Editorial overview

New advances in social neuroscience: from neural computations to social structures

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New advances in social neuroscience:
From neural computations to social structures

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We are delighted to present this special issue on *Social Neuroscience*, in which we feature some of the most exciting recent developments in this vibrant field. These developments reflect an important shift in social neuroscience research, from earlier interest in identifying brain regions that respond to particular social stimuli (i.e., the so-called “blobology” approach), toward questions about the specific neural mechanisms that contribute to social cognition and behavior and their roles in broader contexts of human social interaction.

These conceptual advances regarding mechanism have been made by focusing on two central questions: (1) what computations are performed in specific brain networks and (2) how do they causally contribute to social behavior? These questions are central both to neuroscience and social cognition. Neuroscience seeks to understand how the brain works, and given that the human brain evolved in a context where social functioning promoted survival, social computations are often key to deciphering the operations of the brain. Social cognition, by comparison, seeks to understand the processes that underlie social behavior and the human social experience; exploring the computations performed by the brain and their relation to behavior can inform theoretical models of social cognition and behavior, which in turn help to explain societal and economic phenomena and inform efforts to promote human well-being.

These dramatic advances in our understanding of neural computation were made possible by recent methodological innovations. The use of computational models and multivoxel pattern analyses, in particular, have brought about a significant change in how we study the brain. Computational models transform theories of learning and decision-making into quantitative predictions of neural activation at specific timepoints, which can then be fit to patterns of neural and behavioral data to test a particular hypothesis (Hackel & Amodio, 2018; Kliemann & Adolphs, 2018; Konovalov, Hu, & Ruff, 2018). With this method, one can pit competing theories against one another. Specifically, different theories predict different time-series of brain activity. After measuring the actual brain activity, one can then use Bayesian statistics to calculate the probability that competing models—and by extension, theories—correctly account for the observed data.

Multivoxel pattern classification enriches our understanding by allowing us to explore the dimensionality of the representational space of our brain (Freeman, Stolier, Brooks, & Stillerman, 2018; Weaverdyck & Parkinson, 2018): what processes are more alike, which are more different? Are felt and perceived emotions represented in a similar code (e.g., Zaki, Ager, Singer, Keysers, & Gazzola, 2016)? And to what extend does a neural structure support multiple representations or processes (e.g., Gilbert, Swencionis, & Amodio, 2012)? This trend toward assessing the roles of distributed patterns of activity, either within a region or across multiple regions, has produced new theoretical models of how we perceive people, form impressions, and update impressions (Freeman et al., 2018; Hackel & Amodio, 2018; Mende-Seidlecki, 2018).

Utilization of nonhuman animal models of social behavior, such as nonhuman primate and, increasingly, rodent models, enable us to peer deeper into the cellular code that implements social cognition. Mirror neurons were the key example of the value of this cellular perspective, providing unique evidence for embodied social cognition, but recent work has expanded its purview; new models of emotional contagion and helping behavior in rodents promise to provide further insights into the computations that underpin affective social processes (Meyza & Knapska, 2018), and non-human primate data is shedding light on how mentalizing might have evolved (Kliemann & Adolphs, 2018).

Our understanding of the necessary nature of the computations performed in particular brain circuits remain central to our understanding of the brain, and this continues to rely mainly on the use of neuromodulation and lesion studies. For instance, years of neuroimaging provided evidence for both mentalizing and simulation processes in the perception of others' actions and emotions, with much debate regarding which is more important. Lesion studies and neuromodulation have now provided robust evidence that both processes are important, and combinations of neuromodulation with neuroimaging have begun to provide a more refined understanding of the fact that modulation of one network often induces effects in other networks (Keysers, Paracampo & Gazzola, 2018). This approach has encouraged a more holistic understanding of social cognition in which different classes of processes operate in concert. The field also increasingly recognizes that interoceptive signals from the body play a causal role in many aspects of social cognition (Palmer & Tsakiris, 2018). Again, animal models now pave the way to more fine-grained insights into the necessary nature of particular processes (Meyza & Knapska, 2018). While traditional neuromodulation alters the activity of entire brain regions, molecular tools now allow us to selectively modulate neurons of a certain cell type, or engrams of neurons that had been involved in a particular task. This will allow us eventually to address much more specific questions of how neurons involved in one process influence social behavior in a different context.

Alongside these advances in low-level precision is an expanding appreciation that high-level factors, such as society, culture, status, and groups, can influence basic neural function and development. If the human brain evolved to support survival in social contexts, these contexts include groups and cultures, not just mates and kin. And thus an understanding of neural mechanism is incomplete without an appreciation of its range of social function. Indeed, the neural processes underlying social perception, cognition, and emotion are modulated by group membership and status cues (Vollberg & Cikara, 2018; Mattan, Wei, Cloutier, & Kubota, 2018), and the brain is attuned to the structure social networks and the way information moves through them (Weaverdyck & Parkinson, 2018; Baek & Falk, 2018). Many aspects of social cognition, such as empathy, are no longer considered automatic processes that unfold with subject specific intensity, but rather processes that people selectively approach or avoid based on motivation in a social context (Weisz & Zaki, 2018).

Finally, the field is becoming increasingly aware of the fact that processes observed in constrained lab setting may or may-not be representative of social processes ‘in the wild’ (Kliemann & Adolphs, 2018; Nummenmaa, Lahnakoski & Glerean, 2018). Novel technologies that allow us to measure physiology, behavior, and brain activity while participants move and interact more freely offers an opportunity to perform neuroscience in naturalistic settings. Of course, by relaxing experimental controls on what our participants do and perceive, these more naturalistic paradigms challenge traditional analysis methods. However, recent advances in analytical techniques, which use signals from one participant as the model for analyzing those from other participants, are helping us to maintain rigor while moving beyond controlled experimental lab settings (Nummenmaa et al., 2018). These advances allow us to break new ground in identifying the processes involved in true interactions.

Our aim in this special issue is to showcase some of these fundamental changes in how we perform social neuroscience. We have focused on work that offers conceptual advances that are relevant both to the social psychologist interested in process and the neuroscientist interested in mechanism. Einstein and Infeld (1961) famously wrote that "In our endeavor to understand reality we are somewhat like a man trying to understand the mechanism of a closed watch. He sees the face and the moving hands, even hears its ticking, but he has no way of opening the case. If he is ingenious he may form some picture of a mechanism which could be responsible for all the things he observes, but he may never be quite sure his picture is the only one which could explain his observations" (p. 31). Social neuroscience offers the opportunity to look beyond the dials of human social behaviour. We hope that the examples we selected here will inspire those interested in social behaviour to put their sophisticated theories of social cognition to the test of social neuroscience to generate exciting new insights into our social nature.

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