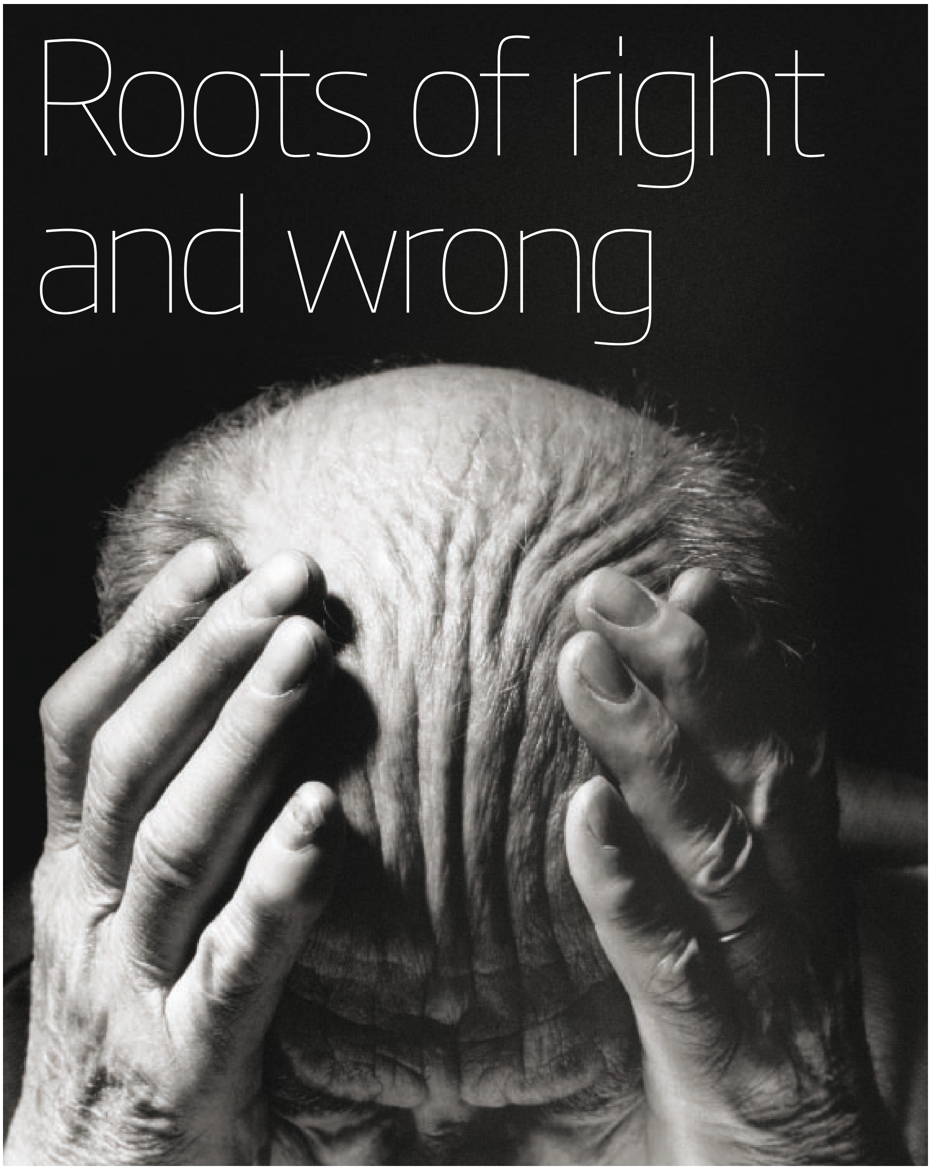
Roots of right and wrong



BENNY DE GROVE/IMAGE BANK/GETTY

We are figuring out how the brain and its chemicals give rise to social values, says Patricia Churchland

WHERE do moral values come from? Not from Plato's heaven, nor from any other. Aristotle, Confucius and Darwin all recognised valuing as a basic function of biological creatures generally, and moral valuing as a basic function of highly social and intelligent animals like humans. Until very recently, however, science could not explain how brains, built by gene networks interacting with the environment, give rise to morality.

Natural selection being what it is, caring for others must serve the fitness of the animals involved. Evolutionary biologists have developed models to show how this might work, but it is only now that neuroscientists are catching the first glimpses of how altruistic behaviour happens in the brain.

Morality seems to be shaped by four interlocking brain processes: caring, rooted in attachment to and nurture of offspring; recognition of others' psychological states, bringing the benefit of predicting their behaviour; problem-solving in a social context, such as how to distribute scarce goods or defend the clan; and social learning, by positive and negative reinforcement, imitation, conditioning and analogy. These factors result in the emergence of a conscience: a set of socially sanctioned responses to prototypical circumstances.

Social values, real as they are, depend on an evolutionary modification of the neural circuitry involved in basic survival. In all vertebrates, brain-stem circuitry keeps crucial parameters such as temperature and carbon dioxide and glucose levels within the right range. In order to maintain this homeostasis, the brain deploys motivations such as pain, hunger, thirst and fear, as well the complementary pleasures of food, water, sex and safety.

As the mammalian brain evolved, the homeostasis network enabling "me" to survive expanded its scope to embrace "mine", at first meaning one's own helpless offspring. Pain and anxiety responses were triggered by

"These four interlocking brain processes result in the emergence of a conscience"

separation or perceived need; pleasure and comfort came with being suckled, licked and cuddled. In some species, additional adjustments in attachment circuitry widened the circle to include mates, kin and others in the group, depending on selection pressures.

At the hub of the neural circuitry of attachment are ancient peptides: oxytocin and its sibling, vasopressin. Along with other reproductive hormones and neurotransmitters, these peptides organise the circuitry in the hypothalamus, the part of the brain stem involved in attachment to "mine". Though much remains to be discovered, vasopressin seems to be related more to aggressive care, such as defence, while oxytocin dampens fear and anxiety, which feels good and is associated with trust.

The neocortex – the six-layered mantle covering the brain's hemispheres – is unique to mammals. The high cost of mammalian dependency at birth is offset by the singular advantages of new forms of learning made possible by the neocortex. In primates, the neocortex appears to be responsible for an enhanced capacity to predict others' behaviour. It also enables more abstract learning and problem-solving, as well enhanced flexibility in impulse control and social skills. These skills paved the way for the emergence of cultural institutions such as trade practices, criminal justice systems and religions – all of which served to regulate trust among non-kin and allow for a wider range of trusting relationships than isolated hunter-gathering groups could offer. In short, the brain's regulation of attachment and bonding is what makes us want to be together, to care for one another, and to value our family, friends and community. The interplay of our neural and cultural institutions comprises our moral history. ■

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Would knowing the neural basis of murder make it any less wrong?

KAREN MOSKOWITZ/GETTY/STONE

My brain made me do it

Understanding how morality is linked to brain function will require us to rethink our justice system, says Martha J. Farah

AS SCIENCE exposes the gears and sprockets of moral cognition, how will it affect our laws and ethical norms?

We have long known that moral character is related to brain function. One remarkable demonstration of this was provided by Phineas Gage, a 19th-century construction foreman injured in an explosion. After a large iron rod was blown through his head, destroying bits of his prefrontal cortex, Gage was transformed from a conscientious, dependable worker to a selfish and erratic character, described by some as antisocial.

Recent research has shown that psychopaths, who behave antisocially and without remorse, differ from the rest of us in several brain regions associated with self-control and moral cognition (*Behavioral Sciences and the Law*, vol 26, p 7). Even psychologically normal people who merely score higher in psychopathic traits show distinctive differences in their patterns of brain activation when contemplating moral decisions (*Molecular Psychiatry*, vol 14, p 5).

The idea that moral behaviour is dependent on brain function presents a challenge to our usual ways of thinking about moral responsibility. A remorseless murderer is unlikely to win much sympathy, but show us that his cold-blooded cruelty is a neuropsychological impairment and we are apt to hold him less responsible for his actions. Presumably for this reason, fMRI evidence was introduced by the defence in a recent murder trial to show that the perpetrator had differences in various brain regions which they argued reduced his culpability. Indeed, neuroscientific evidence has been found to exert a powerful influence over decisions by judges and juries to find defendants "not guilty by reason of insanity" (*Behavioral Sciences and the Law*, vol 26, p 85).

Outside the courtroom, people tend to judge the behaviour of others less harshly when it is explained in light of physiological, rather than psychological processes (*Ethics and Behavior*, vol 15, p 139). This is as true for serious moral transgressions, like killing, as for behaviours that are merely socially undesirable, like overeating. The decreased moral stigma surrounding drug addiction is undoubtedly due in part to our emerging view of addiction as a brain disease.

What about our own actions? Might an awareness of the neural causes of behaviour influence our own behaviour? Perhaps so. In a 2008 study, researchers asked subjects to read a passage on the incompatibility of free will and neuroscience from Francis Crick's book *The Astonishing Hypothesis* (Simon and Schuster, 1995). This included the statement, "'You', your joys and your sorrows, your memories and your ambitions, your sense of personal identity and free will, are in fact no more than the behaviour of a vast assembly of nerve cells and their associated molecules." The researchers found that these people were then more likely to cheat on a computerised test than those who had read an unrelated passage (*Psychological Science*, vol 19, p 49).

So will the field of moral neuroscience change our laws, ethics and mores? The growing use of brain scans in courtrooms, societal precedents like the destigmatisation of addiction, and studies like those described above seem to say the answer is yes. And this makes sense. For laws and mores to persist, they must accord with our understanding of behaviour. For example, we know that young children have limited moral understanding and self-control, so we do not hold them criminally accountable for their behaviour. To the extent that neuroscience changes our understanding of human behaviour – and misbehaviour – it seems destined to alter society's standards of morality. ■

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