Spring 2010

EMORY | health

PATIENT CARE, RESEARCH, AND EDUCATION FROM THE **WOODRUFF HEALTH SCIENCES CENTER**

Why do voles fall in love?

And what that means for human health. 2

Yerkes researchers are merging insights about animal hormones with implications for human health.

Coupling

By Sylvia Wrobel

Monogamy—vole style

What does love—or at least monogamy—have to do with autism, schizophrenia, and other conditions with deficits in social awareness and attachment? Larry Young (left) believes his quirky little prairie voles hold some answers.

Once mating is over, fidelity does not come naturally to the vast majority of species. Even within species whose members do engage in social bonding, like humans, some individuals are better at it than others.

The popular question was, "Why do voles fall in love?" The answer, said the scientists, was that oxytocin created lifelong attachment.

In the 1990s, Young (William P. Timmie Professor of Psychiatry at Emory and chief of behavioral neuroscience at Yerkes National Primate Research Center) and Tom Insel (then director of Yerkes and now director of the National Institute of Mental Health) created a scientific and media storm when they reported that the surprisingly ubiquitous and long-lasting monogamy exhibited by a species of voles is attributable to hormones. The popular question was, "Why do voles fall in love?" The answer, said the scientists, was that oxytocin—the same hormone released during labor, delivery, and breast feeding in humans and that promotes mother-infant bonding—creates the female prairie vole's lifelong attachment to her male partner. A related hormone, vasopressin, causes the male prairie vole to cling to the female with whom he has just had sex, forsaking all others as long as they both shall live.

But the story is not so romantic for all voles. Unlike the highly social, monogamous, and shared-parenting prairie voles, meadow voles couldn't care less about past sexual partners or, for that matter, pretty much any other animal in the colony. Meadow voles are solitary and promiscuous. Males are uninvolved and seemingly unaware of their offspring.

In a finding that could have interesting implications for humans, Young next discovered that the chief difference between the two species centers on the number and location of neuroreceptors that select, bind, and respond to oxytocin and vasopressin. While both species of voles have these receptors, the prairie voles' receptors are concentrated in the brain's pleasure regions, the same regions involved in addiction. Young believes that activation of these receptors during mating leads to a kind of addiction to the partner.

A male meadow vole, on the other hand, is more likely to respond to vasopressin with territorial behavior. Unless, that is, a vasopressin receptor gene is inserted into the pleasure region of the brain. This single change converts the promiscuous meadow vole into an animal capable of forming strong social bonds, beginning with the female placed in his cage. Conversely, blocking the vasopressin receptor in a prairie vole's brain is sufficient to prevent such attachments. Hormonally and behaviorally, the once faithful prairie vole is turned into a cad.

In nature, the production of these hormones occurs in response to events like birth or sex. But remember the beauteous queen in *A Midsummer Night's Dream*, who becomes besmitten with the cloddish, donkey-headed Bottom the Weaver after she consumes a love potion designed to make her fall for the first creature she sees? When Young gives a female prairie vole a dose of oxytocin or a male a dose of vasopressin, the animal bonds on sight with the nearest potential mate, even before mating occurs.

Young believes similar processes are going on in the human brain, which also contains oxytocin and vasopressin receptors. Previous studies conducted at other institutions have shown that sniffing oxytocin (pills would not make it past the blood-brain barrier) causes the human brain to pay more attention to the fine details of social signals. Eye contact increases. Individuals become better at deciphering emotions from facial expressions and body movements, more likely to remember faces as being familiar, even more likely to trust.

One predictable response to this research was the sudden availability of pricey oxytocin sprays designed for dating, business meetings, or other situations in which a little instant bonding might come in handy. Someday, maybe, shrugs Young. What compels *him*, he says, is what these discoveries may say about autism, schizophrenia, and other disorders characterized by deficits in social engagement.

We know, he says, that variations in the gene for vasopressin can predict whether a person will be generous, altruistic—even, according to a Swedish study, more likely to marry or report satisfaction with relationships. What role might these genetic variations play in human disorders—and what could be done to compensate for them?

For example, the best treatment now available for autism is behavioral therapy focused on social stimulation. Could oxytocin help people with autism be more receptive to social interaction? Psychosis symptoms in schizophrenia can be treated, but patients often are left with social deficits, for which there is no current treatment. Could oxytocin activate the social part of the brain in these people?

Young recently took two major steps to garner more information from his hamster-sized rodents. First, he and a colleague convinced the NIH to sequence the vole genome within the next two years, a move that will accelerate the discovery of genes contributing to social function.

Second, the Yerkes collaborators developed the first transgenic voles, a technology that allows them to manipulate individual genes to understand their effect on social bonding and other complex social behaviors. Eventually, he believes the model could be used to improve social cognition.

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The next step will be to apply the discoveries made in voles to non-human primates, whose brain function is more similar to that of humans. Young already is working with other Yerkes investigators to examine the role of oxytocin and vasopressin in non-human primate social behavior.

WEB CONNECTION *To see a video on vole bonding, visit* **whsc.emory.edu/home/multimedia/videos/social-bonding-voles.html.**