CLOSE ENCOUNTERS

THE HORMONAL *Ties* THAT *Bind*

BY MARGIE PATLAK*

For a long time, the hormones oxytocin and vasopressin have been known to help govern such basic unsung functions as labor contractions, lactation, blood pressure, and urine concentration. But in recent years, these hormones have hit the social scene, being linked to a number of social behaviors, including trust, altruism, attachment, nurturing, cooperation, facial recognition, and empathy. A greater understanding of the role these neurohormones play in normal social interactions has led to the suggestion that they be used to treat social disorders such as autism, or to develop "love potions" that might improve marital counseling.

"It's clear now that these neuropeptides are involved in making our brains process social information—they tune us into the social world. It seems like every month there's a new study showing how they affect social behavior," said neurobiologist Larry Young, Ph.D., of Emory University, Ga., in an interview with ***Endocrine News.***

His research and that of others on voles is responsible, in large part, for the sexy new spin being put on oxytocin and vasopressin. Meadow voles, like more than 95% of mammalian species, are promiscuous, and males don't help raise their young. Prairie voles, in contrast, are monogamous, and both males and females are doting parents. Intrigued by the remarkably different social behaviors of these closely related species, Dr. C. Sue Carter, Ph.D., of the University of Illinois in Chicago, followed by Dr. Young, conducted a number of experiments revealing that these differences stemmed from where in the brain the animals' oxytocin or vasopressin receptors are located.

Location, Location, Location

Unlike in male meadow voles, the receptors for vasopressin or for oxytocin in prairie voles congregate densely in the portion of the brain that houses the dopamine-based reward and reinforcement system. This neuronal circuitry fosters both the euphoria and the cravings of addicts, and suggests there might be something to all those songs that view love as an addiction. Remarkably, when Dr. Young genetically manipulated male meadow voles to heighten vasopressin receptor expression in this region of the brain, the animals left their philandering ways and entered into pair bonding.

Female bonding behavior is more influenced by oxytocin than vasopressin and when, in separate experiments, Drs. Carter and Young blocked oxytocin signaling within the reward and reinforcement portion of the brain, female prairie voles not yet in pair bonds became promiscuous and never settled down with a single mate.

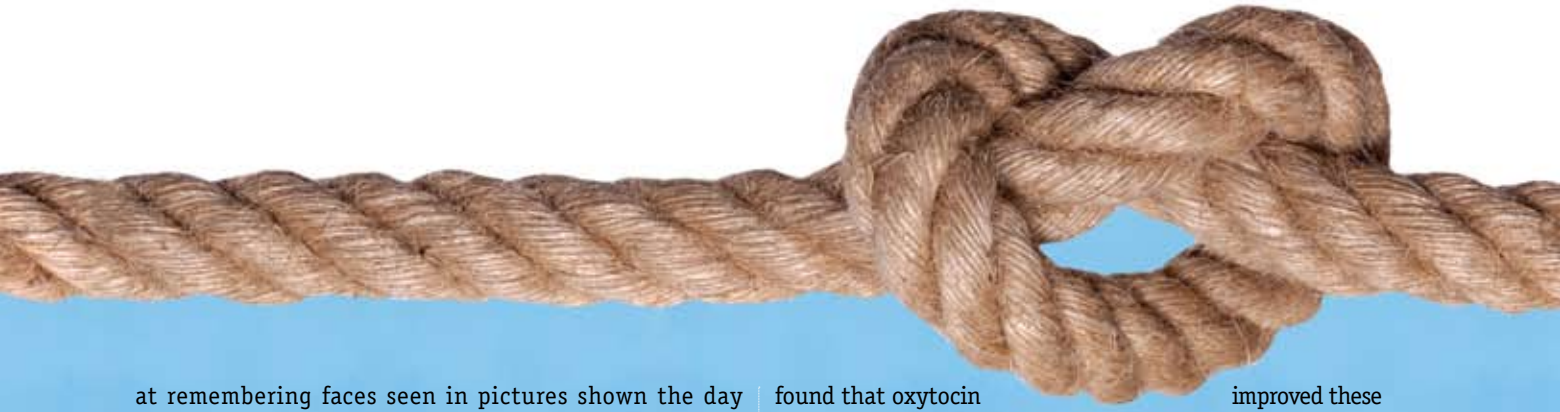
Could the same neuroendocrinology that underlies the prairie vole pair bonding also foster marital fidelity? Reinforcing this notion are recent studies that link genetic variation in vasopressin receptor expression to sexual partner attachment. Dr. Young found that a gene which influences vasopressin receptor expression in male voles also affects their pair bonding. And a Swedish study found that men with a particular variant of the human version of this receptor expression gene were twice as likely to remain unmarried, or twice as likely to have marital problems, than those without it.

Less is known about what influences women's tendencies to be loyal to their partners, but oxytocin is suspected to play a role. The stimulation of the cervix and nipples during sexual interactions has been shown to strongly trigger brain oxytocin, and Dr. Young speculates it may prime a woman to become emotionally attached to her sexual partner, as it does for other species. "I'm pretty sure these ancient systems that drive our emotions didn't suddenly change when we evolved," he said.

Motherly Love

But it's not just romantic love that these neuropeptides might affect. Oxytocin has been linked to maternal behavior in several mammalian species. The heightened release of oxytocin during labor and nursing is thought to foster mother–child bonding. Part of that bonding, at least in animals, is due to the mother being able to recognize her offspring, as well as to intuit their needs. In sheep, this recognition is mainly scent-based, so it's no surprise that researchers have shown oxytocin's effects extending to the part of the sheep's brain that processes scent signals, the olfactory bulb.

In humans, facial recognition and reading of emotions plays more of a role in bonding than scent, and oxytocin seems to affect this. When psychologist Marcus Heinrichs, Ph.D., at the University of Zurich, and his colleagues, gave men a nasal spray of oxytocin, they scored better



at remembering faces seen in pictures shown the day before than men given a placebo spray, even though both groups of men had the same recall rate for the pictures of houses, landscapes, and sculptures. In another study by the same researchers, men given an oxytocin spray were significantly better than the placebo group at correctly guessing people's emotions in pictures with only the upper portions of their faces showing.

Vasopressin receptor expression genes have also been tied to altruistic behavior in men participating in experimental political games, and an oxytocin nasal spray boosted trust and cooperation in economic experimental games. For example, Dr. Heinrichs and his colleagues showed that oxytocin made participants twice as willing to invest money with other "trustee" participants, presumably by furthering their belief that the trustees would return a large sum. By contrast, the hormonal spray did not affect how much money participants allocated to investments whose returns were determined by a random lottery. In another experiment by the Swiss researchers, an oxytocin nasal spray seemed to make participants blind to the fact that "trustees" were returning less than participants' investments. Those who received the spray continued to invest the same amounts with these trustees, whereas the control group reduced their investments when they saw diminishing returns.

Treating Autism and Other Social Disorders

If oxytocin and vasopressin foster attachment and the reading of emotions from facial expressions, then could the actions of these neuropeptides be altered in autism? This disorder is characterized by difficulties making attachments to others and picking up social cues, such as facial expressions or voice intonations. So far, there is modest evidence that oxytocin and vasopressin may play a part in autism, and some encouraging preliminary results have been seen testing oxytocin in people with autism or a milder variant called Asberger's syndrome. Psychiatrist Eric Hollander, M.D., of the Mount Sinai School of Medicine in New York, found that oxytocin improved these patients' ability to detect emotions, such as anger, sadness, or happiness, embedded in people's tone of voice. A placebo did not cause such improvement.

Other applications may be close at hand, such as in marital therapy. Dr. Heinrichs' team recently showed that couples given an oxytocin spray prior to discussing a conflict in their relationship had more positive communication and reduced cortisol levels (a stress indicator that oxytocin is thought to stem) than those who received a placebo spray. Australian researchers are currently testing whether an oxytocin spray boosts the success rate of marital therapy.

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Anti-Abuse

Oxytocin may even have a role in repairing the psychological damage of neglect during childhood. Studies find that people who experienced emotional trauma early in life have abnormal oxytocin responses to social situations or lower than normal levels of the neurohormone in their brains. As both Drs. Heinrichs and Young point out, oxytocin might make therapy more effective for these individuals and others with social phobias by making them more trusting of the therapist and receptive to the therapy. Dr. Heinrichs told ***Endocrine News*** that he's "very optimistic" about the usefulness of combining oxytocin treatment with behavior therapy to create innovative "psychobiological" therapy, and is currently testing the approach in his clinical studies. He said this is an outcome that nobody expected when oxytocin and vasopressin were first isolated. Dr. Young added, "This is an area of future study that could have a huge impact on mental health." ■

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For further reading:

1. Donaldson AR, Young LJ. Oxytocin, vasopressin, and the neurogenetics of sociality. *Science,* 2008;322: 900–904.
2. Heinrichs M, Domes G. Neuropeptides and social behaviour: effects of oxytocin and vasopressin in humans. *Prog Brain Res,* 2008;170:337–350.