Received: 2 May 2021 | Revised: 27 September 2021 | Accepted: 18 January 2022

DOI: 10.1111/eip.13269

ORIGINAL ARTICLE

WILEY

Relating self-disorders to neurocognitive and psychopathological measures in first-episode schizophrenia

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Abstract

Aim: The notion of a disturbed self as the core feature of schizophrenia dates back to the founding texts on the illness. Since the development of the psychometric tool for examination of anomalous self-experience (EASE), self-disorders have become accessible to empirical research. Empirical studies have shown that EASE measured self-disorders predict schizophrenia spectrum in prospective studies and consistently show a selective hyper aggregation of self-disorder in schizophrenia and schizotypal disorders. The aim of this study is to investigate the relationship between self-disorders cognitive deficits and symptoms in schizophrenia.

Methods: Thirty-five non-acute first-episode patients with schizophrenia and 35 matched healthy controls were evaluated with EASE, cognitive deficits, and symptoms (PANSS positive, negative and general). [Correction added on 28 January 2022, after first online publication: the words, 'evaluated with' were missing and have now been added to the preceding sentence.]

Results: The results show that self-disorders and symptoms are correlated among patients with schizophrenia, but not with cognitive deficits. Moreover, with the exception of attentional deficits, neurocognitive impairment was not significantly higher among patients with schizophrenia compared to healthy controls.

Conclusions: We argue that this adds support to a view of schizophrenia as being characterized by specific traits of pre-reflective self-disturbance, which are related to the severity of symptoms, whereas neurocognitive impairment reflects a separate or distinct aspect of schizophrenia.

KEYWORDS
cognition, neuropsychology, psychopathology, schizophrenia, self-disorder

1 | INTRODUCTION

The multifaceted nature of psychopathology in schizophrenia is a longstanding challenge to psychiatry. A key issue concerns identification of the core features underlying and unifying the defining symptoms

Funding sources had no role in the design, execution, analysis, interpretation or submission of this study.

of schizophrenia. Interestingly, most foundational texts on schizophrenia agreed on the notion of a disturbed ego- (or self) as the core phenotypic feature of the disorder (Bleuler, 1911; De Kock, 2020; Jansson & Parnas, 2020; Parnas, 2011, 2012). Self-disorders were regarded as specific to schizophrenia and the disturbance of subjectivity was conceived as something expressed in the *Gestalt* of the clinical manifestation, that is, in the particularity of the part-whole relation of the patients expressive, subjective and existential patterns (Parnas, 2012).

The conceptualization of schizophrenia as a disordered self has especially been preserved in European phenomenological psychiatry. From a phenomenological perspective, self-disorders (SD's) in schizophrenia reflect a structural instability of experience, that is, an alteration of the first-person (subjective) articulation of experience. This is sometimes felt by patients as a diminished sense of presence, or as a distance between the sense of subjecthood and mental or bodily acts. With the development of the examination of anomalous self-experience (EASE), these aspects of psychopathology have been made accessible to empirical research (Parnas et al., 2005). A series of studies have demonstrated that SD's hyper-aggregate selectively in schizophrenia spectrum disorders (for meta-analysis see [Raballo et al., 2021], for review see [Henriksen et al., 2021]), are temporally stable (Koren, Tzivoni, et al., 2019; Nordgaard, Handest, et al., 2017; Nordgaard, Nilsson, et al., 2017), predict the onset of psychosis in high-risk populations (Koren, Tzivoni, et al., 2019; Nelson et al., 2012; Parnas et al., 2011) and transition to schizophrenia spectrum in help-seeking adolescents (Koren, Tzivoni, et al., 2019). SD's are thus regarded as a pre-psychotic vulnerability trait to schizophrenia, which has been further supported by findings of SD's in first-degree relatives (Maggini & Raballo, 2004) and in schizotypal disorder (Parnas et al., 2011b; Raballo & Parnas, 2011).

The relation between SD's and symptomatology has been addressed in previous studies. Some studies have reported weak-moderate correlations between SD's and both positive and negative symptoms (Nordgaard & Parnas, 2014; Raballo & Parnas, 2012). Another follow-up study on schizophrenia-spectrum patients found non-significant correlations between SD's and negative symptoms but significant correlations between SD's and positive symptoms (Nordgaard, Nilsson, et al., 2017). Another study reported moderate-high correlation between SD's and prodromal psychotic dimensions (SIPS) in clinical high-risk subjects, suggesting SD's to be related to symptomatology during pre-psychotic phases of schizophrenia (Raballo et al., 2016). Other studies on high-risk populations have found correlation between SD's and positive and negative symptoms (Comparelli et al., 2016; Koren et al., 2013; Værnes et al., 2019). Recently, significant correlation between SD's, negative symptoms and first-rank symptoms in first-admission patients were reported (Nordgaard et al., 2020).

Overall, studies support that SD's correlate with pre-psychotic and psychotic symptomatology in schizophrenia spectrum disorders.

Neurocognitive impairments have likewise been documented in schizophrenia, and regarded as having an impact on prognosis and general outcome (Heinrichs, 2005). Group differences between patients and healthy controls have moderate to large effect sizes on a broad array of neurocognitive domains (Heinrichs & Zakzanis, 1998) and cognitive impairments have shown to persist over time in increasing or stable trajectories (Thompson et al., 2013). In a prospective longitudinal high-risk study, (Erlenmeyer-Kimling & Cornblatt, 1992) identified global attentional dysfunction as the single most important bio-behavioural marker for schizophrenia among a variety of neurocognitive predictors. Some have gone so far as to suggest that the cognitive impairments should be regarded as the 'core feature' of schizophrenia (Green et al., 2019). Others disagree, on conceptual grounds (Urfer-Parnas, Mortensen, & Parnas, 2010), or point to the fact that neurocognitive dysfunctions (CDs) lack specificity as they are also present in other psychiatric disorders (Barch, 2019; Reichenberg et al., 2009). Furthermore, a substantial proportion of patients with schizophrenia, approximately one-quarter, perform within or above the normal range on neurocognitive tests (Reichenberg et al., 2009) and reviews have suggested that general cognitive abilities remain relatively intact in ultra-high-risk patients and constitute a poor predictor relative to other vulnerability markers (Brewer et al., 2006).

The relationship between SD's and CD in schizophrenia has only recently become a topic of empirical investigation. (Haug et al., 2012) investigated SD's and CD's in a sample of 57 outpatients and found a correlation between SD's and deficits in verbal recognition memory. No other neurocognitive measures correlated with SD's. In another study, investigating SD's and CD's in early phase patients, (Nordgaard et al., 2015) did not observe correlation between SD's and CD's. Both studies argued that SD's and CD's reflect different aspects of psychopathology in schizophrenia. Similar results with non-significant correlations between SD's and CD's have been reported in high-risk samples and help-seeking adolescents (Comparelli et al., 2016; Koren, Scheyer, et al., 2019). Others have associated anomalous self-experience with metacognition with one study done on first-episode psychosis patients finding non-significant correlations between SD's and metacognitive performance (Wright et al., 2020) and another study finding positive modest association between SD's and metacognitive scores in non-psychotic help-seeking adolescents (Koren, Scheyer, et al., 2019).

Overall, these studies suggest that whereas some neurocognitive test-scores may be associated with SD's, the majority of traditional neurocognitive measures are not.

On the basis of these observations, this study aims to further elucidate the relationship between SD's, CD's and symptoms in schizophrenia. More precisely, we compared a sample of recent onset schizophrenia patients to healthy controls to estimate the differences in CD's and intelligence between groups. Moreover, we explored associations between SD's, CD's and symptoms in the schizophrenia group. We hypothesized, that SD's and CD's would not correlate and furthermore that the severity of symptoms would be associated with the level of SD's but not CD's.

2 | METHODS

2.1 | Subjects

The sample of this study comprise 35 patients recently diagnosed with schizophrenia (SCZ) (mean age 22.11 years, SD 3.93, 14 males) and 35 matched healthy controls (HC) (mean age 24.06 years, SD 3.24, 14 males) (see Table 1). Patients were recruited from three psychiatric outpatient clinics in Region Zealand in Denmark.

TABLE 1 Background demographic information presented with mean scores, percentage in group (%), standard deviation (SD) and estimated between-group differences with mean and *p*-values

Scales	SCZ	HC	Between-group difference
Participants (Male/Female)	35 (14 / 21)	35 (14 / 21)	0
Age (years)	22.11; SD 3.93	24.06; SD 3.24	1.95; $p = .027$*
Education (years)	11.06; SD 1.85	14.63; SD 1.59	3.57; $p < .001$*
Intelligence score	93.15; SD 10.96	96.32; SD 10.20	3.17; $p = .21$
Antipsychotic medication (%)	30 (86)	0 (0)	30; $p < .001$*
Antiepileptic (%)	2 (6)	0 (0)	2; $p = .156$
Antidepressant (%)	5 (14)	2 (6)	3; $p = .238$

Note: Significant differences between groups are marked with asterisk.
Abbreviations: HC, healthy control group; SCZ, schizophrenia patient group.

Inclusion criteria for SCZ group were (1) age between 18 and 40 years (2) diagnosed with schizophrenia within the last year according to Diagnostic and Statistical Manual of Mental Disorders V (DSM V) (APA, 2013) (3) a stable non-acute phase of the illness (without need for hospitalization).

Exclusion criteria were (1) active or past clinically significant drug or alcohol abuse (2) any organic pathological conditions likely to affect cognition or the somatosensory system (known injury or illness in the central nervous system and mental retardation) (3) Forensic status.

Inclusion criteria for HC were an age between 18 and 40 years. Exclusion criteria where the same as in the SCZ group, moreover participants were excluded if they suffered from a current episode of any mental illness or had a history of a chronic mental illness (schizophrenia, schizotypal disorder, bipolar illness and severe personality disorder) or had a first-degree relative within schizophrenia spectrum disorders.

Two participants from the SCZ group dropped out due to worsening of their mental condition and one HC was excluded due to fulfilling the diagnostic criteria of schizotypal disorder.

Written consent was obtained from all participants after having received a thorough oral and written description and the study was approved by the regional data agency and ethics committee in Region Zealand, Denmark, in line with the ethical standards of the Declaration of Helsinki 2013.

2.2 | Clinical evaluation

All participants went through a comprehensive psychopathological evaluation including Assessment of positive and negative syndrome scale (PANSS) (Kay et al., 1987), the operational criteria checklist for psychotic illness and affective illness (OPCRIT) (McGuffin et al., 1991) and EASE (Parnas et al., 2005).

Psychiatric evaluation was performed by K.E.S., a senior resident in psychiatry, specifically trained and reliability tested by the founder of the EASE scale (J.P.) and another senior EASE expert (J.N.). The majority of the psychiatric interviews were video recorded. In cases of diagnostic or assessment problems, the clinical material was reviewed and discussed with a senior psychiatrist (J.P.) and a consensus resolution was achieved.

TABLE 2 An overview of applied tests and their respective measures with scores

Test	Parameter
EASE domain 1	Stream of consciousness (score: 0–17)
EASE domain 2	Self-awareness and presence (score: 0–19)
EASE domain 3	Bodily experiences (score: 0–9)
EASE domain 4	Demarcation/transitivism (score: 0–5)
EASE domain 5	Existential reorientation (score: 0–8)
PANSS general psychopathology	General measure of symptom severity (score: 16–112)
PANSS positive scale	Current positive (psychotic) symptom severity (score: 7–49)
PANSS negative scale	Current negative (deficit) symptom severity (score: 7–49)
Reaction time (RT)	Assessment of attention and psychomotor response in ms (release button)
Paired associates learning (PAL)	Visual memory and learning acquisition (total errors adjusted)
One touch stockings of Cambridge (OTSC)	Planning and working memory (problems solved in first attempt)
Multitasking (MT)	Managing of conflicting information (total incorrect responses)
Rapid visual information processing (RVIP)	Measure of sustained attention (target detecting ability)
Emotion recognition task (ERT)	Evaluation of facially expressed emotions (total correct responses)
Spatial working memory (SWM)	Visuo-spatial working memory (strategy ability)
Verbal recognition memory (VRM)	Verbal memory and new learning (total short term recognition)

2.3 | Psychopathological assessment

The interviews were performed in a semi-structured and narrative style in order to obtain faithful self-descriptions according to the standards of phenomenological interviews (Jansson & Nordgaard, 2016). The EASE consists of 57 items, divided into subtypes (see Table 2).

2.4 | Neurocognition

Assessment of neurocognitive performance was conducted by the use of the Cambridge Neuropsychological Test Automated Battery (CANTAB) for schizophrenia (Barnett et al., 2010). This computational test-battery consists of eight neurocognitive domains (see Table 2). The test was performed on a recommended device, iPad Pro 9,7. The test was guided by the verbal instructions from the automated test battery. The participant would perform the tests alone by following the verbal instructions from the automated test battery. The test lasted approximately 55 min in total and was completed in one session.

All participants were intelligence-tested with the computer based test-system Hogrefe IST 2000R (Liepmann et al., 2001) comprising sentence completion, verbal analogies, number series and matrices (see Table 1).

2.5 | Statistical analyses

Statistical procedures were performed in Matlab R 2017a. Group comparisons of EASE scores, PANSS symptoms and the CANTAB domains were computed using a two-sample *t*-test for the continuous data between SCZ and HC. The measure of CD's (CANTAB total score) was obtained by initially converting those measures which had higher score for better performance such that all measures had same directionality, that is, higher score meant higher levels of CD's for all variables. The total CANTAB score was computed as the sum of the z-scored values of all the constituent CANTAB measurements. The relationship between SD's (EASE total), CD's (CANTAB scores) and symptoms (PANSS scores) was analysed with Spearman's rank-order correlation.

None of the target variables correlated with age.

3 | RESULTS

3.1 | Group comparison

The first aim was to address group differences between SCZ and HC on the main measures. As displayed in Table 3, the five domains of EASE as well as the general, positive and negative symptoms were all significantly higher in the SCZ group compared to HC. On the neurocognitive tests the HC performed significantly better on *Rapid Information Processing* (sustained attention) and *Reaction Time* (attention and psychomotor speed) (see Table 3). On the remaining measures, there were no significant differences. In the *Paired Associates Learning* test assessing visual memory, patients had a numerically albeit non-significant better performance. In the remaining tests, there was a numerically better performance by HC compared to SCZ which did not reach significance.

Although no correlations were found between age and any key measures, we re-ran the analysis with age as covariate. In *Rapid*

TABLE 3 Displaying overall baseline scores for patients (SCZ) and healthy controls (HC)

Measure	SCZMean score (SD)	HCMean score (SD)	Mean group differences (*p*-value; [CI])
EASE domain 1-stream of consciousness	9.17 (2.83)	0.31 (0.63)	8.86 ($p < .001$; [7.78;9.84])*
EASE domain 2-self-awareness and presence	9.09 (3.80)	0.34 (0.68)	8.75 ($p < .001$; [7.44;10.04])*
EASE domain 3-bodily experiences	3.06 (1.83)	0.03 (0.17)	3.03 ($p < .001$; [2.04;3.65])*
EASE domain 4-demarcation/transitivism	1.49 (1.20)	0	1.49 ($p < .001$; [1.08;1.89])*
EASE domain 5-existential reorientation	2.31 (1.75)	0.26 (0.44)	2.05 ($p < .001$; [1.44;2.66])*
EASE domain total (sum)	25.11 (9.46)	0.94 (1.33)	24.17 ($p < .001$; [20.95;27.39])*
PANSS general symptoms	42.43 (7.07)	18.06 (2.51)	24.37 ($p < .001$; [21.84;26.90])*
PANSS positive symptoms	17.74 (3.72)	7.09 (0.37)	10.65 ($p < .001$; [9.40;11.92])*
PANSS negative symptoms	22.57 (4.98)	7.60 (1.56)	14.97 ($p < .001$; [13.21;16.73])*
Reaction time	330 (32.76)	306 (21.50)	24.00 ($p < .001$; [10.38;36.82])*
Paired associates learning	6.69 (6.62)	8.11 (10.25)	−1.42 ($p = .491$; [−5.545;2.688])
One touch stockings of Cambridge	10.97 (2.60)	11.94 (2.44)	−0.97 ($p = .111$; [−2.172;−0.229])
Multitasking test	6.86 (8.78)	4.66 (6.03)	2.20 ($p = .226$; [−1.396;5.796])
Rapid visual information processing	0.89 (0.06)	0.91 (0.04)	−0.03 ($p = .033$; [−0.050;−0.002])*
Emotion recognition task	28.49 (5.20)	28.87 (4.60)	−0.38 ($p = .753$; [−2.712;1.969])
Spatial working memory	7.29 (2.78)	6.97 (2.80)	0.32 ($p = .639$; [−1.018;1.646])
Verbal recognition memory	31.63 (3.02)	32.11 (2.26)	−0.48 ($p = .449$; [−1.758;0.787])
CANTAB total score (z-score)	1.25 (4.35)	−1.25 (4.64)	2.50 ($p = .372$; [−1.603;0.603])

Note: Notably, for the CANTAB tests one touch stockings of Cambridge, rapid visual information processing, emotion recognition task and verbal recognition memory, a high score would mean a better performance on the test. For the other CANTAB measures, a low score would indicate a better performance on the test. The CANTAB total score is a sum of all z-scores with similar directionality, that is, higher score meaning more cognitive deficits. Significant group differences are displayed with an asterisk.

Information Processing, we observed a change in the significance level, that is, the significance was lost ($p = .0534$). The remaining group comparisons did not change in significance after an age correction.

3.2 | Relationships between SD's, CD's and symptoms in SCZ group

The internal relationship between SD's (EASE total-score), CD's (CANTAB total-score) and symptoms (PANSS-scores) in the SCZ group, was explored through correlation analysis in a first step (see Table 4). Apart from the listed results the correlation between SD's and with positive symptoms was near significant ($r = 0.318$; $p = .063$) and similarly the correlation between CD's and negative symptoms was near significant ($r = 0.299$; $p = .081$).

3.3 | Correlations with cognitive subdomains and IQ

The correlations between IQ, SD's, PANSS and CD's (subdomains and total-score) are displayed in Table 5. A significant negative correlation was reached between IQ and all cognitive subdomains apart from *reaction time* and *verbal memory*. IQ had a further negative significant correlation with PANSS negative, but did not correlate with EASE, PANSS positive or PANSS general.

EASE did not correlate significantly with any of the cognitive subdomains. There was a significant correlation between *reaction time* and PANSS general and *reaction time* and PANSS positive.

4 | DISCUSSION

The comparison between SZC and HC demonstrated that SD's and symptoms were higher in SCZ group. This was however not the case for CD's, where only the measures of *reaction time* and *sustained attention* were significantly affected in the SCZ group. In the measure on visual memory, the patients performed better than the HC. The finding of difference on attentional performance and reaction time is consistent with previous studies (Cornblatt & Keilp, 1994; Erlenmeyer-Kimling & Cornblatt, 1992; Kumar et al., 2010; McGhie & Chapman, 1961; Mohn & Torgalsbøen, 2018) which jointly point to these features as important disturbances in patients with schizophrenia as well as in their unaffected biological relatives (Birkett et al., 2007; Chen et al., 1998; Laurent et al., 1999). However, our results deviate markedly from many other studies reporting a multiplicity of CD's in first-episode schizophrenia (Bak et al., 2017; Rodriguez et al., 2019; She et al., 2019; Xiong et al., 2019; Zhang

TABLE 4 Summarizing the correlations between a sum score of cognitive dysfunction (CANTAB total), total score of self-disorders (EASE total), general symptoms (PANSS general), positive symptoms (PANSS positive) and negative symptoms (PANSS negative)

	EASE total	CANTAB total	PANSS general	PANSS positive	PANSS negative
EASE total	1	0.107	0.401*	0.318	−0.079
CANTAB total	–	1	0.117	0.142	0.299
PANSS general	–	–	1	0.345	0.439**
PANSS positive	–	–	–	1	0.295
PANSS negative	–	–	–	–	1

Note: Significant correlations are marked in the following way: *$p < .05$ and **$p < .01$.

TABLE 5 Displaying correlations coefficients between all eight neurocognitive subdomains from CANTAB test, CANTAB total score, intelligence (IQ), EASE total score and PANSS general, positive and negative for the schizophrenia patient group

	IQ	EASE (total)	PANSS general	PANSS positive	PANSS negative
IQ	–	−0.05	−0.04	−0.20	−0.41*
Reaction time	−0.27	0.19	0.37*	0.40*	0.26
Sustained attention	−0.48**	0.05	0.18	0.06	0.33
Multitasking	−0.38*	−0.02	0.09	0.07	0.22
Planning and working memory	−0.34*	0.01	−0.15	0.19	0.08
Emotional recognition	−0.40*	0.00	0.07	0.17	0.25
Spatial working memory	−0.35*	−0.05	−0.32	−0.03	0.08
Visual memory	−0.34*	−0.15	−0.15	−0.11	−0.03
Verbal memory	−0.15	−0.04	0.19	−0.11	0.05
CANTAB (total-score)	−0.57***	0.11	0.12	0.14	0.30

Note: Significant correlations are marked in the following way: *$p < .05$; **$p < .01$; ***$p < .001$.

et al., 2019; Zhu et al., 2019). However these studies examined mainly hospitalized samples with mean ages typically between 25 and 30 years with one study reporting a study sample with mean age of 38 years (Zhu et al., 2019). The difference might thus be partially ascribed to a high variability of the definition of 'first-episode' or 'recent onset' schizophrenia (Newton et al., 2018). Our sample consisted of non-acute patients with a mean age of 22 years. We therefore believe that our sample is less chronic than the samples reported in other studies, with subsequent effect on the cognitive findings.

As reported in previous prospective studies, patients with schizophrenia as a group score premorbidly lower on IQ (David et al., 2008; Davidson et al., 1999; Rabinowitz et al., 2000; Urfer-Parnas, Mortensen, Saebye, & Parnas, 2010; Zammit et al., 2004). This finding is however not specific to schizophrenia because several studies have found that intelligence is premorbidly lower in most other mental illnesses as well (David et al., 2008; Mortensen et al., 2005; Reichenberg et al., 2009; Urfer-Parnas, Mortensen, Saebye, & Parnas, 2010). It might be assumed that IQ reflects a mental performance which may be influenced by multiple factors, for example, genetic vulnerability (Carter et al., 2011), socio-economic factors, upbringing and so forth. IQ scores in our study and in schizophrenia in general, is thus more likely to reflect a non-specific functional aspect of the proneness to mental illness in general. Our study suggests that IQ is related to CD's whereas the relation to the morbidity specific of schizophrenia is missing or marginal.

CD's did not correlate with SD's nor the general and positive symptoms. Our finding of a weak and nearly significant correlation between CD's and negative symptoms is perhaps not surprising. It may be expected that negative symptoms such as slowness, apathy and difficulties with abstract thinking will be tautologically reflected in cognitive measures that require processing speed and flexibility. However, the same argument cannot be applied to the correlations between SD's and symptoms. First of all, PANSS rates the severity of the state of symptoms, whereas EASE is rated on lifetime basis reflecting trait phenomena. Secondly, SD's are not measures of symptoms but altered structures of experience. The relation to symptoms is therefore likely due to SD's status as trait phenomena and antecedents of symptoms. This is strongly supported by a recent prospected study (Koren, Tzivoni, et al., 2019) and consistent with the EASE studies tracing SD's to childhood and early adolescence (Fuchs, 2015; Jansson & Parnas, 2020; Parnas & Henriksen, 2014).

The moderate and significant correlation between SD's and general symptoms suggests an association between SD's and symptoms. PANSS general symptoms reflect various aspects of subjective suffering and therefore this particular correlation is supported both by our clinical experience and empirical studies (Nilsson et al., 2020; Skodlar & Parnas, 2010). In this study, the correlation between SD's and positive symptoms was near significant. Significant correlations between SD's and both positive and negative symptoms have however been reported in previous studies in schizophrenia spectrum samples (Nordgaard & Parnas, 2014; Raballo & Parnas, 2012). Moreover, a correlation between SD's and Schneiderian first-rank symptoms have been reported (Nordgaard et al., 2020) which is in line with the notion that SD's constitute an antecedent of Schneiderian phenomena (Fuchs, 2015). Lack of correlation between SD's and IQ found in our study accords previous studies (Nordgaard et al., 2015; Nordgaard & Parnas, 2014).

One could make the argument that our sample with lower scores on CD's than is typically reported in schizophrenia studies on CD's is a limitation for investigating its relation to SD's. However, a lack of correlation between CD's and SD's as well as other measures of abnormal subjective experience in schizophrenia have been shown in previous studies with higher scores of CD's (Haug et al., 2012; Koren, Scheyer, et al., 2019; Nordgaard et al., 2015; Schultze-Lutter et al., 2016; Zanello & Huguelet, 2001). This study replicates this finding and furthermore suggests that SD's are at least temporally antecedent to CD's.

The poor discrimination in CD's between schizophrenia patients and healthy controls using a standard cognitive test battery suggests a need for alternative approaches. We used a standard test-battery for assessing cognitive impairment in schizophrenia (Barnett et al., 2010), whereas more novel approaches are available. (Nelson et al., 2019) found no significant differences in intelligence and memory between ultra-high-risk populations, first-episode psychosis group and healthy controls, whereas source monitoring deficits differed significantly. Source monitoring deficits, referring to the ability of ascribing the origin of experience, is a good example of a neurocognitive approach assessing neurocognitive dimensions related to the self-disturbances in schizophrenia. Another example of a self-related measure in schizophrenia is the Enfacement Illusion (Sandsten et al., 2020). Other neuroscientific approaches of self-experience, suggest a central role of time–space dynamics as it is manifest in both the brain's neural activity and the subjective experience of time and space. This has been described as 'Spatiotemporal Psychopathology' (Fingelkurts & Fingelkurts, 2019; Northoff, 2018a, 2018b; Northoff et al., 2019; Northoff & Stanghellini, 2016). In a recent study (Northoff et al., 2020) found abnormal temporal integration in EEG during self-related processing in schizophrenia indicating a relationship between the temporal dynamics in the brain and SD's.

Due to the cross sectional design of this study, we are unable to draw any causal conclusions. Our study was furthermore limited by a relatively small sample size of 35 patients and 35 controls. However, the sample size must also be evaluated upon an extensive battery of tests and time consuming psychopathological evaluation.

5 | CONCLUSION

This study suggests that SD's and CD's reflect different disturbances in schizophrenia, in line with previous studies. Furthermore, this study suggests that SD's are temporally antecedent to CD's. Apart from reaction time and attentional disturbances, this study suggests that in recent onset schizophrenia patients IQ and CD's are only marginally affected and lacks association with symptoms and SD's. Moreover, SD's are correlated with general symptoms. Overall, our results support a notion of schizophrenia as characterized by SD's and oppose any assumption that SD's and symptoms could be consequences of CD's. The study calls for novel approaches in the neurocognitive

sciences integrating the psychopathology of SD's in schizophrenia, into future cognitive test-paradigms.

ACKNOWLEDGEMENT

We thank Region Zealand Psychiatry (Denmark), for financial support.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Research data are not shared.

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How to cite this article: Sandsten, K. E., Wainio-Theberge, S., Nordgaard, J., Kjaer, T. W., Northoff, G., & Parnas, J. (2022). Relating self-disorders to neurocognitive and psychopathological measures in first-episode schizophrenia. *Early Intervention in Psychiatry*, *16*(11), 1202–1210. https://doi.org/10.1111/eip.13269