



The crisis of minimal self-awareness in schizophrenia: A meta-analytic review

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ABSTRACT

Disturbances of the minimal self, characterized by abnormal sense of the body, body ownership and agency have been proposed as the phenomenological phenotype of schizophrenia. However, self-disturbances have not been extensively investigated, in part, due to the subjective nature of such processes, and the associated difficulty of studying these phenomena using empirical methodology.

Of 115 potential studies on self-awareness in schizophrenia, a total of 25 studies met the inclusion criteria for the meta-analysis comprising 690 patients with schizophrenia and 979 healthy controls. We calculated Hedge's g to obtain a better estimate for the standardized mean difference in small samples.

We identified significant basic self-disturbance in schizophrenia, as compared with healthy controls (25 studies, effect size = 0.51). Additional comparison of three sub-categories of the sense of body ownership (4 studies, effect size = 0.91), the sense of agency (15 studies, effect size = 0.49), and self-reported subjective experiences (6 studies, effect size = 0.57) also confirmed group differences. The complete set of 25 studies, and the studies in the sub-categories showed the statistical homogeneity of the characteristics. After a correction for potential publication bias using the trim-and-fill method, the main findings for all studies combined remained significant.

Overall, patients with schizophrenia showed deficits in the sense of the minimal self, driven by abnormal sense of body ownership and sense of agency. Interestingly, the disturbed sense of agency in schizophrenia suggests an exaggerated self-consciousness rather than a diminished sense of self. Further research that utilizes sophisticated study designs is needed to examine the nature of self-disturbances in schizophrenia.

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1. Introduction

I feel I am always divided against my self by myself.

[Bryan Charnley, 18th May 1991]

One of the most haunting and beautiful images of disintegrating self can be glimpsed in a series of powerful self-portraits painted by the late Bryan Charnley during the last four months of his life (see <http://www.bryancharnley.info/index.asp>). Mr. Charnley was an artist of immense talent and poetic vision, who struggled with schizophrenia until his suicide in 1991. For his self-portrait series, he kept a detailed and lucid diary of his thoughts and feelings, which allows us to grasp the subjective phenomenology of self-disturbances. His final self portrait, completed shortly before his death, is a canvas filled with swaths

of hues merging into one another; there are no shapes or forms to communicate to the observer where the self begins or ends, just strips of color stranded in space and time. This is how he saw himself.

For decades, concepts of the self were considered to be abstract and vague notions that could only be discussed in phenomenological terms. The neurobiological substrates of the self, however, are becoming increasingly accessible as a result of recent advances in brain imaging techniques. Specifically, one particular intrinsic brain network, known as the default mode network (DMN), appears to play a significant role in the sense of self (Qin and Northoff, 2011) such that altered patterns of connectivity in the DMN may lead to deficits in self-referential processing and aberrant experience of self in psychosis (Carhart-Harris and Friston, 2010).

Traditionally, self-disorders and anomalous subjective experiences have always been essential to the concept of psychosis. Kraepelin noted that a *loss of inner unity* was the core feature in dementia praecox (Kraepelin, 1896). A *basic alteration of self-consciousness, basic disorder of personality, loss of natural self-evidence or loss of ego boundary* (Bleuler, 1911; Berze, 1914; Schneider, 1959; Blankenburg, 1971) are terms that have also been used to describe and define schizophrenia. The

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term 'basic' when describing self-awareness refers to the most fundamental selfhood, the minimal self. The minimal sense of self is an immediate conscious experience of oneself, which remains when the 'pre-reflective self (the extended and relatively explicit awareness of the self as invariable and steadfast subject through time and place)' and the 'narrative self (the most complex and sophisticated level of selfhood which is formulated from autobiographical memory such as personality, body, habits and other sociocultural characteristics)' are stripped away (Sass and Parnas, 2003; Zahavi, 2005). Minimal self, basic self, core self, and proto-self are other terms used interchangeably to describe this pre-reflective and primitive level of selfhood.

The important features of the core sense of self are body ownership and sense of agency, based on conceptual, neurocognitive and psychopathological evidence (Synofzik et al., 2008; Stanghellini, 2009; Blanke, 2012; Ferri et al., 2012). A sense of body ownership involves implicit and tacit feelings of possession of the physical body and identification of the self as the one who is undergoing the bodily experience (Ferri et al., 2012). Body ownership has been studied empirically with proprioceptive and somatic tasks such as the rubber hand illusion in schizophrenia (Thakkar et al., 2011) and schizotypy (Thakkar et al., 2011; Germine et al., 2013). When subjects watch the stimulation of a rubber hand while synchronously feeling a congruent stroke on their own hand, they may feel that "the (rubber) hand being stroked is (their) part of the body".

The sense of body ownership occurs regardless of whether an action is generated by the self or other, whereas the sense of agency refers to the sense of being the one who initiates an action. In other words, one's sense of agency is linked to the ability to maintain the distinction between the individual and the environment (Kircher and Leube, 2003; Lallart et al., 2009). This type of self-awareness is often investigated empirically with action attribution or action monitoring tasks; mis-attributions occur when individuals misjudge the causality between an intentional action and an external event (Haggard et al., 2003; Jeannerod, 2009; Synofzik et al., 2010), and monitoring errors arise when we are unable to detect whether we are in control of action or not (e.g., being in control or out of control) (Russell, 1996; de Vignemont and Fournier, 2004; Miele et al., 2011).

Although a large body of literature comprising self-reports, neuroimaging studies, commentaries, and reviews provide evidence for abnormal sense of minimal self in schizophrenia (e.g., Ferri et al., 2012; Maeda et al., 2012; Sass, 2001; Sass and Parnas, 2003), the nature and extent of this disruption has not been precisely identified. Moreover, the wide range of methodologies and conceptual differences inherent in these studies make it difficult to directly evaluate the strength of evidence for self-disturbances in schizophrenia. The goal of the present study was to conduct a meta-analysis to test the significance of altered minimal self-awareness in schizophrenia. Furthermore, we aimed to test for homogeneity and examine sub-categories of self-disturbances: the sense of the body, body ownership, the sense of agency, and anomalous self-perceptions.

2. Methods

2.1. Literature search

Studies to be included in the meta-analysis were identified through a thorough search in MEDLINE and PsycINFO (January 1980–January 2013). See Fig. 1 for a summary of the study selection process. Studies of dissociative experiences and sensory monitoring were excluded because the former is state-dependent (Brunner et al., 2004; Schäfer et al., 2012) and the latter is more involved with signal detection and hallucination than with the genuine self-disorders (Morrison and Haddock, 1997) and we were primarily focused on trait-like disturbances of self. Additional articles were selected from the reference

lists of the studies retrieved. The articles were limited to peer-reviewed articles published in the English language.

2.2. Inclusion criteria

The study design had to include patients with schizophrenia and a healthy control group. The diagnostic criteria for schizophrenia had to be made according to either the Diagnostic and Statistical Manual of Mental Disorders (DSM) or the International Statistical Classification of Diseases (ICD). The studies were required to have included one or more measures for self-awareness. Access to sufficient information for analysis had to be available. Duplicate data were removed.

2.3. Review and coding

Among 800+ papers, selected from the initial screening by electronic and manual search, 115 potentially relevant studies were selected based on the study title and abstract. Full text articles of these 115 studies were retrieved and of these, 90 records were excluded. The reasons for exclusions are provided in Fig. 1. Thus, a total of 25 publications survived for the meta-analysis. In the main meta-analysis, for studies that reported multiple outcomes, they were either combined or, when combination was inappropriate, one representative variable that best defined self-awareness was selected. Data were extracted independently and compared by two investigators. Any discrepancies were discussed until a consensus was reached.

The variables recorded were authors, year published, sample sizes, gender distribution, mean age, diagnostic system used, duration of the illness, history of medication, information on measurements, means and SDs of measurements on minimal self-disturbances (Table 1). Lastly, these 25 publications used various combinations of keywords, indicating a wide variety of experimental domains and methods for measuring minimal self-awareness (see Fig. 2 for word clouds generated from <http://www.wordle.net>; the physical size of the words corresponds to the frequency of the words). Therefore, we classified and coded the publication with respect to the sense of body and ownership (O), sense of agency (A), and reported anomalous self-experiences (R), according to the authors' definitions, descriptions and keywords of the measurements (Fig. 1).

2.4. Meta-analytical calculations

Statistical analyses were performed using Stata (version 11; Stata Corporation, College Station, TX, USA). Both random-effects models and fixed-effects models were adopted for each analysis. Random-effects models are usually used when the test of heterogeneity for the selected studies exists. Fixed-effects models are used when heterogeneity is absent. To assess the possible effects of publication bias, funnel plots were used and the trim-and-fill procedure was generated (Higgins et al., 2008). Unreported means and SD values were calculated from other statistics, exact *t*-values, or *F*-values. After computing effect sizes for each study, Hedges' *g*, that is, the difference between the means of the experimental and comparison groups divided by the pooled SD and weighted for sample size, was used to obtain a better estimate for the standardized mean difference in small samples (Rosenthal, 1991). The effect sizes were weighted for sample size in order to correct for upwardly biased estimation of the effect in small sample sizes. All statistics were 2-sided, and $P < .05$ was regarded as significant.

Cochran's *Q* statistic and I^2 were calculated to test homogeneity of effect size across studies (Cochran, 1954; Higgins et al., 2003). Statistically significant heterogeneity was considered at $P < .05$ and $I^2 > 50$. To investigate the possible effects of publication bias, the Egger test and a funnel plot were used (Sutton et al., 2000). We used the trim-and-fill method to correct for small study effects due to publication bias (Duval and Tweedie, 2000).

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