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Nature's philanderers

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Could chemistry be at the heart of sexual wanderings? Or of sexual devotion? Though the idea certainly lacks romantic appeal, there are signs which point in this direction. The neuropeptide vasopressin is not a newcomer to research on animal social behaviour. However, narrowing one of its roles down to what scientists coolly term 'social cohesion', and Christians call 'infidelity', is a breakthrough, and deserves some thought. It is not so much the quantity of vasopressin but the tissue distribution of its receptor – in males - which seems to have a role in defining flirt or faithfulness.

Monogamy in the animal world is not common. And examples are few. Amongst them the California mouse, the marmoset monkey and certain species of voles. In fact, only five percent of mammals stick to their mates. The ongoing theory is that most males tend to mate with more than one female, not in the pursuit of pleasure but in the pursuit of producing offspring with the same genetic build up as themselves. Physiologically speaking, sperm is cheap so males can afford to spread their wares in this manner.

Microtus montanus, the furry flirt

Courtesy of Daniell Odell

Where do humans stand? From a purely biological point of view, humans are no different from the other 95% of non-monogamous mammals. As an illustration, monogamous species are monomorphic, i.e. males and females are the same size. Humans are dimorphic: men, on the whole, are larger than women. Monogamy – or polygamy – in human societies today is really set on human beliefs. Monogamy probably became popular in our parts of the world by way of the Roman Catholics in the 11^{th} century. In those days, it was common for priests to have more than one wife, or even mistress. However, if they had a son, he could inherit church property. So sons were declared illegitimate. The next step was to ban marriage for priests altogether. And, accordingly, celibacy became a standard of spirituality. Monogamy was all right for the spiritually inferior; infidelity was not to be heard of.

The knowledge that vasopressin has a role in male social behaviour – such as communication, aggression, sexual commitment and paternal care of offspring – is not new. The idea had already been emitted in the 1960s following research on rats and mice. Vasopressin was administered into various tissues of the rodents, and modulations in their behaviour were observed. More recently, the same kinds of test were carried out on various species of voles: the monogamous prairie voles (*Microtus ochrogaster*) and their promiscuous relatives, the non-monogamous meadow vole (*Microtus pennsylvanicus*). When vasopressin antagonists were administered to male prairie voles, they turned into little furry philanderers, happily mating with many females. However, when vasopressin was administered to male meadow voles, it had no effect whatsoever on their mating habits.

What made the difference? The number of vasopressin receptors. Prairie voles bear far more vasopressin receptors in their ventral forebrains than their meadow vole homologues. When voles – or any mammal including humans – mate, they release vasopressin in the forebrain, which then binds to its receptors. The forebrain happens to be very close to what is known as the 'reward centre'. And what vasopressin ultimately triggers off is the feeling that mating is agreeable. But this is not enough to remain faithful – in order to be loyal, a vole must also remember who its partner is... So, besides behaviour, vasopressin also has a role in social recognition and memory. The vole cue for recognition is probably olfactory. As a result, the feeling of something nice coupled to recognising its partner leads the prairie vole to a form of fidelity.

Meadow voles also have vasopressin receptors in their forebrains – but not so many as their prairie counterparts. To prove the fidelity theory, the vasopressin receptor gene was introduced into the forebrains of young meadow voles. And yes, the meadow voles lost all wish to flirt. Once they had mated with one female, no other female could lead them astray.

Why is it that prairie voles have more receptors in their forebrain than meadow voles? As a species, they are very close; their vasopressin receptor sequences are also 99% identical. The flanking sequences on the vasopressin receptor genes differ however, and it is these flanking sequences that determine the tissue distribution of the receptors. These particular sequences are comparable within a species but vary between species. Hence, differences in the flanking regions could echo differences in social behaviour between individuals as well as between species.

So, does the way we behave depend solely on a bunch of hormones? Can the act of adultery be waved off on the basis of chemistry? Discussing promiscuousness is not the issue here. What is interesting is that the distribution of vasopressin receptors could have a role in the variability of human social behaviour. Vasopressin distribution could explain, in part, light differences in social behaviour between people but also more extreme dysfunctions such as autism where individuals have great difficulty in forming social bonds. Humans are not voles though and an individual's ways cannot be reduced to a single gene. Social conduct involves highly complex biological pathways which themselves interact with an individual's particular past and present environment. And let us hope that we have our own say in all this as well.

Cross-references to Swiss-Prot

Vasopressin V1a receptor, *Microtus montanus* (Montane vole) : Q9WTV8
Vasopressin V1a receptor, *Microtus ochrogaster* (Prairie vole) : Q9WTV9

References

1. Lim M.M., Wang Z., Olazabal D.E., Ren X., Terwilliger E.F., Young L.J.
   Enhanced partner preference in a promiscuous species by manipulating the expression of a single gene
   Nature 429:754-757(2004)
   PMID: 15201909

2. Lim M.M., Hammock E.A.D., Young L.J.
   The role of vasopressin in the genetic and neural regulation of monogamy
   J. Neuroendocrinol. 16:325-332(2004)
   PMID: 15089970

3. Balaban E.
   Why voles stick together
   Nature 429:711-712(2004)
   PMID: 15201896