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Mohamed Kabbaj

LOVE AT THE MOLECULAR LEVEL

BY JULIE JORDAN

Ever wonder what might be going on beneath the surface as you cuddle with a loved one, spend quality time together and develop deeper intimacy? Why do you continue to desire time together during your time apart? The answer may be more than just attraction and warm feelings.

According to College of Medicine researcher Mohamed Kabbaj, the answer involves a change in genetic makeup. Without altering actual DNA, gene expression changes during this time of relationship development for one animal in particular – and potentially for humans as well.

The animal Kabbaj and his team chose to focus on was the prairie vole. This small mammal looks similar to a hamster, but don't let this image of a child's pet fool you. Socially, prairie voles behave very similarly to humans.

When random partners of the opposite sex spend time together, prairie voles begin to become socially attached to each other. After consummating the relationship, they stay together for life as a couple. They are not only physically monogamous but socially monogamous. In some cases, even after death, the widowed animal will not develop this social bond again.

Humans develop similar attachments, sometimes resulting in the same commitment, but exactly how similar are we to this little creature?

"I think the particular thing about prairie voles is when they mate and spend time together, they develop social bonding for life," said Kabbaj, who recently published his latest social attachment findings in *Nature Neuroscience*. "This social monogamy produces aggression toward intruders, including those of the opposite sex, and shared parental care activities. Some cheat occasionally, like humans, but they always go back home to their mate. That's what makes them unique to study."

As a result of these behaviors, prairie voles are a common model for making educated guesses about what may be going on biologically for humans when social attachments form.

"It's important to understand social attachment and the mechanism behind social attachment, even in these creatures, because they help us understand ourselves," said Kabbaj, a professor in the Department of Biomedical Sciences.

And for humans, the benefits of a close, committed relationship are numerous.

"In humans, it has been shown that this social attachment – the formation of this strong couple, a healthy couple – leads to an increase in life expectancy, a reduction in psychological disorders, a stronger immune system and a stronger cardiovascular system," said Kabbaj.

Those without such close, healthy relationships and attachments, or those who struggle to form them, such as autistic children, may not reap such benefits.

Until Kabbaj published his findings, the genetic mechanism behind these close, socially monogamous relationships in prairie voles was unknown. He and his team have shown the "epigenetic" basis for the formation of this behavior in prairie voles – findings that may be helpful during clinical trials and in treating humans later.

"Epigenetics is everything that can change gene expression without changing the structure of DNA itself," said Kabbaj.

Changes in our environment, such as stress and diet, or major life events, such as puberty and pregnancy, can all increase or decrease the expression of different genes, potentially altering us permanently. Epigenetics is what causes these changes.

With prairie voles, it is mating and quality time with the partner that changes their gene expression to facilitate social bonding and a preference for the partner. This is what Kabbaj calls "partner preference formation," and the basis for it is biological.

Think of everything that makes you feel happy. Then imagine a place in your brain that controls this emotion. This is the pleasure center of the brain. It is where reward and social attachment are controlled. Genes here can be expressed more fully or silenced, depending on epigenetic changes.

Kabbaj and his team set out to discover the epigenetic basis for the permanent change in prairie voles after they mate and become socially monogamous for life.

In their experiment, Kabbaj and his lab allowed random vole partners to cohabit for six hours without mating. Then they administered a drug to the females that loosens chromatin around DNA in the pleasure center of the voles' brains.

After this, they saw an increase in expression of the pleasure-related genes. The females then chose between their cohabitation partners and a stranger.

Kabbaj's findings showed that the females consistently chose their cohabitation partners as a result of the cohabitation time and the drug. They also huddled, the human equivalent of snuggling, with their partner for up to three hours after the drug was administered.

This was the first experiment to show epigenetic mechanisms at work in partner preference.

Does this mean that individuals who spend quality time together and take the same drug will develop a stronger social attachment?

"People are using the drug we used in our experiment already to treat depression, epilepsy and cancer," said Kabbaj. "Clinical trials to determine whether it will increase social attachment are needed. Hopefully, if we can give it to autistic kids, for example, we can determine whether it helps strengthen social attachment in humans. The potential is there."

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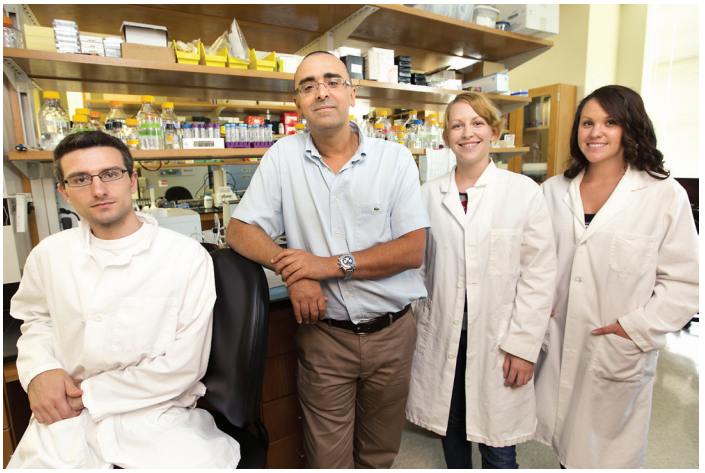
Imagine a boy who makes little or no eye contact and lacks interest in peer relationships who is diagnosed with autism. Imagine the boy grown up with minimal feelings of attachment toward loved ones. Now imagine the healing effects of increased social bonding and love that could improve his quality of life and overall health. Kabbaj's study points to this potential.

"The prairie vole model has been used as a model for love," said Kabbaj. "These animals show a strong bond when you see them huddling together. I cannot prove that they love each other, but at least at the molecular level, you can see it."



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Mohamed Kabbaj with his research team (from left): Florian Duclot, Katherine Wright and graduate student Amanda Dossat.