Multi-Layered Model of Self: A Functional Neuroimaging Perspective

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Recent functional neuroimaging findings suggest that the self is not a unitary entity in the brain. Cortical areas specifically activated during self-face recognition are unlikely to comprise a single network associated with a unitary process (Sugiura et al., 2006). These regions do not respond to the self-name (Sugiura et al., 2008), and do not overlap with the areas involved in social self-awareness (Kampe, Frith, & Frith, 2003) or emotional self-regulation (Beauregard, Lévesque, & Bourgouin, 2001).

We propose a model of self that is independently implemented in multiple cognitive layers. Our brain must evaluate and respond to any environmental signal that is potentially critical to our survival. "Self" is assumed to represent a system that suppresses signal processing when the signal is predictable as a consequence of a self-generated cognitive or motor act. This feedforward inhibitory system allows efficient use of cognitive resources. We hypothesized four hierarchical layers relevant to social cognitive development:

i) Sensorimotor Layer: Physical Self

Sensory input is derived both from environmental change and from one's own movement. Successful feedforward suppression of the sensorimotor integration of the latter represents "physical self". This suppression is likely to occur in the frontoparietal network (Fink et al., 1999), which also associates bodily expression with mental state.

ii) Social-Signal Layer: Personal Self

Signals of mental states mediated by bodily expressions and representations (e.g., clothes, names) of others have prime importance in social survival. Successful suppression of the processing of such signals attributable to the self represents the "personal self". This suppression occurs in the posterior superior temporal sulcus (Sugiura et al., 2005, 2008), which also integrates perceived mental states into identity-specific representations (i.e., theory of mind).

iii) Social-Behavior Layer: Social Self

Animals having mature representations of others' mental states consequently recognize a self represented in the minds of others, and try to improve this representation by changing social behaviors. This effort is suppressed when the representation is stable and satisfactory, which represents the "social self." This process may involve the medial prefrontal cortex, which is implicated in social self-awareness (Kampe et al., 2003).

iv) Conflict-Reconciliation Layer: Integrated Self

Since one establishes multiple social selves as appropriate for various communities and occasions, conflict may arise because the values (i.e., ideals) of these social selves differ. One's resources (e.g., physical, economic) and innate preferences may also limit pursuit of the ideal social self. Successful reconciliation of these conflicts may represent the "integrated self", which may be supported by the orbital and/or dorsolateral prefrontal cortex, also implicated in emotional self-regulation (Beauregard et al., 2001).

Future Direction of the Model

This model generates many hypotheses for each layer that can be tested by examining the suppression of neural activity in specific areas during relevant conditions. The current model is intended only to begin a sequence in which it is evaluated and revised by testing hypotheses. An established model could serve as a biologically valid model of the self and contribute to clinical research into psychiatric diseases related to the self, such as schizophrenia.

References

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