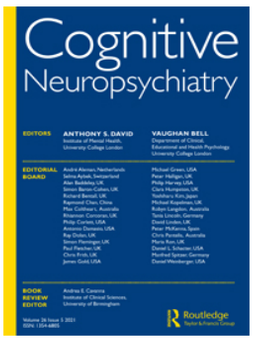

Cognitive Neuropsychiatry

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/pcnp20

Anomalous self-experiences in cognition are negatively associated with neurocognitive functioning in schizophrenia

Christi L. Trask, Marina M. Matsui, Jonathan R. Cohn, Mallory J. Klaunig & David C. Cicero

To cite this article: Christi L. Trask, Marina M. Matsui, Jonathan R. Cohn, Mallory J. Klaunig & David C. Cicero (2021) Anomalous self-experiences in cognition are negatively associated with neurocognitive functioning in schizophrenia, Cognitive Neuropsychiatry, 26:5, 307-320, DOI: 10.1080/13546805.2021.1935225

To link to this article: https://doi.org/10.1080/13546805.2021.1935225

Published online: 31 May 2021.

COGNITIVE NEUROPSYCHIATRY
2021, VOL. 26, NO. 5, 307–320
https://doi.org/10.1080/13546805.2021.1935225

Routledge
Taylor & Francis Group

Anomalous self-experiences in cognition are negatively associated with neurocognitive functioning in schizophrenia

Christi L. Trask[a,b], Marina M. Matsui[a], Jonathan R. Cohn[a,c], Mallory J. Klaunig[a,d] and David C. Cicero [a,c]

[a]Department of Psychology, University of Hawai'i at Mānoa, Honolulu, HI, USA; [b]Department of Psychiatry, Dartmouth-Hitchcock Medical Center, Lebanon, NH, USA; [c]Department of Psychology, University of North Texas, Denton, TX, USA; [d]Department of Psychology, University of Maryland Baltimore County, Baltimore, MD, USA

ABSTRACT

Introduction: Anomalous self-experiences (ASEs) are disturbances in the subjective experience of the self and are common in people with schizophrenia. Theorists have suggested that ASEs may underlie the neurocognitive deficits that are also common in people with schizophrenia; however, few studies have empirically investigated the relationship between these variables. Thus, the current study aimed to determine whether self-reported ASEs, particularly disturbances in cognitive or mental experiences, are meaningfully related to neurocognitive performance in individuals with schizophrenia. Methods: 48 individuals with schizophrenia and 34 healthy comparison participants completed the Inventory of Psychotic-Like Anomalous Experiences (IPASE), which is composed of five subscales including disturbances in cognition, and the MATRICS Consensus Cognitive Battery (MCCB). Results: Participants with schizophrenia performed worse than controls on each MCCB domain and had higher ASE scores on the total IPASE and all five subscales. Only the IPASE-Cognition subscale was associated with cognitive performance. Specifically, IPASE-Cognition was negatively correlated with scores in attention, visual learning, reasoning, and working memory. Conclusions: These results suggest that self-reported subjective disturbances in cognition may be meaningfully associated with several objectively-measured domains of neurocognition. Severity of ASEs may therefore be an important consideration when analysing the extent of cognitive deficits in schizophrenia.

ARTICLE HISTORY
Received 16 November 2020
Accepted 21 May 2021

KEYWORDS
Neurocognition; schizophrenia; anomalous self-experiences; self-disturbances; IPASE

Introduction

Over the past thirty years, research has established that schizophrenia is a disorder characterised not only by prototypic positive and negative symptoms of psychosis, but also by deficits in neurocognition (Heinrichs & Zakzanis, 1998). Cognitive impairment in people with schizophrenia is well-documented across a wide variety of domains including executive functioning (Meier et al., 2014; Orellana & Slachevsky, 2013),

CONTACT David C. Cicero David.cicero@unt.edu Department of Psychology, University of North Texas, 1155 Union Circle #311280, Denton, TX, USA

reasoning (Goel et al., 2004; Mirian et al., 2011), visual and verbal memory (Aleman et al., 1999; Brebion et al., 1997; Rushe et al., 1999), working memory (Barch et al., 2002; Gold et al., 2018), and attention (Cannon et al., 2006; Welham et al., 2010), among others. These impairments have been shown to be associated with severity of symptoms, primarily negative symptoms (Goff, 2013; Strassnig et al., 2018), quality of life (Savilla et al., 2008; Sum et al., 2018), course of the illness (Sheffield et al., 2018), and functional impairment (Green, 1996; Velligan et al., 1997). Thus, cognitive impairments are important variables in understanding morbidity in schizophrenia. One understudied symptom that has been hypothesised to be associated with cognitive impairment in schizophrenia is anomalous self-experiences.

Anomalous self-experiences (ASEs) are subjective disturbances in the experience of self and are common experiences among people with schizophrenia (Park & Nasrallah, 2014; Parnas et al., 2005; Parnas & Handest, 2003). ASEs have been shown to be associated with all phases of schizophrenia including the premorbid (Brent et al., 2014), prodromal (Moller & Husby, 2000; Nelson et al., 2012), first-episode (Haug et al., 2012a), and chronic phases of the illness (Nordgaard & Parnas, 2014). Moreover, ASEs predict conversion to psychosis in those at clinical high risk (Nelson et al., 2012) and are elevated in first-degree relatives of people with schizophrenia (Raballo et al., 2011). ASEs may also be specific to schizophrenia spectrum disorders, as they are less common in other disorders with psychosis such as mood disorders with psychotic features or psychosis associated with posttraumatic stress disorder (Nordgaard & Parnas, 2014; Parnas & Jansson, 2015; Sass et al., 2018).

Theories of ASEs suggest that there are several different types of disturbances in the sense of self including disturbances in: (1) cognition (disturbances in thinking, such as thoughts being generated or belonging to someone else); (2) stream of consciousness (feeling distanced from one's mental content); (3) self-awareness and presence (uncertainty about one's effect on the external world, or the effect that others have on the self); (4) corporeality (feeling disconnected from the physical body); (5) self-demarcation (dissolution of the boundary between the self and the world); and (6) existential reorientation (preoccupation with supernatural or metaphysical themes at the expense of one's self-integration). Theorists have suggested that ASEs may underlie neurocognitive deficits in schizophrenia (Nelson et al., 2014a, 2014b), but very few studies have empirically examined these links. Thus, the primary goal of the current research is to explore the relations among ASEs and neurocognitive deficits in people with schizophrenia.

Of the domains of ASEs, disturbances in cognition are the most likely to be associated with deficits in neurocognition because they represent the phenomenological manifestation of these deficits. For example, the feeling that one's thoughts are disappearing may be related to underlying cognitive deficits such as poor working memory. However, past research has been unable to examine this connection directly because the most commonly-used measure of ASEs, the Examination of Anomalous Self-Experiences (EASE; Parnas et al., 2005), combines disturbances in cognition with disturbances in consciousness. This prevents researchers from examining the unique contribution of ASEs related to cognition. In recent work using objective scale development techniques (i.e. the Inventory for Psychotic-Like Anomalous Self-Experiences; IPASE; Cicero et al., 2017), disturbances in cognition and disturbances in consciousness have been found to create separate subscales, measuring distinct aspects of ASEs. Thus, using the IPASE in

the current study allowed us to specifically examine whether subjective disturbances in cognition, independent of disturbances in consciousness, were related to objectively-measured domains of neurocognition. Moreover, previous research has demonstrated a very large correlation (r=.92) between the IPASE and the EASE (Nelson et al., 2018). Given the strong relationship between the two instruments and the relative ease of administering a self-report measure versus conducting the EASE interview, using the IPASE can help reduce the demand on research participants.

As mentioned, researchers have recently argued that ASEs may underlie the cognitive deficits common in people with schizophrenia, and have specifically called for the inclusion of neurocognitive measures related to self-disturbances in research (Nelson et al., 2014a, 2014b). Despite these calls for increased work, few studies have empirically examined the link between ASEs and neurocognition, and these studies have produced mixed results. For example, one study using a wide variety of tasks inspired by the Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) Consensus Cognitive Battery (MCCB; Kern et al., 2008; Nuechterlein et al., 2008) found a link between deficits in verbal memory and global ASE scores in people with first episode psychosis (Haug et al., 2012b). In contrast, another study found no correlations between domains of cognition and ASEs in people at high risk for developing schizophrenia (Comparelli et al., 2016). One recent study (Hernández-García et al., 2020) employed a brief battery of cognitive tasks (Brief Assessment of Cognition in Schizophrenia; BACS) including tests of working memory, verbal memory, motor speed, problem solving, and performance speed to assess the relationship between cognition and domains of ASEs in a mixed sample of individuals with schizophrenia and early psychosis. This study found significant negative relations between the IPASE Self-Awareness and Presence as well as Somatization scale scores and motor speed scale in the BACS; additionally, a significant inverse relation was found between the IPASE Consciousness scale score and problem-solving performance (Hernández-García et al., 2020). The authors posited that these relationships may indicate shared neural systems between certain ASEs and domains of neurocognition. Previous research has therefore demonstrated cause for further empirical examination of the connection between cognitive skills and ASEs in schizophrenia-spectrum disorders. However, to our knowledge, no previous studies have used the MCCB itself to examine the links between cognitive functioning and ASEs.

The MCCB was developed as a comprehensive measure of cognition by experts in conjunction with the National Institute of Mental Health. The goal of the MCCB was to create a battery that could monitor change in cognition over time in randomised controlled trials (Nuechterlein et al., 2008), specifically among individuals with schizophrenia-spectrum disorders. Seven important domains were selected including speed of processing, attention/vigilance, working memory, verbal learning, visual learning, reasoning and problem solving, and social cognition. Ten tasks were selected that were the most representative of these domains and had the best psychometric properties (Kern et al., 2008). We chose the MCCB for the current study because: (1) it is a comprehensive measure that examines robust areas of cognitive deficits; (2) it is sensitive to the types of cognitive deficits that individuals with schizophrenia tend to exhibit (August et al., 2012); and (3) research has shown that scores on the MCCB have important functional correlates for people with schizophrenia, such as employment status (e.g. Kern et al., 2011).

In addition to the absence of a comprehensive cognitive battery, no previous research has considered the relationship between ASEs and neurocognition in a sample composed of individuals with chronic schizophrenia-spectrum disorders in comparison to healthy controls. Studies have generally been limited to either individuals at risk for schizophrenia (Comparelli et al., 2016) or first-episode populations (Haug et al., 2012b), or have included a mix of first-episode and chronic schizophrenia (Hernández-García et al., 2020). Since cognitive deficits tend to worsen as the disorder progresses (Sheffield et al., 2018), the link between ASEs and cognitive deficits may potentially be better examined in people with chronic schizophrenia. It is possible that early disturbances in self-processing in the prodromal and initial acute phases of the disorder lead to poorer cognitive functioning in the chronic phases of schizophrenia. Thus, in the current study, participants were people with a long-term history of schizophrenia or schizoaffective disorder, with a comparison sample of healthy controls.

The first goal of the current research was to replicate previous findings showing that people with schizophrenia have broad deficits in neurocognition and elevated levels of ASEs compared to a non-psychiatric healthy control group. The second goal of the current research was to examine the correlations among domains of ASEs and MCCB scores within individuals diagnosed with schizophrenia. We expected to find that disturbances in cognition, but not other domains of ASEs, would be associated with deficits in cognition as measured by neuropsychological testing.

Methods

Participants

Participants included 48 people with schizophrenia or schizoaffective disorder and 34 non-psychiatric controls. Participants in the schizophrenia group were recruited via the Adult Mental Health Division of the Hawai'i Department of Health outpatient centres, clubhouses, and community outpatient clinics. Healthy controls were recruited via fliers posted in the community and Craigslist advertisements, and were excluded if they self-reported a history of any mental disorder or reported symptoms meeting criteria for a mental disorder on the Structured Clinical Interview for the DSM-IV (SCID). Demographic information for the groups can be seen in Table 1. The groups did not significantly differ by gender, ethnicity, or age; however, there was a significant between-group difference ($p < .05$) in average years of parental education and estimated full-scale IQ (FSIQ). Given well-documented lower IQ scores in schizophrenia, we chose not to exclude participants based on IQ, in order to protect external validity. Although we did not collect information from participants regarding age of onset of schizophrenia symptoms, we note that our sample was drawn from clinics that serve people with chronic schizophrenia. Thus, on average, our participants likely had a relatively long duration of illness.

Materials

Diagnostic and symptom ratings

The Structured Clinical Interview for DSM-IV (SCID; First et al., 1998) was used to confirm participant diagnosis of schizophrenia or schizoaffective disorder. The Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987) was used to assess and rate

Table 1. Demographic information for the schizophrenia and control groups.

	Schizophrenia Group (n = 48)	Control Group (n = 34)
Sex (% Female)	36.7%	41.7%
Ethnicity	–	–
White (%)	29.2%	48.4%
Native Hawaiian/Pacific Islander	20.9%	9.7%
Asian	20.8%	6.4%
Multiethnic	14.6%	22.6%
African American	8.3%	0%
Other	6.3%	12.9%
Mean (SD) age (years)	48.81 (10.82)	43.13 (13.91)
Mean (SD) parental education (years)	11.43 (3.54)	13.5 (3.46)*
Mean (SD) WASI-II FSIQ	87.43 (14.32)	108.45 (10.84)*
Antipsychotic dosage (CPZ-Eq.)	340.2 (286.7)	–
PANSS Total	66.01 (16.16)	–
PANSS Positive	18.32 (6.87)	–
PANSS Negative	15.34 (4.39)	–
PANSS General	32.40 (8.51)	–

Note: *$p < .05$. SD = standard deviation; WASI-II FSIQ = Wechsler Abbreviated Scale of Intelligence, second edition, full-scale intelligence quotient; CPZ-Eq = therapeutic equivalent dose of antipsychotic medication, using Chlorpromazine mg/day as a reference; PANSS = Positive and Negative Syndrome Scale.

common symptoms of schizophrenia. The PANSS includes ratings of positive symptoms, negative symptoms, and general psychopathology (see Table 1). Ratings were completed by a PhD level clinical psychologist and three advanced PhD graduate students, all of whom were extensively trained in administration of the structured interview and scoring of the PANSS. All four raters participated in regular scoring meetings to achieve sufficient inter-rater reliability, which is generally regarded as $k \geq .6$. The inter-class correlation coefficient among the four raters was .78, indicating moderate inter-rater reliability (McHugh, 2012).

Neurocognitive functioning

The MATRICS Consensus Cognitive Battery (MCCB; Kern et al., 2008; Nuechterlein et al., 2008) is a standardised battery that is intended for use with adults with schizophrenia and related disorders. This battery was used to measure performance in seven domains: speed of processing, working memory (verbal and non-verbal), verbal learning, visual learning, reasoning and problem solving, attention/vigilance, and social cognition. A prior publication (Cicero et al., 2016) reported significant associations among anomalous self-experiences and full version of the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT; Mayer et al., 2003) scores, and therefore we did not include the social cognition domain in the current analyses. MCCB scores are highly sensitive to the type and level of cognitive impairment observed in schizophrenia, and the composite scores are highly correlated with WASI-II FSIQ (August et al., 2012).

Anomalous self-experiences

ASEs were measured with the Inventory for Psychotic-Like Anomalous Self-Experiences (IPASE; Cicero et al., 2017). The IPASE is a 57-item self-report questionnaire in which participants indicate how much they agree or disagree with statements on a scale of 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). The IPASE measures basic self-disturbances

and is composed of five domains of ASEs, including Self-Awareness and Presence (e.g. "I feel as though I no longer have an identity"), Consciousness (e.g. "I have difficulty telling whether I am experiencing something or just imagining it"), Somatization (e.g. "I have had the feeling that I am watching myself from outside of my body"), Cognition (e.g. "I feel like my thoughts are being generated by someone else"), and Demarcation/Transitivism (e.g. "I wonder whether or not I truly exist"). IPASE scores have been found to be associated with positive symptoms and self-concept clarity in people with schizophrenia (Cicero et al., 2016; Klaunig et al., 2018) as well as psychotic-like experiences, self-consciousness, and self-concept clarity in people at risk for developing psychosis (Cicero et al., 2017). Other research has found a very large positive correlation ($r = 0.92$) between the IPASE and total scores on the EASE, the gold standard measurement for assessing ASEs, in people during the prodromal phase and first episode of psychosis (Nelson et al., 2018).

Procedure

This research was approved by the University of Hawai'i Institutional Review Board (Protocol ID: 2016–30153). Informed consent was obtained from each participant by a PhD level clinical psychologist or an advanced PhD graduate student. As part of a larger study, participants first completed the SCID-I and PANSS interviews (which were videotaped with participant consent), followed by the remaining tasks and questionnaires (including the IPASE) in random order. Participants completed the study over the course of two or three sessions of approximately two-to-three hours each and were compensated $50–75 for their time, depending on the length of time needed to complete the study.

Multiple imputations

Missing data were imputed using multiple imputation (Rubin, 1987) in SPSS. First, we evaluated missing data patterns and found them to be missing at random. Five imputations were run with the aggregate of multiple imputations, using the automatic function to increase monotenecity. We had a maximum of 100 parameters in the imputation model and used the monicano method to change the iterations, having a fully conditional specification method of 10 iterations.

Results

3.1. Between-group comparisons

The first goal of this research was to discern whether individuals with schizophrenia had anomalous self-experiences and neurocognitive deficits as compared to the control group. As can be seen in Table 2, participants with schizophrenia had higher total IPASE scores and higher scores on all five subscales. Participants with schizophrenia also showed deficits on all of the cognitive tasks included in the MCCB compared to healthy controls.

Table 2. Independent samples t-tests between schizophrenia and control groups.

	Schizophrenia Mean (SD)	Control Mean (SD)	t (df)	*p*-value	Cohen's *d*
IPASE Subscales					
Total	129.15 (45.90)	76.97 (22.14)	−5.83 (70)	0.000	−1.39
Cognition	14.61 (6.64)	9.00 (3.79)	−4.21 (70)	0.000	−1.00
Demarcation/Transitivism	9.71 (4.58)	6.22 (1.98)	−3.95 (70)	0.000	−0.94
Consciousness	15.29 (5.78)	10.52 (4.64)	−3.77 (70)	0.000	−0.90
Self-Awareness & Presence	50.80 (19.96)	28.48 (7.77)	−5.89 (70)	0.000	−1.40
Somatization	38.73 (14.56)	22.74 (7.60)	−5.56 (70)	0.000	−1.32
MCCB Subscales					
Attention	36.92 (13.34)	43.37 (9.14)	2.17 (62)	0.034	0.55
Verbal Learning	35.36 (7.51)	47.38 (13.20)	5.03 (74)	0.000	1.17
Visual Learning	37.29 (10.82)	47.75 (13.18)	3.75 (72)	0.000	0.88
Reasoning	42.79 (8.95)	49.53 (9.99)	3.07 (73)	0.003	0.72
Speed of Processing	36.48 (10.84)	50.90 (9.99)	5.81 (71)	0.000	1.38
Working Memory	39.88 (11.97)	47.22 (13.45)	2.49 (73)	0.015	0.58

Note: IPASE = Inventory for Psychotic-Like Anomalous Self-Experiences, MCCB = MATRICS Consensus Cognitive Battery.

Associations among anomalous self-experiences and cognitive domains

The next goal was to examine the relations between IPASE subscales and the MCCB domains in the schizophrenia group only. First, we subjected the MCCB scores to a principle components analysis. A parallel analysis and an analysis of the scree plot confirmed that a one component solution, explaining 49.75% of the variance was the most appropriate. We then correlated the MCCB component scores with the IPASE scores. As expected, the Cognition subscale was significantly associated with the MCCB component ($r = -0.325$, $p = .024$), but the total score and the other four subscales were not significantly associated with the MCCB component (rs −0.145–0.263, ps 0.070–0.326). Second, we examined the Pearson correlations between the IPASE subscales and the MCCB measures in the schizophrenia group only. Although the hypotheses were primarily related to the IPASE Cognition scale, we report the correlations with the total score and each subscale as well. As can be seen in Table 3, the IPASE-Cognition scale was negatively correlated with the MCCB domains of Attention, Visual Learning, Reasoning, and Working Memory. Neither the total score nor any of the other subscales were significantly associated with any MCCB domain. Moreover, the subscales within each measure were significantly correlated with each other. For the IPASE, correlations ranged from .63 to .87 and all scales were highly correlated with the total score. Domains within the MCCB were mostly significantly correlated with each other, albeit less strongly. Verbal learning was not correlated with attention or reasoning. Otherwise, all correlations were significant, ranging from .30 to .53.

Discussion

The current study aimed to determine whether anomalous self-experiences are meaningfully related to neurocognitive impairment. Our study replicated previous findings showing that, in comparison to control participants, people with schizophrenia have broad deficits in neurocognition as well as elevated levels of ASEs. As expected, subjective disturbances in cognition, but not other domains of ASEs, were significantly associated with deficits in objective measures of cognition, although the magnitude of these associations would be considered moderate (Cohen, 1988). Specifically, IPASE Cognition was

Table 3. Bivariate correlations among variables in the schizophrenia group.

	1	2	3	4	5	6	7	8	9	10	11	12
IPASE Subscales												
1) Total	–											
2) Cognition	.79**	–										
3) Demarcation/Transitivism	.90**	.65**	–									
4) Consciousness	.77**	.67**	.59**	–								
5) Self-Awareness & Presence	.95**	.63**	.87**	.65**	–							
6) Somatization	.96**	.76**	.86**	.70**	.87**	–						
MCCB Domains												
7) MCCB Component	−.26	−.33*	−.25	−.16	−.25	−.22	–					
8) Attention	−.18	−.35*	−.04	−.22	−.22	−.12	–					
9) Verbal Learning	−.16	−.06	−.21	.03	−.19	−.18	.09	–				
10) Visual Learning	−.28	−.29*	−.25	−.07	−.16	−.18	.30*	.31*	–			
11) Reasoning	−.16	−.31*	−.14	−.14	−.14	−.25	.43**	.12	.51**	–		
12) Speed of Processing	−.14	−.15	−.10	−.14	−.15	−.09	.41**	.44**	.48**	.51**	–	
13) Working Memory	−.20	−.29*	−.24	−.16	−.18	−.14	.30*	.39**	.53**	.44**	.53**	–

*$p < .05$, **$p < .01$.
IPASE = Inventory for Psychotic-Like Anomalous Self-Experiences, MCCB = MATRICS Consensus Cognitive Battery.

negatively associated with the cognitive domains of attention, visual learning, reasoning, and working memory, as measured by the MCCB. Importantly, the current study did not find a relationship between the MCCB domains and other factors of self-disturbances. This suggests that the relation between cognitive deficits and anomalous self-experience may be specific to cognitive aspects of self-experiences.

This study empirically demonstrated a connection between task-based measures of neurocognition and self-reported disturbances in thought processes. These relationships were found particularly within domains that require intact attentional functioning and capacity for mental manipulation of stimuli. A subjective disconnection from one's thought processes may therefore disproportionately affect these abilities. This notion is consistent with theoretical accounts of self-disturbance in schizophrenia, which posit that symptoms of the disorder arise from a combination of aberrant salience, or increased attention to otherwise benign or irrelevant stimuli, and deficits in source monitoring, or inability to distinguish the origin of a stimulus (Nelson et al., 2014a, 2014b).

Although previous literature has reported associations between self-disturbances and objective measures of neurocognitive function, the methods of the current study differ from previous work in several ways. First, the IPASE may allow for more targeted assessment of disturbances in cognition as they are experienced by the individual. The IPASE, in contrast to other assessments of ASEs, dissociates ASEs related to cognition from those related to consciousness. For example, Haug et al. (2012b) found a significant relation between the total score of an interviewer-rated measure of ASEs (i.e. EASE) and verbal memory only, with no meaningful relationship found between any domains of cognition and ASEs in the combined cognition and stream of consciousness factor. It is therefore possible that the relation between cognitive ASEs and cognitive deficits in that study may have been obfuscated by variance from ASEs related to stream of consciousness. As well, to our knowledge, there has only been one previous study that examined the IPASE and cognitive domains (Hernández-García et al., 2020) and this study found no significant relationships between the Cognition factor and any of the neuropsychological tasks of the BACS. One explanation for this difference may lie in the nature of cognitive tasks between studies. For example, the BACS combines the domains of attention and processing speed by utilising a digit-symbol coding task (Keefe et al., 2004), whereas the MCCB employs a continuous performance test (CPT-IP) as a measure of attention/vigilance, and includes digit-symbol coding among other tests in a separate domain of speed of processing. Moreover, Hernández-García et al. (2020) found meaningful relationships between domains of the IPASE (Somatization and Self-Awareness and Presence) and the BACS motor speed task, for which there is no comparable subtest on the MCCB. It is possible that cognitive constructs as operationalised by the MCCB, particularly with regard to attention, visual learning, reasoning, and working memory, rely more heavily on the disordered processes that underlie cognitive ASEs. Future research may benefit from a thorough exploration of ASEs with different aspects of functioning that make up particular cognitive domains (e.g. including both verbal and visual reasoning tasks).

In addition to differences in methodology, the current study differed from past research in potentially important sample characteristics. Previous work included individuals at risk for schizophrenia (Comparelli et al., 2016) and individuals experiencing a first

episode of psychosis (Haug et al., 2012b), or a mixed sample of chronic and first episode schizophrenia (Hernández-García et al., 2020), while the current study used a sample of individuals with chronic schizophrenia as confirmed by structured diagnostic interview. The lack of a significant relation between subjective and objective disturbances in at-risk samples may be due to "false positives" of people identified as prodromal who are, in fact, not at risk for developing psychosis. On average, only about one-third of individuals identified as at risk for developing schizophrenia actually convert to a full psychotic disorder after several years of follow-up (Riecher-Rössler & Studerus, 2017; Simon et al., 2011). Thus, in a sample of individuals identified as at-risk for schizophrenia, the majority of individuals are not truly in an early stage of schizophrenia. In addition, objective cognitive deficits, particularly working memory and visual learning predicts conversion to psychosis in people at risk (De Herdt et al., 2013), and people in the prodrome tend to have intermediate deficits compared to people with chronic schizophrenia and healthy controls (Pukrop et al., 2006). This indicates that people who ultimately do not convert to psychosis show better overall cognitive performance and therefore may not show the same levels and patterns of association between subjective and objective cognitive symptoms.

The current study is subject to some limitations. One primary limitation pertains to the relatively small sample size and the increased possibility of type II error due to low power. It is possible that significant relationships exist between other domains of ASEs and cognition that were unable to be detected with the current sample. Replication of this research with a larger sample of individuals with schizophrenia would therefore allow for more fine-grained analysis of potential mediating factors. A second potential limitation of the current study is the lack of information about temporal features of the association between the subjective and objective measures of cognitive disturbance. For example, the current study did not measure whether individuals experienced subjective cognitive disturbance continuously or whether these experiences varied over time. Although objective cognitive deficits tend to be stable traits after onset of schizophrenia (Addington et al., 2005; Nuechterlein et al., 2014), it is not clear if subjective cognitive deficits have a stable time course. In the future, it may be useful to employ ecological momentary assessments techniques, in which participants are prompted at several time points each day over an extended period of time, to better understand whether the association between subjective and objective cognitive disturbances is stable over time.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The current research was supported by an internal grant from the University of Hawai'i at Mānoa.

ORCID

David C. Cicero http://orcid.org/0000-0002-5666-9139

References

Addington, J., Saeedi, H., & Addington, D. (2005). The course of cognitive functioning in first episode psychosis: Changes over time and impact on outcome. *Schizophrenia Research*, *78*(1), 35–43. https://doi.org/10.1016/j.schres.2005.05.008

Aleman, A., Hijman, R., de Haan, E. H., & Kahn, R. S. (1999). Memory impairment in schizophrenia: A meta-analysis. *American Journal of Psychiatry*, *156*(9), 1358–1366. https://doi.org/10.1176/ajp.156.9.1358

August, S. M., Kiwanuka, J. N., McMahon, R. P., & Gold, J. M. (2012). The MATRICS Consensus Cognitive Battery (MCCB): Clinical and cognitive correlates. *Schizophrenia Research*, *134*(1), 76–82. https://doi.org/10.1016/j.schres.2011.10.015

Barch, D. M., Csernansky, J. G., Conturo, T., & Snyder, A. Z. (2002). Working and long-term memory deficits in schizophrenia: Is there a common prefrontal mechanism? *Journal of Abnormal Psychology*, *111*(3), 478–494. https://doi.org/10.1037/0021-843X.111.3.478

Brebion, G., Amador, X., Smith, M. J., & Gorman, J. M. (1997). Mechanisms underlying memory impairment in schizophrenia. *Psychological Medicine*, *27*(2), 383–393. https://doi.org/10.1017/S0033291796004448

Brent, B. K., Seidman, L. J., Thermenos, H. W., Holt, D. J., & Keshavan, M. S. (2014). Self-disturbances as a possible premorbid indicator of schizophrenia risk: A neurodevelopmental perspective. *Schizophrenia Research*, *152*(1), 73–80. https://doi.org/10.1016/j.schres.2013.07.038

Cannon, M., Moffitt, T. E., Caspi, A., Murray, R. M., Harrington, H., & Poulton, R. (2006). Neuropsychological performance at the age of 13 years and adult schizophreniform disorder: Prospective birth cohort study. *British Journal of Psychiatry*, *189*(5), 463–464. https://doi.org/10.1192/bjp.bp.105.020552

Cicero, D. C., Klaunig, M. J., Trask, C. L., & Neis, A. M. (2016). Anomalous self-experiences and positive symptoms are independently associated with emotion processing deficits in schizophrenia. *Schizophrenia Research*, *176*(2–3), 456–461. https://doi.org/10.1016/j.schres.2016.08.018

Cicero, D. C., Neis, A. M., Klaunig, M. J., & Trask, C. L. (2017). The inventory of psychotic-like anomalous self-experiences (IPASE): Development and validation. *Psychological Assessment*, *29*(1), 13–25. https://doi.org/10.1037/pas0000304

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Routledge Academic.

Comparelli, A., Corigliano, V., De Carolis, A., Pucci, D., Angelone, M., Di Pietro, S., Kotzalidis, G. D., Terzariol, L., Manni, L., Trisolini, A., & Girardi, P. (2016). Anomalous self-experiences and their relationship with symptoms, neuro-cognition, and functioning in at-risk adolescents and young adults. *Comprehensive Psychiatry*, *65*, 44–49. https://doi.org/10.1016/j.comppsych.2015.09.011

De Herdt, A., Wampers, M., Vancampfort, D., De Hert, M., Vanhees, L., Demunter, H., Van Bouwel, L., Brunner, E., & Probst, M. (2013). Neurocognition in clinical high risk young adults who did or did not convert to a first schizophrenic psychosis: A meta-analysis. *Schizophrenia Research*, *149*(1–3), 48–55. https://doi.org/10.1016/j.schres.2013.06.017

First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. W. (1998). *Structured clinical interview for DSM-IV axis I disorders*. New York State Psychiatric Institute.

Goel, V., Bartolo, A., St Clair, D., & Venneri, A. (2004). Logical reasoning deficits in schizophrenia. *Schizophrenia Research*, *66*(1), 87–88. https://doi.org/10.1016/S0920-9964(02)00499-1

Goff, D. C. (2013). Future perspectives on the treatment of cognitive deficits and negative symptoms in schizophrenia. *World Psychiatry*, *12*(2), 99–107. https://doi.org/10.1002/wps.20026

Gold, J. M., Robinson, B., Leonard, C. J., Hahn, B., Chen, S., McMahon, R. P., & Luck, S. J. (2018). Selective attention, working memory, and executive function as potential independent sources of cognitive dysfunction in schizophrenia. *Schizophrenia Bulletin*, *44*(6), 1227–1234. https://doi.org/10.1093/schbul/sbx155

Green, M. F. (1996). What are the functional consequences of neurocognitive deficits in schizophrenia? *American Journal of Psychiatry*, *153*(3), 321–330. https://doi.org/10.1176/ajp.153.3.321

Haug, E., Lien, L., Raballo, A., Bratlien, U., Øie, M., Andreassen, O. A., Melle, I., & Møller, P. (2012a). Selective aggregation of self-disorders in first-treatment DSM-IV schizophrenia spectrum disorders. *Journal of Nervous and Mental Disease*, *200*(7), 632–636. https://doi.org/10.1097/NMD.0b013e31825bfd6f

Haug, E., Øie, M., Melle, I., Andreassen, O. A., Raballo, A., Bratlien, U., Lien, L., & Møller, P. (2012b). The association between self-disorders and neurocognitive dysfunction in schizophrenia. *Schizophrenia Research*, *135*(1–3), 79–83. https://doi.org/10.1016/j.schres.2011.11.015

Heinrichs, R. W., & Zakzanis, K. K. (1998). Neurocognitive deficit in schizophrenia: A quantitative review of the evidence. *Neuropsychology*, *12*(3), 426–445. https://doi.org/10.1037/0894-4105.12.3.426

Hernández-García, M., Gomez-Garcia, M., Sotelo, E., Fernandez-Linsenbarth, I., Andres-Olivera, P., Alarcon-Gomez, R., Munoz-Moreno, M. F., & Molina, V. (2020). Anomalous self-experiences are related to general cognition deficits in schizophrenia. *European Archives of Psychiatry and Clinical Neuroscience*. https://doi.org/10.1007/s0040 6-020-01213-z

Kay, S. R., Fiszbein, A., & Opler, L. A. (1987). The positive and negative syndrome scale (PANSS) for schizophrenia. *Schizophrenia Bulletin*, *13*(2), 261–276. https://doi.org/10.1093/schbul/13.2.261

Keefe, R S E, Goldberg, T E, Harvey, P D, Gold, J M, Poe, M P. (2004). The Brief Assessment of Cognition in Schizophrenia: Reliability, sensitivity, and comparison with a standard neurocognitive battery. *Schizophrenia Research*, *68*(2-3), 283–297.

Kern, R S, Gold, J M, Dickinson, D, Green, M F, Nuechterlein, K H, Baade, L E, Keefe, R S E, Mesholam-Gately, R I, Seidman, L J, Lee, C, Sugar, C A, & Marder, S R. (2011). The MCCB impairment profile for schizophrenia outpatients: Results from the MATRICS psychometric and standardization study. *Schizophrenia Research*, *126*(1-3), 124–131.

Kern, R. S., Nuechterlein, K. H., Green, M. F., Baade, L. E., Fenton, W. S., Gold, J. M., Keefe, R. S. E., Mesholam-Gately, R., Mintz, J., Seidman, L. J., Stover, E., & Marder, S. R. (2008). The MATRICS Consensus Cognitive Battery, part 2: Co-norming and standardization. *American Journal of Psychiatry*, *165*(2), 214–220. https://doi.org/10.1176/appi.ajp.2007.07010043

Klaunig, M. J., Trask, C. L., Neis, A. M., Cohn, J. R., Chen, X., Berglund, A. M., & Cicero, D. C. (2018). Associations among domains of self-disturbance in schizophrenia. *Psychiatry Research*, *267*, 187–194. https://doi.org/10.1016/j.psychres.2018.05.082

Mayer, J. D., Salovey, P., Caruso, D. R., & Sitarenios, G. (2003). Measuring emotional intelligence with the MSCEIT V2.0. *Emotion*, *3*(1), 97–105. https://doi.org/10.1037/1528-3542.3.1.97

McHugh, M. L. (2012). Interrater reliability: The kappa statistic. *Biochemia Medica*, *22*(3), 276–282. https://doi.org/10.11613/BM.2012.031

Meier, M. H., Caspi, A., Reichenberg, A., Keefe, R. S. E., Fisher, H. L., Harrington, H., Houts, R., Poulton, R., & Moffitt, T. E. (2014). Neuropsychological decline in schizophrenia from the premorbid to the postonset period: Evidence from a population-representative longitudinal study. *American Journal of Psychiatry*, *171*(1), 91–101. https://doi.org/10.1176/appi.ajp.2013.12111438

Mirian, D., Heinrichs, R. W., & McDermid Vaz, S. (2011). Exploring logical reasoning abilities in schizophrenia patients. *Schizophrenia Research*, *127*(1–3), 178–180. https://doi.org/10.1016/j.schres.2011.01.007

Moller, P., & Husby, R. (2000). The initial prodrome in schizophrenia: Searching for naturalistic core dimensions of experience and behavior. *Schizophrenia Bulletin*, *26*(1), 217–232. https://doi.org/10.1093/oxfordjournals.schbul.a033442

Nelson, B., Li, E., Cicero, D. C., Gawęda, Ł., Hartmann, J. A., Koren, D., Polari, A., Whitford, T. J., & Lavoie, S. (2018). The construct validity of the Inventory of Psychotic-Like Anomalous Self-Experiences (IPASE) as a measure of minimal self-disturbance: Preliminary data. *Early Intervention in Psychiatry*, *13*(3), 686–691. https://doi.org/10.1111/eip.12711

Nelson, B., Thompson, A., & Yung, A. R. (2012). Basic self-disturbance predicts psychosis onset in the ultra high risk for psychosis "prodromal" population. *Schizophrenia Bulletin*, *38*(6), 1277–1287. https://doi.org/10.1093/schbul/sbs007

Nelson, B., Whitford, T. J., Lavoie, S., & Sass, L. A. (2014a). What are the neurocognitive correlates of basic self-disturbance in schizophrenia?: Integrating phenomenology and neurocognition. Part 1 (source monitoring deficits). *Schizophrenia Research*, *152*(1), 12–19. https://doi.org/10.1016/j.schres.2013.06.022

Nelson, B., Whitford, T. J., Lavoie, S., & Sass, L. A. (2014b). What are the neurocognitive correlates of basic self-disturbance in schizophrenia?: Integrating phenomenology and neurocognition: Part 2 (aberrant salience). *Schizophrenia Research*, *152*(1), 20–27. https://doi.org/10.1016/j.schres.2013.06.033

Nordgaard, J., & Parnas, J. (2014). Self-disorders and the schizophrenia spectrum: A study of 100 first hospital admissions. *Schizophrenia Bulletin*, *40*(6), 1300–1307. https://doi.org/10.1093/schbul/sbt239

Nuechterlein, K. H., Green, M. F., Kern, R. S., Baade, L. E., Barch, D. M., Cohen, J. D., Essock, S., Fenton, W. S., Frese, F. J., Gold, J. M., Goldberg, T., Heaton, R. K., Keefe, R. S. E., Kraemer, H., Mesholam-Gately, R., Seidman, L. J., Stover, E., Weinberger, D. R., Young, A. S., … Marder, S. R. (2008). The MATRICS Consensus Cognitive Battery, part 1: Test selection, reliability, and validity. *American Journal of Psychiatry*, *165*(2), 203–213. https://doi.org/10.1176/appi.ajp.2007.07010042

Nuechterlein, K. H., Ventura, J., Subotnik, K. L., & Bartzokis, G. (2014). The early longitudinal course of cognitive deficits in schizophrenia. *Journal of Clinical Psychiatry*, *75*(0–2), 25–29. https://doi.org/10.4088/JCP.13065su1.06

Orellana, G., & Slachevsky, A. (2013). Executive functioning in schizophrenia. *Frontiers in Psychiatry*, *4*, 35. https://doi.org/10.3389/fpsyt.2013.00035

Park, S., & Nasrallah, H. A. (2014). The varieties of anomalous self experiences in schizophrenia: Splitting of the mind at a crossroad. *Schizophrenia Research*, *152*(1), 1–4. https://doi.org/10.1016/j.schres.2013.11.036

Parnas, J., & Handest, P. (2003). Phenomenology of anomalous self-experience in early schizophrenia. *Comprehensive Psychiatry*, *44*(2), 121–134. https://doi.org/10.1053/comp.2003.50017

Parnas, J., & Jansson, L. B. (2015). Self-disorders: Clinical and conceptual implications for the diagnostic concept of schizophrenia. *Psychopathology*, *48*(5), 332–338. https://doi.org/10.1159/000437232

Parnas, J., Moller, P., Kircher, T., Thalbitzer, J., Jansson, L., Handest, P., & Zahavi, D. (2005). EASE: Examination of anomalous self-experience. *Psychopathology*, *38*(5), 236–258. https://doi.org/10.1159/000088441

Pukrop, R., Schultze-Lutter, F., Ruhrmann, S., Brockhaus-Dumke, A., Tendolkar, I., Bechdolf, A., Matuschek, E., & Klosterkötter, J. (2006). Neurocognitive functioning in subjects at risk for a first episode of psychosis compared with first- and multiple-episode schizophrenia. *Journal of Clinical and Experimental Neuropsychology*, *28*(8), 1388–1407. https://doi.org/10.1080/13803390500434425

Raballo, A, Saebye, D. (2011). Looking at the schizophrenia spectrum through the prism of self-disorders: An empirical study. *Schizophrenia Bulletin*, *37*(2), 344–351.

Riecher-Rössler, A., & Studerus, E. (2017). Prediction of conversion to psychosis in individuals with an at-risk mental state: A brief update on recent developments. *Current Opinion in Psychiatry*, *30*(3), 209–219. https://doi.org/10.1097/YCO.0000000000000320

Rubin, D. B. (1987). *Multiple imputation for nonresponse in surveys*. John Wiley & Sons, Inc.

Rushe, T. M., Woodruff, P. W., Murray, R. M., & Morris, R. G. (1999). Episodic memory and learning in patients with chronic schizophrenia. *Schizophrenia Research*, *35*(1), 85–96. https://doi.org/10.1016/S0920-9964(98)00117-0

Sass, L., Borda, J. P., Madeira, L., Pienkos, E., & Nelson, B. (2018). Varieties of self disorder: A bio-pheno-social model of schizophrenia. *Schizophrenia Bulletin*, *44*(4), 720–727. https://doi.org/10.1093/schbul/sby001

Savilla, K., Kettler, L., & Galletly, C. (2008). Relationships between cognitive deficits, symptoms and quality of life in schizophrenia. *Australian & New Zealand Journal of Psychiatry*, *42*(6), 496–504. https://doi.org/10.1080/00048670802050512

Sheffield, J. M., Karcher, N. R., & Barch, D. M. (2018). Cognitive deficits in psychotic disorders: A lifespan perspective. *Neuropsychology Review*, *28*(4), 509–533. https://doi.org/10.1007/s11065-018-9388-2

Simon, A. E., Velthorst, E., Nieman, D. H., Linszen, D., Umbricht, D., & de Haan, L. (2011). Ultra high-risk state for psychosis and non-transition: A systematic review. *Schizophrenia Research*, *132*(1), 8–17. https://doi.org/10.1016/j.schres.2011.07.002

Strassnig, M., Bowie, C., Pinkham, A. E., Penn, D., Twamley, E. W., Patterson, T. L., & Harvey, P. D. (2018). Which levels of cognitive impairments and negative symptoms are related to functional deficits in schizophrenia? *Journal of Psychiatric Research*, *104*, 124–129. https://doi.org/10.1016/j.jpsychires.2018.06.018

Sum, M. Y., Tay, K. H., Sengupta, S., & Sim, K. (2018). Neurocognitive functioning and quality of life in patients with and without deficit syndrome of schizophrenia. *Psychiatry Research*, *263*, 54–60. https://doi.org/10.1016/j.psychres.2018.02.025

Velligan, D. I., Mahurin, R. K., Diamond, P. L., Hazleton, B. C., Eckert, S. L., & Miller, A. L. (1997). The functional significance of symptomatology and cognitive function in schizophrenia. *Schizophrenia Research*, *25*(1), 21–31. https://doi.org/10.1016/s0920-9964(97)00010-8

Welham, J., Scott, J., Williams, G. M., Najman, J. M., Bor, W., O'Callaghan, M., & McGrath, J. (2010). The antecedents of non-affective psychosis in a birth-cohort, with a focus on measures related to cognitive ability, attentional dysfunction and speech problems. *Acta Psychiatrica Scandinavica*, *121*(4), 273–279. https://doi.org/10.1111/j.1600-0447.2009.01470.x