GOOD TO THE BONE

Is there a biological basis to morality? **Marcello Costa** takes a closer look at free will and our sense of ethics, altruism and cooperation, and finds why we do good.

What is right and what is wrong, or in a more colloquial way, what is good and what is bad? This is what morality is about.

Until recently, it was widely held that morality is a unique human gift that results from the uniqueness of human free will and that divides us sharply from animals. Has anything changed to justify modifying this strongly held belief?

Increasing knowledge of the brain and mind begins to reveal some hints of just how humans are both driven by similar biological processes as any mammalian species and yet have a high sense of being in control of their own behaviour. The reconciliation between hard biology and a humanistic perspective of humans is underway, removing the subject of morality from the sole territory of lawmakers and moral activists.

Without entering into exceedingly deep philosophical arguments, morality is said to be a "system for defining rules for judging the behaviour of individuals in a society". The major argument is whether such rules are the result of absolute values, that transcend nature and, although indecipherable, must be obeyed inexorably, or they are part of a natural value system that emerged during evolution. Humans like to believe they are special, that they can escape the mundane constraints of physical life.

The uncertainty of how to deal with the apparent paradox of being part of nature, with its apparently rigid laws, and yet of feeling that we have a special, unique "free will", generates significant anxiety amongst those preoccupied with human behaviour. Are we free or determined by our genes? This question appears most often in the media. Are we responsible for our actions or can we find justification in our genes for anything we do? Do we have free will or are we determined by blind rules? We may not have the answer to this question put as a simple dichotomy, but we must look for changes of perspectives that enable apparent incompatible points of view to come together under a broader view.

Exploring the biological roots of moral behaviour is no longer regarded by most as a threat to society (see Arnhart, 1998; Katz, 2000). Darwin thought that if altruism benefited the species or the group in which an individual lived, it would tend to be favoured by natural selection. Tribes, in which people were prepared to help one another or sacrifice themselves for the common good, would be more cohesive and thus more successful than other tribes. Getting along with others seems to be an evolutionary advantage. As a result, social skills are well embedded in neural circuits of the brain.

Knowledge that has accrued over the past centuries compels us to accept that our decisions may not be always as free as we would like them to be, but also that we do hold significant power to decide on most of our actions. Far from showing that humans are simple beasts incapable of intentional "moral" control, acting just as machines or simply guided by the selfish principle to maximise their own individual advantage, evolutionary biology reveals how intentionality, altruism and cooperation, with associated mutual accountability, are well-grounded in our biological makeup and are indeed essential for our survival. Morality begins to be seen as a natural phenomenon based on empathy and cooperation that is one of the natural ways to improve human condition. Even religion can be seen as a human evolutionary advance (see Dennett 2006). Not surprisingly advances in neuroscience, particularly after the "decade of the brain" of the nineties, enable us to tackle all aspects of the "social brain".

ARE PARTS OF THE BRAIN DEDICATED TO MORALITY?

What is the role of the brain in morality? If we accept a simple definition of morality as "a system for defining rules for judging the behaviour of individuals in a society" then is not surprising that the part of the brain involved in social interactions is called the "social brain"(see Cacioppo et al, 2005). We, as most high vertebrates, live in communities and these are fundamentally based on cooperation. Cooperation must have evolved as a good survival trait in higher mammals. Our brains are indeed well adapted to dealing with personal exchange: monitoring and reaching optimal levels of cooperation within reasonably small groups.

The ability to recognise other individuals and to "read" emotional states, whether amicable or hostile, and beliefs, is regarded as one of the hallmarks of human evolution from animal to human society. With this novel capability, a greater degree of mutual interactions become possible, including reading intentions and evaluating the desirability of certain behaviours before they are enacted.

De Waal (2002), working with nonhuman primates, suggests that social animals have evolved to inhibit actions that disrupt group harmony and to balance private interests with peaceful coexistence. In his view the evolution of morality can be explained in terms of individual and kin selection. They argue that it is hard to imagine human morality based on cooperation without major natural tendencies and capacities already present in other animal species, namely empathy, social rules, expectation of some sort of justice and punishment.

It is interesting that in trying to establish what would be the minimal requirements for evolution of co-operative behaviour in a game simulation, a simple model with very few rules was discovered during a worldwide computer competition. The winning strategy in 1981 was "Tit for Tat" and ever since then it has grown in stature to where it now dominates thinking about the evolution of co-operative behaviour in animal and human societies. The most recent version involves just two rules: on the first move co-operate; on each succeeding move do what your opponent did the previous move. Thus, Tit for Tat was a strategy of co-operation based on reciprocity (A feature, "Tit for tat", by C. Meredith was shown on the ABC in 1998.) Is our brain wired in this way?

The primary origin of moral instincts may indeed be the dynamic relation between cooperation and defection like in the model Tit for Tat. In the course of evolutionary history, genes predisposing people toward cooperative behaviour would have come to predominate in the human population as a whole because of the advantages given to the individuals within that group. Indeed, the heritability of moral aptitude adds the abundant evidence of history that co-operative individuals generally survive longer and leave more offspring. Special circuits for cooperation would then be present in our brains. McCabe and collaborators (2001) found that one area in the frontal lobes (anterior paracingulate cortex) is activated during cooperative behaviour, which the authors suggest "requires the ability to infer each other's mental states to form shared expectations over mutual gains and make cooperative choices that realise these gains".

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Reading other people's minds is at the core of ongoing neuroscience research, involved in the fascinating and challenging issue of answering just how do we know that behind the eyes of another person there is a thinking being like us? Brain imaging suggests that a network of areas, linking with the medial prefrontal cortex, forms the neural circuits of "mentalising", of becoming aware of oneself and another person's mental state. This involves self-monitoring (medial prefrontal areas) while awareness of self-intentional plans involves the temporal regions of the cortex (Frith and Frith, 2001).

The first move of the game Tit for Tat - to cooperate - suggests trust and empathy, both based in evolutionary terms on the strong parent-offspring bonding in mammals, which is robustly wired in brain circuits and then probably extended to other human interactions (see my article on the role of trust in economic transactions, Fast Thinking, Autumn 2006) and to feel sympathy for the distress of others.

The degree of sympathy and trust we feel for others is highly associated with our responses to facial expressions. These are detected by the same emotional centres involved in fear and aggression. Lesion and brain imaging studies in humans have demonstrated that amygdala, an almond-shaped structure within the brain, participates in recognising emotional facial expressions. Its role in human social behaviour has been shown by neuroscientist Antonio Damasio and his collaborators to be required for accurate social judgments of other individuals on the basis of their facial appearance.

They asked three subjects, with complete damage of the amygdala, to judge faces of unfamiliar people with respect to two attributes important in real-life social encounters: approachability and trustworthiness. All three subjects judged unfamiliar individuals to be more approachable and more trustworthy than did normal subjects. The impairment in judging was most striking for faces to which normal subjects assign the most negative ratings: unapproachable and untrustworthy-looking individuals (Bechara et al 1997; Damasio 1996). These experiments point to a role of specific parts of the "emotional brain" in judging how to approach other people.

The second advantageous move of Tit for Tat - to imitate the opponent - reminds us of the unique imitative ability higher animals possess. The remarkable discovery made just over a decade ago by Giacomo Rizzolati and his colleagues at the University of Parma marked the shift of studies of the social brain from psychology to neuroscience (Gallese et al 2004). These investigators discovered that some nerve cells in the frontal lobes of monkeys not only were active when the monkey performed a particular action, but also when they observed another monkey performing that same action. Since then, these nerve cells have been called "mirror neurons" and are regarded as the bases for imitation and also for social empathy. Since the discovery in monkeys, neural activity that mirrors not only movement but also sensations, emotions and intentions has been found in the human brain. If you get a sense of sympathy for somebody with a toothache, it is because the scene excites the same neurons as when you are in pain.

Abnormalities in this mirror system may well be at the base of autism and other disorders with an impaired ability to understand the behaviour of others. It is likely that mirror neural systems also underpin abilities to learn language and tasks involving complex manual dexterity such as playing music. Extension of such mirror activity is also likely to be involved in correctly predicting sequences of others' actions in particular contexts (Miller 2005).

From an analysis of the three million choices made in a second competition of Tit for Tat, four features emerged as winning strategy: never be the first to defect; retaliate only after your partner has defected; be prepared to forgive after carrying out just one act of retaliation; and finally adopt this strategy only if you are familiar with the same player. It is interesting that these "rules" appear to be those that actually ensure good coexistence and success in human societies.

CHEATING, PUNISHMENT AND REWARD

Recent models of the evolution of collective action have focused on the role of punishment (Boyd et al 2003). These models show that a willingness to contribute to the public good can be evolutionarily stable as long as free riders are punished, along with those who refuse to punish free riders. Matt Ridley (1997) suggests that humans are hard wired not for logic but to detect injustices. Robin Dunbar (1996) even proposes that finding cheats is behind the emergence of language as a substitute for grooming. Evolutionary psychologist Leda Cosmides and collaborators (2005) maintain that humans have evolved special skills to reason about social situations and in particular to detect cheaters. Her team showed that this ability is well maintained across different cultures. It is interesting that deception, persuasion and trading all require understanding of "false beliefs". This ability appears in around 4 year olds while "pretence" appears around 18 months. Autistic children may not be able to lie or pretend.

Some psychologists argue that social rejection might be encoded in our brain as pain.

Retaliation and punishing violators of rules within a society are certainly present in all human cultures and well-embedded in our brain circuits, probably dating from an early evolution of aggression for survival. Primitive parts of the brain (including the amygdala) have been well documented to underlie rage and aggression. The forgiveness mentioned in the model Tit for Tat may well correspond to the reconciliatory behaviour that evolved with higher apes. Nonhuman primates adjust submissive and reconciliation behaviours in response to population density. Chimpanzees housed in small indoor cages in the winter have higher rates of submission and lower rates of aggression than they do in a much larger outside facility where they live in the summer.

Primates appeared to be sensitive to potential problems of greater density and increased the expression of friendly and reconciliation behaviours. It is probable that excessive density may well trigger greater aggressiveness.

Mutual tolerance emerges thus as part of the "social brain" and is associated with social features such as peacemaking, avoiding conflict, negotiation and trading. It is interesting that social exclusion (ostracism, religious excommunication, jailing, etc) is a very powerful way of punishing violators of social rules. The associated punitive sentiment is perhaps an anti-free rider psychological device (Cosmides et al 2005). Some evolutionary psychologists argue that social rejection might be encoded in our brain as pain because those who are motivated to maintain group relations would be more likely to survive. Therefore pain and suffering associated with social rejection may be a response of individuals which is evolutionarily advantageous for the group.

Similarly, rewards for socially acceptable behaviour may have also evolved into special brain circuits. Primate studies suggest that one area, called nucleus accumbens, shows neural activity as monkeys anticipate making a response for a reward, but other special areas in the frontal cortex subsequently become active after the monkey has responded and receives the reward (Schultz et al, 2000).

Is it possible then to apply neuroscience to the law? Is it possible to catch a thief? To read the mind of a criminal? The promise of a future role of neuroscience in the law, with its challenges and dangers, is for another story. ■

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