Our sense of self

Phenomenology is a philosophical discipline that gives a detailed description of selfhood; it can contribute to understanding psychiatric diseases such as schizophrenia and its neurological causes

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A feeling of 'self' is fundamental to human experience. We know that we cause our own actions and that we are the authors of our thoughts; we perceive that we are the same person across time. This experience of self—of being able to distinguish ourselves from others—is so fundamental that we are hardly aware of it. However, some neurological disorders, notably schizophrenia, can impair the crucial neurological functions that are responsible for this ability. As such, they can cause people to lose the feeling of 'self' and to live instead with the impression that other people or unknown forces are controlling their thoughts and actions.

Neurobiologists and geneticists have long tried to unravel the causes of schizophrenia, but a detailed biological understanding of the genes, pathways and brain structures involved has so far remained elusive. Interestingly, the philosophical discipline of phenomenology is contributing insights into how we understand 'self' and how this is impaired in schizophrenic individuals. Phenomenology might well therefore open new avenues for neurobiological research.

The Swiss psychiatrist Eugen Bleuler (1857–1939) coined the term schizophrenia in 1908. It is derived from the Greek *schizein* (σχίζειν) 'to split' and *phrēn*, meaning 'mind'. As such, Bleuler's term highlights the fragmentation of mental functions that is characteristic of the disease: the fact that the schizophrenic individual's personality loses its unity. In 1913, the German psychiatrist Emil Kraepelin characterized schizophrenia as the "peculiar destruction of the psychic personality's inner integrity"; in 1914, Josef Berze proposed that a basic

alteration of self-consciousness causes the disorder. Thus, even 100 years ago, schizophrenia was already understood as a disorder of selfhood.

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But what exactly does philosophy have to say about what is going wrong in the brains of schizophrenic individuals? "Philosophers have a role to play in trying to sort out what exactly we mean by self. It is not just by looking in the brain that we are going to solve the problem," commented Shaun Gallagher, who holds the Lillian and Morrie Moss Chair of Excellence in Philosophy at the University of Memphis in the USA. Having a first-person perspective, feeling that one is the author of one's thoughts and actions, feeling embedded in one's own body are features of the self that might be difficult to understand by looking at molecules or neuronal activity alone. "We should understand how some of these phenomena contribute to the constitution of the self before we go in search of neuronal processes that might correlate with or disrupt such phenomena," said Gallagher.

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The German mathematician and philosopher Edmund Husserl (1859–1938) founded phenomenology as a philosophical movement in the early years of the twentieth century and scholars such as Martin Heidegger, Jean-Paul Sartre and Maurice Merleau-Ponty developed it further. Phenomenology aims to understand the essential structures of human experience and existence. By carefully describing experience from a first-person perspective, phenomenologists attempt to gain a better understanding of what conscious experience is like. Although there are various hypotheses at play among phenomenologists, they are united in distinguishing between a basic, core, or pre-reflective form of self-consciousness and a reflective, extended form. The pre-reflective consciousness is characterized by experience from the first-person perspective and does not involve further contemplation or introspection. If you were asked what you are doing at the moment, you might say, "I am reading an article". But before being asked, you were already implicitly aware of reading without further reflection: this implicit awareness constitutes the pre-reflective self [1]. Being able to reflect on what you were just doing is only possible if there is a pre-reflective awareness of experience.

According to phenomenological psychopathology, this pre-reflective aspect of selfhood—the implicit distinction between self and other—is disturbed in schizophrenia [2,3]. "The patient no longer feels naturally embedded in his own body and actions. He is situated outside his own perceptions, emotions and corporeality, as it were," explained Thomas Fuchs, Professor of Philosophical Foundations of Psychiatry and Psychotherapy at the University Clinic

Fig 1 | An efference copy of the intention to speak is sent to the auditory cortex, preparing it for the self-generated sensory signal.

Heidelberg in Germany. This might lead to schizophrenic autism—a withdrawal from the threatening experience of social encounters—or experiences of alien influence when the individual believes his or her actions are controlled by strange forces [4]. “When we assume that symptoms like delusions of control or thought insertions have to do with a very basic sense of self, then we need to work out what aspect is at stake. The idea that the sense of agency is at least part of the picture gives us some guidance in what we are looking for,” Gallagher said. ‘Sense of agency’ is what phenomenologists call the impression that you are

the initiator of your own actions—and this fundamental sense might, according to some phenomenologists, be impaired in schizophrenia.

Phenomenology claims that the sense of agency is rooted in sensory–motor processes that control physical interaction with the environment [1–3]. Every movement creates sensory inputs—if we move our eyes to the left, for example, the visual field shifts to the right. To interact with the environment, an organism needs to be able to distinguish between sensory changes arising from its own movements and sensory changes arising from changes in the environment. According to the comparator model, the brain constantly monitors movement intensions, makes predictions about the anticipated sensory changes and tags these as self-caused. To this end, the brain uses a forward model: a copy of the efferent signal—the intended motor command,

also termed ‘corollary discharge’—travels to the appropriate sensory cortex to modulate its response. It prepares the sensory cortex to account for expected self-induced sensory changes (Fig 1). The efference copy/corollary discharge signal thus helps to distinguish self-generated stimuli from other stimuli in the environment [5,6]. A defect in the efference copy might impair the sense of agency—the sense that I am the initiator of my own actions.

Corollary discharge signals have been implicated in a variety of sensory networks. For instance, sensory input that results from eye movements must be taken into account when the brain processes visual information. Within the somatosensory system, the cerebellum is involved in predicting the sensory consequences of action and relays this information to the parietal cortex. Similarly, within the auditory system, a corollary discharge signal from the frontal cortex has been implicated in attenuating activity in the auditory cortex in response to one’s own voice or other self-generated sounds (Fig 1) [6].

One of the characteristics of schizophrenia is that many individuals with the disease experience delusions that another person or an alien force controls their actions. Such delusions might be caused by a dysfunction of the efference copy at the forward comparator [5], such that self-induced sensory changes lose their ‘self’ tag and the individual no longer feels that he or she controls his or her own movements. Similarly, a failure to process correctly the auditory efference copy might result in an inability to recognize one’s own voice or inner monologue, which could then feel to the individual as though he or she is hearing voices [2].

Indeed, several studies indicate that a failure of the corollary discharge signal underlies these kinds of schizophrenic symptoms [7]. “The exact neuronal cause of this deficit has not yet been sufficiently investigated, but it seems reasonable to assume that neuronal oscillations are involved in this process. Corollary discharge requires a tight coordination between different brain regions, and there are not many mechanisms that could account for this precise communication,” explained Peter Uhlhaas, a scientist at the Institute of Neuroscience and Psychology at the University of Glasgow in the UK. These neuronal oscillations—coordinated, rhythmic activity patterns of large groups of neurons—have intrigued

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researchers ever since the invention of electroencephalography by the German neurologist Hans Berger. This oscillatory activity is distorted in schizophrenic individuals and these aberrations seem to be related to core symptoms [7].

There is more direct evidence for a link between corollary discharge and neuronal oscillations. For example, synchrony between the brain's frontal areas of speech production and the auditory cortex increases during active talking, relative to listening to one's own recorded voice in healthy people. This neural synchrony is correlated with the subsequent suppression of the auditory cortical response to the spoken sound: because we expect to hear ourselves speak, the equivalent auditory response is attenuated. In contrast to healthy controls, people with schizophrenia fail to show this increased synchronization during talking. This indicates that their auditory cortex is not sufficiently prepared to anticipate the self-generated sensory signals. As a consequence, they might interpret them as alien. Similar experiments also indicate a role for neuronal oscillations in anticipating the sound of self-generated movements [7].

Corollary discharge cannot be the only cause of schizophrenia—there is more to it than just sensory–motor disturbances. Individuals with the disease can also have delusions that they are not the author of their own thoughts, which is harder to explain with a comparator model. Gallagher is certainly sceptical: “The comparator model was developed in the context of motor control processes. If you try to use that same model to explain thought insertion, you run into phenomenological problems. There would be certain assumptions that you would have to make that don't seem to match up with the things going on in thought processes.”

In fact, thinking and moving are processes that have little in common. If the intention to act is compromised in delusions of control, what does that mean in terms of cognition? What might an intention to think be? There might be cases when we can identify an intention to think—for example, if we sit down to solve a problem—but in most cases, thoughts are rather spontaneous. “So then the question is: Is there something more basic that might be disrupted in both cases?” Gallagher asked.

One possible explanation of both thought insertion and delusions of motor control

is a defect in the basic temporal structure of mental life [2,5]. In the same way that a schizophrenic individual does not anticipate his or her own movements, he or she might not be able to anticipate his or her own thoughts. “The idea that the anticipatory aspect of working memory is disrupted would fit both thought insertions and delusions of control. It could tie into an explanation of why things are surprising to the schizophrenic,” Gallagher explained. If the individual's own actions and thoughts are not anticipated, then he or she will not have the sense that he or she has initiated them and as a consequence would attribute them to someone else.

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According to phenomenology, time is an important aspect of the pre-reflective self and sense of agency, as the brain integrates succeeding moments into a coherent experience [1,2]. When someone reads, speaks or listens to music, his or her brain combines the immediate past, the present and an anticipation of the next moment as part of the conscious impression. “We do not move from one moment to the next in a series of ‘nows’, like pictures in a movie. Rather, we experience continuity. Our consciousness creates a temporally extended presence,” Fuchs explained. According to Husserl, the “primal impression” of consciousness—what is happening just now—is always accompanied by an awareness of what has just happened, “retentions”, as well as a rough anticipation of the next moment in time, “protentions”. Schizophrenia could be caused by an impairment of the protentional aspect: a defect in the anticipation of the next moment to come [1].

However, science has not yet identified a neurological system dedicated to time perception analogous to the auditory or the visual system. Rather, temporality might be implemented in the temporal structure of neural activity patterns. The way an external stimulus is processed will depend on the state of the brain just before the stimulus—the ‘neural present’ is thus determined partly by the recent past. Similarly, the present state will have an impact on how further signals are

processed. “The idea that the brain actively participates in sensory processing is not completely new, but it has regained attention in the past few years. And oscillations have been brought in to better understand the process,” Uhlhaas said.

Oscillatory activity can occur in different frequency bands that are indicated by Greek letters. “The different frequency bands—beta and gamma—most likely have different functions in the prediction of events. They are located in different layers of the cortex that mediate different aspects of information processing,” said Uhlhaas. According to recent models, beta and gamma oscillation might be involved in transporting information in different directions through the cortical layers. Oscillations in the beta-range probably play a role in transporting the prediction signal—information about the expected sensory inputs—from deeper cortical layers to higher ones. When such prediction fails, internal representations of the world are updated. This could be achieved through gamma oscillations, which might propagate ‘prediction errors’ from superficial to deeper cortical areas [8]. Thus, both beta and gamma oscillations play a role in predictive coding and in updating our own models of the world to new evidence. These features may be affected in schizophrenia; indeed, alterations in both beta and gamma band activity have been associated with core symptoms of schizophrenia.

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Distortions of these neural oscillations are not the only possible explanation for schizophrenia: dopamine plays an important role in prediction error coding, and alterations in dopamine signalling have been implicated in schizophrenia [9]. The prefrontal cortex, for example, plays an important role in working memory and temporal integration [2] and has also been shown to be affected in schizophrenia [10]. Similarly, the thalamus—the main gateway of nearly all sensory inputs to the corresponding cortical areas—might play a central role in the pathology of the disease [10]. It is difficult to

pin down the ultimate cause because there might be more than one. But the fragmentation of perception and temporal processing that is characteristic of the disease might find its neuronal representation as a defect of the processes that bind together different brain areas.

Has phenomenology therefore contributed to a scientific explanation of schizophrenia, or even to one of the 'self'? "I do think that a detailed phenomenological description could play an important role in understanding the neural underpinnings of the disease," Uhlhaas commented. But he added that it is difficult to link these disciplines. "Phenomenology and neuroscience operate on different descriptive levels. It is extremely difficult to reconcile these levels. Many neuroscientists have probably never heard of phenomenology. Or else, they don't really know what to do with it," he said.

Nonetheless, phenomenology has influenced psychopathology [2,3]. Understanding the pathology of schizophrenia requires a detailed description of pre-reflective experience and of how the disease affects temporal continuity or implicit bodily actions. This is exactly what phenomenology provides. "Phenomenology forms the basis of psychopathology," Fuchs said. "Without phenomenology, psychiatry today would be at a very superficial level, in terms of analysing pathological conditions". A better

understanding of the psychopathology of the disease is also required to track its neuronal underpinnings. "The idea that schizophrenia cannot only be explained by a disturbance of cognition and executive functions, but rather by very basic perceptual changes, has gained attention in neuroscience the past 10–20 years," Uhlhaas said. In that sense, phenomenology might lead to a better understanding not only of schizophrenia, but also of the neuronal mechanisms behind the pre-reflective self.

Phenomenology states that consciousness is always about something; that it is never an isolated process: "one does not merely love, fear, see, or judge; one loves, fears, sees, or judges something" [3]. Thus, conscious experience is based on our interactions with the environment and is informed by previous experience. Perception is therefore always an interpretation of what we sense. Many of these ideas are not new to neuroscience: neuroscientists interpret perception as an active process in which the brain makes predictions about the next moment to come, based on previous knowledge. Yet, many neuroscientists might not be aware that these explanations align with phenomenological concepts from almost a century ago—concepts that have been developed to explain the basic structure of the self.

CONFLICT OF INTEREST

The author declares that she has no conflict of interest.

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