Psychiatric Ethics (5 edn)

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Neuroethics

Chapter: Neuroethics

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Introduction

Neuroethics is concerned with the relationship between neuroscientific findings and ethical concepts like free will, moral judgment, and informed consent. On the one hand, it focuses on the investigation of the psychological and neural conditions of these ethical concepts, and, on the other, on ethical problems arising from neuroscientific advances.

Roskies (1) distinguishes correspondingly between ethics of neuroscience and neuroscience of ethics. The former deals with ethical problems arising in neuroscience, such as validity of informed consent in psychiatric patients, enhancement of cognitive functions by neuroscientific interventions, and coincidental findings in neuroimaging. The latter investigates neural mechanisms that may underlie such ethical concepts as informed consent, moral judgment, and will (Figure **17.1**).

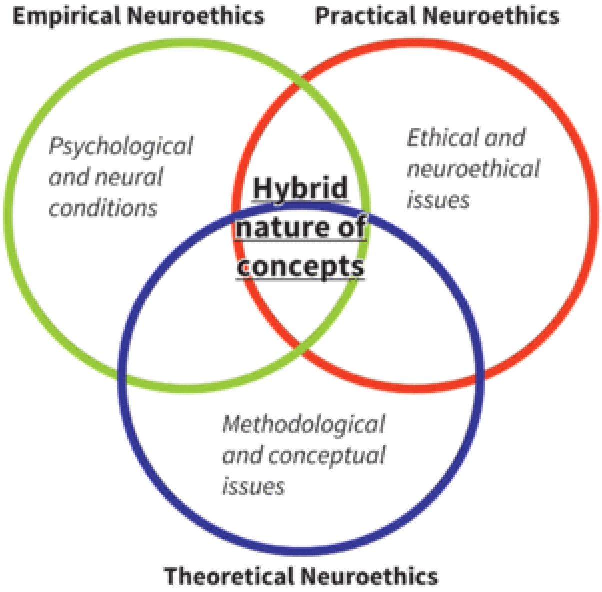

Figure 17.1
Distinction between empirical, practical, and theoretical neuroethics

My purpose in this chapter is to demonstrate the relevance of empirical findings for issues in the neuroscience of ethics and in the ethics of neuroscience. While the conceptual distinction between the two holds firm, empirical reality often provides a more blurred picture. Three examples at the interface between neuroscience and ethics demonstrate that the line between neuroscience of ethics and ethics of neuroscience can become unclear, with particular relevance for psychiatry.

First, I explore how data clearly show that the brain's neuronal activity aligns to its ecological context, implying a relational, and spatio-temporal model of brain. Second, I examine the concept of self in a neuro-relational way, on the premise that agency cannot be reduced to the brain but instead to the relationship between the external world and the brain. Third, I discuss the issue of self-enhancement in the context of deep brain stimulation (DBS).

Example I: A nonreductionistic and neuro-ecological model of brain

History of neuroscience—passive versus active models of brain

The way neuroscience researchers approach the study of the brain can have significant impact on their empirical investigations, as well as on the interpretation of their philosophical implications. One model, favoured by the British neurologist Charles Sherrington (2), proposed that the brain and the spinal cord were primarily reflexive; that is, the brain reacts in predefined and automatic ways to sensory stimuli. Those stimuli from outside the brain, originating in either the body or the environment, are assumed to determine subsequent neural activity. The resulting activity, and more generally any neural activity in the brain, is then traced back to the stimuli to which the brain passively reacts. One may therefore speak of passive model (Figure **17.2**).

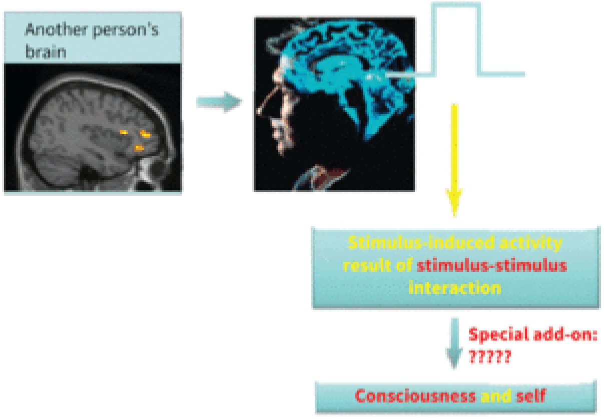

Figure 17.2
Passive model of the brain: neural activity as resulting sufficiently from extrinsic stimuli

Thomas Brown, one of Sherrington's students, advanced an alternative view, namely that neural activity in the spinal cord and brain stem is not driven and sustained by external stimuli, but by spontaneous activity originating in the brain itself. Hans Berger, who introduced the electroencephalogram (EEG), also observed spontaneous activity within the brain that remained independent of any external stimuli (3). Other neuroscientists agreed with Brown, proposing that brain actively generates operational-behavioural activity known as spontaneous activity (4, 5, 6). The idea of spontaneous activity has gained traction in neuroscience with the observation of spontaneous oscillations, as well as connectivity between different regions of the brain and what is referred to as the default-mode network (DMN) (6, 7, 8); the DMN is a network that includes mainly regions in the middle of the brain that have been shown to be related to our experience or sense of self. These observations highlight the central role of the brain's spontaneous activity, including both resting state and stimulus-induced activity; the implication is an active model. This is well illustrated in a 1934 passage by Kurt Goldstein:

> … The nervous system has often been considered as an organ at rest, in which excitation arises only as a response to stimuli. … It was not recognized that events that follow a definite stimulus are only an expression of a change of excitation in the nervous system, that they represent only a special pattern of the excitation process… (9, pp. 95–6)

Neuroscience—passive versus active models of the brain

The question of which model of the brain is valid has gained increased attention with the discovery of the DMN, a neural network that covers various regions in the so-called cortical midline structures (CMS) (10, 11, 18, 19). The DMN shows particularly high levels of metabolism (when compared to the rest of the brain) and neural activity in the absence of any external stimuli.

The DMN's high levels of resting state activity are associated with diverse mental features including sense or experience of self, consciousness, inner thoughts which are also described as mind wandering, episodic memory retrieval, time perception of both past and future, and random thoughts. Given this wide range of functions, the DMN's role remains unclear.

Clear is that the nature of the DMN supports the concept of an active model of the brain. Put more philosophically, the active model has been regarded as similar to Immanuel Kant's argument against a passive model of the mind (14). David Hume proposed the opposite view, namely external stimuli completely determined brain activity. This dispute has resurfaced in the context of theoretical neuroscience.

A spectrum model—the hybrid nature of the brain's activity

An empirically plausible model of brain activity that takes into account the relationship between spontaneous and stimulus-induced activity would be highly desirable. (see 15 for details). The brain neither generates its neural activity in a completely passive way, driven by external stimuli, nor in an exclusively active way, driven by spontaneous activity. Given the evidence, we need to accept a model of the brain that undermines the passive/active dichotomy and integrates both in a spectrum that allows for categorizing different forms of neural activity according to the degree of the brain's participation in generating that activity.

A spectrum model assumes that different sorts of neural activity involve various levels of resting state, some more active, others more passive. This is relevant for placing the brain in the context of body and environment. Neural activity is thus intrinsic to the brain, and to the body and the environment—usefully referred to as a 'trinity' (16) (Figure **17.3**).

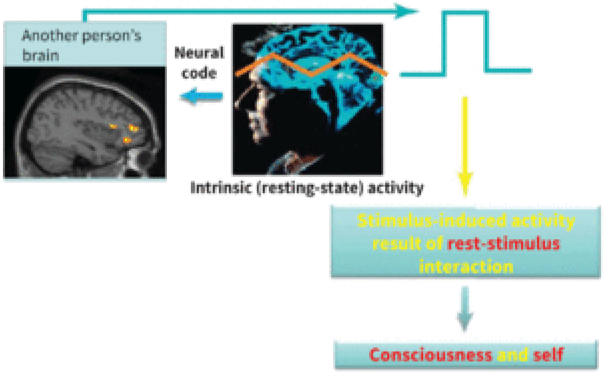

Figure 17.3
Spectrum model of the brain: neural activity as resulting from the interaction between intrinsic resting-state activity and extrinsic stimuli

The brain's spontaneous activity—a spatio-temporal structure

The brain's spontaneous activity is relevant for such mental features as consciousness and self (17, 18, 19). They also appear to relate, albeit in an ill-defined way, to a spatio-temporal structure of the brain which can be characterized by various neural networks consisting of regions that show close functional connectivity with each other. Other neural networks include the sensorimotor, salience networks involved in attention, and a more cognitive network (12). These relate to one another in dynamically changing constellations, resulting in what may be described as a spatial structure that, through its functional nature, supersedes an anatomical one.

The spontaneous activity can also be characterized by a complex temporal structure whose neural activity fluctuates in different bands of frequency. These are coupled with each other; for example, slower frequency bands with higher ones. The result is that complex temporal structures in the brain's spontaneous activity relate, albeit unclearly, to spatial structures, as well as to a range of neural networks.

Spontaneous activity and mental features—neuro-ecological rather than neuronal

Spontaneous activity in the spatio-temporal structure extends beyond the brain and is aligned to the body (e.g., the heart and stomach) and to the external world (13, see 20, 21 for a helpful review), suggesting a spatio-temporal alignment of the brain to the body (15, 22). Alignment to the world is especially obvious when listening to music and dancing; that is, we align our brain's temporal features and rhythms of its neural activity (its frequencies and synchronization) to the temporal feature and rhythm of the music or, more generally, to the world (23, 24).

The above forms of alignment are central for the state of consciousness; the better the alignment the more we can become conscious of the body and the world. I therefore posit a spatio-temporal model of both consciousness and mental features in general (5, 15, 22). The brain and its spatio-temporal features must be related to the world’s spatio-temporal structure to make consciousness possible; if they are not related, consciousness is lost, as in disorders of unresponsive wakefulness, sleep, and anaesthesia. Most importantly, the extension of the spatio-temporal structure beyond brain and body to the world signifies spontaneous activity as intrinsically neuro-ecological and relational, also entailing a nonreductionistic view of the brain. This is of utmost importance to psychiatric disorders where the mental changes can be traced to the impact of social and developmental factors such that both neuronal and social changes cannot be separated.

Psychiatric disorders—neuro-ecological and ‘spatio-temporal psychopathology’

We are now ready to confront the relevance of the spectrum model in the case of psychiatric disorders. For example, major changes occur in the brain’s spontaneous activity in schizophrenia (25) and bipolar disorder (BD) (26). This is manifest in the networks’ resting states, as well as in the variability of their neural activity. At the same time, patients with these conditions react abnormally or differently in stimulus-induced or task-evoked activity. The abnormal neuronal speed of spontaneous activity in these patients, as reflected in neuronal variability, is related to the experience of abnormal consciousness of time speed which, in turn, manifests as symptoms like abnormal speed of thought or movement (25, 26). The spectrum model can thus be invoked when linking spontaneous and task-evoked activity to mental features (see Figure **17.4**).

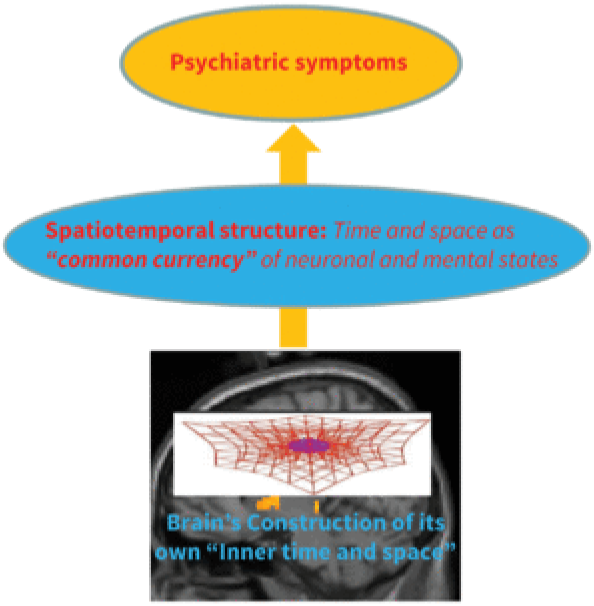

Figure 17.4
Spatiotemporal psychopathology

It becomes more understandable why these patients do not experience their symptoms as being 'located' in the brain; instead, they perceive themselves as in an abnormal relationship to their body and to the external environment.

Example II: from the neural basis of sense of self to relational agency

Neuroscience of the self—mapping distinct aspects of the self onto different brain regions

The question of the self has been one of the most salient problems in philosophy, psychology, and neuroscience. William James distinguished between three selves: physical, mental, and spiritual; similar concepts of self have been discussed by neuroscientists (27). Damasio (28) and Panksepp (29), among others, suggest what has been referred to as 'proto-self' in sensory and motor domains, which resembles James's account of the physical self. Similarly, what has been termed as 'minimal self' (30) or 'core or mental self' (28) might correspond to James's concept of mental self. Finally, Damasio's (28) 'autobiographical self' and Gallagher's (30) 'narrative self' strongly rely on linking past, present, and future links akin to James' spiritual self.

These selves are related to distinct brain regions. For instance, the 'proto-self', outlining one's body in emotional and sensory-motor terms, is associated with subcortical regions like the peri-aqueductal grey matter, colliculi, and tectum (29), and the 'core or mental self' building on the 'proto-self', with the thalamus and cortical regions, such as the ventromedial prefrontal cortex (see for instance (28)). Finally, the ‘autobiographical or extended self’ is associated with such cortical regions as the hippocampus and cingulate gyrus.

Neuro-imaging studies reveal that various cortical regions, especially midline structures, integrated with subcortical regions like the thalamus are involved in self-related processing to yield an integrated subcortical-cortical midline system (SCMS). The assumption of the existence of this system is consistent with research findings that show that core self-related functioning involves both cortical and subcortical regions.

Cortical regions have been studied in particular since cognitive components, including evaluative judgments, are involved (see 10, 11); this is reflected in the experimental paradigms of most imaging studies of the self which compare the evaluation of self-related and non-self-related stimuli. That at raises the question of whether neural activity in the SCMS is associated with the cognitive functions implicated in the evaluation of stimuli as self-related, or in the self-relatedness of the stimuli themselves (Figure **17.5**).

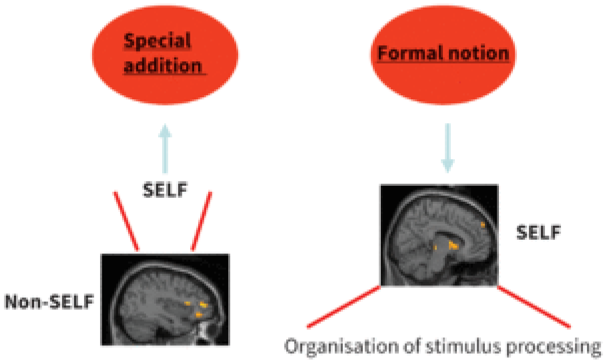

Figure 17.5
Self as ‘special addition’ or ‘formal notion’

Self and brain—agency is ecological and relational

The data have major implications for ethical concepts like agency (e.g., the ability to voluntarily initiate an action) and moral responsibility, since both are based on the sense of self. If that same self is based in the brain’s spontaneous activity and its spatio-temporal structure, the two concepts need to be defined in a spatio-temporal rather than cognitive content-based way. Consequently, agency and responsibility are not about specific content generated by cognition, but about spatio-temporal features and scales, offering a novel line of study for ethicists and philosophers. The closer a person’s self is to the spatio-temporal features of the world, the more robust their agency and responsibility. Furthermore, since the self is strongly based on spontaneous activity, it is more appropriately viewed as neuro-ecological rather than being located in the brain and its neuronal activity. The same applies to agency and moral responsibility.

Assuming a sense of moral responsibility is ecological in nature, an individual is only the symptom bearer, as it operates within a wider relational social and cultural context, and not the cause, of moral failure. Analogously, the same can be said for the brain and its neuronal activity which is associated with agency and moral responsibility. That, in turn, is relevant in the case of psychiatric disorders which are relational and neuro-ecological, and thus spatio-temporal disorders of the world-brain relation (15). Given a patient's altered relationship with the world, and sense of self, they may manifest a changed sense of agency and moral responsibility. Psychiatrists, therefore, should not impose their values onto their patients. Instead, we should try to understand the world as perceived by patients from their perspective on the world including their values.

Example III: enhancement of self—deep brain stimulation

DBS is a potential form of treatment for severe forms of such conditions as anorexia nervosa, major depression, and obsessive-compulsive disorder (31). Whether and how DBS impacts on the self in terms of effectiveness and unwarranted side effects generates ethical concerns. Gilbert discusses different notions of self in the context of DBS (32), like a predominant definition of the self in terms of cognitive contents rather than in terms of relation. Gilbert and Goering observe a relationship between the preoperative effects of the disease on self and postoperative effects on self-estrangement. As mentioned earlier the patient's spontaneous activity and spatio-temporal features may have been already affected by the disease process and thus predispose him subsequently to an experience of being estranged from his own self (i.e., self-estrangement through DBS).

We may then set up a specific, hypothesis that the preoperative spontaneous activity's CMS and their fluctuations in different frequencies including the association between slow and fast frequencies, predicts effects of DBS on self. Clinically there is the possible option of measuring the power spectrum in the brain's spontaneous activity (via functional MRI and EEG) in relation to the self in order to predict risk of the DBS-induced experience of being estranged from the own self.

Gilbert and his colleagues (32) argue correctly that DBS is no different from other forms of treatment, such as psychotropic medications and psychological therapies, in that all of them change the spatio-temporal structure and, in turn, the self. The interaction possibly restores the self rather than replacing it. My colleagues and I have shown that inserting foetal cells when transplanting brain tissue in Parkinson disease does not adversely affect the patient's sense of self. On the contrary the foetal tissue improves abnormal movement, as well as restoring their original sense of self and personal identity.

Deep brain stimulation—its application in bipolar disorder

Goering et al. (33) point out how DBS potentially affects the self. They suggest that it registers neural activity and delivers stimulation each time when the neural activity related to the target symptom occurs. Although Goering and colleagues welcome the introduction of DBS, they are careful, if not sceptical, about its potential effects on the self, specifically agency. They believe these effects may be mitigated by the support of family and friends, leading to their concept of 'relational agency'.

Can neuroscience, in tandem with neuro-philosophy, contribute to better understand the mechanisms and effects of DBS? We need to be clear about the neuronal mechanisms underlying specific psychopathological symptoms. For example, fMRI studies in BD (26) demonstrate in manic patients elevated neuronal activity and variability in the resting state in the somatomotor cortex. These findings may be associated with a hallmark of manic BD, namely spontaneous initiation of movement and subsequent psychomotor agitation. The opposite pattern is observed in depressed BD patients manifesting psychomotor retardation (see 34 for the latter).

Effects of DBS on the self—a quest for neuronal mechanisms

What about the effects of DBS on the self? There should be none since only motor cortical activity is altered. However, as mentioned earlier DMN neural variability changes occur that are the opposite of those in the motor network; namely depressed patients show increased neural variability, whereas in manic patients, neural variability declines.

What do these findings imply for a potential influence of DBS on the self and agency? First, 'normalization' of motor neuronal variability should also rebalance its relationship to DMN/CMS; this, in turn, should 'normalize' the self. We know that if we do not move, ruminations can develop, and we can get 'stuck' in our self. In contrast if we are overactive, our sense of self can evaporate. In short, psychomotor behaviour and self are closely linked. That is, DBS may restore the 'original self' by replacing the 'disease self'.

DBS may also affect agency (33). Thus, movements either initiated or suppressed by external stimulation may depend on the degree to which the effects of DBS are integrated with the brain's spontaneous activity. The more effective the response to the stimulation, the more likely will it be attributed to the self rather than to an external agent.

The introduction of DBS for individually tailored therapy is a welcome development though, as a neuroscientist, I remain wary since the neuronal mechanisms underlying psychopathological symptoms remain unknown. As a neurophilosopher, I am equally wary of DBS; I suggest a need to redefine the notion of self in spatio-temporal terms that cross boundaries between neuronal and social dimensions, and thus between brain and world, thereby facilitating a novel view of self.

As a clinical psychiatrist, I will judge the therapeutic effects of DBS by its ecological and social manifestations concerning the perception and behaviour of the respective subjects. For that DBS must manipulate those mechanism that account for spatio-temporal alignment while, at the same time, provide ecological and social stimuli that activate the brain's spatio-temporal alignment. Accordingly, DBS alone is not sufficient; complimentary and individually tailored ecological and social therapies (e.g., contact with others, music therapy) are necessary to fully exploit potential benefits of DBS.

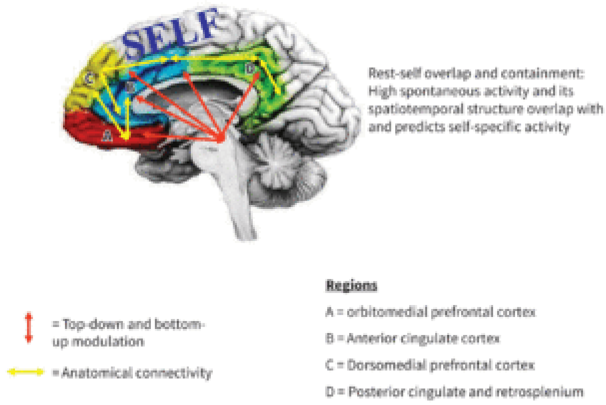

Figure 17.6
The figure shows the cortical and subcortical midline structures with their various regions and how they are related to each in terms of different forms of modulation as being relevant to the sense of self.

Conclusion

The convergence of neuroscience and ethics has major implications for psychiatry. Neuroethics cannot be reduced to an exclusively neuronal view of concepts, such as agency and moral responsibility. An ecological or better neuro-ecological and relational approach is indicated (15, 35, 36). The encounter of ethics with neuroscience has the potential to change the widely held view of the association of psychiatric disorders to the brain. Moreover, the history of psychiatry informs us that empirical findings and conceptual issues are inseparable and highly relevant to the future study of psychiatric disorder.

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