

# Thinking, believing, and hallucinating self in schizophrenia

Humpston, Clara; Broome, Matthew

DOI:

[10.1016/S2215-0366\(20\)30007-9](https://doi.org/10.1016/S2215-0366(20)30007-9)

License:

Creative Commons: Attribution-NonCommercial-NoDerivs (CC BY-NC-ND)

*Document Version*

Peer reviewed version

*Citation for published version (Harvard):*

Humpston, C & Broome, M 2020, 'Thinking, believing, and hallucinating self in schizophrenia', *The Lancet Psychiatry*, vol. 7, no. 7, pp. 638-646. [https://doi.org/10.1016/S2215-0366\(20\)30007-9](https://doi.org/10.1016/S2215-0366(20)30007-9)

[Link to publication on Research at Birmingham portal](#)

## General rights

Unless a licence is specified above, all rights (including copyright and moral rights) in this document are retained by the authors and/or the copyright holders. The express permission of the copyright holder must be obtained for any use of this material other than for purposes permitted by law.

- Users may freely distribute the URL that is used to identify this publication.
- Users may download and/or print one copy of the publication from the University of Birmingham research portal for the purpose of private study or non-commercial research.
- User may use extracts from the document in line with the concept of 'fair dealing' under the Copyright, Designs and Patents Act 1988 (?)
- Users may not further distribute the material nor use it for the purposes of commercial gain.

Where a licence is displayed above, please note the terms and conditions of the licence govern your use of this document.

When citing, please reference the published version.

## Take down policy

While the University of Birmingham exercises care and attention in making items available there are rare occasions when an item has been uploaded in error or has been deemed to be commercially or otherwise sensitive.

If you believe that this is the case for this document, please contact [UBIRA@lists.bham.ac.uk](mailto:UBIRA@lists.bham.ac.uk) providing details and we will remove access to the work immediately and investigate.

## Thinking, believing and hallucinating self in schizophrenia

Clara S. Humpston, PhD<sup>1\*</sup> and Prof Matthew R. Broome, PhD<sup>1</sup>

<sup>1</sup>Institute for Mental Health, School of Psychology, University of Birmingham, B15 2TT, United Kingdom.

\*Correspondence: [c.s.humpston@bham.ac.uk](mailto:c.s.humpston@bham.ac.uk)

### Summary

In this Personal View, we discuss the history and concepts of self-disturbance in relation to the pathophysiology and subjective experience of schizophrenia in terms of three approaches: 1. The perceptual anomalies approach of the Early Heidelberg School of Psychiatry; 2. The more recent ipseity model; and 3. The predictive coding framework. Despite their importance, there has been a notable absence of efforts to compare them and to consider how they might be integrated. The position represented in the current contribution is novel in that it compares the three approaches and offers suggestions how the three may work together. We view self-disturbances as transformations of self that form the inseparable background against which psychotic symptoms emerge. Integrating computational psychiatric approaches with those employed by phenomenologists in the first two approaches listed above, we argue that delusions and hallucinations are inferences produced under ‘extraordinary’ conditions and are both statistically and experientially as real for patients as other mental events. Such inferences still approximate Bayes-optimality given the circumstances and may be the only ones available to minimise prediction error. The added contribution we hope to make focuses on how the dialogue between neuroscience and phenomenology may improve clinical practice. We hope this article will act as a timely primer and bridging point for both computational psychiatry and phenomenological psychopathology in its different approaches for interested clinicians.

## Introduction

The most well-known formulation of schizophrenia is as a neurodevelopmental disorder<sup>1-5</sup>. For many years, psychotic symptoms such as delusions and hallucinations were seen as no more than abnormal brain activity that distorted the patients' perceptions of reality, frequently linked to aberrant dopamine signalling<sup>6</sup>. Often, successful treatment outcome was defined as the amelioration of positive symptoms<sup>7</sup>. As such, it is rare for biologically-focused clinicians and researchers to take an interest in *how* patients with schizophrenia suffer from their illness from a personally meaningful perspective.

In the early 20<sup>th</sup> Century, phenomenological psychopathology was a line of inquiry that emerged alongside the biologically-driven focus on schizophrenia. Whilst more recent neurobiological accounts of schizophrenia, such as the neurodevelopmental model, did not directly originate from phenomenology but drew on clinical and developmental observations together with findings from epidemiology and neuropathology, it is not an exaggeration to say that the signs and symptoms of schizophrenia as clinicians see them today would never have been constructed at such a refined or detailed level without the efforts of philosophically-minded psychiatrists in the early to mid-20<sup>th</sup> Century, such as Jaspers and Schneider.

It was this level of clinical observation that led to significant formulations about potential underlying mechanisms of schizophrenia. This includes the Early Heidelberg School of Psychiatry<sup>8</sup> which employed a phenomenological approach as well as a search for mechanisms in, for example, their study of mescaline as a model psychosis<sup>18,22,46</sup>. As one of the forefathers of phenomenological psychopathology, Jaspers turned to phenomenology due in part to failings of 'first biological psychiatry' of the late 19<sup>th</sup> Century, yet he had never been against neuroscience. Jaspers spoke of the soma and the psyche as forming 'an inseparable unity' with a sense of caution that neither psychopathology nor neuroscience should be the sole method to study mental illness<sup>9</sup>. Despite Jaspers' cautionary stance, research employing phenomenological methods has largely faded out of focus since the advent of antipsychotic medication and the 'second biological psychiatry' during the latter half of the 20<sup>th</sup> Century and the advance of the 'mainstream' neuroscience era that followed. Nevertheless, despite advances in neuroscience and genetics, the actual development of new treatments has been disappointing. Instead, the main advances which directly influence the treatment and outcomes of patients

have been through service delivery, evidence-based practice and patient inclusion in decision-making.

It was only in recent years that a significant revival of theories and empirical studies of schizophrenia which adopt a phenomenological approach took place: that is, by viewing schizophrenia and related psychoses as fundamental transformations of consciousness and subjectivity (i.e. the question of *how* individuals experience self and world) rather than simply *what* is experienced as psychiatric symptoms<sup>10,22</sup>. However, much of this research has been received as something entirely separate, if not incompatible, with their neuroscientific counterparts. In this article we aim to offer further arguments for such an integration, building upon the efforts by a handful of phenomenologically-minded contemporary clinical researchers<sup>10–13,16,22</sup>. Moreover, we provide the framework, hitherto not undertaken as far as we can document, to support the novel effort of integrating the original contributions from the Early Heidelberg School concerning the self-disturbances in schizophrenia (neglected until recently) with the later ipseity and neurocomputational approaches.

### **Schizophrenia as a self-disturbance**

Most people would never wonder, let alone doubt, whether the thoughts they think are indeed their own – and this is because most of them under the usual circumstances have an intact sense of the ‘minimal self’ (see Panel 3: Glossary for a list of key terms and their definitions). As Zahavi (2005, p.100)<sup>14</sup> states, ‘Minimal self-awareness should, consequently, be understood as the acquaintance that consciousness has with itself and not as an awareness of an experiencing self’. This is the core of one’s subjectivity upon which one can build higher-order identities and societal roles (called the ‘narrative self’). Certainly, even in schizophrenia the minimal self is never truly absent<sup>15</sup> but is argued to be impaired.

Nevertheless, there are diverse views on this topic. One view is that ‘damaged minimal self’ does not arise from impaired conscious self-acquaintance (ipseity), but rather involves unconscious processing: ‘minimal [embodied] self need not be consciously processed or experienced to play a role in how conscious experience is shaped’<sup>16</sup> (p. 3). Giersch and Mishara find that both the experimental timing data and ‘genetic phenomenology’ indicate different levels of conscious and non-conscious processing<sup>16-18</sup>. For example, patients with schizophrenia exhibit dis-coordination or misalignment of timing between conscious and non-conscious processing which results in a fragile sense of time anticipation. These observations support their view that (genetic) phenomenology allows for the study of both conscious and unconscious automatic processes and not only what can be consciously experienced. (See Panel 1)

Some of these unconscious processes occur at extremely rapid time scales that are not available to slower conscious processing. In cases of schizophrenia, the disruptions in implicit unconscious processes are compatible with earlier phenomenological accounts (e.g., the Early Heidelberg School). On the other hand, the ipseity model by Sass and Parnas (see below) proposes a heightened self-awareness leading to the alienation of mental events and places less

**Panel 1: Binswanger on ‘genetic phenomenology’**

‘[T]he phenomenological psychiatrist, Binswanger made use of the phenomenological approach to study automatic processing (i.e., a procedure called genetic phenomenology) in his analyses of self and schizophrenia. He proposed that psychosis itself is a “natural experiment” in which “deeper,” otherwise inaccessible unconscious levels of processing are exposed. The phenomenology of [unconscious] automatic processing involves the systematic removing of phases of complete-objects in their constitutive meaning, starting with the most conscious ones first – as if peeling the layers of an onion – to see what layers remain underneath. These layers, or genetic phases become separated “abstractly” in reflection but may not be said to exist on their own.’<sup>16</sup> (p. 8).

emphasis on unconscious processing. Such divergence in current models and methods in the examination of self-disturbances enriches further clinical research and stimulates debate which enables the field to grow<sup>19</sup>.

Despite considerable interest in self-disturbances, their history has been surprisingly neglected until recently. Mishara and colleagues<sup>20-23</sup> map this history, and how it impacts more recent formulations of self-disturbances (see Panel 2). During the critical years 1915-1932 (Mishara, personal communication), the Early Heidelberg School of Psychiatry (Gruhle, Mayer-Gross, Beringer), first developed and systematically described ‘self-disturbances’ in schizophrenia<sup>20-23</sup>. Later, Kurt Schneider (1939) incorporated many self-disturbances in his first-rank symptoms of schizophrenia<sup>8</sup>.

**Panel 2: Gruhle’s definition of self-disturbances** (quotations taken from Kaminski, Sterzer and Mishara<sup>23</sup>)

‘1. In doubling of the I (*Doppelich*), the self looks on his or her experiences passively as non-participatory bystander. Unable to detach but also unable to participate in these experiences, everything plays before the patient as if on a stage. [This may include] unpleasant bodily sensations, and other sensory disturbances.... For the patient with self-disturbances, the automatic processing underlying perception, movement, feeling, thinking, speech and volition is experienced as occurring independently of the I, and therefore, as foreign, or strange, split-off in a doubled-I.

2. In the paralysis of the I (*Ichlähmung*), the automatic processes described in the doubled-I are brought under foreign control in violation of the I’s sphere of power...i.e., in one-sided relationship attributed to omnipotent agents. Although the patient may struggle with all the effort that can be mustered against these powers, the patient never triumphs. (p.2)’

One of the paradoxical features of self in schizophrenia<sup>24</sup> is that the I is neither fully oneself nor another, but an in-between state between pure observation (passivity) and participation. This supports Gruhle’s first component. Similarly, it has been suggested that patients experience a vicious circle in which phases of psychosis feed into each other which in turn reinforces the former, and so on<sup>25</sup>. The doubling of the I can trigger a ‘becoming sensory’ (externalisation) of normal psychological activities supposed to originate from self. This may render the subjective experiences of the I as under foreign control, ‘paralysed’ in increasing passivity, as for instance in the ‘becoming sensory’ of those thoughts which are experienced as

inserted<sup>22</sup>. The first experimental evidence for the perceptual anomalies approach came in the 1920s when Heidelberg psychiatrists Beringer and Mayer-Gross conducted a phenomenological study of the effects of mescaline in healthy participants to model self-disturbances and psychosis<sup>22,23</sup>. This is the view that low-level perceptual anomalies play a critical role in self-disturbances. The phenomenological psychiatrists Binswanger, Blankenburg, Conrad, Janzarik, Matussek, Straus, and others developed this view<sup>23</sup>.

Sass and Parnas<sup>26</sup> propose a model which differs from that of the Early Heidelberg School. They argue for two factors in the self-disturbance (or disorders of *ipseity*) model: hyper-reflexivity and diminished self-affection. The former concept involves an exaggerated self-consciousness, an inward-facing focus of excessive introspection whereas the latter is a diminished feeling of being-in-the-world as a subject. Thoughts and other internal processes turn inwards as objects of observation rather than having first-person authority, or even a sense of being in control of one's mental processes. As one continues the introspective process, willingly or not, thoughts become increasingly alien and detached from the very self that is supposed to protect the integrity of thinking. In later iterations of the ipseity model Sass further clarified the distinction between *reflective* and *operative* aspects of hyper-reflexivity<sup>27</sup>, the latter of which describes what should be automatic processes 'popping out' into the field of awareness and engage attention. In Sass' view, the operative aspect is more pathogenically primary than the reflective aspect. Although the concept of operative hyper-reflexivity may sound similar to the automatic processes mentioned above, Giersch and Mishara's account indicates that these unconscious processes remain implicit or unconscious.

Phenomenological approaches illustrate structural changes in subjectivity and consciousness which have both descriptive and pathogenic importance. Neuroscientific research, however, seems unable to progress without a solid understanding of what the processes or symptoms in question actually are, and which it seeks to study. Next, we offer an overview of an account that has attracted a great deal of interest in recent years and one that may act as the 'bridge' unifying neuroscience, psychiatry and phenomenology.

### **Predictive coding and the pathogenesis of psychotic symptoms**

For any individual, his or her subjective experiences of self and its internal processes are unable to exist in isolation from what is happening in the external world. This is a key

phenomenological insight – self is embodied and embedded in the world. How an individual makes inferences and constructs a coherent sense of self using a generative model as agent situated in the common-sensical world is the product of what the individual believes, expects and experiences at any given time.

The most well-known implementation of this is the predictive coding framework (however, there are alternatives to this such as the circular inference model; see<sup>28</sup>), where it posits that (using Bayesian statistics terms) the posterior probability is the outcome (such as a perception) that is the most likely given the probabilistic prediction (prior, such as a belief about the world) and the likelihood (such as incoming sensory input). When there is a mismatch between what is expected (prior belief) and what is actually experienced (likelihood), a ‘prediction error’ signals the need to update the brain’s model of the current state and change the prior belief according to the nature of the error signal. Indeed, a prediction error can be formalised by calculating the difference between the means of the prior and the likelihood distributions, weighted by the inverse variances of their respective probability distributions (i.e. their precisions)<sup>29</sup>. In other words, if the precision of sensory data (likelihood) is high, the error signal will be greater and has more power to update the prior belief; however, priors also have precision weightings and a very precise prior will ‘resist’ against being updated. The brain therefore needs to constantly balance between the precisions of the prior and the likelihood in order to minimise prediction errors<sup>30,31</sup>.

Under this framework, psychotic symptoms are thought to occur due to the imbalance between precisions of the prior belief and the incoming sensory data<sup>32,33</sup>. However, the neural structures of the brain also necessitate the hierarchical nature of prediction coding. Imbalances of precision weightings at different levels of the hierarchy can have varied and sometimes contradictory effects on cognition and perception. Reviews of the effects of strong and weak priors locally and globally on the pathogenesis of psychosis have been published<sup>22,23,34,35</sup>. It is however crucial to bear in mind that under the circumstances in which individuals with delusions, hallucinations or a mixture of both make their inferences, such inferences still approximate Bayes-optimality which are conditional on the individual's prior beliefs and the individual's neurobiological implementation of approximated Bayesian inference<sup>36</sup>. It is only because the patient’s inferences deviate from ‘consensual reality’ (i.e. the collective inferences made by a majority of individuals) that clinicians label them delusional or unreal<sup>37</sup>. It by no means indicates a falsehood in perception or inference *for the experiencing individual* – which

is curiously what phenomenological accounts have argued for all along<sup>38,39</sup>. Nevertheless, it is not entirely clear whether this account applies more specifically to schizophrenia-spectrum psychoses rather than psychotic disorders more broadly; however, given the higher rates of complex and bizarre (i.e. ‘more unreal’) delusions in the former<sup>40,41</sup>, individuals with schizophrenia and those with, for example, an affective psychosis may well employ different inferential processes when it comes to approximating Bayes-optimality.

### **The permeable boundaries between thought and perception**

In the previous section we outlined how predictive coding may help to explain how delusions and hallucinations manifest. Still, can this framework be applied to self-disturbances as a whole? In addition, psychotic symptoms are trans-diagnostic and not pathognomonic of, or interchangeable with, the syndrome of schizophrenia. Self-disturbances on the other hand have been consistently and specifically associated with schizophrenia, including transition from an ultra-high risk period<sup>42-45</sup>.

Here we find another potential difference between models in the definition of self-disturbances: that is, Parnas and colleagues often studied self-disturbances as non-psychotic occurrences during the prodromal period, whereas Mishara and colleagues<sup>46</sup> observed that Mayer-Gross ‘anticipated’ Huber’s basic symptoms concept. Basic symptoms are subtle subclinical disturbances, which are experienced as arising from the self. *As such, they do not overlap with self-disturbances, which, are perceived, by definition, as happening to self, without the self’s participation.*’ (p. 875, our emphases). Nevertheless, the mescaline model psychosis both elicits the earlier self-perceived subtle cognitive difficulties (*Denkerschwerung*) and, at higher doses, their transition to thoughts becoming sensory in the self-disturbances leading to experiences of thought insertion/withdrawal/broadcasting, etc. Despite playing a significant role in defining what later would be called ‘basic symptoms’, Mayer-Gross was very careful not to confuse these prodromal manifestations with self-disturbances which, rather, occur later in full-blown psychosis. Here, self is no longer experienced as the source of anomalous experiences, but these experiences are attributed to automatic processing as alien to self (doubling of the I), or to external agents (I-paralysis) (Mishara, personal communication).

However, basic symptoms may yet also be a common ground between the models: Sass and Parnas frequently referred to basic symptoms as a precursor to ipseity disturbances and there

are significant overlaps between the Examination of Anomalous Self-Experiences (EASE) and the Bonn Scale for the Assessment of Basic Symptoms (BSABS) or the Schizophrenia Proneness Instrument, Adult version (SPI-A)<sup>47-50</sup>. Although Parnas and colleagues did focus much of their work on the prodrome and early psychosis, their formulation of self-disturbances does not apply exclusively to the early phases of the illness. Many of their more recent studies included first episode patients ('first admission'). They also discussed self-disturbances further in the course of schizophrenia-spectrum psychoses<sup>51,52</sup>.

We have previously argued that inserted, alien thoughts and auditory-verbal hallucinations are two sides of the same coin and both are rooted deeply in a fragmented self-consciousness<sup>53</sup>. According to the predictive coding account, enhanced precision weighting of internal events such as thoughts makes the prediction error signal much more salient and calls for an update of the brain's current hypothesis<sup>22</sup>. In this case the 'incoming' thoughts would become akin to sensory data input (likelihood) as the Bayesian framework is not limited to 'real-world' sensory data only. The salience may originate from a disruption of the continuity of the usual contextualised thinking in an individual and may be related to unconscious, automatic processing<sup>17</sup>; e.g., the enlarged temporal binding windows in schizophrenia could lead to time gaps in the flow of thoughts themselves and distort what is consciously experienced (Mishara, personal communication). Unlike actions, the error signals are not due to a mismatch between actual expected sensory consequences of thoughts, but the (near-)sensory properties of thoughts themselves. How the individual subsequently attributes the salience and tries to 'explain away' (i.e. minimising) the error signals largely depends on the shift towards prior knowledge, and the outcome may be a delusional elaboration or an amplified sensory feature in the form of an auditory-verbal hallucination.

Counter to the contemporary psychiatrist, Schröder, who, influenced by Wernicke, put forth the thesis that 'there is a successive progression of related symptoms from thought insertion to thoughts becoming loud and then, auditory verbal hallucinations, Mayer-Gross observed in some patients even at the very beginning of illness the nearly simultaneous experience of 'akoasm' (nonverbal auditory hallucinations, e.g., buzzing, whistling, roaring), auditory verbal hallucinations, and thought insertion'<sup>22</sup>. He described rather a 'hallucinating together of the senses'<sup>23</sup>.

As such, the generative experience of thought insertion by itself cannot be readily classed as a

delusion, or indeed a hallucination. What completes the phenomenology of thought insertion is the loss of mineness and its devastating effects on minimal self – as disorders of ego-boundary – and an individual’s own self becomes highly permeable (but does not ‘dissolve’ entirely) and unstable. Such permeability exists between internal and external states (self and other), but also between the myriad of internal processes themselves (within self) such as thoughts, emotions and volition. In such extraordinary states a seemingly erroneous explanation may just fit with the individual’s structure of consciousness<sup>23,54</sup>, and the revelation<sup>55,56</sup> offered by the delusion (‘cancellation’ or minimisation of prediction error) leads to its consolidation and thus persistence where the individual latches onto the delusional meaning because no matter how frightening the content of the delusion may be, existentially it is far less threatening than the perpetual uncertainty and instability experienced by the individual’s self. Experiences of somatic passivity symptoms could be used to balance frightening or confusing sensory anomalies at lower levels of processing as suggested by Mayer-Gross’ ‘perceptual anomalies approach’ to schizophrenia<sup>22,23,46</sup>.

### **Clinical and scientific implications**

In order to implement treatment, the clinician should acknowledge that what one considers ‘real’ (i.e., subjectively real for the person having the experience) is constructed in analogous ways for both the clinician and patient. This conflict between ‘realities’ – between their individual reality and consensual reality – may be particularly pronounced in the early phases of the illness where patients often display a ‘lack of insight’. Nevertheless, such conflicts do not disappear after the patients respond to treatment and display improved functioning. Clinicians may observe a kind of ‘sealing over’ (i.e. not talking about prior episode, denial) and narrative ‘break’ in the self-concept of their patients, even a slight hypochondriasis sometimes in those who are on the path to recovery and who may mislabel even normal thought processes as odd or unusual. These patients often become hyper-aware and reflective of internal thoughts and are concerned that these may be, for example, early signs of thought insertion even though the latter may emerge with unpredictable intrusiveness (see <sup>22</sup>). The ‘well’ self is now always experienced on the backdrop of psychopathology, which clinicians may exacerbate with self-monitoring and management strategies of ‘early warning signs’<sup>57</sup>.

The next wave of psychotherapy should address these limitations and carefully gauge the risks and benefits on an individual basis. Certainly, we are very much aware of the heterogeneity of,

and fluctuations in, patients' experiences both of the illness and of the therapeutic interventions. We are supporting an approach that truly focuses on the individual's needs, wishes and aspirations, which neither offers false hope nor wallows in unnecessary pessimism. This does not mean accepting the symptoms as truth – but as a part of another person's experience of reality that is not necessarily shared by the clinician.

In our view, the priority for clinical intervention is misplaced if it focuses solely on the 'correction' of the patient's thoughts and perceptions. Rather, the emphasis should be on how patients can lead a fulfilling life *with* their symptoms, and over time become better able to control and counteract their perceived influence on the patients.

The value of phenomenology for psychiatric practice, first and foremost as we see it, is that it teaches the clinician to listen more carefully with an open mind. This may involve not taking what patients report at face value, while at the same time maintaining a non-judgemental attitude and willingness to share clinical knowledge with the patients. Patients often do seek knowledge of their own condition and it can be very empowering for the patients to form their own understanding of their illness<sup>58-61</sup>. We believe that clinical relationships are best supported when the clinician combines neuroscientific and phenomenological approaches. It used to be the case that delusions for example are seen as entirely false, 'un-understandable', irrational and erroneous products of dysfunctional neural processes, but none of these qualities makes the experience any less *real*. Even from a neuroscientific point of view, as shown by the Bayesian inference framework, delusions are still the best hypotheses the patient can generate and to a certain degree defend, given the unusual circumstances (Figure 1). These circumstances may be subtle or profoundly intrusive perceptual anomalies the patient is experiencing or individual differences in neurotransmission that help to compute the posterior probability, or indeed both. Sometimes such misconstrued hypotheses may even carry epistemic benefits<sup>62</sup> and are far preferable compared to considerable reductions in functioning (e.g. a catatonic state).

Clinicians can learn a tremendous amount about themselves and their vulnerabilities by understanding disturbances of the self in schizophrenia through a kind of bracketing (again in the phenomenological tradition) of their presumptions and judgements about 'normality' or 'consensual reality'. No matter how distant and 'untrue' the patient's experience of reality appears to the clinician, it is still no less real for the patient and it is here that the clinician can

apply his or her understanding of what it means to be attached to one's preferred reality. Hearing this from a clinician – with supporting scientific evidence – may be an incredible relief for patients, which will in turn alleviate self-stigmatisation, diminish guardedness and equip them with better coping mechanisms.

**Insert Figure 1 about here**

In terms of how phenomenology is able to inform basic science research, neuroscientific methods are limited to the extent that they lack a concrete understanding of the questions we raise here. Phenomenology in its various forms presented here is critical for this understanding and the definition of pertinent neuroscientific problems, for example, how self-consciousness is best defined and studied<sup>63</sup>. Experientially-rich first-person data (whether processed consciously or unconsciously<sup>17</sup>) can improve the models developed in computational predictive coding frameworks and beyond. What exactly is being investigated or represented in the latter has been subjected to much debate and critique<sup>64</sup>, and how to measure self-disturbances under a computational framework remains a contentious topic<sup>65</sup>. Empirical evidence so far has shown that that these frameworks ought not to be used as simple correlates to symptom severity<sup>66</sup>, but should be further dissected with their complexities and nuances (e.g. at which level of the cortical hierarchy is the prediction error being signalled? Low-level error signals may serve drastically different functions to higher level ones regarding firmly held beliefs for example). Indeed, some contemporary researchers<sup>67</sup> have already shed light on ways in which computational psychiatry may be useful for patient care and recovery-focused practices.

## **Limitations**

We are aware that it would be well beyond the scope of the current Personal View if we were to provide a fully comprehensive overview of phenomenology and computational psychiatry. Predictive processing alone has many different 'flavours' (predictive coding is only one of them) and their applications to phenomenology (and vice versa) vary greatly based on their particular implementations and theoretical premises. One criticism of predictive coding as we outlined here may be that it ignores the enactive, embodied, and encultured aspects of the

phenomenological approach<sup>68</sup>. Pertinent to the embodied aspect is the notion of the bodily self which includes interoception (i.e. sensory information arising from the sensation, perception, and awareness of afferent feedback from the viscera/autonomic nervous system), where the brain also processes these incoming bodily signals in a hierarchical manner using active inference<sup>69</sup>. The ability to accurately represent bodily self is crucial to self-other distinction<sup>70</sup> and deficits in self-other boundaries in relation to agency and ownership of physical and mental actions in schizophrenia are well-established (for a review about Bayesian inferences and self-other distinction, see Moutoussis et al. <sup>71</sup>). Even at the basic level of the minimal self, the first-person perspective would be unable to emerge or be modelled without the body's prediction and integration of multisensory information first<sup>72,73</sup>.

The enactive view of cognition argues that the purpose of self serves more than hypothesis testing or statistical sampling. According to Gallagher and Allen<sup>74</sup>, 'enactivists suggest that the brain is not located at the centre, conducting tests along the radiuses...it's on the circumference, one station amongst other stations involved in the loop that also navigates through the body and environment and forms the whole (p. 2635).' The view that active inference is integral to enactive inference has received statistical and experimental support<sup>75</sup>; importantly, the enactive approach also emphasises the relational, cultural and social aspects of mental health and illness<sup>76,77</sup>. Again, whilst it is not our aim to review all these approaches, we think at least one needs to be careful when using the cognitive science various terms in and be aware of the nuances and subtleties in their meaning and application.

## **Recommendations and future directions**

In this contribution, we addressed a hitherto unanswered question: how do the perceptual anomalies (Early Heidelberg School), ipseity, and predictive coding models mutually support or contradict one another? We then raised a further question: how can these approaches in their combined effort, or inherent tension, be applied to the future research and treatment of self-disturbances for individuals with schizophrenia?

Furthermore, we proposed that self-disturbances in schizophrenia may offer unique values in diagnosis and treatment, and how thoughts and beliefs are not always discernible from their milieu of sensory and perceptual backgrounds. We recommend that clinicians ought to move away from the attractive yet unhelpful mindset that there is something fundamentally erroneous

and false about patients' experiences of reality; whilst patients might well be wrong about what is true – at least in terms of prevailing common sense – they cannot be wrong about what is real. Clinicians can still encourage their patients to find truth without denying what is being experienced as real or exacerbating the suffering caused by schizophrenia and its associated stigma. Perhaps one way in which patients can reconcile these drastically different or even apparently incompatible 'realities' is by accepting the fact that despite being untrue and painful, they nonetheless have meaning and can coexist within a damaged selfhood which can be addressed therapeutically. It is the clinicians' role to help their patients find the best adhesive that holds their selfhood together without causing further impairment.

Undoubtedly, it necessitates a tremendous effort on the part of both the clinician and the patient to work towards repairing minimal self. Such an effort may well exceed what current service provisions realistically offer for each affected individual. Disorders of minimal self are mainly considered as temporally stable<sup>78</sup>, however, a recent 7-year follow-up study observed significant changes in self-disturbances in some individuals<sup>79</sup>. Moreover, they found that low levels of self-disturbances at baseline combined with further reductions over time independently predicted functional recovery. As such, more cost-effective therapies and interventions are urgently needed. We also recommend that neuroscience researchers familiarise themselves with phenomenology, and vice versa<sup>38</sup>.

Going forward, there are a number of unanswered questions that likely impact future research. For example, what is the relationship between initial alien and fully formed delusions, and why do the themes of these delusions differ so much despite possibly similar prediction error signals? It may be that the hierarchy at which these error signals occur is the key to this discrepancy in phenomenology, but further empirical support is clearly needed. Further, anomalous self-experiences have very recently been associated with negative symptoms<sup>80</sup>. We are also aware that predictive coding is not the only approach to investigating self-disturbances in schizophrenia (e.g. a network-based model of self-referential processing; see<sup>81</sup>), and that other psychiatric disorders have also benefitted from detailed phenomenological investigations<sup>82-84</sup>. Sass himself has emphasised the presence of self-disturbances in other conditions including panic, trauma and dissociative disorders<sup>85,86</sup>. It should be borne in mind that schizophrenia carries the heavy burden of stigma even in the clinic because some clinicians do not (and perhaps refuse to) understand the illness, and not that patients living with the illness cannot understand their clinicians. After all, there are intersects between the patients' and the

clinicians' experiences of reality – and actively seeking these intersects may just form the first steps of any meaningful therapeutic alliance.

### Panel 3: Glossary of Key Terms

- **Active inference:** A computational process to minimise prediction error by acting on the external environment, rather than by changing the internal model (perceptual inference).
- **Agency:** The sense that mental events and behaviours such as thoughts and actions originate from oneself; that one is the initiator of these events.
- **Bayesian inference:** A method of computationally combining existing information with new evidence in accordance with Bayes' rule; i.e. computing the posterior distribution  $p(c|e) = p(e|c)p(c)/p(e)$ . In other words, to calculate the probability ( $p$ ) that a cause ( $c$ ) for an experience is true given the sensory evidence ( $e$ ).
- **First-person authority:** The concept that the first-person (privileged) introspective judgements an individual makes about the contents of one's own thoughts, feelings and willed actions are epistemically superior to the third-person (ordinary) perceptual judgements one makes about the external world.
- **Generative model:** The joint probability distribution of two or more random variables often denoted as a prior and a likelihood,  $p(e,c) = p(e|c)p(c)$ . It models how sensory evidence ( $e$ ) are generated by hidden causes ( $c$ ).
- **Iipseity:** Sometimes considered synonymous with minimal self, this is a *pre-reflective, tacit* level of selfhood. It refers to the implicit first-person quality of consciousness, i.e., the implicit awareness that all experiences of reality present themselves in the first-person perspective as 'my' experience.
- **Lifeworld:** The totality of an individual's lived experiences as conscious beings, including the way in which phenomena (events, objects, thoughts, emotions) appear to the individual in one's conscious experience or everyday life.
- **Minimal self:** The most fundamental level of selfhood; the sense that an individual's mental events, experiences and actions are imbued with first-person authority and givenness.
- **Multisensory integration:** The process by which information (input) from multiple sensory modalities are synthesised (integrated) by the nervous system.
- **Narrative self:** The level of selfhood that is built upon the minimal self; the sense that an individual has a continuously evolving identity through past, present and future.
- **Ownership:** The sense that one is physically responsible for ('owns') the mental events one initiates.
- **Perceptual anomalies approach:** Developed by the early Heidelberg School, this approach examined how disruption of early levels of sensory processing could lead to self-disturbances.
- **Predictive coding:** A way in which neurons compute ('code') and represent the difference between a sensory input and a prediction (rather than representing the input directly), then respond according to the resulting prediction error.
- **Pre-reflective:** An aspect of conscious awareness of one's experience before any reflection on said experience can take place; an implicit and first-order awareness rather than an explicit or higher-order form of self-consciousness.

### **Search strategy and selection criteria**

References for this article were selected from previous work by the authors as well as a search of PubMed and Google Scholar from January 1980 to July 2019 with the terms ‘schizophrenia’, ‘psychosis’, ‘predictive coding’, ‘consciousness’, ‘hallucinations’, ‘delusions’, ‘self-disturbance’, ‘self-disorder’ and ‘minimal self’. Articles published in English were identified from these searches and the citations within them were also reviewed. A final list of references was determined on the basis of relevance to the theme of the current article.

### **Contributors**

CSH and MRB developed the initial concept of the article, CSH did the literature search, drew the figure and wrote the first draft, which was critically revised by MRB.

### **Acknowledgements**

We would like to thank Aaron L. Mishara, PhD, PsyD, for his helpful comments and input. We confirm there is no involvement by any medical writer or editor.

### **Declaration of interests**

None.

### **Role of the funding source**

There is no involvement by the funding source.

### **References**

- 1 Owen MJ, O'Donovan MC, Thapar A, Craddock N. Neurodevelopmental hypothesis of schizophrenia. *British Journal of Psychiatry* 2011; 198(3):173–175.
- 2 Insel TR. Rethinking schizophrenia. *Nature* 2010; 468(7321):187–193.
- 3 Rapoport JL, Giedd JN, Gogtay N. Neurodevelopmental model of schizophrenia: update 2012. *Molecular Psychiatry* 2012;17(12):1228–1238.

- 4 Weinberger DR, Berman KF, Zec RF. Physiologic dysfunction of dorsolateral prefrontal cortex in schizophrenia: I. Regional cerebral blood flow evidence. *Archives of General Psychiatry* 1986; 43(2):114–124.
- 5 Murray RM, Lewis SW. Is schizophrenia a neurodevelopmental disorder?. *British Medical Journal* 1987; 295(6600):681–682.
- 6 Howes OD, Nour MM. Dopamine and the aberrant salience hypothesis of schizophrenia. *World Psychiatry* 2016;15(1):3–4.
- 7 Fusar-Poli P, Papanastasiou E, Stahl D, Rocchetti M, Carpenter W, Shergill S, McGuire P. Treatments of negative symptoms in schizophrenia: meta-analysis of 168 randomized placebo-controlled trials. *Schizophrenia Bulletin* 2015;41(4):892–899.
- 8 Kendler KS, Mishara A. The Prehistory of Schneider’s First-Rank Symptoms: Texts From 1810 to 1932. *Schizophrenia Bulletin* 2019; 45(5): 971–990.
- 9 Broome MR. Jaspers and neuroscience. In: Stanghellini and Fuchs (Eds.) *One century of Karl Jaspers’ general psychopathology*. Oxford University Press, Oxford 2013:121–132.
- 10 Poletti M, Gebhardt E, Raballo A. Corollary discharge, self-agency, and the neurodevelopment of the psychotic mind. *JAMA Psychiatry* 2017;74(11):1169–1170.
- 11 Nelson B, Lavoie S, Li E, Sass LA, Koren D, McGorry PD, Jack BN, Parnas J, Polari A, Allott K, Hartmann JA. The neurophenomenology of early psychosis: An integrative empirical study. *Consciousness and Cognition* 2020; 77:102845.
- 12 Clowes RW. Rethinking the Ipseity Disturbance Theory of Schizophrenia Through Predictive Processing. In: Hipólito I., Gonçalves J., Pereira J. (Eds.) *Schizophrenia and Common Sense. Studies in Brain and Mind*, vol 12. Springer, Cham 2018: 113–136.
- 13 Raballo A, Sæbye D, Parnas J. Looking at the schizophrenia spectrum through the prism of self-disorders: an empirical study. *Schizophrenia Bulletin* 2009; 37(2):344–351.
- 14 Zahavi D. *Subjectivity and Selfhood: Investigating the First-Person Perspective*. MIT Press, Cambridge MA 2005.
- 15 Henriksen MG, Parnas J, Zahavi D. Thought insertion and disturbed for-me-ness (minimal selfhood) in schizophrenia. *Consciousness and Cognition* 2019; 74:102770.

- 16 Giersch A, Mishara AL. Is schizophrenia a disorder of consciousness? experimental and phenomenological support for anomalous unconscious processing. *Frontiers in Psychology*. 2017; 8:1659.
- 17 Giersch A, Mishara A. Disrupted continuity of subjective time in the milliseconds range in the self-disturbances of schizophrenia: convergence of experimental, phenomenological, and predictive coding accounts. *Journal of Consciousness Studies* 2017; 24(3–4):62–87.
- 18 Mishara AL. The ‘Unconscious’ in paranoid delusional psychosis: phenomenology, neuroscience, psychoanalysis. In: Lohmar and Brudzinska (Eds.) *Founding psychoanalysis Phenomenologically* (pp. 169–197). Springer, Dordrecht 2012.
- 19 Pienkos E, Giersch A, Hansen M, Humpston C, McCarthy-Jones S, Mishara A, Nelson B, Park S, Raballo A, Sharma R, Thomas N. Hallucinations beyond voices: a conceptual review of the phenomenology of altered perception in psychosis. *Schizophrenia Bulletin* 2019; 45(Supplement\_1): S67–S77.
- 20 Mishara AL, Fusar-Poli P. The phenomenology and neurobiology of delusion formation during psychosis onset: Jaspers, Truman symptoms, and aberrant salience. *Schizophrenia Bulletin* 2013; 39(2):278–286.
- 21 Mishara AL, Lysaker PH, Schwartz MA. Self-disturbances in schizophrenia: history, phenomenology, and relevant findings from research on metacognition. *Schizophrenia Bulletin* 2013; 40(1):5–12.
- 22 Sterzer P, Mishara AL, Voss M, Heinz A. Thought insertion as a self-disturbance: an integration of predictive coding and phenomenological approaches. *Frontiers in Human Neuroscience* 2016; 10: 502.
- 23 Kaminski JA, Sterzer P, Mishara AL. “Seeing Rain”: Integrating phenomenological and Bayesian predictive coding approaches to visual hallucinations and self-disturbances (Ichstörungen) in schizophrenia. *Consciousness and Cognition* 2019; 73:102757.
- 24 Humpston CS. The paradoxical self: Awareness, solipsism and first-rank symptoms in schizophrenia. *Philosophical Psychology* 2018;31(2):210–231.
- 25 Ratcliffe M, Broome M. Existential phenomenology, psychiatric illness and the death of possibilities. In: Crowell (Ed.) *Cambridge companion to existentialism*. Cambridge University Press, Cambridge 2012:361–382.
- 26 Sass LA, Parnas J. Schizophrenia, consciousness, and the self. *Schizophrenia Bulletin* 2003; 29(3):427–444.

- 27 Sass LA. Self-disturbance and schizophrenia: structure, specificity, pathogenesis (current issues, new directions). *Schizophrenia Research* 2014;152(1):5–11.
- 28 Jardri R, Deneve S. Circular inferences in schizophrenia. *Brain* 2013;136(11):3227–3241.
- 29 Adams RA, Brown HR, Friston KJ. Bayesian inference, predictive coding and delusions. *Avant* 2014; 3: 51–88.
- 30 Fletcher PC, Frith CD. Perceiving is believing: a Bayesian approach to explaining the positive symptoms of schizophrenia. *Nature Reviews Neuroscience* 2009; 10(1):48–58.
- 31 Hohwy J. Priors in perception: Top-down modulation, Bayesian perceptual learning rate, and prediction error minimization. *Consciousness and Cognition* 2017; 47:75–85.
- 32 Stephan KE, Mathys C. Computational approaches to psychiatry. *Current Opinion in Neurobiology* 2014; 25:85–92.
- 33 Horga G, Abi-Dargham A. An integrative framework for perceptual disturbances in psychosis. *Nature Reviews Neuroscience* 2019; 20: 763–778.
- 34 Sterzer P, Adams RA, Fletcher P, Frith C, Lawrie SM, Muckli L, Petrovic P, Uhlhaas P, Voss M, Corlett PR. The predictive coding account of psychosis. *Biological Psychiatry* 2018; 84(9):634–643.
- 35 Corlett PR, Horga G, Fletcher PC, Alderson-Day B, Schmack K, Powers III AR. Hallucinations and strong priors. *Trends in Cognitive Sciences* 2019; 23(2): 114–127.
- 36 Iglesias S, Mathys C, Brodersen KH, Kasper L, Piccirelli M, den Ouden HE, Stephan KE. Hierarchical prediction errors in midbrain and basal forebrain during sensory learning. *Neuron* 2013;80(2):519–530.
- 37 Adams RA, Stephan KE, Brown HR, Frith CD, Friston KJ. The computational anatomy of psychosis. *Frontiers in Psychiatry* 2013; 4:47.
- 38 Humpston CS, Adams RA, Benrimoh D, Broome MR, Corlett PR, Gerrans P, Horga G, Parr T, Pienkos E, Powers III AR, Raballo A. From computation to the first-person: auditory-verbal hallucinations and delusions of thought interference in schizophrenia-spectrum psychoses. *Schizophrenia Bulletin* 2019; 45(Supplement\_1): S56–S66.
- 39 Nour MM, Barrera A. Schizophrenia, subjectivity, and mindreading. *Schizophrenia Bulletin* 2015; 41(6):1214–1219.

- 40 Cermolacce M, Sass L, Parnas J. What is bizarre in bizarre delusions? A critical review. *Schizophrenia Bulletin* 2010; 36(4):667–679.
- 41 Sass LA, Byrom G. Self-disturbance and the bizarre: On incomprehensibility in schizophrenic delusions. *Psychopathology* 2015; 48(5):293–300.
- 42 Haug E, Lien L, Raballo A, Bratlien U, Øie M, Andreassen OA, Melle I, Møller P. Selective aggregation of self-disorders in first-treatment DSM-IV schizophrenia spectrum disorders. *Journal of Nervous and Mental Disease*. 2012; 200(7):632–636.
- 43 Nordgaard J, Parnas J. Self-disorders and the schizophrenia spectrum: a study of 100 first hospital admissions. *Schizophrenia Bulletin* 2014;40(6):1300–1307.
- 44 Raballo A, Pappagallo E, Dell’Erba A, Lo Cascio N, Patane’ M, Gebhardt E, Boldrini T, Terzariol L, Angelone M, Trisolini A, Girardi P. Self-disorders and clinical high risk for psychosis: an empirical study in help-seeking youth attending community mental health facilities. *Schizophrenia Bulletin* 2016; 42(4):926–932.
- 45 Nelson B, Thompson A, Yung AR. Basic self-disturbance predicts psychosis onset in the ultra high risk for psychosis “prodromal” population. *Schizophrenia Bulletin* 2012; 38(6):1277–1287.
- 46 Mishara A, Bonoldi I, Allen P, Rutigliano G, Perez J, Fusar-Poli P, McGuire P. Neurobiological models of self-disorders in early schizophrenia. *Schizophrenia Bulletin* 2016; 42(4):874–880.
- 47 Vollmer-Larsen A, Handest P, Parnas J. Reliability of measuring anomalous experience: the Bonn Scale for the Assessment of Basic Symptoms. *Psychopathology* 2007; 40(5):345–348.
- 48 Parnas J, Møller P, Kircher T, Thalbitzer J, Jansson L, Handest P, Zahavi D. EASE: examination of anomalous self-experience. *Psychopathology* 2005; 38(5):236–258.
- 49 Schultze-Lutter F. Subjective symptoms of schizophrenia in research and the clinic: the basic symptom concept. *Schizophrenia Bulletin* 2009; 35(1):5–8.
- 50 Schultze-Lutter F, Ruhrmann S, Fusar-Poli P, Bechdolf A, G Schimmelmann B, Klosterkötter J. Basic symptoms and the prediction of first-episode psychosis. *Current Pharmaceutical Design* 2012; 18(4):351–357.
- 51 Parnas J, Henriksen MG. Disordered self in the schizophrenia spectrum: a clinical and research perspective. *Harvard Review of Psychiatry* 2014; 22(5):251–265.
- 52 Nordgaard J, Parnas J. Self-disorders and the schizophrenia spectrum: a study of 100 first hospital admissions. *Schizophrenia Bulletin* 2014; 40(6):1300–1307.

- 53 Humpston CS, Broome MR. The spectra of soundless voices and audible thoughts: Towards an integrative model of auditory verbal hallucinations and thought insertion. *Review of Philosophy and Psychology* 2016; 7(3):611–629.
- 54 Humpston CS, Broome MR. Perplexity. In: Stanghellini and Aragona (Eds.) *An Experiential Approach to Psychopathology*. Springer, Switzerland 2016.
- 55 Mishara AL. Klaus Conrad (1905–1961): delusional mood, psychosis, and beginning schizophrenia. *Schizophrenia Bulletin* 2009; 36(1):9–13.
- 56 Conrad K. Beginning schizophrenia: attempt for a Gestalt-analysis of delusion. trans. by A. Mishara) in MR Broome, R. Harland, GS Owen, A. Stringaris (eds), *The Maudsley Reader in Phenomenological Psychiatry*. Cambridge University Press, Cambridge 2012.
- 57 Sass L. Three Dangers: Phenomenological Reflections on the Psychotherapy of Psychosis. *Psychopathology* 2019; 52:129–134.
- 58 Carel H, Macnaughton J. “How do you feel?”: oscillating perspectives in the clinic. *The Lancet* 2012;379(9834):2334–2335.
- 59 Farrelly S, Lester H. Therapeutic relationships between mental health service users with psychotic disorders and their clinicians: a critical interpretive synthesis. *Health & Social Care in the Community* 2014;22(5):449–60.
- 60 Laugharne R, Priebe S, McCabe R, Garland N, Clifford D. Trust, choice and power in mental health care: Experiences of patients with psychosis. *International Journal of Social Psychiatry* 2011;58(5):496–504.
- 61 Jansen JE, Wøldike PM, Haahr UH, Simonsen E. Service User Perspectives on the Experience of Illness and Pathway to Care in First-Episode Psychosis: A Qualitative Study Within the TOP Project. *Psychiatric Quarterly* 2015;86(1):83–94.
- 62 Bortolotti L. Epistemic benefits of elaborated and systematized delusions in schizophrenia. *British Journal for the Philosophy of Science* 2015; 67(3):879–900.
- 63 Ellis RD. Neuroscience as a Human Science: Integrating Phenomenology and Empiricism in the Study of Action and Consciousness. *Human Studies* 2013;36(4):491–507.
- 64 Williams D. Predictive processing and the representation wars. *Minds and Machines* 2018;28(1):141–172.
- 65 Moe AM, Docherty NM. Schizophrenia and the Sense of Self. *Schizophrenia Bulletin* 2014;40(1):161–168.

- 66 Erickson M, Ruffle A, Fleming L, Corlett P, Gold J. 49. The Predictive Coding Account of Psychosis: A Meta-Analysis of the Relationship Between Mismatch Negativity and Symptom Severity. *Schizophrenia Bulletin* 2017;43(Suppl 1): S26.
- 67 Powers AR, Bien C, Corlett PR. Aligning computational psychiatry with the hearing voices movement: hearing their voices. *JAMA Psychiatry* 2018;75(6):640–641.
- 68 Allen M, Friston KJ. From cognitivism to autopoiesis: towards a computational framework for the embodied mind. *Synthese* 2018; 195(6):2459–2482.
- 69 Owens AP, Allen M, Ondobaka S, Friston KJ. Interoceptive inference: from computational neuroscience to clinic. *Neuroscience & Biobehavioral Reviews* 2018; 90:174–183.
- 70 Ainley V, Apps MA, Fotopoulou A, Tsakiris M. ‘Bodily precision’: a predictive coding account of individual differences in interoceptive accuracy. *Philosophical Transactions of the Royal Society B: Biological Sciences* 2016 ;371(1708):20160003.
- 71 Moutoussis M, Fearon P, El-Deredy W, Dolan RJ, Friston KJ. Bayesian inferences about the self (and others): A review. *Consciousness and Cognition* 2014; 25:67–76.
- 72 Limanowski J, Blankenburg F. Minimal self-models and the free energy principle. *Frontiers in Human Neuroscience* 2013; 7:547.
- 73 Apps MA, Tsakiris M. The free-energy self: a predictive coding account of self-recognition. *Neuroscience & Biobehavioral Reviews* 2014; 41:85–97.
- 74 Gallagher S, Allen M. Active inference, enactivism and the hermeneutics of social cognition. *Synthese* 2018; 195(6):2627–2648.
- 75 Ramstead MJ, Kirchhoff MD, Friston KJ. A tale of two densities: Active inference is enactive inference. *Adaptive Behavior* 2019:1059712319862774.
- 76 Kiverstein J. Free energy and the self: an ecological–enactive interpretation. *Topoi* 2018:1–16.
- 77 Adolphs R. How do we know the minds of others? Domain-specificity, simulation, and enactive social cognition. *Brain Research* 2006; 1079(1):25–35.
- 78 Nordgaard J, Handest P, Vollmer-Larsen A, Sæbye D, Pedersen JT, Parnas J. Temporal persistence of anomalous self-experience: a 5 years follow-up. *Schizophrenia Research* 2017; 179:36–40.

- 79 Svendsen IH, Øie MG, Møller P, Nelson B, Haug E, Melle I. Basic self-disturbances independently predict recovery in psychotic disorders: A seven year follow-up study. *Schizophrenia Research* 2019; in press. <https://doi.org/10.1016/j.schres.2019.08.009>.
- 80 Værnes TG, Røssberg JI, Møller P. Anomalous self-experiences are strongly associated with negative symptoms in a clinical high-risk for psychosis sample. *Comprehensive Psychiatry* 2019; 93:65–72.
- 81 Ebisch SJ, Aleman A. The fragmented self: imbalance between intrinsic and extrinsic self-networks in psychotic disorders. *Lancet Psychiatry* 2016; 3(8):784–790.
- 82 De Haan S, Rietveld E, Stokhof M, Denys D. The phenomenology of deep brain stimulation-induced changes in OCD: an enactive affordance-based model. *Frontiers in Human Neuroscience* 2013; 7:653.
- 83 Legrand D. Objects and others: Diverting Heidegger to conceptualize anorexia. *Philosophy, Psychiatry, & Psychology* 2012; 19(3):243–246.
- 84 Legrand D. Subjective and physical dimensions of bodily self-consciousness, and their dis-integration in anorexia nervosa. *Neuropsychologia* 2010; 48(3):726–737.
- 85 Sass L, Borda JP, Madeira L, Pienkos E, Nelson B. Varieties of self disorder: a bio-pheno-social model of schizophrenia. *Schizophrenia Bulletin* 2018; 44(4):720–727.
- 86 Sass L, Pienkos E, Nelson B, Medford N. Anomalous self-experience in depersonalization and schizophrenia: a comparative investigation. *Consciousness and Cognition* 2013 ;22(2):430–441.