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Social Neuroscience

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Abstract
Social species are so characterized because they form organizations that extend beyond the individual; such structures evolved hand in hand with psychological, neural, hormonal, cellular, and genetic mechanisms. The goal of social neuroscience is to identify these biological mechanisms and to specify the influences between social and neural structures and processes. Such an endeavor is challenging because it necessitates the integration of theory and data across levels of analysis. Social neuroscience has nevertheless grown dramatically as an interdisciplinary science and has expanded to include the relationship among social factors, genes, and gene expression.

Keywords
social neuroscience, social cognition, history

Humans are fundamentally a social species, and social species by definition create organizations beyond the individual. These superorganismal structures evolved hand in hand with psychological, neural, hormonal, cellular, and genetic mechanisms because the consequent social behaviors helped these organisms survive, reproduce, and leave a genetic legacy. Scientific research on the brain and biological processes underlying social cognition and behaviors can be traced back to the late 19th century and saw important contributions from many scholars throughout the 20th century, but work in the field was largely fragmented. When the field of social neuroscience was first proposed almost 25 years ago, one had to address why the notion of a "social neuroscience" was not an oxymoron and articulate a doctrine of multilevel analysis that justified attention to superorganismal structures in the analysis of the function of the nervous system and brain of a single organism (Cacioppo & Berntson, 1992). This was prior to the recognition of the importance of epigenetics, prior to the discovery of mirror neurons, prior to the probes of the human brain in normal waking individuals that exist today, and prior to the massive interconnectivity of computational devices through the Internet.

To Study the Human Brain

A single human brain is the most complex living structure known, so targeting the biological bases of social processes and behavior a quarter century ago represented an understandably daunting target for the neurosciences. The human brain, perhaps, is also a surprisingly recent evolutionary development. If we compressed the 4.5 billion year history of the Earth into a 24-hour period, the first single-cell organisms would have emerged around 18 hours ago, the first simple nervous systems separating animals from plants would have emerged around 3.75 hours ago, the first brain would have emerged about 2 hours and 40 minutes ago, the first hominid brain would have emerged less than 2.5 minutes ago, and the current version of the human brain would have emerged less than 3 seconds ago. The human brain shares many design features with those of other organisms, but it is apparently unique in its ability to contemplate the history of the Earth, the reach of the universe, the origin of the species, the genetic blueprint of life, and the physical basis of its own unique mental existence.

The study of the structure and function of the brain is so complex that it requires disparate basic, clinical, and applied disciplines to cover the terrain. Although scientific investigations of structure and function go hand in hand, differences in emphasis exist in this scientific frontier. The emphasis in some fields is on identifying constituent structures at different levels of organization, such as neuroanatomy, neurobiology, cellular and molecular neuroscience, genetics, and biochemistry. The emphasis in other fields is weighted more toward understanding

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the function of the brain and nervous system. Among the latter are the complementary fields of behavioral, cognitive, and social neuroscience. Behavioral neuroscience generally views the nervous system and brain as instruments of sensation and response, with representative topics of study including learning, motivation, homeostasis, biological rhythms, and reproduction. Cognitive neuroscience generally views the brain as a computer, with representative topics of study including attention, representations, memory systems, reasoning, and executive functioning. Social neuroscience represents yet another broad perspective in which, rather than viewing the brain as a solitary computer, it is viewed as a mobile, broadband connected computing device closer metaphorically to a cell phone than to a desktop computer that is connected only to an electrical outlet. The brain functions that immediately come into focus given this perspective include communication, attachment, social perception, social recognition, impression formation, empathy, competition, cooperation, status hierarchies, imitation, norms, social learning, conformity, contagion, social networks, and culture. Behavioral, cognitive and social neuroscience may look at the same construct or behavior but do so from different angles and interests. For instance, from the perspective of cognitive neuroscience, language is a system for the representation and processing of information within the brain; from the perspective of social neuroscience, language is a system for information exchange between brains—a system that promotes communication and coordination across discrete and sometimes distant organisms.

Contemporary Social Neuroscience

Contemporary social neuroscience has grown into a broad and interdisciplinary field, with some researchers focused on social insects to understand the genetics of social behavior, others focused on nonhuman animal models to probe the epigenetics and neurobiology of social behavior, others focused on human brain imaging in an attempt to elucidate social cognition, and still others focused on the interplay of social and biological factors underlying human distress associated with atypical social behavior or disease. Although some of the fragmentation that characterized research in the field throughout most of the 20th century can still be found, there is also emerging evidence of increased communication and collaborations among what had long been distinct research areas (e.g., Blumstein, 2010; Decety & Cacioppo, 2011; cf. Cacioppo et al., 2007). The increased communication and collaboration among scientists using animal models, patient studies, and healthy individuals across the life span is an important development if the mechanisms underlying the social brain are to be fully delineated.

These interdisciplinary collaborations have also capitalized on a variety of methods and techniques, including nationally representative surveys that include biomarkers and genetic data (e.g., the Health and Retirement Study); anthropological and ethological investigations (e.g., Dunbar, 2003); behavioral studies of brain lesions in animal models and patients (e.g., Damasio, Grabowski, Frank, Galaburda, & Damasio, 1994; Klein & Kihlstrom, 1998); pharmacologic and electrical manipulations of specific brain regions in human and nonhuman animals (e.g., Burkett & Young, 2012; Insel & Fernald, 2004); genetic knockout models of social behavior (e.g,. Lim et al., 2004); structural, functional, and/or electrical neuroimaging studies across scales of neural organization in human and nonhuman animals (e.g., Frith & Frith, 1999; cf. Decety & Cacioppo, 2011); cellular and molecular techniques in genetics and epigenetics (e.g., Cole, Hawkley, Arevalo, & Cacioppo, 2011; Young & Wang, 2004); twin studies and molecular techniques (e.g., Abdellaoui et al., in press); and high performance computing and meta-analytic statistics (e.g., Cacioppo et al., 2013; He, Johnson, Dovidio, & McCarthy, 2009; Ortigue, Bianchi-Demicheli, Patel, Frum, & Lewis, 2010).

A recent study by Abdellaoui et al. (in press) illustrates the expansion of work in the field to investigate the social influences on and outcomes of genes and gene expression. (See Slavich & Cole, 2013, for an overview of work in social genomics more generally.) For centuries, religious affiliation has served as a basis for societal segregation in The Netherlands. Genome-wide analyses based on data from The Netherlands Twin Register revealed greater levels of background parental relatedness in the religious groups than in the nonreligious groups, as expected based on cultural influences. Analyses of the phenotypic data confirmed that religiosity was protective for major depression disorder (MDD). Although inbreeding is typically associated with higher rates of disease, autozygosity (i.e., individuals possessing two copies of same ancestral gene due to inbreeding) in this sample was associated with lower rates of MDD—an effect that was due to a stratification artifact associated with religiosity rather than to inbreeding having a protective effect for MDD.

Summary

There have been tremendous advances in our understanding of the links between the social brain, mind, and behavior over the past two decades. The tools for investigating the biological mechanisms underlying social cognition, emotion, and their interactions as well as the interdisciplinary teams that wield these tools are now ripe with the promise of new discoveries. As Frith and Wolpert (2004) have noted, specifying the biological mechanisms underlying social interactions has become one of the major problems for the neurosciences to address in the 21st century.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

References

Abdellaoui, A., Jan Hottenga, J., Xiao, X., Scheet, P., Ehli, E. A., Davies, G. E., . . . Boomsma, D. I. (in press). Association between autozygosity and major depression: Stratification due to religious assortment. *Behavioral Genetics*.

Blumstein, D. T. (2010). Towards an integrative understanding of social behavior: New models and new opportunities. *Frontiers in Behavioral Neuroscience*, *4*, 1–9.

Burkett, J. P., & Young, L. J. (2012). The behavioral, anatomical, and pharmacological parallels between social attachment, love, and addiction. *Psychopharmacology*, *224*, 1–26.

Cacioppo, J. T., Amaral, D. G., Blanchard, J. J., Cameron, J. L., Carter, C. S., Crews, D., . . . Quinn, K. J. (2007). Social neuroscience: Progress and implications for mental health. *Perspectives on Psychological Science*, *2*, 99–123.

Cacioppo, J. T., & Berntson, G. G. (1992). Social psychological contributions to the decade of the brain: Doctrine of multilevel analysis. *American Psychologist*, *47*, 1019–1028.

Cacioppo, S., Frum, C., Asp, E., Weiss, R., Lewis, J. W., & Cacioppo, J. T. (2013). A quantitative meta-analysis of functional imaging studies of social rejection. *Scientific Reports*, *3*, Article 2027. doi:10.1038/srep02027

Cole, S. W., Hawkley, L. C., Arevalo, J. M. G., & Cacioppo, J. T. (2011). Transcript origin analysis identifies antigen presenting cells as primary targets of socially regulated leukocyte gene expression. *Proceedings of the National Academy of Sciences, USA*, *108*, 3080–3085.

Damasio, H., Grabowski, T., Frank, R., Galaburda, A. M., & Damasio, A. R. (1994). The return of Phineas Gage: Clues about the brain from the skull of a famous patient. *Science*, *264*, 1102–1105.

Decety, J., & Cacioppo, J. T. (2011). *The Oxford handbook of social neuroscience*. New York, NY: Oxford University Press.

Dunbar, R. (2003). Evolution of the social brain. *Science*, *302*, 1160–1161.

Frith, C. D., & Frith, U. (1999). Interacting minds—A biological basis. *Science*, *286*, 1692–1695.

Frith, C. D., & Wolpert, D. M. (2004). *The neuroscience of social interaction: Decoding, imitating, and influencing the actions of others*. New York, NY: Oxford University Press.

He, Y., Johnson, M. K., Dovidio, J. F., & McCarthy, G. (2009). The relation between race-related implicit associations and scalp-recorded neural activity evoked by faces from different races. *Social Neuroscience*, *4*, 426–442.

Insel, T. R., & Fernald, R. D. (2004). How the brain processes social information: Searching for the social brain. *Annual Review of Neuroscience*, *27*, 697–722.

Klein, S. B., & Kihlstrom, J. F. (1998). On bridging the gap between social-personality psychology and neuropsychology. *Personality and Social Psychology Review*, *2*, 228–242.

Lim, M. M., Wang, Z., Olazabal, D. E., Ren, X., Gterwilliger, E. F., & Young, L. J. (2004). Enhanced partner preference in a promiscuous species by manipulating the expression of a single gene. *Nature*, *429*, 754–757.

Ortigue, S., Bianchi-Demicheli, F., Patel, N., Frum, C., & Lewis, J. W. (2010). Neuroimaging of love: fMRI meta-analysis evidence towards new perspectives in sexual medicine. *Journal of Sexual Medicine*, *7*, 3541–3552.

Slavich, G. M., & Cole, S. W. (2013). The emerging field of human social genomics. *Clinical Psychological Science*, *1*, 331–348.

Young, L. J., & Wang, Z. (2004). The neurobiology of pair bonding. *Nature Neuroscience*, *7*, 1048–1054.