Research and Perspectives in Neurosciences

J. Decety Y. Christen (Eds.)

New Frontiers in Social Neuroscience

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Foreword

The Scope of Social Neuroscience: From Cells to Societies

Traditionally, neuroscience has considered the nervous system as an isolated entity and largely ignored influences of the social environments in which humans and many animal species live. However, there is mounting evidence that the social environment affects behavior (and vice versa) across species, from microbes to humans. Vertebrate species display a remarkable range in social organization, from living relatively asocial and territorial lives, to being socially monogamous and living as bonded pairs, to being highly gregarious and living in large social groups. There is also considerable diversity in social behavior between individuals of a given species, which can be shaped by early social relationships, neuroendocrine state, and genetic factors.

Thus, we were social before we were humans, and as neuroscience matures, it becomes increasingly apparent that the nervous system cannot be considered as an isolated entity, without consideration of the social environments in which humans and many animal species live.

Social neuroscience, the interdisciplinary field devoted to the study of the neural, hormonal, cellular, and genetic mechanisms underlying the emergent organizations beyond the individual that characterize social species, is rapidly growing (Cacioppo and Decety 2011a). This multi-level interdisciplinary endeavor is not limited to humans, even if this is what many of us are ultimately interested in. According to work in evolutionary biology and genetics, we share a lot of genes with other animals, even with simple organisms such as the worm *Caenorhabditis elegans*. Based on the whole genome sequences that have become available for diverse species, we now know that a remarkably large number of protein-coding genes are shared across all animals. Simple animals such as nematodes, flies and bees have simpler behaviors, simpler nervous systems, and often (but not always) smaller genomes, than more complex animals. Yet simple animal models can greatly inform social behavior. Further, many of the social behaviors exhibited by simple animals (e.g., courtship, mating, aggression, parenting, foraging, learning and memory) are reminiscent of

social behaviors in more complex animals (Sokolowski 2010). For example, after an inexperienced male watches two males fight, he alters his subsequent behavior accordingly, depending on whether he encounters the loser or winner (Yurkovic 2006).

Social processes influence neuro-hormonal events and neuro-hormonal processes influences social behavior. Examples of such reciprocal influences abound. In monkeys, testosterone levels promote sexual behavior in males, whereas the availability of sexually receptive females, in turn, influences testosterone levels (Bernstein et al. 1983). In a study conducted in Australia, a group of teenage male skateboarders performed two tricks – one that they could do easily, another that they often crashed on – ten times in front of a male experimenter and then repeated the process (Ronay and von Hippel 2010). A second group did the same, first in front of a male experimenter and then in front of an attractive 18-year-old female. When observed by this attractive female, the skateboarders in the second group aborted fewer of their difficult tricks. Saliva samples after the experiment indicated that the second group had higher testosterone levels than the first, suggesting that the young woman's proximity elevated the skateboarders' testosterone and that elevated testosterone may have sparked a drive to mate and demonstrate health and vigor through risk taking.

An interdisciplinary field of study that includes behavioral neuroscience, system neuroscience, behavioral ecology, and social psychology, and which seeks to understand how biological systems implement social behavior allows us to understand how the molecular and cellular mechanisms underpinning social interaction have evolved across species. In addition, non-human animal models allow investigation of neurobiological and cellular mechanisms in ways not available in humans, for obvious ethical reasons. Thus comparative research is extremely important and valuable, and there is much to be learned from sharing our knowledge and work across species and levels of analysis. For instance, homologues of oxytocin and vasopressin have existed for 700 million years and play a general role in the modulation of social behavior and reproduction. Their roles in facilitating species-typical social and reproductive behaviors are as evolutionarily conserved as their structure and expression, although the specific behaviors that they regulate are quite diverse (Donaldson and Young 2008).

Recognizing the continuity of evolution makes clear the futility of selecting any particular time period for the development of human social processing capacities like focusing on the so-called environment of evolutionary adaptedness, from 60,000 to 10,000 years ago, when supposedly humans became what they are today. This is what Marlene Zuk (2013) calls a paleofantasy. Additionally, humans are still evolving as a species. Numerous human genes have changed over just the last few thousand years – a blink of an eye, evolutionarily speaking – while others are the same as they have been for millions of years, relatively unchanged from the form we share with ancestors as distant as worms and yeast.

The 21st Fondation IPSEN *Colloque Médecine et Recherche* in the Neuroscience Series, held in Paris on April 22, 2013, focused on the current state of research of the social brain from a multi-level perspective with scholars from diverse disciplines including, evolutionary biology, anthropology, behavioral ecology,

ethology, neurobiology, developmental science, social psychology and clinical and affective neuroscience. This one-day meeting was a wonderful illustration of the range of topics that benefit from this approach. The social brain was examined in multiple species from insects to humans; on multiple levels, from genetic expression to behavior; and from multiple functions such as parental care and empathy, rescue and helping behavior, morality, leadership, deception, racial biases, and social dominance.

Finally, it is important to note that bringing the laws that link different levels of analysis – the goal of social neuroscience – is not synonymous to reducing or eliminating higher levels of analysis (Cacioppo and Decety 2011b). The constructs developed by social scientists (e.g., behavioral economists or sociologists) are valuable in relation to those of biology, but can, and need to be, informed and refined through integration with theories and methods from social neuroscience. Social neuroscience research provides genetic and molecular insights that clearly translate to investigations of social behavior in other species. It is critical that those primarily interested in explaining human behavior begin to validate their hypotheses using animal models, including the study of the behavioral impact of pharmacological modulations and brain lesions that closely mimic some of the lesions found in humans. It is also important for those primarily using animal models to understand the psychological constructs used by scientists studying human mental and behavioral processes. This will allow the former to better develop appropriate behavioral paradigms. By bridging the gap between animal and human studies, social neuroscience contributes much to our understanding of the mechanisms by which the social world (and its disorders) impacts health, life span, and cognition. The translational bridge, however, needs to be built with careful consideration of species differences, based on evolutionary adaptations. While some of the principles may be conserved (i.e. importance of receptor maps and role of gonadal steroids), the details for social organization need to be explored for each species, recognizing the importance of diversity in the neural mechanisms for social cognition (Insel 2010).

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