Psychosis-Risk: The Prodromal Questionnaire-16 item version (PQ-16; Ising, et al., 2012) was used to assesses psychotic-like experiences (PLE) and related distress. The PQ-16 asks participants to endorse up to 16 PLEs, and to rate accompanying distress for each endorsed PLE on a 4-point Likert scale. A score of 6 or more endorsements of PLE items on the PQ-16 classifies participants as at high-risk for psychosis (Ising, et al., 2012). We used this cut-off score to designate groups at low- and high-risk for developing psychosis.

Felt Presence: Participants who endorsed at least one past instance of FP completed the 16-item Sensed Presence Questionnaire (SenPQ; Barnby & Bell, 2017). Participants who did not endorse past FP experience did not complete the SenPQ. SenPQ assesses instance of FP experience, including a range of scenarios wherein a participant may experience FP. We added additional follow-up questions to each item about the frequency, degree of vividness, and distress associated with each of the 16 items; these follow-up items were rated using 5-point Likert scales and summed to create continuous subscales.

Mental Health: The 21-item Depression, Anxiety, and Stress Scale (DASS-21; Henry & Crawford, 2005) was used to gauge general mental health.

Social Disconnection: The 21-item UCLA Loneliness Scale (Russell, 1996) was included in the survey to assess perceived social isolation using 4-point Likert scales.

Trauma: The 10-item Brief Trauma Questionnaire (BTQ; Schnurr et al., 1999) was used to assess past instance of trauma, including assault, natural disaster, life-threatening illness, serious accident, and war among others.

Resilience: The 4-item Brief Resilient Coping Scale (BRCS; Sinclair & Wallston, 2004) was administered to captures adaptive coping under stressful situations using a 5-point Likert scale.

2.1.4 Assessing Qualities of Anomalous Bodily Experience

If participants endorsed at least one past experience of FP, they were directed to a second part of the survey with questions about specific qualities of the FP experience.

Physical Location of FP: A question about the physical location of FP in relation to the participant had nine response options: on the left side, right side, above, below, in front, behind, all around, nearby, and/or far away; participants were able to endorse as many or as few locations as they preferred. The number of endorsed locations was summed to yield a total number of FP Locations.

Sensations Associated with FP: Participants were also asked about internal physical sensations associated with FP, including nine sensations: blood rushing to the head, headache, dizziness, prickly sensations, changes in breathing or heartbeat, visual changes, changes in self-consciousness/awareness, hearing changes, and distortions in sense of time; participants could endorse as many or as few sensations as they chose. The number of endorsed sensations associated with FP was summed to create a variable reflecting the total number of Sensations Associated With FP.

Meaning of the FP: A question assessed the participant's understanding of FP's identity and/or meaning and included 13 response options: FP is a guide, the symptom of an illness, someone from the past, a bad spirit, a good spirit, an aura, representative of telepathic/mediumistic ability, a creature of the imagination, the result of trauma, the result of grief, the result of loneliness, the result of stress, or the result of lack of sleep. Again, participants were able to endorse as many or as few items as they preferred. The number of endorsed understandings/meanings of FP was summed to yield the total Number of Understandings/Meanings of FP.

Perceived Agency of the FP: Participants were asked to endorse whether or not the FP was known or familiar to them; whether the FP did or did not make physical contact with them; whether or not the FP moved; whether or not the FP made sounds; whether or not the FP communicated with them; whether the FP could be controlled by the respondent or not; and whether or not the FP could influence the participant. Participants were able to endorse as many or as few items as preferred. The number of endorsed items was summed to yield the total Perceived Agency of FP.

2.1.5 Statistical Analyses

All statistical analyses were performed using JMP Pro16. False discovery rate (FDR; Benjamini & Hochberg, 1995) of $p < .05$ was applied for multiple comparisons to correct for the occurrence of false positives (i.e., type I errors) without significantly decreasing power (Lindquist & Mejia, 2015).

Pairwise correlation analyses were performed to examine the strength and direction of associations between continuous variables of interest (i.e., PQ16 Total and Distress scores, UCLA Loneliness, BTQ, and BRCS totals) and continuous measures of FP experience (i.e.,

SenPQ subscale scores, Total FP Locations, Sensations During FP, Understandings/Meanings of FP, Perceived Agency of FP). ANOVAs were conducted to compare groups at high- versus low-risk for psychosis on measures of FP and psychosocial measures.

Independent *t*-tests were performed on endorsement (versus non-endorsement) of Perceived Agency of FP items and continuous variables of interest. Chi-square analyses were also performed to examine endorsement of specific items of Perceived Agency of FP and psychosis-risk status.

To determine potential differences between FP and OBE experiences, participants were split into groups based on endorsement of experience into FP Only ($n = 54$), OBE Only ($n = 24$), and Both FP and OBE ($n = 68$) groups. ANOVAs compared continuous variables of interest between groups and Chi-square analyses were performed to compare categorical variables of interest between groups.

2.2 Results

The majority of participants endorsed at least one past experience of FP, OBE, or Both FP and OBE (see Table 1); only 30% of the full sample did not endorse any anomalous bodily experience. Individuals who endorsed having Both FP and OBE had significantly more PLE ($F[2,143] = 14.28$, $p < .001$) and related distress ($F[2,143] = 6.97$, $p = .002$) compared to those who endorsed having FP Only or OBE Only. Further, PQ-16 Total endorsement and Distress scores were both significantly correlated with higher SenPQ frequency (PQ-16 Total: $r = 0.45$, $p < .001$; PQ-16 Distress: $r = 0.3$, $p < .001$), vividness (PQ-16 Total: $r = 0.48$, $p < .001$; PQ-16

Distress: $r = 0.28$, $p < .001$), and distress (PQ-16 Total: $r = 0.5$, $p < .001$; PQ-16 Distress: 0.48, $p < .001$) subscale scores.

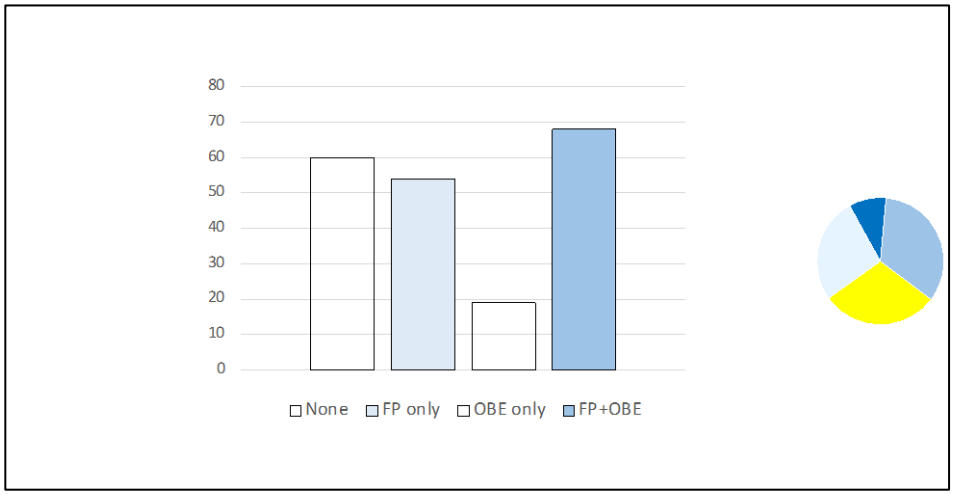


Figure 5. Number of participants who endorsed each experience.

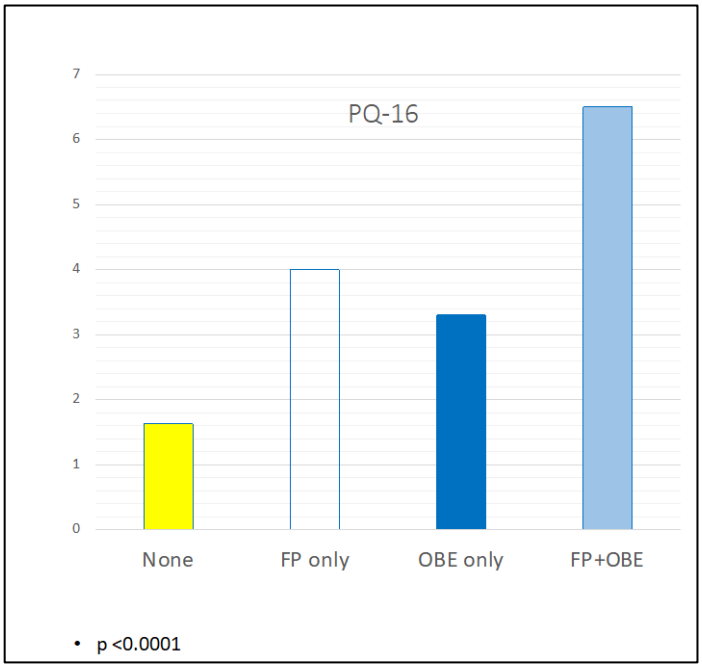


Figure 6. Psychosis-risk increases with more anomalous bodily experience.

Participants in the OBE Only group had significantly higher BTQ Trauma (F[2,137] = 3.62, p = .04) scores compared to individuals in the FP Only group. BTQ Trauma was significantly correlated with total endorsement of PLE on the PQ16 (r = 0.25, p < .001).

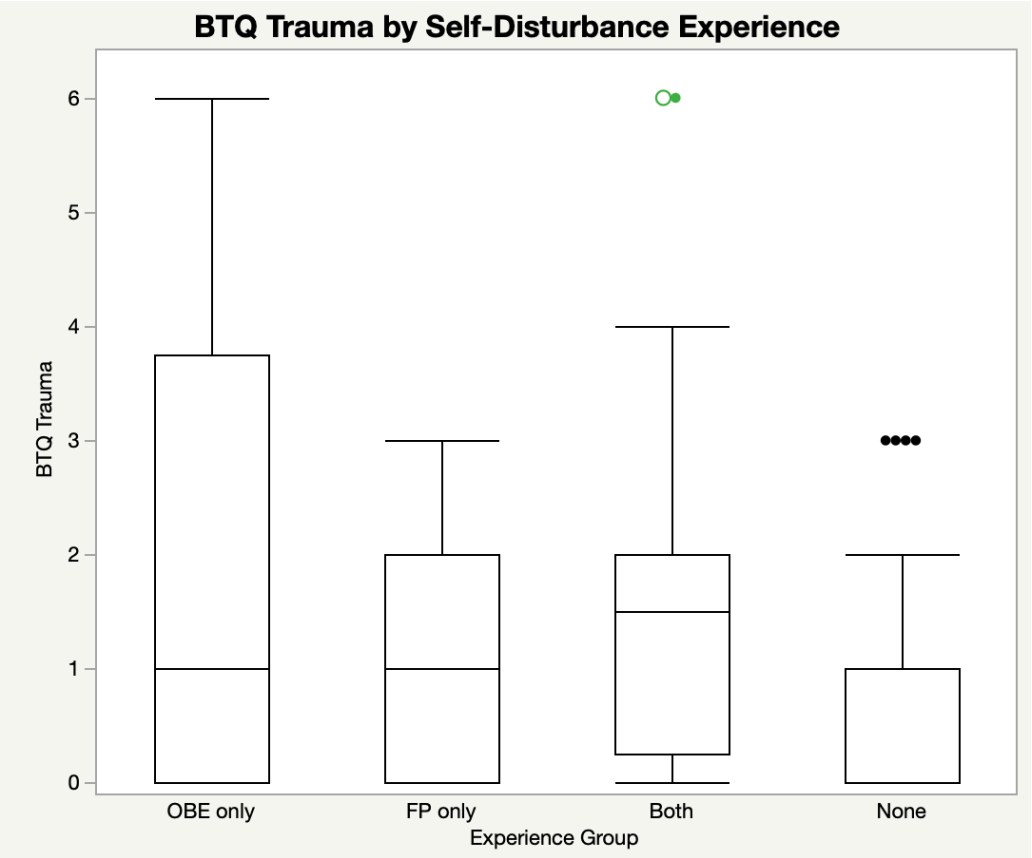


Figure 7. Study 1a BTQ Trauma by self-disturbance experience (OBE Only, FP Only, Both FP and OBE, or neither).

Respondents who endorsed FP Only had significantly higher UCLA Loneliness (F[2,138] = 10.62, p < .001) compared to the OBE Only group. This finding suggests that loneliness may drive the FP experience as a temporary solution to the problem of social isolation. If this is the case, then participants who reported having experienced FP would likely be more resilient compared to those who did not endorse FP. Indeed, respondents who endorsed FP Only were significantly more resilient than those who endorsed OBE Only (F[2,138] = 17.68, p < .001) and

those who did not endorse any anomalous bodily experience (F[3,196] = 12.4, p < .001) (see Figure 8).

UCLA Loneliness (r = 0.3, p < .001) and BRCS Resilience (r = 0.2, p = .005) were significantly correlated with greater endorsement of PLE. Notably, only UCLA Loneliness was also significantly correlated with PQ-16 Distress total score (r = 0.22, p = 0.002).

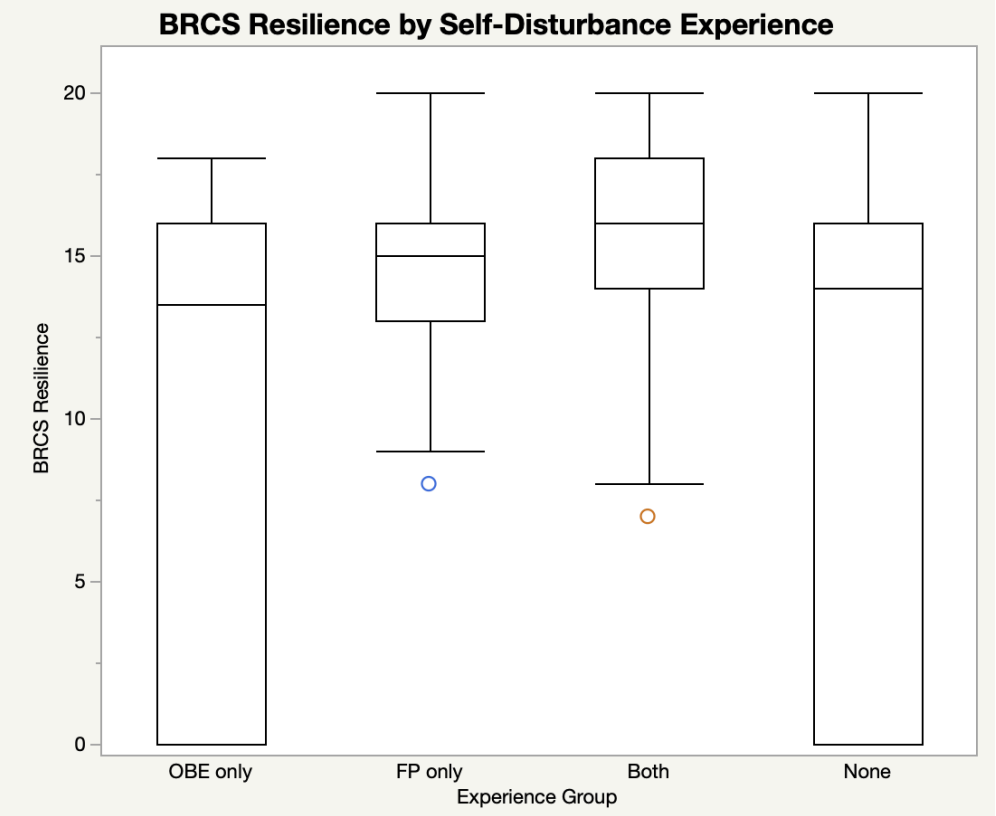


Figure 8. BRCS Resilience by self-disturbance experience (OBE Only, FP Only, Both FP and OBE, or neither).

There were no significant differences in DASS-21 mental health between experience groups (F[2,141] = 1.4, p = 0.2). However, individuals at high-risk for psychosis had significantly higher levels of depression, anxiety, and stress on DASS-21 (F[1,200] = 70.4, p < .001) compared to low-risk participants.

2.2.1 Qualities of FP

Pairwise Correlations: Total endorsement of PLE and related distress were both significantly correlated with more Total FP Locations (PQ-16 Total: $r = 0.38$, $p < .001$; PQ-16 Distress: $r = 0.25$, $p < .001$), greater Total Sensations Associated With FP (PQ-16 Total: $r = 0.45$, $p < .001$; PQ-16 Distress: $r = 0.35$, $p < .001$), and a higher total number of Understandings/Meanings of FP (PQ-16 Total: $r = 0.48$, $p < .001$; PQ-16 Distress: $r = 0.4$, $p < .001$).

ANOVA: When individuals at high-risk for psychosis were compared to low-risk, Total FP Locations ($F[1,206] = 12.3$, $p = .001$), Total Sensations Associated With FP ($F[1,206] = 21.4$, $p < .001$), and Total Understandings/Meanings of FP ($F[1,206] = 22.4$, $p < .001$) were elevated in high-risk participants (see Figure 9). There were no significant differences between high-risk and low-risk groups in Total Perceived Agency of FP ($F[1,107] = 2.84$, $p = .09$); however, endorsement that the FP made sounds was significantly related to higher total endorsement of PLE ($t[30] = 2.5$, $p = .02$) and greater related distress ($t[30] = 2.18$, $p = .04$).

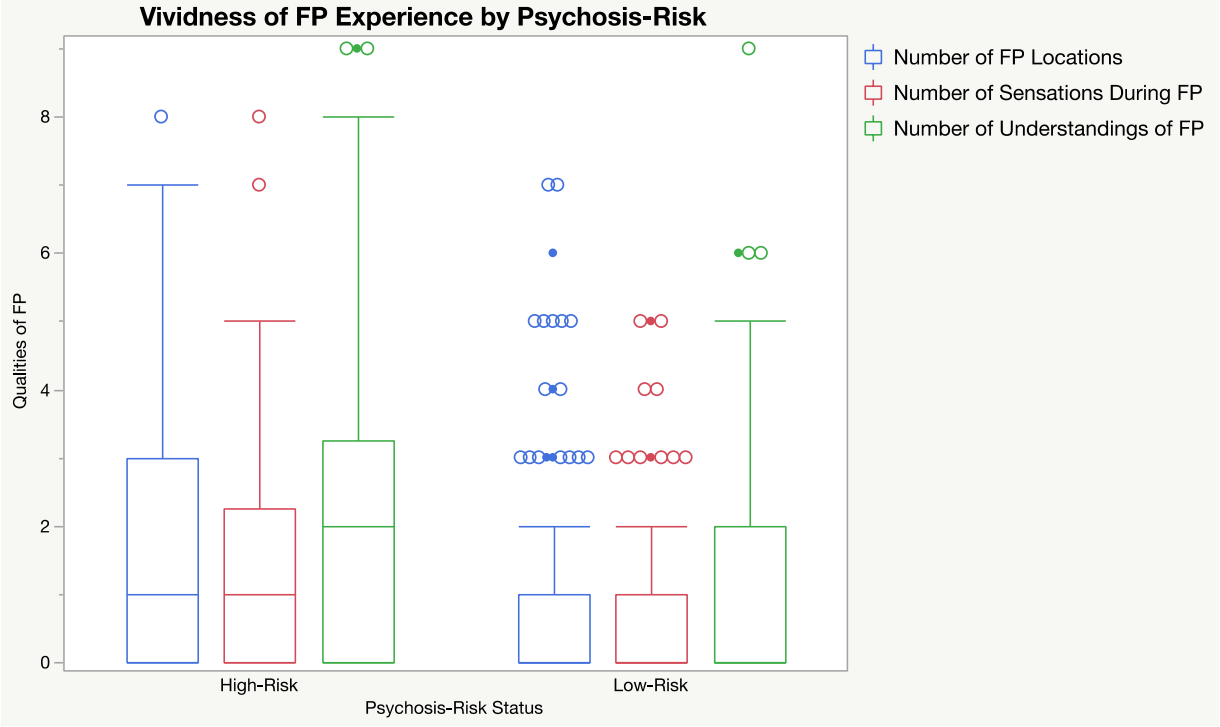


Figure 9. Comparison of Total FP Locations, Sensations During FP, and Understandings/Meanings of FP between individuals at high-risk for psychosis and those at low-risk in Study 1a.

Relationships to Psychosocial Factors: UCLA Loneliness was associated with Total FP Locations ($r = 0.22$, $p = .002$), Sensations Associated With FP ($r = 0.16$, $p = .02$), and Understandings/Meanings of FP ($r = 0.2$, $p = .005$); higher loneliness scores were also significantly linked with elevated SenPQ frequency ($r = 0.16$, $p = .03$), vividness ($r = 0.17$, $p = .02$), and distress ($r = 0.17$, $p = .02$). UCLA Loneliness was not significantly correlated with Total Perceived Agency of FP ($r = 0.06$, $p = .55$).

BRCS Resilience was similarly significantly related with Total FP Locations ($r = 0.26$, $p < .001$), Sensations Associated With FP ($r = 0.16$, $p = .02$), and Understandings/Meanings of FP ($r = 0.22$, $p = .002$), as well as SenPQ frequency ($r = 0.26$, $p < .001$), vividness ($r = 0.3$ $p < .001$), and distress ($r = 0.2$. $p = .004$) subscales. BRCS Resilience was not significantly correlated with Total Perceived Agency of FP ($r = 0.007$, $p = .95$).

BTQ Trauma was significantly correlated with Total Understandings/Meanings of FP (r = 0.2, p = .003) but was not related to Total FP Locations (r = 0.14, p = .06) or Sensations Associated With FP (r = 0.12, p = .09). BTQ trauma was significantly associated with SenPQ frequency (r = 0.17, p = .02), vividness (r = 0.25, p < .001), and distress (r = 0.24, p < .001) subscale scores. Further, BTQ Trauma was significantly correlated with Total Perceived Agency of FP (r = 0.22, p = .02).

DASS-21 mental health was significantly correlated with Total Sensations Associated With FP (r = 0.17, p = .01) and Understandings/Meanings of FP (r = 0.21, p = .002), but not with Total FP Locations (r = 0.13, p = .06). DASS-21 mental health was also significantly associated with SenPQ distress (r = 0.24, p < .001), but not frequency (r = 0.08, p = .25) or vividness (r = 0.08, p = .26). DASS-21 was also not significantly associated with Perceived Agency of FP (r = 0.006, p = .95).

2.3 Discussion

Both FP and OBE were elevated among individuals at high-risk for psychosis. This finding is consistent with previous studies (Benson et al., 2019; Barbato et al., 2021; Benson & Park, 2019; Davidsen, 2009). Furthermore, the experience of FP in the high-risk group was more vivid across all dimensions: including increased sensory experience during FP, perception that FP occupied more locations, and elevated audibility of FP. In addition, participants at high-risk for psychosis reported FP as more emotionally salient, vivid, and distressing (findings from SenPQ subscales). These results suggest that FP is more likely to be experienced as a social ‘other’ in the group at high-risk for psychosis.

Loneliness, resilience, and trauma play significant roles in self-disturbance among the group at high-risk for psychosis. Loneliness and resilience were associated with the experience of FP, while trauma was associated with endorsement of OBE. These results align with previous findings that loneliness precipitates greater instance of social hallucinatory experiences in the general population (Brederoo et al., 2023; Butter et al., 2017; Le et al., 2019). Conversely, increased social activity has been shown to promote resilience (Ji et al., 2022) and resilience has been shown to reduce loneliness (Jakobsen et al., 2020). Taken together, these findings suggest that FP may arise as an adaptive (resilient) response to loneliness, supporting a central argument of the Social Deafferentation Hypothesis that false detection of social agents is an adaptive response to social disconnection (Hoffman, 2007). Furthermore, loneliness and resilience were also associated with more frequent experience of FP as well as detection of FP over more locations, greater sensory experience during FP, and more meaning-laden experiences of FP. These findings are in line with previous work highlighting the link between social interaction and improved bodily awareness and multisensory integration (Arnold et al., 2019; Pellencin et al., 2018). Perhaps, for the high-risk group, the generation of social 'other' (i.e., FP) is adaptive both in addressing loneliness and improving sense of bodily self.

In sum, we found evidence for increased prevalence of vivid FP experience among individuals at high-risk of developing psychosis. However, online studies have limitations and are difficult to interpret in a clinical context. Therefore, we conducted a second study with the aim of furthering understandings of the role of FP in the schizophrenia spectrum population. Study 1b sought to replicate the results of the first study in an additional sample and examine additional qualities of FP and OBE in relation to psychosis-risk.

3. STUDY 1b: FELT PRESENCE AT HIGH PSYCHOSIS RISK IN THE GENERAL POPULATION

Occurrence of FP experience has been observed across the schizophrenia spectrum, including at sub-clinical and clinical thresholds (Barnby et al., 2023). A foundational component of schizophrenia-spectrum conditions is disruption in sense of bodily self (Burgin et al., 2022; Benson et al., 2019; Nelson et al., 2012; Brent et al., 2014). Given FP's roots as an autoscopic hallucination that may arise due to fundamental disruptions of the bodily self (Brugger et al., 1996; Blanke et al., 2014), qualities of the FP experience in psychosis-risk merit further exploration. Similarly, qualities of OBE in schizophrenia-spectrum conditions warrant additional study, considering OBE is another autoscopic hallucination that involves disembodiment from the self. Study 1b aimed to replicate the findings from Study 1a and secondarily sought to examine additional qualities of FP and OBE in individuals at high-risk for psychosis.

3.1 Methods

3.1.1 Procedure

Data were collected via an anonymous, online survey hosted on the platform REDCap. Study 1b was advertised on social media platforms (i.e., Twitter, Facebook, Reddit) and mass emailing lists. Anyone aged 18 or older was eligible to take the survey, which was available in English. The survey took an average of 45 – 60 minutes to complete. Since the study did not collect identifying information, the survey was granted exempt status by the Vanderbilt University Institutional Review Board (IRB #212181).

3.1.2 Participants

A total of 229 participants participated in the survey between November 2021 and November 2022. The final sample size for Study 2 was $N = 165$, after 64 participants were excluded for incomplete or duplicate responses. A complete summary of the demographics based on the final sample can be found in Table 1.

Of our sample, 62.4% reported at least one past or current psychiatric diagnosis; this is consistent with current self-reported prevalence among U.S. adults, which is higher than clinician-reported diagnostic prevalence (National Institute of Mental Health, 2023). A full breakdown of the self-reported prevalence of each psychiatric disorder is included in Appendix A. As the study did not collect identifying information, there was no way to verify psychiatric diagnosis.

3.1.3 Self-Report Measures

General Demographic Information: Participants self-reported their age, years of education, gender identity, race/ethnicity, and country of residence. Similar to Study 1a, participants also endorsed items indicating whether they had or had never experienced FP and/or OBE. Endorsement of at least one past experience of FP directed respondents to a second part of the survey, where they answered a series of questions about specific qualities of the FP experience (see below).

Psychosis Risk: As in Study 1, participants completed The Prodromal Questionnaire-16 (PQ-16; Ising et al., 2012) to assess psychosis risk.

Felt Presence: The 16-item Sensed Presence Questionnaire (SenPQ; Barnby & Bell, 2017) was again administered and maintained additional subscales from Study 1 assessing frequency, vividness, and distress associated with each item. In Study 1b, we introduced a

subscale to evaluate positive feelings associated with each item (using a 5-point Likert scale to match the other subscales).

Mental Health: The 21-item Depression, Anxiety, and Stress Scale (DASS-21; Henry & Crawford, 2005) was again used to gauge general mental health.

Social Disconnection: The 21-item UCLA Loneliness Scale (Russell, 1996) was again used to determine degree of loneliness.

Trauma: The 10-item Brief Trauma Questionnaire (BTQ; Schnurr et al., 1999) was administered again to evaluate past instance of trauma.

Resilience: The Brief Resilient Coping Scale (BRCS; Sinclair & Wallston, 2004) was again used to assess resilience.

3.1.4 Qualities of Anomalous Bodily Experience

Participants endorsed past experience of FP and/or OBE. Endorsement of at least one past experience again directed respondents to additional questions about the qualities of the experience, including Physical Location of FP, Sensations Associated with FP, Understandings/Meanings of FP, and Perceived Agency of FP (see Study 1a).

In addition to these measures, Study 1b included several new questions about qualities of anomalous bodily experience as follows:

Social Situations in Which FP Occurs: Participants were asked to endorse up to six response options describing social situations in which FP occurs: alone, with strangers, with loved ones, when people enter a room, when people leave a room, or another social situation; participants were invited to endorse as many or as few responses as they preferred. The total number of social situations in which participants experienced FP was summed to create a variable of Total Social Situations in Which FP Occurs.

Sensory Input From FP: Respondents were asked to report up to four perceptual sensations occurring with the FP: I can feel FP move, I can feel FP touch me, I can smell FP, and I can hear FP; participants were able to endorse as many or as few responses as they chose. The total number of external sensory inputs endorsed by a participant was summed to create total Sensory Input From FP.

Qualities of OBE: To better assess qualities of OBE, an abbreviated version of the Benson et al., Body Disturbances Inventory (B-BODI; Benson et al., 2019) was added. Four items were included from the original B-BODI: (1) "I have had an 'out of body' experience during which my mind seems to, or actually has, left my body," (2) "My soul sometimes leaves my body," (3) "I have had the feeling of the presence of another being, even though nobody was there," and (4) "I have experienced or seen my 'doppelgänger' or 'double'." As on the original B-BODI, participants rated the frequency, vividness, and distress associated with each item. An additional subscale was added, rating the degree of positivity for each item. Each subscale was rated on a 5-point Likert scale.

3.1.5 Statistical Analyses

The same statistical analyses were performed (Pairwise correlations, One-way ANOVAs, Chi-squares, and Independent *t*-tests) as in Study 1a. FDR of $p < .05$ was applied for multiple comparisons.

Pursuant with Study 1a, in Study 1b, participants were divided into three groups based on endorsement of experience into FP Only ($n = 32$), OBE Only ($n = 25$), and Both FP and OBE ($n = 47$) groups. One-way ANOVAs again compared continuous variables of interest between groups and Chi-square analyses again compared categorical variables of interest between groups.

3.2 Results

Participants who endorsed Both FP and OBE had significantly higher PQ-16 Total (F[2,102] = 6.9, p = .01) and PQ-16 Distress (F[2,102] = 6.7, p = .01) scores compared to those who reported FP Only or OBE Only. Furthermore, there were significantly more high-risk participants in the FP Only and Both FP and OBE groups compared to OBE Only (X^2[2,103] = 6.16, p = .04) (Figure 10).

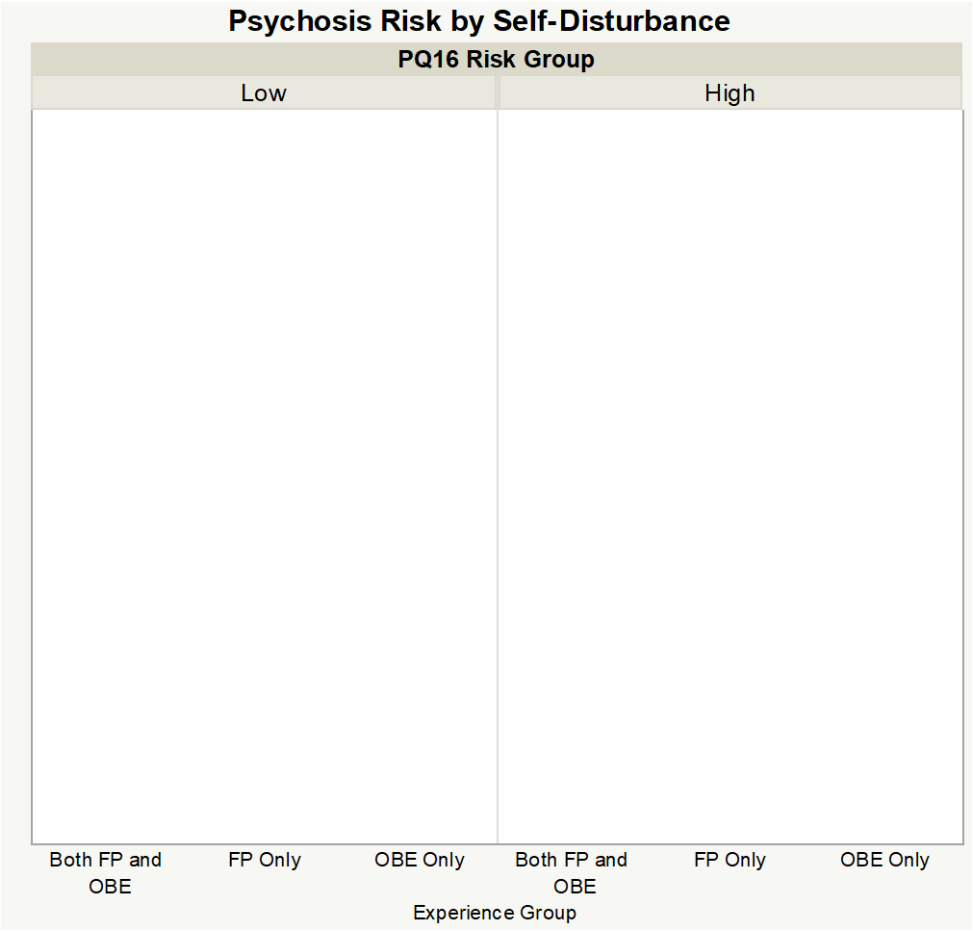


Figure 10. Psychosis-risk status by self-disturbance experience group.

Study 1a findings that the FP Only group had significantly higher UCLA Loneliness and BRCS Resilience compared to the OBE Only group did not hold. However, the finding that participants in the OBE Only group had significantly more BTQ Trauma compared to individuals in the FP Only group (F[2,102] = 3.5, p = .03) was consistent with Study 1a.

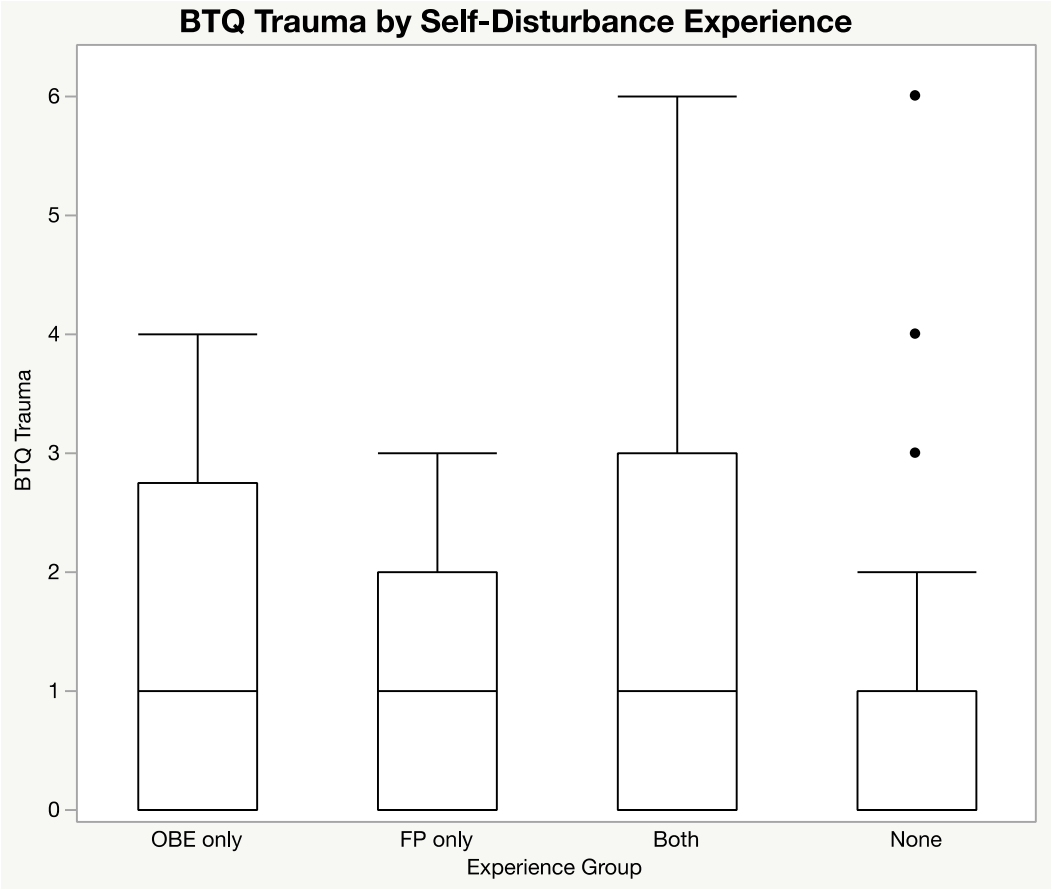


Figure 11. Study 1b BTQ Trauma by self-disturbance experience (OBE Only, FP Only, Both FP and OBE, or neither).

In Study 1a, UCLA Loneliness, BRCS Resilience, and BTQ Trauma were all also significantly correlated with endorsement of PLE, and loneliness was also significantly correlated with related distress. By contrast, in Study 1b, UCLA Loneliness (r = 0.3, p = .003) and BTQ Trauma (r = 0.26, p < .001) were both significantly associated with total PLE, as well

as related distress (UCLA Loneliness: $r = 0.33$, $p < .001$; BTQ Trauma: $r = 0.24$, $p = .002$). Interestingly, in Study 1b, BRCS Resilience was positively correlated with BTQ Trauma ($r = 0.27$, $p < .001$) but inversely correlated with UCLA Loneliness ($r = -0.25$, $p = .01$).

As in Study 1a, there were no significant differences in DASS-21 mental health between experience groups ($F[2,70 = 0.36$, $p = 0.7]$, but individuals at high-risk for psychosis had significantly higher levels of depression, anxiety, and stress on DASS-21 ($F[1,102] = 18.8$, $p < .001$) compared to low-risk participants.

3.2.1 Qualities of FP

Pairwise Correlations: PQ-16 Total and PQ-16 Distress were significantly correlated with more Social Situations in Which FP Occurs (PQ-16 Total: $r = 0.34$, $p = .002$; PQ-16 Distress: $r = 0.35$, $p = .008$).

ANOVA: When individuals at high-risk for psychosis were compared to low-risk, SenPQ frequency ($F[1,156] = 39.1$, $p < .001$), vividness ($F[1,156] = 36$, $p < .001$), and distress ($F[1,156] = 44.4$, $p < .001$) subscales were elevated in high-risk participants. In addition, high-risk respondents had significantly higher SenPQ positivity subscale scores ($F[1,156] = 21.6$, $p < .001$) suggesting that their experience of FP was also emotionally positive despite the fact that they also endorsed higher distress.

Further, the group at high-risk for psychosis had significantly more total FP Locations ($F[1,78] = 7.4$, $p = .01$), more Sensations Associated With FP ($F[1,78] = 4.96$, $p = .04$), and a higher number of Understandings/Meanings of FP ($F[1,78] = 11.5$, $p = .002$) (Figure 12). Study 1b analyses additionally revealed that high-risk participants endorsed significantly more Sensory Input From FP ($F[1,78] = 11.3$, $p = .002$) and Perceived Agency of FP ($F[1,78] = 8.38$, $p = .005$) than low-risk individuals; the significance of Perceived Agency of FP was driven by elevated

endorsement that FP moves (X^2[1,79] = 3.9, p = .04), makes physical contact (X^2[1,79] = 7, p = .008), and makes sounds (X^2[1,79] = 5.27, p = .02) in the high-risk group.

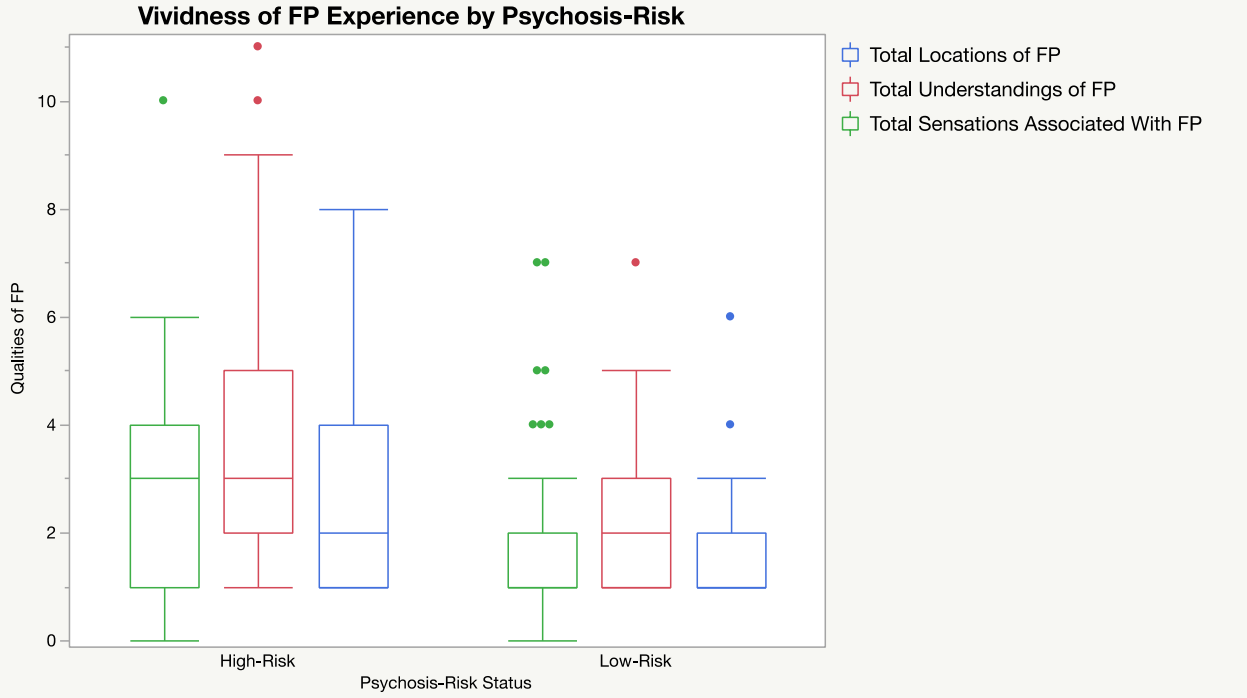


Figure 12. Comparison of Total FP Locations, Sensations During FP, and Understandings/Meanings of FP between individuals at high-risk for psychosis and those at low-risk in Study 1b.

Relationship to Psychosocial Factors: Results examining UCLA Loneliness, BRCS Resilience, BTQ Trauma, and DASS-21 were not consistent with findings from Study 1a. In Study 1b, BTQ Trauma alone was related to more Total FP Locations (r = 0.27, p = .01), while BTQ Trauma and DASS-21 were the only psychosocial variables significantly correlated with Total Sensations Associated With FP (BTQ: r = 0.25, p = .02; DASS-21: r = 0.43, p = .001), and a higher number of total Understandings/Meanings of FP (BTQ: r = 0.31, p = .005; DASS-21: r = 0.61, p < .001). Furthermore, only BTQ Trauma was significantly associated with higher scores on the SenPQ frequency (r = 0.25, p = .001), vividness (r = 0.31, p < .001), and distress (r

= 0.33, $p < .001$) subscales, as well as the added positivity subscale ($r = 0.23$, $p = .003$). None of the psychosocial variables were significantly correlated with Perceived Agency of FP.

3.2.2. Qualities of OBE (2 Items From the B-BODI)

Study 1b added items from the B-BODI (Benson et al., 2019) to assess endorsement, frequency, vividness, distress, and positivity of two OBE experiences: (1) "I have had an 'out of body' experience during which my mind seems to, or actually has, left my body" and (2) "My soul sometimes leaves my body." Subscale scores were summed across these two items.

When individuals at high-risk for psychosis were compared to those at low-risk, overall endorsement of OBE ($F[1,97] = 8.12$, $p = .005$) was elevated in the high-risk group. Total OBE frequency ($F[1,38] = 0.8$, $p = .37$), vividness ($F[1,38] = 1.6$, $p = .21$), distress ($F[1,38] = 1.3$, $p = .3$), and positivity ($F[1,38] = 1.9$, $p = .18$) were not significantly different between psychosis risk groups.

Overall endorsement of OBE was also significantly correlated with DASS-21 ($r = 0.3$, $p = .003$) and BTQ Trauma ($r = 0.33$, $p < .001$), but not UCLA Loneliness ($r = 0.15$, $p = .15$) or BRCS Resilience ($r = 0.1$, $p = .36$). DASS-21 alone was additionally correlated with OBE frequency ($r = 0.34$, $p = .04$).

3.3 Discussion

The results of Study 1b replicated several key findings from Study 1a. Both studies demonstrated that FP and OBE are elevated with PLE and related distress. In both studies, individuals at high-risk for psychosis reported FPs that were more vivid and salient across all

dimensions. We also replicated the significant associations between loneliness, resilience, trauma, and psychosis risk. These results align with previous findings (Alderson Day, 2022).

A key finding that emerged in Study 1b centers around the role of trauma. We observed significant relationships between trauma and aspects of the FP experience and OBE. Firstly, trauma was associated with increased psychosis-risk. Moreover, vividness of FP experience and incidence of OBE were associated with trauma. These findings suggest that trauma may precipitate self-disturbance in general; trauma has been noted as a significant predictor of psychosis-risk (van Os et al., 2009; Janssen et al., 2003; Read et al., 2001) and additional evidence suggests a strong connection between trauma and anomalous bodily experience (Lanius et al., 2020; Rabeyron & Loose, 2015; Lanius et al., 2015; Frewen et al., 2020), including OBE and dissociative experiences in general (Mudgal et al., 2021; Bünning & Blanke, 2005; Lanius et al., 2015).

In sum, results of Studies 1a and 1b reinforce the link between self-disturbance and psychosis-risk. In particular, some previous evidence has suggested that perception of an external social agent improves sense of bodily self (Thirioux et al., 2016; Tajadura-Jiménez et al., 2012), suggesting that FP may be an adaptive experience for individuals on the schizophrenia spectrum. Further, there is evidence that sensing 'other' in the proximal environment can help restore the boundary between self and other, strengthening one's sense of the bodily self (Lee et al., 2021). Findings from Studies 1a and 1b seem to support this evidence.

However, there are caveats to these survey studies. Primarily, reliance on self-reports and a lack of observational data, as well as no inclusion of individuals with a verified schizophrenia diagnosis limit generalizability. Therefore, qualities of bodily self-disturbance need to be examined among individuals with a verified schizophrenia diagnosis as well as healthy control

subjects. In addition, the nature of self-disturbance is such that it has been challenging to assess and quantify these internal and very personal experiences. This lack of measurement tools presents a major barrier; in order to make significant progress beyond self-reports, it is necessary to develop valid methods. So, the aim of Study 2 was twofold: to examine self-disturbance in participants with schizophrenia and to test the feasibility of a new tool to study qualities of self-disturbance. Whilst we obtained information about locations and qualities of FP in Studies 1a and 1b, the topographical relationship of FP to the bodily self is still not well-understood. Therefore, we conducted an exploratory study to visualize the topography of sensations that are central to the construction of the bodily self: the core self, loneliness, (if past experience of FP was endorsed) sensed presence, and two biological sensations (headache and hunger) to control for typical physiological perception.

4. STUDY 2: TOPOGRAPHY OF FELT PRESENCE IN SCHIZOPHRENIA

Previous work examining qualities of FP and OBE in psychosis has noted the importance of spatial qualities of the experience in relation to the bodily self; for instance, disembodiment of the self during OBE (Stanghellini, 2009; Irarrázaval, 2015; de Boer et al., 2020) and ambiguous spatial location of FP (Barnby et al., 2023). However, the specific topography of sensations related to self-disturbance is not currently known. Furthermore, despite documented disruptions in sense of bodily self in psychosis (Sass & Parnas, 2003; Park & Baxter, 2022; Moe & Docherty, 2014), the topography of sensations that are central to the construction of the bodily self in psychosis are also not currently well-known.

In order to explore these questions, a novel paper-and-pencil mapping task adapted from the emBODY paradigm (Hietanen et al., 2016) was implemented for Study 2. The emBODY task

has successfully been used to measure disruptions in emotional embodiment among individuals with schizophrenia across cultures (Torregrossa et al., 2019b; Lee et al., 2022; Hong et al., 2017). In the present study, we developed a method to explore topographical locations of FP, loneliness, core sense of self, and common physiological sensations (hunger and headache) in relation to physical representations of the body.

Past research has demonstrated comparable topography of physiological sensations (i.e., headache, nausea) between individuals with schizophrenia and healthy control participants (Lee et al., 2022), despite variable interoceptive signal detection observed across the schizophrenia spectrum (Torregrossa et al., 2019a; Torregrossa et al., 2022; Barbato et al., 2021). Previous findings also suggest that the topography of loneliness (in the chest and abdomen) is similar between individuals with schizophrenia and healthy control subjects, despite attenuated embodiment of loneliness in schizophrenia (Lee et al., 2022). While disembodiment of the self (i.e., OBE) has also been observed in psychosis (Stanghellini, 2009; Irarrázaval, 2015; de Boer et al., 2020; Thakkar et al., 2011), the perceived location of the self in schizophrenia is not currently well-understood. Similarly, qualitative reports of FP in psychosis have described ambiguous spatial locations of the presence, despite the FP often having a clear identity and salient emotional meaning (Barnby et al., 2023), but the topography of FP in schizophrenia-spectrum conditions is not presently well-understood. Study 2 was an exploratory study that aimed to examine the topography of sensations essential to the construction of the bodily self, including the core self, loneliness, FP, and two biological sensations (headache and hunger) controlling for typical physiological perception.

4.1 Methods

4.1.1 Participants

Thirteen participants with schizophrenia (SZ) were recruited from a community mental health center in Nashville, TN. All individuals with schizophrenia were taking antipsychotic medication. Thirty-nine healthy control participants (CO) were recruited from the same community. The Structured Clinical Interview for DSM-5 (SCID-5RV; First et al., 2015) was administered to verify diagnostic status for SZ and to confirm that CO did not have any DSM-5 disorders. For both groups, exclusion criteria included 1) history of head injury or seizure, 2) current/past neurological disease, and 3) current problematic substance use. For CO, current or past use of antipsychotic medications was also grounds for exclusion. Data from 13 SZ and 39 CO were analyzed as part of Study 2. All participants provided written informed consent prior to assessment and were paid after completing all study procedures, as approved by the Vanderbilt Institutional Review Board (IRB #200629). Demographic and clinical information is summarized in Table 2.

Table 2. Demographics of participants in Study 2.

	Total *N* = 52	**CO** *n*=39	**SZ** *n*=13
	Mean (*SD*)	*Mean* (*SD*)	*Mean* (*SD*)
Age (yrs)*	29.9 (12.75)	25.3 (7.9)	44.1 (14.3)
Education (yrs)*	14.4 (1.9)	14.8 (1.6)	12.9 (1.9)
	n (%)	*n (%)*	*n (%)*
Gender			
Male	23 (44.2%)	15 (38.5%)	8 (61.5%)
Female	29 (55.8%)	24 (61.5%)	5 (38.5%)
Race/Ethnicity			
Black	14 (26.9%)	6 (15.4%)	8 (61.5%)
Asian	15 (28.8%)	14 (35.9%)	1 (7.7%)
Latino	4 (7.7%)	4 (10.3%)	0 (0%)
White	21 (40.4%)	17 (43.6%)	4 (30.8%)
Middle Eastern	1 (1.9%)	1 (2.6%)	0 (0%)
Psychosis Syndrome			
		Mean (*SD*)	*Mean* (*SD*)
	PQ-16 Total	2.6 (2.3)	N/A
	PQ-16 Distress	2.5 (2.8)	N/A
	BPRS	N/A	30.5 (14.3)
	SAPS	N/A	32.5 (20.5)
	SANS	N/A	35.8 (13.9)
Antipsychotic Medication			
Chlorpromazine Equivalent Dose (mg)		N/A	199.6 (188.7)

Note. Race/ethnicity categories include participants who endorsed more than one race/ethnicity.
* Participants in the SZ group had significantly older age ($t[50] = 5.9$, $p < .001$) and more years of education ($t[50] = -3.5$, $p < .001$) compared to those in the CO group.
Note. All SZ participants were medicated. Antipsychotic dosage was converted to chlorpromazine (CPZ) equivalent following guidelines provided by Andreasen et al. (2010); *One participant was on Vraylar (generic: Cariprazine), which does not currently have a known CPZ equivalent, therefore, this participant's medication dose was not included.

4.1.2 Measures

Psychosis Symptoms and Risk: For SZ, the Brief Psychiatric Rating Scale (BPRS; Overall & Gorham, 1962), the Scale for the Assessment of Positive Symptoms (SAPS; Andreasen, 1984), and the Scale for the Assessment of Negative Symptoms (SANS; Andreasen, 1989) were administered to assess current symptoms and corresponding severity. CO completed

the PQ-16 (Ising et al., 2012). In total, 5 CO participants met criteria as high-risk for psychosis on the PQ-16; removing them from statistical analyses did not significantly change results, so these participants were included in the sample.

Felt Presence: The 16-item Sensed Presence Questionnaire (SenPQ; Barnby & Bell, 2017) was administered to evaluate instance of FP experience.

Trauma: The 10-item Brief Trauma Questionnaire (BTQ; Schnurr et al., 1999) was used to evaluate past instance of trauma.

Resilience: The 4-item Brief Resilient Coping Scale (BRCS; Sinclair & Wallston, 2004) was administered to assess adaptive coping.

Interoceptive Awareness: A measure of interoception was included to assess participants' awareness of bodily sensations, since they were asked to map specific bodily sensations. The Multidimensional Assessment of Interoceptive Awareness, Version 2 (MAIA-2; Mehling et al., 2018) is self-report questionnaire that asks participants to rate their degree of agreement with 37 items on a 6-point Likert scale (where 0 = Never and 5 = Always). Scores on the MAIA-2 are divided into eight subscales assessing various aspects of interoceptive awareness. The Noticing subscale reflects conscious awareness of uncomfortable, comfortable, and neutral body sensations. The Not-Distracting subscale measures tendency not to ignore or distract from sensations of pain or discomfort. The Not-Worrying subscale captures tendency not to worry or experience emotional distress in relation to sensations of pain or discomfort. The Attention Regulation subscale reflects ability to sustain and control attention to bodily sensations. The Emotional Awareness subscale assesses awareness of the connection between bodily sensations and emotional states. The Self-Regulation subscale measures ability to regulate distress by

attention to bodily sensations. The Body Listening subscale captures active listening to the body for insight. The Trusting subscale reflects experience of one's body as safe and trustworthy.

4.1.3 Mapping Task Procedure

Participants were given an HB #2 graphite pencil and asked to color the locations in or around a gender-neutral body outline on letter size paper (21.6x28cm) where they felt a given sensation. There were five total conditions: two control conditions (headache and hunger), loneliness, core self, and FP. For example, in the core self condition, the instructions specified: "Please color where you feel the core of your self is located." Each condition included four body outlines from different perspectives: one body outline from the front view, one body outline from the back view, one body outline from the left-side view, and one body outline from the right-side view (Figure 4). Each outline was abstract and two-dimensional to lower the cognitive load of this task. Front and back view body outlines measured 15.3cm tall; both side view body outlines measured 15.45cm tall. Each body outline was centered within a 19x21cm box. Participants were instructed that they were able to color in any area within the box, whether it was inside or outside of the body outline.

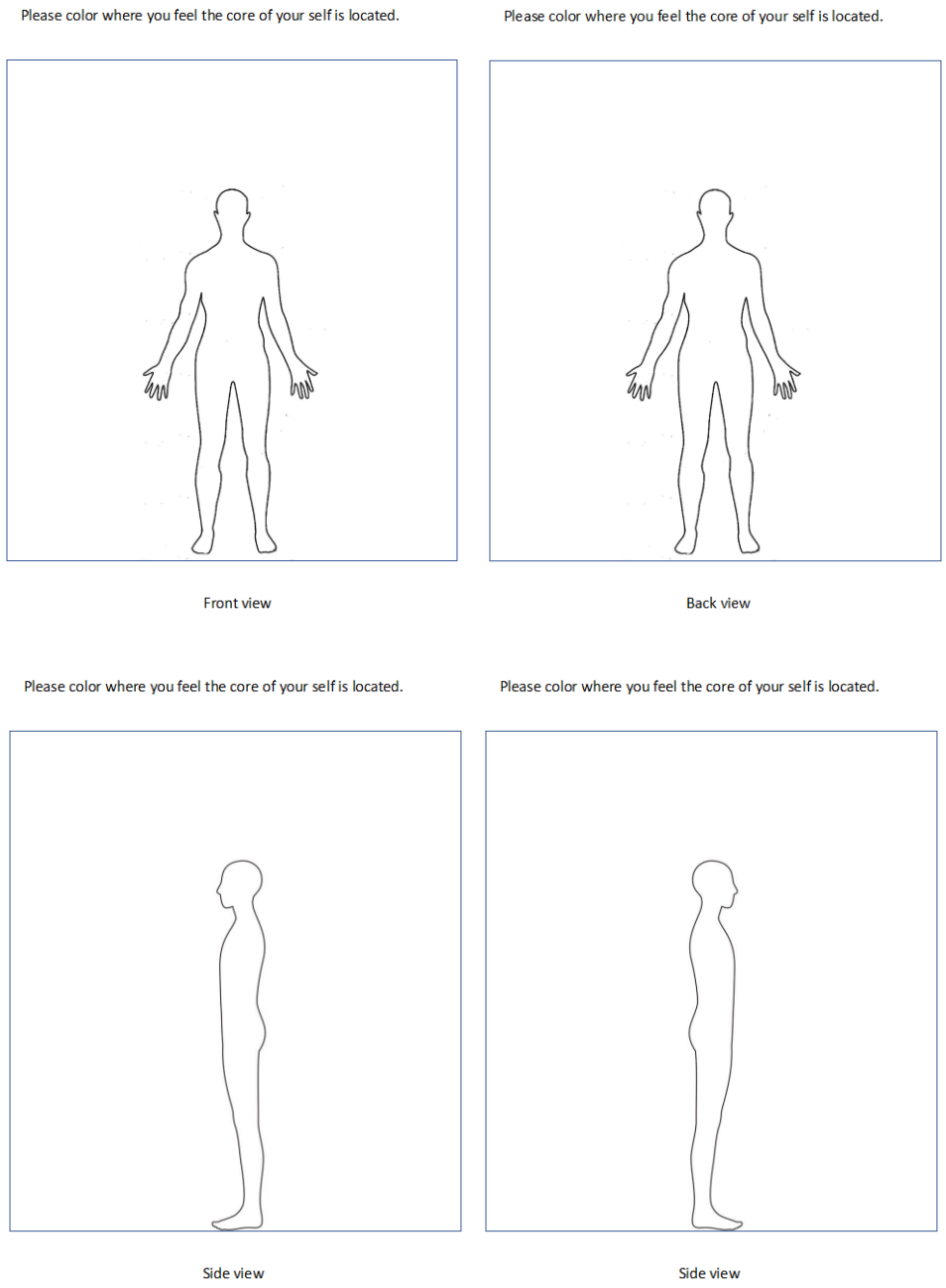


Figure 13. The core self condition of the mapping task demonstrating front, back, left-, and right-side body views.

4.1.4 Analyses of Mapping Task Data

We recorded endorsement of each location inside the body or outside the body, and location of endorsement across body views. For scoring, front and back body outlines were divided into defined into 11 regions: head, neck, chest, abdomen, upper arms, lower arms, hands,

pelvic region, upper legs, lower legs, and feet. Since the side body view outlines did not include defined hands, side body view outlines were divided into 10 regions: head, neck, chest, abdomen, upper arms, lower arms, pelvic region, upper legs, lower legs, and foot (Figure 5). To calculate density, endorsement of each bodily region was counted as one point per body view, such that, in a given condition, endorsement of one region on front, back, left-, and right-side views counted for a total of four points. For example, in the loneliness condition, if a participant colored in the chest on the front, left-, and right-side views (but not the back view), this would be calculated as three points for loneliness in the chest. A higher number of endorsements in each given region across body views conveys more salient or dense embodiment in that region. Yes/no endorsement of any region outside the body was scored.

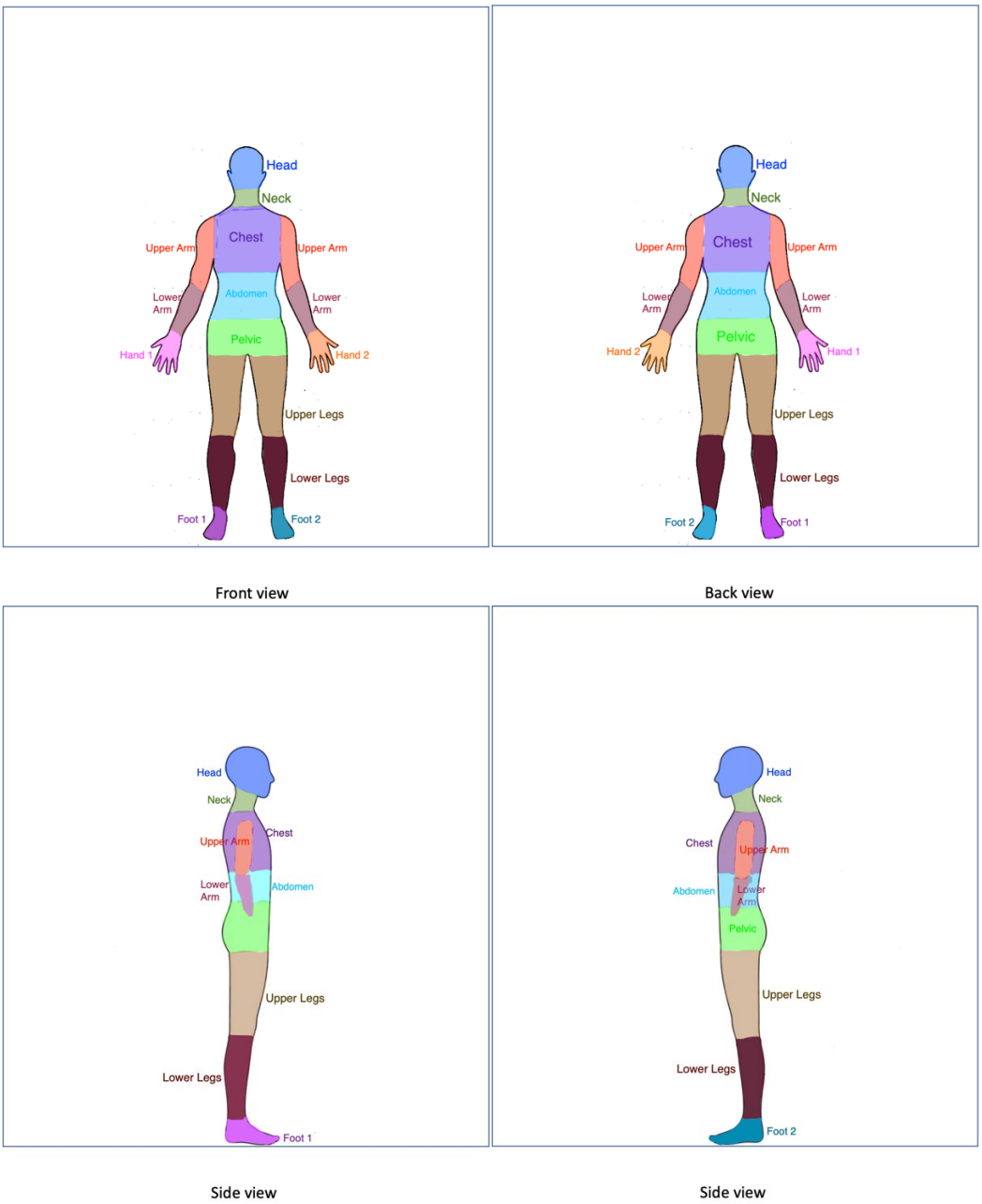


Figure 14. Division of body regions on front, back, left-, and right-side views used in hand scoring.

Total number of regions endorsed per condition was also calculated. Separately from density of region endorsement, yes/no endorsement of a region was counted as one point. For example, if a participant colored in the head (on any of the body outline views) in the headache condition, one point would be counted towards the head, separate from the number of body

views on which the head was endorsed. The total endorsement score reflects the number of body regions involved. A higher total number of endorsed bodily regions suggests less localized embodiment of the condition, such that experiencing a sensation in a smaller number of bodily areas (i.e., having a lower total number of endorsed bodily regions) represents more localized embodiment of that sensation.

4.1.5 Statistical Analyses

Statistical analyses were again performed using JMP Pro16. As in Studies 1a and 1b, FDR of $p < .05$ was applied for multiple comparisons to correct for the occurrence of type I errors without significantly decreasing power (Lindquist & Mejia, 2015).

To compare SZ with CO, ANOVAs were performed on the topography variables (body region localization and density) and psychological variables. Chi-square analyses were performed to compare yes/no endorsement of outside body regions between SZ and CO.

Within each group, pairwise correlations to assess the relationships between continuous demographic variables, BTQ, BRCS, SenPQ, MAIA-2, region density, and total region endorsement scores. ANOVAs were also performed to assess yes/no endorsement of outside body regions with these variables.

4.2 Results

Of the full sample, 61.5% of all participants endorsed having had FP, including 84.6% of SZ ($n = 11$) and 53.8% of CO ($n = 21$). Therefore, the analyses of the FP condition are limited to this sub-population of the full sample. However, all other conditions (loneliness, core self, headache, hunger) were completed by the full participant sample.

First, we examined group differences in the mapped locations of sensations. There were no significant differences between SZ and CO in the number of endorsed body regions for hunger (F[1,51] = .002, p = .97, d = 0.01), loneliness (F[1,51] = .2, p = .65, d = 0.14), headache (F[1,51] = .58, p = .45, d = 0.24), core self (F[1,51] = .02, p = .9, d = 0.05), or FP (F[1,31] = .82, p = .35, d = 0.34) conditions.

There were also no significant differences between SZ and CO in total density of endorsed regions across hunger (F[1,51] = .0015, p = .97, d = 0.01), loneliness (F[1,51] = .45, p = .5, d = 0.21), headache (F[1,51] = .6, p = .5, d = 0.25), core self (F[1,51] = .36, p = .55, d = 0.19), or FP (F[1,31] = 1.1, p = .3, d = 0.39) conditions. Finally, there were no significant differences in yes/no endorsement outside the body of hunger (X^2[0, 52] = 0), loneliness (X^2[1, 52] = 1.44, p = .23, d = 0.33), headache (X^2[1, 52] = 0), core self (X^2[1, 52] = 0), or FP (X^2[1, 32] = 0.75, p = .38, d = 0.31).

Then, we examined group differences in interoceptive awareness. MAIA-2 total score was not significantly different between SZ and CO (F[1,50] = 0.13, p = 0.7, d = 0.1).

4.2.1 Felt Presence

First, SZ scored significantly higher than CO on SenPQ endorsement (F[1,50] = 4.9, p = .04, d = 0.73), frequency (F[1,50] = 8.1, p = .007, d = 0.94), vividness (F[1,50] = 6.8, p = .01, d = 0.86), distress (F[1,50] = 8.9, p = .004, d = 0.98), and positivity (F[1,50] = 6.4, p = .01, d = 0.84) subscales. However, there was no main effect of group on total region endorsement (F[1,31] = 0.92, p = .35, d = 0.36) or density for the FP condition (F[1,31] = 1.11, p = .3, d = 0.39).

Among SZ, there were no significant relationships between total self-report measures, symptoms, and total body region endorsement or density in the FP condition. However, within

SZ, endorsement of the FP outside the body was significantly correlated with lower scores on the MAIA-2 Trusting (F[1,9] = 6.18, p = .03) subscale.

In CO, MAIA-2 total score was not significantly associated with FP total regions (r = 0.06, p = .8) or total density of FP (r = 0.07, p = .77), but FP total regions was inversely correlated with the MAIA-2 Trusting subscale (r = -0.45, p = .04). Furthermore, endorsement of FP outside of the body was significantly related with a higher score on the MAIA-2 Not Distracting (F[1,20] = 5.1, p = .03) subscale.

Interoceptive Awareness and Self-Reported Qualities of FP: Within SZ, MAIA-2 total score was not significant with any SenPQ subscales. However, MAIA-2 Emotional Awareness was significantly correlated with SenPQ endorsement (r = 0.62, p = .03), frequency (r = 0.65, p = .02), vividness (r = 0.65, p = .02), distress (r = .64, p = .02), and positivity (r = 0.71, p = 0.01) subscales. Further, MAIA-2 Not Distracting was inversely correlated with SenPQ positivity (r = -0.6, p = .04).

In CO, MAIA-2 total score was also not significantly correlated with SenPQ endorsement (r = 0.22, p = .17), frequency (r = 0.17, p = .3), vividness (r = 0.2, p = .2), distress (r = .23, p = .16), or positivity (r = 0.2, p = 0.2) subscales. However, MAIA-2 Body Listening was significantly correlated with SenPQ endorsement (r = 0.5, p = .001), frequency (r = 0.43, p = .007), vividness (r = 0.47 p = .002), distress (r = .47, p = .003), and positivity (r = 0.48, p = 0.002) subscales; MAIA-2 Emotional Awareness was also significantly correlated with SenPQ distress (r = 0.34, p = .03).

Also, PQ-16 Total and PQ-16 Distress scores were significantly correlated with SenPQ endorsement (Total: r = 0.56, p < .001; Distress: r = 0.44, p = .005), frequency (Total: r = 0.5, p < .001; Distress: r = 0.45, p = .004), vividness (Total: r = 0.47, p = .002; Distress: r = 0.47, p

= .003), distress (Total: $r = 0.42$, $p = .08$; Distress: $r = 0.4$, $p = .009$), and positivity (Total: $r = 0.54$, $p = .02$; Distress: $r = 0.48$, $p = .002$) subscores.

Furthermore, among CO, total endorsed regions of the core self was significantly associated with SenPQ endorsement ($r = 0.4$, $p = .02$), frequency ($r = 0.38$, $p = .01$), and vividness ($r = 0.37$, $p = .02$) totals. Endorsement of the core self outside of the body was also associated with higher SenPQ distress scores ($F[1,38] = 5.7$, $p = .02$). Additionally, SenPQ positivity was significantly correlated with endorsement of more regions associated with loneliness ($r = 0.36$, $p = .02$) in CO. Total number of endorsed headache regions was also significantly correlated with SenPQ endorsement ($r = 0.39$, $p = .01$) and positivity ($r = 0.33$, $p = .03$) scores.

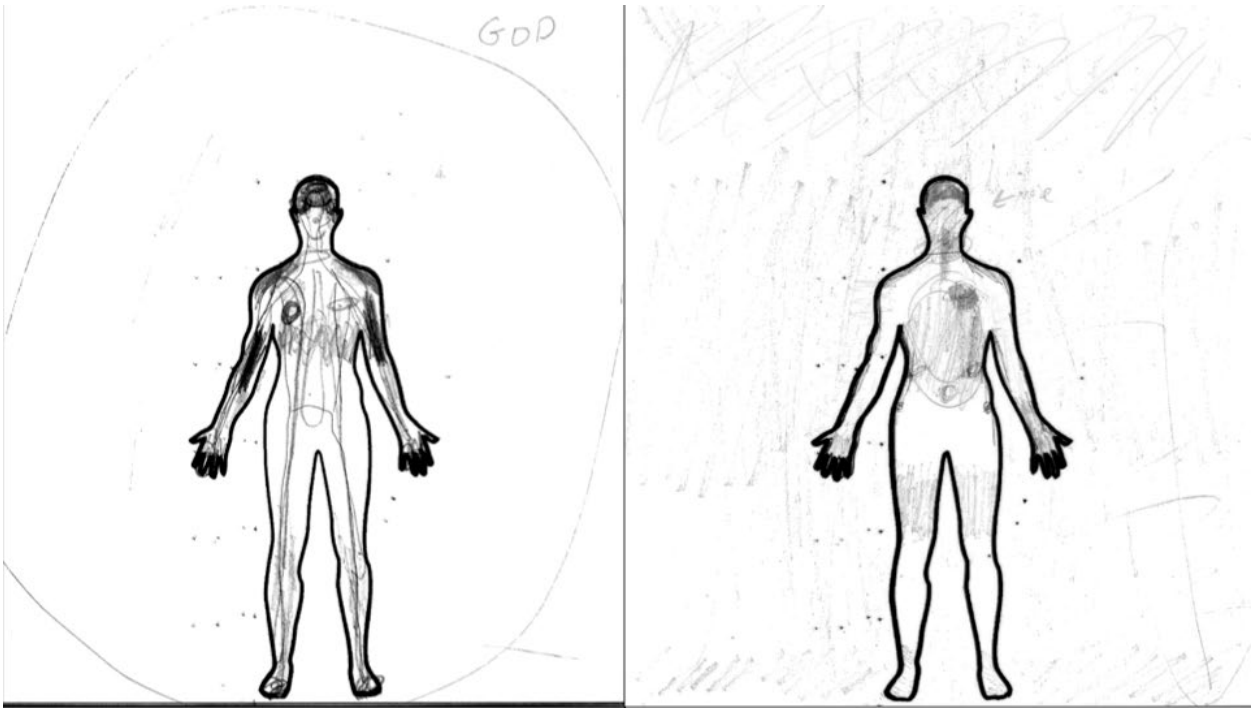


Figure 15. Density maps of responses from SZ (left) and CO (right) in the FP condition.

4.2.3 Core Self

In SZ, total regions endorsed of the core self was not significantly correlated with MAIA-2 total (r = 0.48, p = 0.12), but it was associated with the following subscales: Not Worrying (r = -0.68, p = .01) and Attention Regulation (r = 0.59, p = .04). Among SZ, there were no significant relationships between total density of the core self or endorsement of the core self outside the body and self-report measures or symptoms.

Within CO, total regions of the core self was significantly correlated with MAIA-2 total score (r = 0.34, p = .03) and was additionally associated with MAIA-2 Noticing (r = 0.38, p = .016) and Emotional Awareness (r = 0.36, p = .02) subscales. Total density of the core self was significantly correlated with MAIA-2 total score (r = 0.33, p = .03), but was not significantly associated with any MAIA-2 subscale scores. Curiously, endorsement of the core self outside of the body was significantly associated with higher MAIA-2 total score (F[1,38] = 5.8, p = .02).

In CO, endorsement of the core self outside the body was also significantly associated with higher BTQ Trauma score (F[1,38] = 8.8, p = .005).

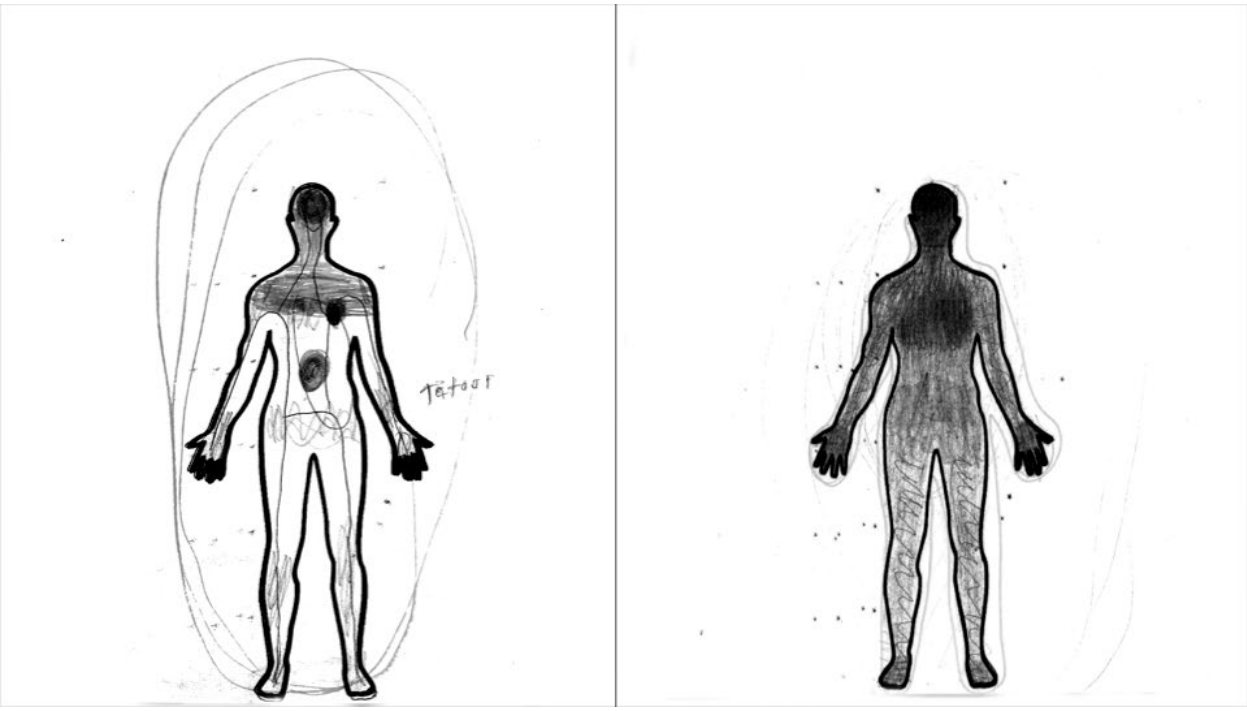


Figure 16. Density maps from SZ (left) and CO (right) in the core self condition.

4.2.2 Loneliness

Among SZ, increased symptoms as assessed by BPRS was associated with fewer total endorsed regions of loneliness (r = -0.64, p = .03). Total MAIA-2 score was not significantly associated with total regions endorsed (r = 0.03, p = 0.9) or total density (r = -0.16, p = 0.6) in the loneliness condition. Yes/no endorsement of loneliness outside the body was not significantly related with self-report measures or symptoms.

Among CO, endorsement of more regions associated with loneliness was significantly correlated with PQ16 Total (r = 0.54, p < .001), PQ16 Distress (r = 0.54, p < .001), and BTQ Trauma (r = 0.35, p = .02). Total density of loneliness was significantly correlated with PQ-16 Total (r = 0.41, p =.009) and PQ-16 Distress (r = 0.48, p = .002) scores. Total MAIA-2 score was not significantly correlated with total regions endorsed for loneliness (r = 0.08, p = .6) or density of loneliness (r = 0.05, p = .8), but total endorsed regions was significantly related with MAIA-2

Body Listening (r = 0.34, p = .03). Of note, endorsement of loneliness outside the body was significantly associated with higher BTQ Trauma score (F[1,38] = 4.5, p = .04).

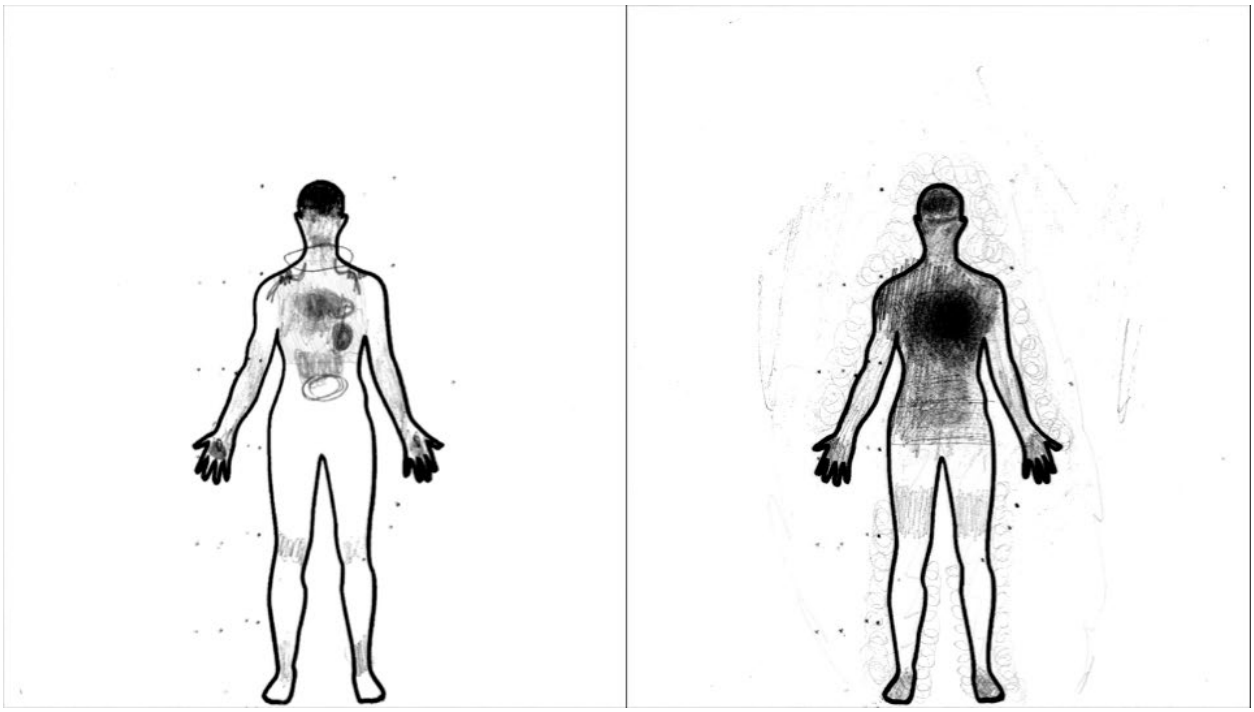


Figure 17. Density maps from SZ (left) and CO (right) in the loneliness condition.

4.2.4 Hunger and Headache

Among SZ participants, there were no significant relationships between continuous variables of interest, total body region endorsement, or total density in the headache or hunger conditions.

Within CO respondents, MAIA-2 total score was not significantly related to either total number of endorsed body regions associated with hunger (r = -0.23, p = .15) or total density of hunger (r = -0.21, p = .18). However, total number of regions endorsed was inversely related with MAIA-2 Attention Regulation (r = -0.48, p = .002) and Self Regulation (r = -0.34, p = .03)

subscales. Density of hunger was also inversely correlated with MAIA-2 Attention Regulation (r = -0.42, p = .007).

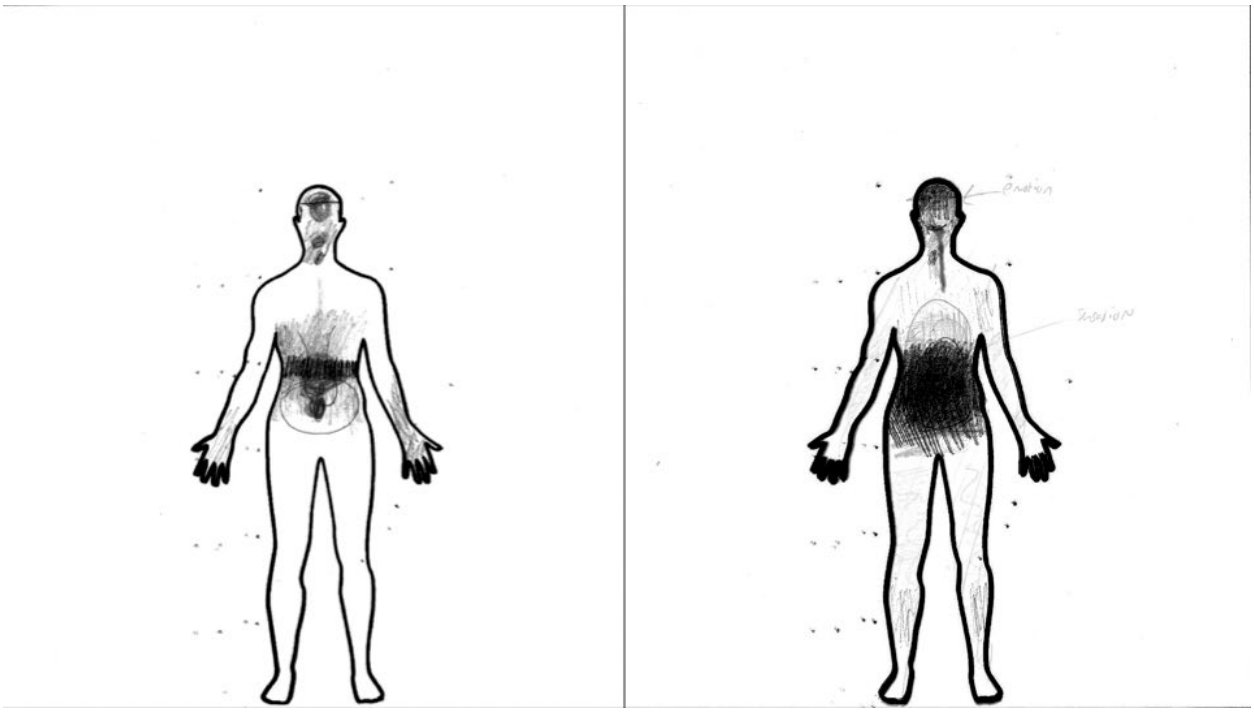


Figure 18. Density maps from SZ (left) and CO (right) in the hunger condition.

In CO, endorsement of headache over more regions was correlated with greater BTQ Trauma (r = 0.31, p = .05). MAIA-2 total score was not significant with total endorsed body regions (r = 0.3, p = .07) or total density of headache (r = 0.02, p = .8). However, total number of endorsed headache regions was significantly correlated with MAIA-2 Body Listening (r = 0.36, p = .02) subscale score.

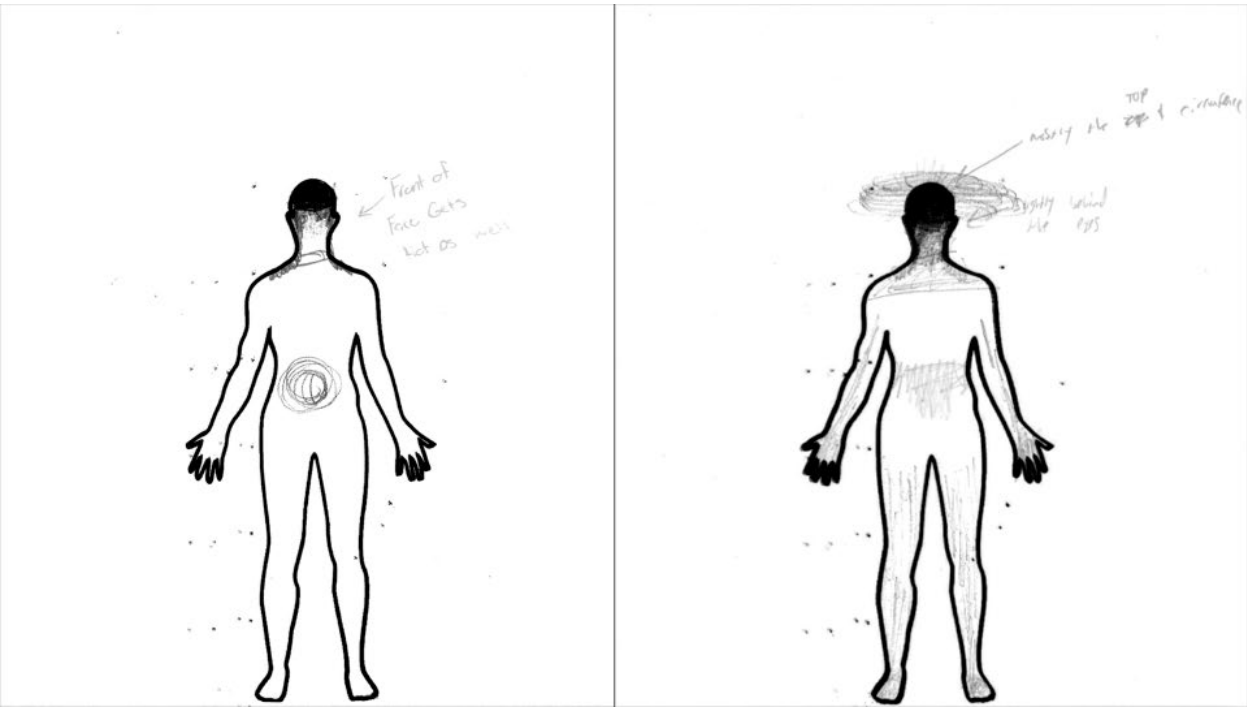


Figure 19. Density maps from SZ (left) and CO (right) in the headache condition.

4.3 Discussion

Study 2 was an exploratory study examining the topography of felt presence, core self, loneliness as well as two control conditions (headache and hunger) in relation to physical representations of the body using a paper-and-pencil mapping task. Interoceptive awareness, psychotic symptoms, and qualities of FP had significant links with mapped density and localization of specific bodily sensations. There were no significant differences between SZ and CO in terms of topographical region endorsement or density across conditions, which aligns with previous findings that the topography of sensations is similar between SZ and CO (Lee et al., 2022). However, the small sample size is a problem. Despite a lack of significant differences between SZ and CO, there were several noteworthy findings within SZ and CO groups, particularly with regards to interoceptive awareness.

In the FP condition, there were no significant relationships between variables of interest and region endorsement or density of FP among SZ. However, FP mapped outside the body was significantly associated with less frequent experience of one's body as safe and trustworthy. For CO, endorsing FP over more regions within the body was associated with less frequent experience of the body as safe and trustworthy, while endorsement of FP outside of the body was associated with greater tendency not to ignore or distract from sensations of pain or discomfort. Since, neurologically, the experience of FP involves projection of the self into the extrapersonal space and recognition of this self as 'other' (Barnby et al., 2023; Blanke et al., 2004; Blanke & Arzy, 2005), the result that SZ find greater trust and safety in their own body when FP is within aligns with evidence that the self-other boundary is highly disrupted in SZ (Sass & Parnas, 2003; Park & Baxter, 2022; Moe & Docherty, 2014; van der Weiden et al., 2015; Lee et al., 2021), even in cases of autoscopic hallucination. By contrast, in CO, sensation of this 'other' as occupying many regions inside the body was associated with distrust of the body, while experiencing the 'other' outside the body (where 'other' *should* be in relation to the self) was linked with improved interoceptive awareness of discomfort within the body.

In addition, compared to CO, SZ endorsed more frequent, vivid, distressing, and positive FP experiences on the SenPQ. Also, in CO, SenPQ subscales were related with greater endorsement of psychotic-like experience and related distress. These results align with findings from Studies 1a and 1b that FP is a more salient experience in psychosis. In SZ, vividness of FP experience was linked with greater awareness of the connection between bodily sensations and emotional states, suggesting salient experience of 'other' seems to improve interoceptive awareness, even though FP was generally embodied for SZ. Conversely, for CO, vividness of FP experience was linked with greater active listening to the body for insight. Despite the disruption

in self-other boundary among SZ, these results align with previous work highlighting the link between social interaction and improved sense of bodily self (Thirioux et al., 2016; Tajadura-Jiménez et al., 2012; Arnold et al., 2019; Pellencin et al., 2018), both in psychosis and among CO. In addition, within SZ, positivity of FP was associated with tendency to ignore or distract from sensations of pain or discomfort. Conversely, for CO, distressing experience of FP was associated with greater awareness of the connection between bodily sensations and emotional states. Evidence suggests there is a strong link between social pain with negative interpersonal reactions and physical pain (Eisenberger, 2012; Eisenberger et al., 2003; Kross et al., 2011). Study 2 results suggest that this is true for CO, but hint that the opposite may also hold true in psychosis: perhaps positive experience of social 'other' reduces awareness of physical pain in psychosis, even in cases of autoscopic hallucination.

In the core self condition, among SZ, more total regions where the core self was endorsed was linked with greater tendency to worry or experience emotional distress in relation to sensations of pain or discomfort, and better ability to sustain and control attention to bodily sensations. Whereas, for CO, endorsement of the core self in more regions was associated with better overall interoceptive awareness and, more specifically, improved awareness of uncomfortable, comfortable, and neutral body sensations, and greater awareness of the connection between bodily sensations and emotional states. Given the links between self-disturbance and reduced interoceptive awareness and emotional embodiment (Torregrossa et al., 2019a; Torregrossa et al., 2019b; Torregrossa et al., 2022), it seems that sensing the core self over more locations within the body is associated with improved salience of the bodily self, both among SZ and CO. Further, in Study 2, we found that CO who endorsed the core self outside of the body had greater trauma, which has been previously linked with self-disturbance in the

general population (Pionke-Ubych et al., 2021). However, curiously, endorsement of the self outside the body was also associated with greater interoceptive awareness in CO. Since the CO core self group map demonstrates that endorsement of the self outside of the body seems to follow the contours of the body outline quite closely (see Figure 16), these results may suggest that extension of the core self to the immediate PPS around the body begets heightened interoceptive awareness; this result would fit with previous work demonstrating PPS is more salient for CO compared to SZ (Lee et al., 2021), but additional exploration is needed to make a clearer conclusion about this result.

In the loneliness condition, among SZ, endorsing fewer bodily regions was associated with increased symptom severity. By contrast, however, CO with greater endorsement of PLE and more related distress reported more total regions and greater total density of loneliness. Previous findings have suggested attenuated embodiment of loneliness among SZ (Lee et al., 2022) and have highlighted relatively more diffuse embodiment of loneliness in SZ compared to CO (Torregrossa et al., 2019b; Lee et al., 2020). Results from Study 2 suggest that there is attenuated embodiment of loneliness among SZ, but not among CO with elevated psychotic symptoms and distress. These results raise questions about whether endorsement of loneliness over more regions in the present task actually represents diffuse (or weaker) embodiment, or more salient embodiment. Weaker embodiment has been linked with higher psychosis-risk, as well as greater trauma (Lanius et al., 2020; van't Wout, 2004). In alignment with these findings, CO who endorsed loneliness over total more regions within the body, and who endorsed loneliness outside of the body had higher amounts of trauma. It is important to consider the effects of antipsychotic medications among SZ. Antipsychotic medications have known side effects including emotional numbness (Mortiz et al., 2013); due to small sample size, we did not

investigate medication effects in the present study, but it is possible that antipsychotic medications may dampen sensations. However, CO with high psychosis-proneness were medication-free and therefore, the patterns of embodied sensation reported by high-risk group cannot be attributed to antipsychotic drug effects.

In SZ, we did not observe any correlations between mapping of the normal bodily sensations and any of the clinical or psychological measures. For CO participants, embodiment of hunger over fewer regions as well as lower density of hunger was linked with better attention towards bodily sensations, suggesting that interoception is improved with greater localization of hunger. This aligns with previous work that suggests interoceptive awareness hinges on our ability to pinpoint physiological signals originating from inside the body (Craig, 2002). Also, among CO, bodily sensations of headache spread over larger surface area was associated with trauma and an increased tendency to listen to the body for insight. There is evidence to suggest that trauma is tightly linked with somatic symptoms and pain, including headache (Caizzi, 2012; Bryant et al., 1999; Defrin et al., 2008). Furthermore, previous findings have linked trauma with reduced interoceptive accuracy and increased dissociation from the body (Reinhardt et al., 2020); this may potentially help explain the need for greater listening to the body in cases of headache embodied over more locations.

4.3.1 Qualitative Observations

Whilst we did not find significant differences between SZ and CO in topographical locations and density of FP, core self, loneliness, hunger, and headache, possibly due to the small sample size, there were visible qualitative differences between SZ and CO individuals across conditions.

Notably, for example, FP was drawn more outside of the body for CO compared to SZ (see Figure 15). Also of note, FP appears much more dense in the head, chest, shoulders, upper arms, hands, and feet of SZ compared to CO.

In the core self condition, CO colored in the self more densely over more regions of the body while SZ appear to color in the core self most densely in the head, chest, abdomen, and hands (see Figure 16). Also, compared to CO, SZ have greater endorsement of the core self outside the body – in the immediate surrounding space – while CO rarely endorse the self outside of the body but, when they do, it seems to follow the curvature of the body outline.

Furthermore, denser mapping of loneliness in the abdomen was associated with interoceptive awareness across CO and SZ. For SZ, denser loneliness in the abdomen (as well as the pelvic region) was also linked with lower resilience. Mapping loneliness more densely in the hands, specifically, was also significantly associated with psychosis risk in CO and symptom severity in SZ. Loneliness density in the feet was also associated with psychosis risk as well as more frequent and salient FP experiences for CO. Conversely, for SZ, denser loneliness in the feet was linked with interoceptive awareness, including tendency not to worry about or distract oneself from bodily sensations of pain, less attendance to emotional reactions within the body, and tendency not to listen to the body for insight.

There is a possible explanation for these results; sense of embodied self is thought to emerge throughout infancy, arising from repeated and consistent sensorimotor actions and contingent proprioceptive signals where the body meets the external world, marking the physical bounds of the bodily self (de Vignemont et al., 2009; Postmes et al., 2014; Rochat, 2019; Rochat & Striano, 2000). In schizophrenia, spatiotemporal integration of exteroceptive, proprioceptive, and interoceptive signals is fractured, disrupting embodiment (Tscacher et al., 2017; Giersch et

al., 2016). Since the hands and the feet are bodily regions that come into contact frequently with the external world, perhaps sense of embodiment is more salient in these regions in schizophrenia.

Although we observe qualitative differences between SZ and CO maps (particularly in the FP and core self conditions), we are currently unable to quantify these differences in a statistically meaningful way. There are several possible explanations: primarily, this exploratory method is a novel way to localize the sensations of FP, core self, loneliness, headache, and hunger, and measurement methods are still being refined. In addition, scoring methods are also novel, and may be overly simplistic or may fail to capture the full scope of available data. Also, the task instructions asked participants to map the regions where they felt the sensation *of* each given condition; participants may have interpreted these instructions variably, perhaps endorsing regions where they felt sensations that accompanied each condition, instead of the condition itself. Finally, small sample size of SZ (n = 13) limits statistical power and generalizability of findings.

However, results from this novel topographical mapping task demonstrate significant associations between embodiment, interoception, and psychosis, suggesting the feasibility of mapping locations associated with seemingly intangible sensations, including FP, core sense of self, and loneliness, to extract important information about the construction of the bodily self.

5. Conclusion

The current thesis aimed to investigate qualities of anomalous bodily experience across the schizophrenia spectrum. Study 1a found that individuals in the general population at high-

risk for psychosis experience FP as a social 'other'; further, results from Study 1a suggest that FP may be an adaptive (resilient) response to loneliness. We noted greater perception and multisensory integration during FP for individuals at high-risk for psychosis, suggesting that sense of bodily self may be improved by FP. These results were unique to anomalous bodily experience that involved a social 'other' (i.e., FP) and were not true of OBE, suggesting that it is the social nature of the FP experience that improves sense of bodily self for individuals at high-risk for psychosis.

In Study 1b, we replicated many of the findings from Study 1a. Results again demonstrate that FP is a vivid phenomenon that heightens perception and multisensory integration for individuals at high-risk for psychosis. However, in Study 1b, FP was not related to loneliness or resilience, but was instead related to trauma; in both studies, trauma was associated with FP and OBE, which highlights its general connection with anomalous bodily experience. Overall results suggest that the experience of FP improves sense of bodily self at higher ends of the psychosis spectrum.

In Study 2, we examined the localization of sensations associated with self-experience, namely FP, location of the core self, loneliness, and typical bodily experiences such as headache and hunger. Findings from Study 2 suggest that FP, the core self, and loneliness are each embodied differently across the psychosis spectrum. Most significantly, for SZ, FP was endorsed associated with greater feelings of bodily trust and safety when endorsed inside the body, compared to outside; the opposite was true for CO, for whom endorsement of FP over more bodily regions was linked with less feeling of safety in one's body. Also of note, embodiment of the core self was linked with improved interoceptive awareness for both SZ and CO, while endorsement of the core self outside of the body was related with trauma among CO.

Importantly, embodiment of loneliness over more bodily regions was related with elevated psychosis-proneness in CO but reduced psychotic symptoms in SZ. Overall, qualitative observations show that salience of the bodily-self is improved in areas that make physical contact with the external world most frequently. Study 2 introduced a novel tool that proved feasibility in assessing the topography of sensations associated with self-experience but requires additional development in terms of methodology.

There are several limitations. Primarily, small sample size of individuals with SZ (n = 13) limits the generalizability of findings from Study 2. Second, many of the measures relied on self-report, which may not reflect participants' objective abilities, statuses, or experiences. Third, participants with schizophrenia were required to have pre-existing prescriptions for antipsychotic medications as part of the inclusion criteria for our studies; antipsychotic medications are known to have side effects including emotional numbness and withdrawal (Mortiz et al., 2013), but due to small sample size, we did not investigate medication effects, although dose is reported in Table 2. Finally, Study 2 was a novel task that aimed to explore the topography of FP, core self, loneliness, and physiological sensations (hunger and headache) in schizophrenia. The methods for scoring and analyzing data from this task may not have the resolution needed to detect fine-grained group differences between SZ and CO.

The next step – further refinement of methods – will lead to progress. One possibility is 3D mapping of the bodily sensations using virtual reality for which the prototype has been completed (see Appendices B and C). Furthermore, we have developed a novel language analysis coding scheme to score first-person narrative accounts of qualities of self-disturbance; this coding scheme is currently being implemented and assessed for reliability and validity.

Despite these limitations, the current thesis built upon prior findings by examining qualities of self-disturbance experience in relation to the bodily-self in psychosis and deepens understandings of these relationships by studying these phenomenon across the psychosis spectrum. Findings across two survey studies and one novel topographical mapping task support the notion that schizophrenia is, at its core, a self-disorder; evidence that autoscopic hallucinations are vividly related to the bodily self in psychosis is consistent across studies. Furthermore, all three studies highlight the importance of points of physical contact with the external world (or 'other') in improving salience of bodily self in psychosis.

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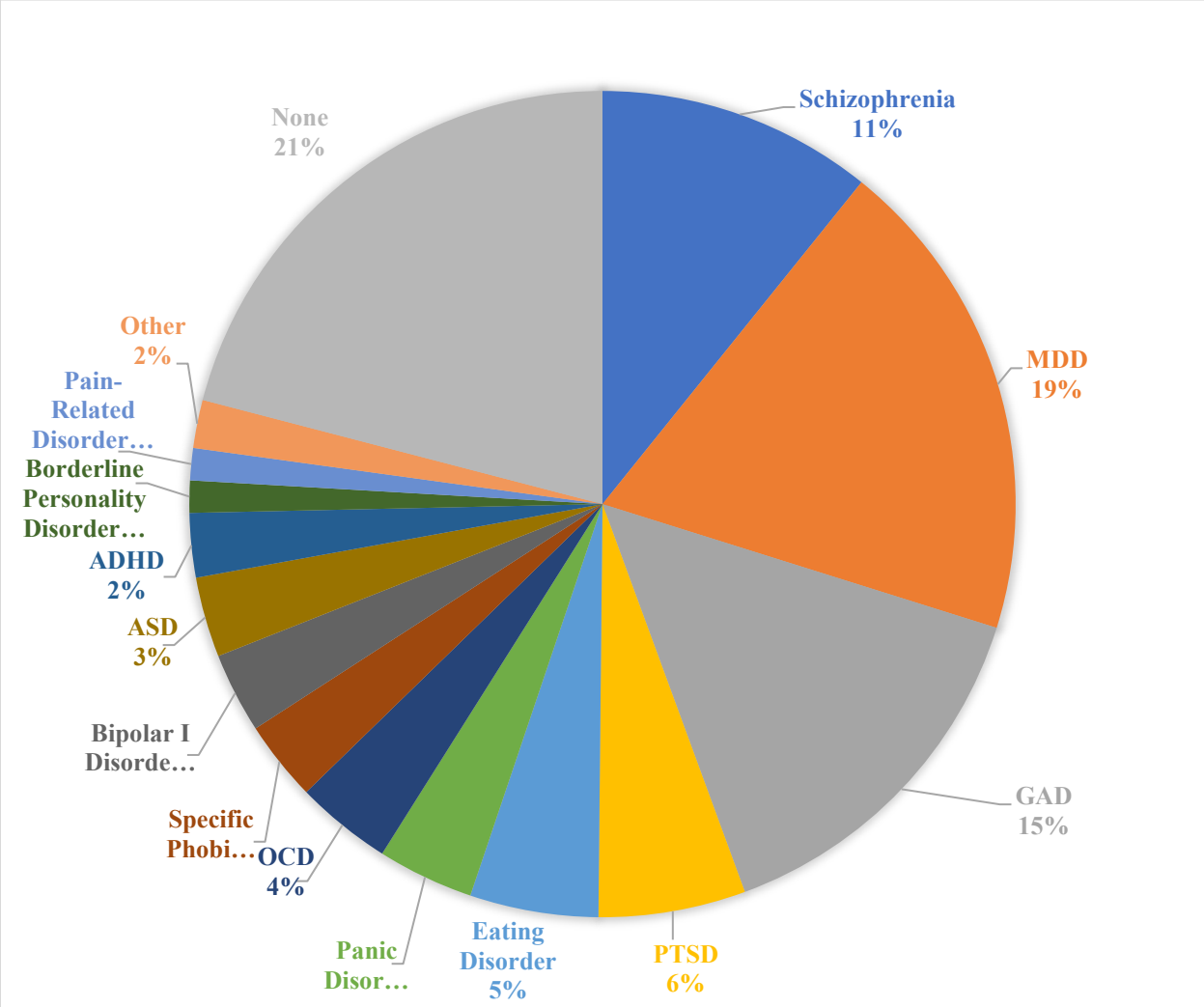
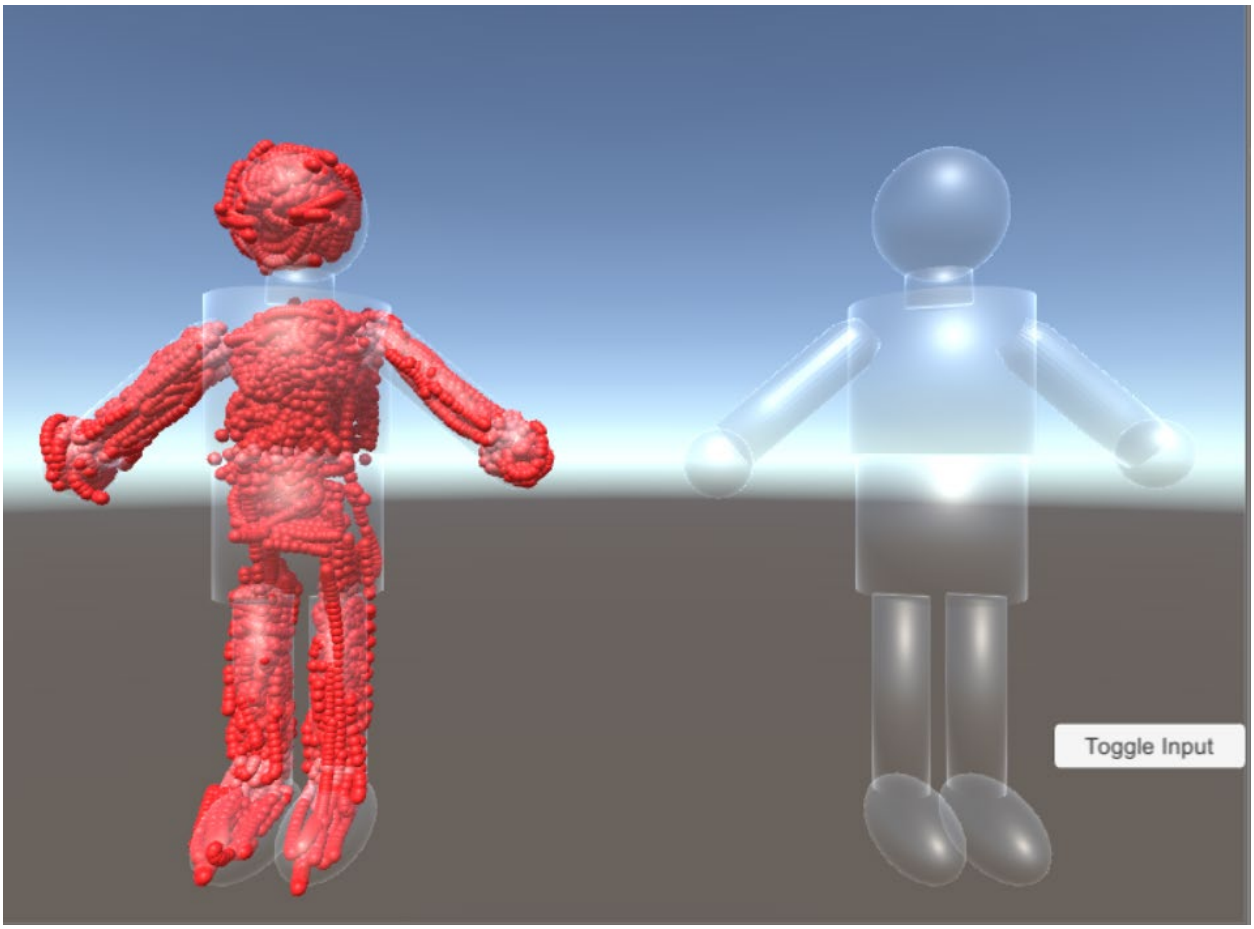
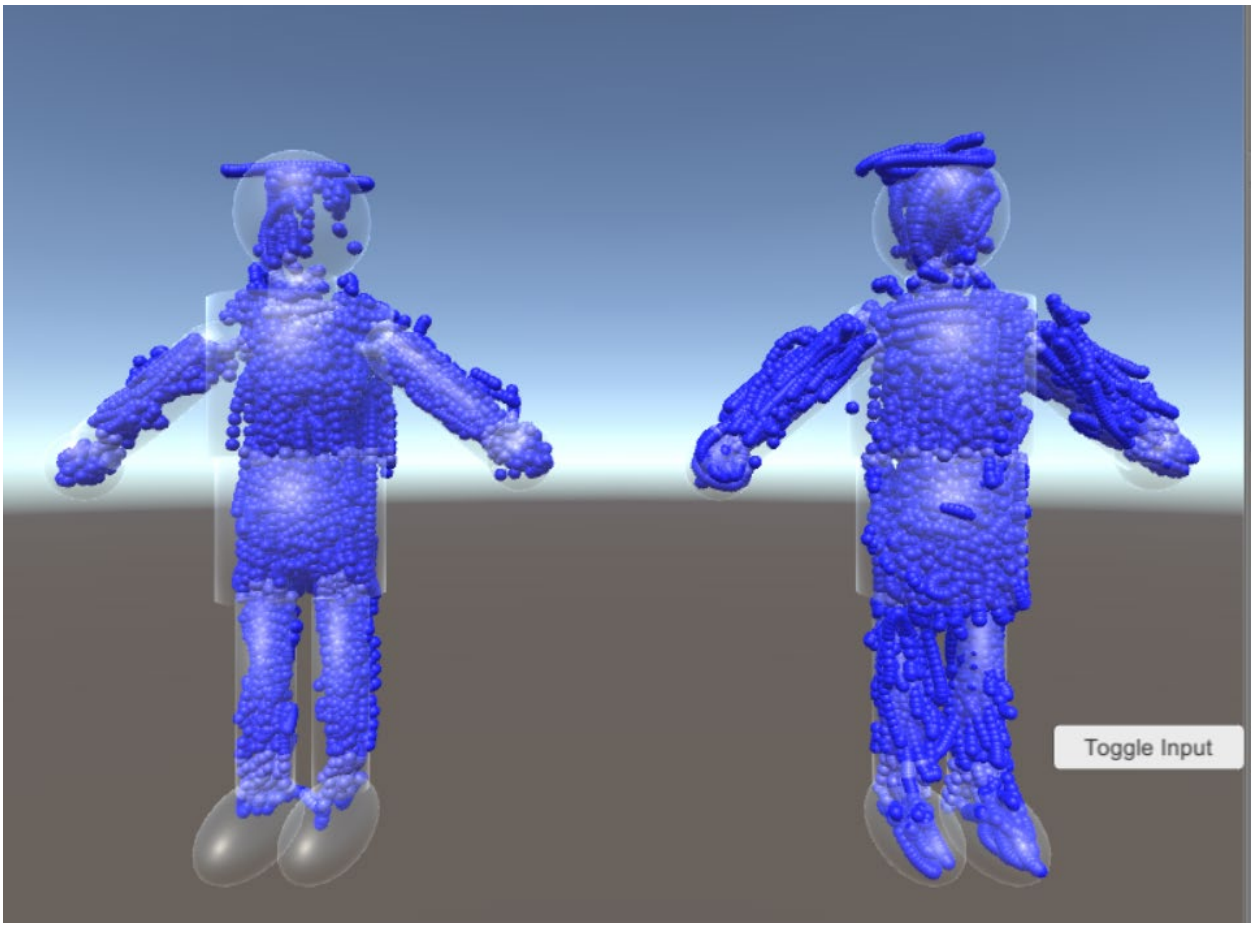
APPENDIX



APPENDIX A. In Study 1b, 20% of participants denied any psychiatric diagnosis. Of the full sample, 10.3% of participants reported a diagnosis of schizophrenia, 18.2% endorsed MDD (Major Depressive Disorder), 13.9% noted GAD (Generalized Anxiety Disorder), 5.5% reported PTSD (Post-Traumatic Stress Disorder), 4.8% endorsed Eating Disorder, 3.6% noted Panic Disorder, 3.6% noted OCD (Obsessive-Compulsive Disorder), 3% endorsed Specific Phobia, 3% reported Bipolar I Disorder, 3% endorsed ASD (Autism Spectrum Disorder), 2.4% noted ADHD (Attention-Deficit/Hyperactivity Disorder), 1.2% reported Borderline Personality Disorder, and a further 1.2% endorsed unspecified pain-related disorder. In total, 1.8% of participants reported "other" disorder, including Dyslexia, Illness Anxiety Disorder, and Oppositional Defiant Disorder.



APPENDIX B. Screenshot of the 3D body mapping task using virtual reality.



APPENDIX C. Screenshot of the 3D body mapping task using virtual reality.