

The ties that bind

Attachment: the nature of the bonds between humans are becoming accessible to scientific investigation.

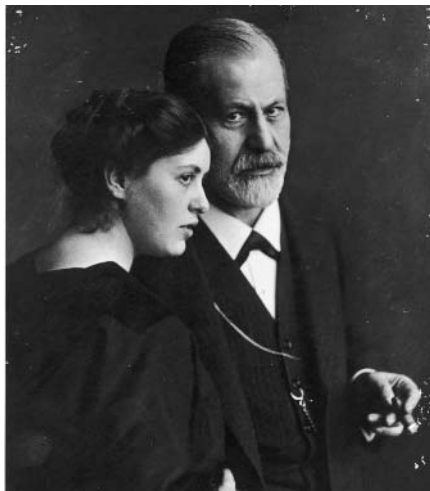
Melvin Konner

Attachment is the name we give to bonds between people. It has been central to song and story since the dawn of human time, but has only recently become a subject of scientific study. Sigmund Freud had much to say about how the mind handles it, but conceded that “our provisional ideas in psychology will someday be based on an organic substructure”. Today, we have glimmerings of that substructure.

John Bowlby emphasized the most basic attachment, that of an infant toward its primary caregiver. Bowlby’s model of attachment was informed by evolution — eons of selection had pressed mothers and infants into each others’ arms. The notion shared by Freud and B. F. Skinner (otherwise sworn enemies) — that infants became attached through reinforcement of their hunger drive — had failed decisively. Harry Harlow demonstrated that “love in infant monkeys” transcended such simplicities when a wire-mesh surrogate mother supplying delicious milk lost out in the battle for infant attachment to another inanimate surrogate providing only warmth and contact comfort. From this and other observations, Bowlby reasoned that attachment was something built into infants and was programmed to unfold on a predetermined schedule. Anthropological evidence supports the general model. In all cultures, attachment behaviours — such as turning and clinging to the primary caregiver in distress and privileging that person by preferentially quieting the distress — becomes very strong in the second half-year of life.

It is probably not a coincidence that in the brain, major pathways of the limbic system become coated with myelin during this phase of infancy. This improves the function of the subcortical circuits that process emotion and their connections to the frontal and cingulate cortex. Although there is no direct evidence, it is reasonable to hypothesize that this facilitates the infant’s side of the bond.

For the other half of the relationship, oxytocin is vital in many non-human mammals. This peptide hormone, also involved in milk let-down and uterine contractions, causes mothers to retrieve and respond normally to infants. Oxytocin knockout mice develop a strange social amnesia. And vole species with strong maternal behaviour have a different and denser distribution of oxytocin receptors in the brain than closely related species where maternal behaviour is weaker.



Fatherly feelings: Freud and his daughter Sophie.

Sue Carter has shown that this brain pattern is also associated with other forms of affiliative behaviour, not just in the maternal realm.

But getting males attached to infants — or their mates — involves a different hormone, as Thomas Insel has shown. Vasopressin is well known to physiologists as being crucial for fluid balance. Like oxytocin, vasopressin is a brain neurotransmitter. Both evolved by one amino-acid substitution from the hormone vasotocin, which in reptiles such as the sea turtle plays a role in nest-building and egg-laying. The much more complicated parental behaviour of mammals required a more refined system.

Male prairie voles are paternal and pair-bonding, whereas montane voles have multiple-mating males that leave the care of the young to the females. The dedication of the prairie voles is due to vasopressin receptors that are distributed strategically throughout the male brain — especially the V1a receptor. On page 754 of this issue, Miranda Lim and colleagues in Larry Young’s laboratory have built on Carter and Insel’s work. Meadow voles are normally promiscuous, but one gene can change all that. Introducing the prairie vole V1a in a viral vector delivered to the fore-brain makes male meadow voles mate for life. As in prairie voles, these genetically modified meadow voles have dopaminergic reward circuits activated by vasopressin — this could mean they not only commit, but like it. This idea is discussed in more detail by Evan Balaban on page 711. We do not yet know if a similar system helps explain male attachment in non-human primates, much less humans, but a medicine that might someday be offered to certain men is an interesting prospect.

We are a long way from a commitment pill, but perhaps closer to a neurology of romance. Recent studies have identified the anterior cingulate cortex, the insula and the caudate nucleus as unusually active in head-over-heels subjects, who also have a low density of serotonin transporters in blood platelets. (Perhaps unsurprisingly, measures for obsessive-compulsive patients looked a lot like the besotted lovers serotonin-wise.)

There are many questions. What happens if romantic fancy becomes long-term commitment? Do oxytocin and vasopressin, those neurochemical workhorses of prairie vole bonding, take over in humans too? Parents and infants may fall in love with each other, but are they using the same circuits as grown-up star-crossed lovers? When people ‘learn to love each other’ after arranged marriages — most since the world began have been in that category — do they look, neurologically, like the quietly loving bond that once began in a burst of romantic delirium?

Some questions are more pragmatic. New large-scale studies from the United States suggest that lower-quality day care may alter infant attachment and cortisol patterns. Does this effect bode ill for the person the infant will become, or is this just a different path on the way to adapted adulthood? At the other end of the spectrum, severely deprived infants — Romanian orphans, for example — sometimes have a syndrome called ‘reactive attachment disorder’, which entails abnormalities in later relationships. Perhaps brain imaging and neuropharmacology will yield treatments for such disorders, and may even help with autism-spectrum syndromes. However amorphous attachment may seem to a physicist, it is one of the most important determinants of human well-being, and we would do well to bring it into scientific focus. ■

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FURTHER READING

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