In Search of the Social Brain

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What are the biological underpinnings of human social behavior? Is it possible for brain research to provide the same degree of insight into human interaction that it recently has into more solitary processes like cognition and memory?

That was the subject of this year's Presidential Symposium at the APS Annual Convention, entitled "Searching for the Social Brain: The Biological Bases of Social Behavior."

To kick off the symposium, and to illustrate the idea of a "social brain," APS president Robert W. Levenson, University of California, Berkeley, showed side-by-side video clips of men with two different neurological disorders. One had a condition called frontaltemporal dementia; the video showed him conversing with his mother about a family pet. The man was reasonably articulate and intelligent — his cognitive abilities were mostly intact, in other words — but he was unresponsive and cold, missing "basic social ingredients" like empathy.

The other video clip showed a patient with advanced Alzheimer's conversing with his wife. In stark contrast to the man in the first video, this man was severely impaired cognitively, with almost no ability to remember. Yet he engaged warmly and actively with his wife, revealing that his condition had somehow left intact his ability to relate to other people.

"So, on the left, the social brain is lost," Levenson said. "On the right, it's all that remains."

The symposium's three invited speakers have approached the problem of the social brain from three very different angles — and species.

C. Sue Carter, University of Illinois at Chicago, described her work with prairie voles, a type of rodent that forms strong monogamous pair bonds. Her research has focused on the role of the brain hormone oxytocin in these animals' pair-bonding and parenting behaviors.

Oxytocin reduces fear and anxiety and produces the positive feelings people and animals get from safe interpersonal contact and touch — both in romantic situations as well as when holding and caring for infants. In her lab, Carter found that prairie voles have much more of this hormone than other rodents do, and that its levels rise in response not only to pair-bonding but also to the presence of vole pups. (In voles as in people, "you feel different when you're holding a baby," Carter noted.)

And it seems that oxytocin produces lasting changes in the brain. Handling of pups produced changes in brain cells, Carter said. Also, pups deprived of parental nurture showed less nurturing behavior or pair-bonding as adults.

"The mammalian nervous system [is] designed to work in a social environment," Carter concluded.

“Social behavior is absolutely necessary for physiological and behavioral homeostasis.”

John T. Cacioppo, University of Chicago, provided direct evidence of the relationship between social interaction and physiological well-being in humans, based on his research on loneliness.

Loneliness, not surprisingly, is bad for people’s mental health: “Lonely individuals are more likely to construe their world as threatening,” Cacioppo said. “They’re more likely to hold more negative expectations. They remember relatively negative social interactions even when the interactions are the same. … They’re also more likely to appraise stressors as threats than challenges and cope in a passive, isolative fashion.” The result is that lonely people reinforce their social isolation by withdrawing further.

Results may include depression and high stress, Cacioppo explained, as well as physical effects such as high blood pressure, arterial stiffening, and impaired sleep. The effects of loneliness can even be seen in the brain: He discussed fMRI scans revealing that the caudate nucleus, a brain area associated with reward, is more active in response to social stimulus in non-lonely people than in lonely people.

Cacioppo emphasized, however, that despite its harmful effects, loneliness actually serves an important purpose. Just as physical pain serves as a warning mechanism, and hunger motivates an individual to seek food, loneliness motivates people to seek nourishing contact with other people.

Loneliness has even been found to be heritable, according to Cacioppo — which supports the argument that it has served an evolutionary function. Without the ability to feel lonely, we would never have become social beings in the first place.

But just as oxytocin and loneliness may encourage social beings to connect, our brains also have natural brakes to ensure we don’t connect too fast with the wrong people. David G. Amaral, University of California, Davis, presented research on the role of the amygdala in modulating social encounters.

Amaral’s work involves rhesus monkeys, which, like humans, are very social. Not unlike people, they can also be violent. “A lot of their social system is actually set up to avoid an aggressive encounter,” Amaral said. This trait accounts for very human-like behavior when monkeys encounter strangers.

“When one monkey meets another monkey it’s never met before, it just looks at it. … They’ll try to figure out: Is this a friendly monkey? Is it a not-friendly monkey? And over time they get used to each other. Think about the cocktail party effect — when you’re looking for somebody that you can talk to and finally find somebody. And the monkeys ultimately adjust and then they start interacting.”

It seems that this “cocktail party” behavior is largely governed by the amygdala. Adult monkeys who had had their amygdala removed showed no hesitation in interacting with strangers, according to Amaral: “They start interacting right off the bat.” The same was true when encountering possibly threatening objects like mock snakes, indicating that the amygdala serves a protective function: “As a protection device, it inhibits behavior to allow time for evaluation.”

Humans who have lost their amygdalas due to disease may also be impaired in their ability to detect

threats and danger. Amaral discussed one such individual, a woman who functions normally in most ways but cannot detect fear in another person’s face.

All of the speakers hinted at possible future directions for research on the social brain. Both Amaral and Carter mentioned the possible light such research may shed into disorders like autism, for example.

And while the study of the social brain is still in its infancy, Cacioppo lauded the great strides made in recent years toward interdisciplinarity: Biological and social psychologists no longer necessarily see their subfields as working at cross-purposes, as they once did.