



Editorial

The varieties of anomalous self experiences in schizophrenia: Splitting of the mind at a crossroad

"I was simply sectioned again, detached from my real self, observing what was being done to me in a third-person perspective."
Clara Kean (2009)

Splitting of the self and self disturbances were important to Bleuler's concept of schizophrenia (Bleuler, 1911), and a distorted, even loss of a sense of self appears to be a core feature of the disorder (Nasrallah, 2012; Lysaker and Lysaker, 2010). Furthermore, aberrant self experiences are highly salient to those who are diagnosed with schizophrenia (Saks, 2008; Kean, 2009, 2011) from the prodromal stage throughout the course of illness (Sass and Parnas, 2003; Nelson et al., 2008), and may increase vulnerability in those at risk for the disorder (e.g., Nelson et al., 2012; Koren et al., 2013). Thus, elucidating self-disturbances in schizophrenia has significant practical implications for implementing treatment strategies, but self-disorder is not even included in the current DSM-5 criteria. So how should we bridge this gap between the diagnostic criteria for schizophrenia, as prescribed by the American Psychiatric Association on one hand and the phenomenological first-person accounts of schizophrenia experience that centers around self disturbances on the other?

This special issue on the theme of "self and schizophrenia" aims to address this disparity by highlighting recent advances in theories and frameworks for understanding self processing, as well as introducing innovative state-of-the-art empirical research that underscores the diverse manifestations and underlying mechanisms of self disturbances that span pre-reflective, automatic and implicit processes (e.g., corollary discharge, proprioception, body ownership) to higher-order, controlled and explicit cognitive functions (e.g., self-reflection, action monitoring, mentalizing, insight). An obstacle to this effort has been the sheer variety of frameworks and definitions with respect to the concept of the self (Strawson, 1999). Given a lack consensus and common vocabulary, empirical studies of self disorders and self disturbances diverge further into self-report measures, interviews and experimental tasks, spanning phenomenological, behavioral and neurobiological levels of analyses. Nevertheless, despite the wide range of theories and methodologies, there is a broad agreement on the core features of self pathologies in schizophrenia. Anomalous sense of self in schizophrenia seems to involve a disturbance in the ownership of one's body, thoughts and actions, accompanied by faulty self-monitoring. In this issue, we present a diverse set of approaches to integrate neurobiological, cognitive and phenomenological explanations of anomalous self-awareness, self-monitoring, self-reflection and insight in the schizophrenia spectrum.

First, recent advances in theories and models that address the etiology of self disturbances in schizophrenia are presented in three articles. Sass' 'ipseity disorder model' clarifies and expands upon his earlier theory that places disturbances of the minimal self or ipseity at the

core of schizophrenia. Ipseity disturbance is thought to arise mainly from two interdependent phenomena of hyper-reflexivity and diminished self-affection, and catalyzed by a loss of 'grip' on the word (Sass and Parnas, 2003). Despite strong predictions generated by this model, the specificity, extent and underlying mechanisms of ipseity disturbance have not been extensively examined. To address the specificity question, Sass compared four conditions with known self aberrations and observed some overlapping similarities but also profound differences. While alienation of thoughts and bodily experiences was commonly experienced in mania, psychotic depression, depersonalization and schizophrenia, only schizophrenia was associated with "severe erosion of minimal self-experience or real confusion of self and other" (Sass, 2014). Just how and why this erosion of ipseity occurs is unknown but the potential neurocognitive origins of basic self disturbances in schizophrenia are proposed by Nelson and his colleagues who highlight two cognitive mechanisms that may underlie basic self-disturbance in schizophrenia: source monitoring deficits, which may contribute particularly to disturbances of "ownership" and "mineness" (i.e., self-affection), and aberrant salience, which may contribute to the hyper-reflexivity and disturbed "grip" on the perceptual field (Nelson et al., 2014 a,b).

Given the compounding problem of self-monitoring deficit coupled with aberrant salience in schizophrenia, depersonalization, derealization, passivity delusions, especially thought insertion or withdrawal, as well as "made feelings" and "made actions", may be understood as a reasonable response to an anomalous experience. Gray (2014) dissects the process of passivity delusions formation into three distinct stages, which begins with an abnormal self experience that engenders a delusional 'proto-hypothesis'. The existence of this proto-hypothesis in the context of normal experiences then leads to a full blown delusion that is maintained despite evidence to the contrary. But what aspect of the anomalous self experience triggers the formation of a proto-hypothesis? Gray proposes that it is the bizarre act of having to identify the author of one's own thought leads to a state of anomalous self-experience. One's own regular thoughts and movements ought to feel familiar and should not raise any questions of identification, but disrupted corollary discharge or delayed efference copy (see Feinberg, 1978) results in a discrepancy or mismatch between the initiation of willed action and the experienced consequences of that action. Such aberrant monitoring experience is likely to diminish self-affection and contribute to the ipseity disturbance.

On the other hand, in addition to the experience of reduced agency in passivity, schizophrenia is also associated with excessive agency. However, this apparent discrepancy may be understood in the framework of a two-stage model, which distinguishes an implicit, pre-reflective feeling of agency from an explicit, cognitive judgment of

agency (Synofzik et al., 2008). Werner et al. (2014) sought to empirically test the judgment of agency in high functioning paranoid schizophrenia patients with a continuous visuomotor self-monitoring task that required the participants to make explicit agency attributions under a condition of uncertainty where sometimes one's own action did not match the perceived consequence of that action. Overall, the performance of the patients on this task was not significantly different from that of the healthy control group but when patients made an erroneous external attribution of action, it took them longer to dispel their false belief that they were not in control of their action. Additionally, reduced cognitive capacity contributed to increased errors on agency judgment. These results suggest that explicit judgment of agency may be relatively spared in high functioning schizophrenia patients but multisensory integration that contributes to an implicit sense of agency may still be impaired. Much needs to be done in the future to clarify the interaction between the implicit feeling of agency and the explicit judgment of agency but nevertheless, Werner et al.'s study illustrates the important benefits of parsing a broad and diffuse construct into empirically testable components.

Corollary discharge model of implicit agency and self brings us to the territory of the multisensory body and the sensory motor origins of self disturbances. The central importance of coherent multisensory integration in achieving a stable sense of self lies at the heart of the Perceptual Incoherence Hypothesis of schizophrenia proposed by Postmes et al. (2014). It has long been known in developmental psychology that the emergence of a basic sense of self is closely linked to the developmental trajectory of sensory integration from infancy (see Rochat and Striano, 2002; Rochat, 2011). Postmes' perceptual incoherence model posits that this sensory self is analogous to the core, minimal self or ipseity (Gallagher, 2000; Sass and Parnas, 2003). A comprehensive review from all sensory modalities confirms the prevalence of multisensory integration problems (abnormal bottom-up input) in the schizophrenia-spectrum and resulting cognitive (top-down) processes activated to resolve the perceptual incoherence. Thus, in this model, impaired somatosensory feedback causes perceptual incoherence and consequently, the underlying self-disturbances.

The fundamentally important relationship linking multisensory integration, body ownership and the sense of self is examined in two papers with very different approaches. Ferri et al. (2014) assessed the malleability of body ownership in schizophrenia with the Rubber Hand Illusion (RHI; Botvinick and Cohen, 1998), which is influenced by both multisensory integration and a top-down representation of the body. The 'classic' RHI is exaggerated or enhanced in the schizophrenia-spectrum (Peled et al., 2000, 2003; Thakkar et al., 2011; Germine et al., 2013), and these results have been typically interpreted to indicate a reduced sense of body ownership or more porous self-other boundary in schizophrenia. But when Ferri et al. administered a new version of the RHI designed to test the role of expectations (rather than actual multisensory integration as in the case of the classic RHI), they found that self-reported RHI experience was weaker in schizophrenia compared with controls and the extent of the RHI was associated with negative symptoms. Note that in the case of the classic RHI paradigm, actual tactile stimuli are delivered (Peled et al., 2000, 2003; Thakkar et al., 2011), whereas in Ferri et al.'s RHI paradigm touch is only expected. If the direction of RHI effect is dependent on the symptomatology as the authors imply, then some aspects of self disturbances may fluctuate over time. This might explain why empirical studies of self processes in schizophrenia have yielded mixed findings to date. To determine whether there is a broad consensus on what aspects of self disturbances are central to schizophrenia, Hur et al. (2014) conducted a meta-analysis and found that an abnormal sense of body ownership and faulty sense of agency contribute to self disturbances, and interestingly their results suggest an exaggerated self-consciousness rather than a diminished sense of existence in schizophrenia.

The heteromodal association area of the inferior parietal lobule plays a central role in multisensory integration and one's awareness of the

body, which contributes to a continuous, stable and unified sense of self. Parietal abnormalities have been associated with varieties of self disturbances including anomalous body image (Cutting, 1989), delusions of passivity (Spence et al., 1997; Farrer and Frith, 2002; Dankert et al., 2004), out-of-body and other dissociative experiences (Blanke et al., 2002; Blanke and Arzy, 2005). Given the important role of parietal regions in body image and agency, Yun and his colleagues investigated effective cortico-cortical connectivity underlying explicit self face recognition to test the hypothesis that parietal-centered networks are disrupted in schizophrenia using [¹⁵O]H₂O PET. Schizophrenia patients failed to show a self-face recognition advantage compared to famous faces, indicating reduced self-other differentiation. Moreover, there was no rCBF difference in self face compared to famous face condition. Connectivity among the inferior parietal lobule, cuneus and prefronto-temporal cortices, was attenuated or ineffective in schizophrenia.

If anomalous sense of the self and the body defines the phenomenological experience of schizophrenia, when does it begin and can we reliably detect these signs in high-risk individuals? Very little is known about developmental events that contribute to self disturbances. Two papers begin to tackle this question; one focusing on individuals at elevated genetic risk (Brent et al., 2014), and the other on adolescents with elevated schizotypal traits (Debbané et al., 2014). Brent and his colleagues propose a comprehensive neurodevelopmental model of schizophrenia, centered on disrupted self processes, from the perinatal period through childhood and adolescents when prodromal signs begin to appear, all the way to the full expression of the disorder. Functional neuroimaging studies indicate that self reflective processes typically recruit midline cortical structures (e.g., ventral and dorsal medial prefrontal cortex, anterior cingulate cortex, and posterior cingulate cortex), other parts of the frontal cortex (e.g., dorsolateral prefrontal cortex, inferior frontal cortex) parts of the lateral temporal cortex (e.g., superior temporal sulcus) and the insula (see Gallagher et al., 2000; Frith and Frith, 2003; Van der Meer et al., 2010; Murray et al., 2012). These regions undergo massive structural changes between mid-childhood and early adulthood, which makes the adolescent period a particularly vulnerable and sensitive period for experiencing self disturbances especially for those who are at genetic high risk. Brent and colleagues propose that self disturbances are an early neuro-behavioral marker for psychosis, based on compelling evidence from neurodevelopmental observations. They point to the reliable findings of abnormalities of medial and lateral prefrontal cortex, and lateral temporal cortical structures in genetic high risk individuals especially in those who eventually develop psychosis, in relation to behavioral signs that accumulate over time indicating the presence of subtle disruptions of self processing during childhood and adolescence. Brain dysmaturational processes that affect core self processes in early childhood exacerbates vulnerability in genetic high risk children as they enter adolescence, when rapidly increasing environmental demands further fractures their capacity for higher-order self monitoring, reflection and insight. Brent et al.'s developmental model of self disturbances provides a comprehensive framework (see Figure 1 in Brent et al., 2014) for longitudinally tracking disrupted brain-behavior interactions that are manifested in self disturbances, and highlight several windows of opportunity for targeted intervention that could ameliorate the surface expression of schizophrenia or modify the neurodevelopmental trajectory.

Psychometrically ascertained adolescents who may share latent liability for schizophrenia are the focus of a fMRI investigation by Debbané and his colleagues. They probed the neural basis of explicit, higher-order self-awareness (rather than pre-reflective self) in adolescents in relation to schizotypy. Positive syndrome of schizotypy was associated with cortical midline activation during a trait judgment task, which required the participants to decide whether a presented adjective was about self or familiar other (one's best friend of the same sex). Interestingly, recruitment of this same region has been shown to be associated with trait judgment of unfamiliar people in non-schizotypal individuals (Murray et al., 2012), suggestive of a less differentiated representation

of the self from that of unfamiliar others in schizotypal adolescents. This pattern of brain activity was distinct from that reported in a study of adult schizophrenia patients who showed hypoactivation of the medial prefrontal coupled with hyperactivation of the posterior cingulate cortex (Holt et al., 2011).

Underlying differences in brain activation patterns between adults with schizophrenia and schizotypal adolescents need to be further elucidated to specify vulnerability and protective factors during the transition from premorbid and prodromal stages to full blown psychosis at which point additional differences such as abnormal functional connectivity centered on the parietal regions (see Yun et al., 2014) may become evident. Together these studies accentuate the complex interplay of brain maturation, environmental challenges and individual differences in vulnerability that cascades to the varieties of self-disturbances described in the schizophrenia-spectrum.

We then turn to the neurological deficit known as anosognosia, or a lack of awareness of illness. Bedford and David (2014) examined the roots of denial of illness in schizophrenia with an episodic memory encoding paradigm. Disorganization during self-reflection and impaired recollection of new self-related information were associated with reduced insight into their illness. These results underscore the importance of intact cognition in maintenance of self integrity. Our capacity for self-evaluation, self-reflection and other higher-order self processes are closely linked to core neurocognitive mechanisms involving memory and attention. If our sense of self is ideally co-localized with the body and seamlessly continuous across time, memory is the glue that binds temporal slices into a unified self and allow us to achieve autoegetic awareness. Even if the pre-reflective, minimal self was intact, memory deficits would make it difficult to integrate explicit and implicit self-related information from moment to moment.

Perhaps the best indicator for self pathology is the subjective experiences in persons with schizophrenia. Published first person accounts paint a vast canvas of diverse self disturbances (see First Person Accounts in many issues of *Schizophrenia Bulletin*), which in turn should be interpreted in the context of culture. The concept of self accepted and endorsed by the Western cultural tradition depicts an independent and autonomous agent who possesses or contains dispositional attributes that are separated from context or others. Yet this conceptualization of the self is hardly universal. Asian cultures hold a more interdependent, contextualized and sociocentric view of selfhood (see Markus and Kitayama, 1991). In other words, the assumption that there is a universal template for the prototype of 'normal' self ought to be scrutinized. One might ask how cultural differences in self concept shape social, affective and motivational experiences during development and how these environmental factors in turn influence the expression of psychopathology, including self disturbances (see Maj, 2012).

An integration of the recent findings across the phenomenological, behavioral, and neurobiological levels of analyses in the broad context of culture would represent a significant advance in the understanding of disrupted neural circuits in schizophrenia and could lead to early identification and personalized intervention strategies in the future. Ultimately, all psychiatric disorders are maladies of the self along a continuum of homeostatic balance with society. As we begin to elucidate the specific etiologies of the varieties of anomalous self experiences in schizophrenia, we will also arrive at a better understanding of self disturbances across a whole spectrum of human distress.

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Conflict of interest

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