

Reward and punishment: the goals that dictate how we feel

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Emotions are obviously central to human existence - they lie at the root of societal behaviour, civilisation, our moral systems and even the ways in which we conceptualise and understand the world around us.

Naturally, the topic of emotion has been studied from many points of view - from anthropology to zoology, and a whole lot in between. Yet, what is emotion? In the sense that we use the word these days, it first entered the language as late as the 17th century. Though we all know or profess to know what it is, emotion is difficult to define in a precise, scientific sense.

Partially because of this difficulty in an objective definition of even the concept, and also its elusive nature, neuroscientists, until recently, have not regarded emotion as an acceptable topic to study.

Among those who study the subject, the careful ones, at least when speaking scientifically, talk of studying specific behaviours (for example, fear conditioning) rather than an ill-defined, broad category of "emotion". Very different brain areas, neuropharmacologies and neural circuitry are involved in the diverse range of brain states that we put under the single linguistic category of emotion. However far-fetched it might seem, the possibility does exist that from a neuroscientific point of view, a unifying concept such as emotion might not even be valid.

All this makes writing about emotions in a scientific sense, let alone explaining them, a rather daunting task. Edmund Rolls, professor of psychology at Oxford University, has admirably attempted just such a task in *Emotions Explained*, a book in the Oxford University Press series in Affective Science. Rolls does a thorough, competent job, following up his previous book *The Brain and Emotion* with a significantly broader analysis of the topic, particularly emphasising evolutionary processes concerning emotion. He also presents us with a Darwinian theory of the adaptive value of emotion. The book is a rich tutorial that discusses, in considerable detail and depth, the neurophysiological, neuropsychological, behavioural, neuroanatomical and computational modelling studies that bear on emotion.

The mutual modulation between cognition and emotion is also well considered. In the final chapters, Rolls takes on a philosophical bent and looks also at emotion associated with a variety of fields: decision theory, ethics, literature and consciousness.

Especially considering the complexity of the subject matter, Rolls has accomplished the praiseworthy feat of producing a volume that remains accessible to interested scholars from a variety of disciplines - psychiatry, psychology, neuroscience, evolutionary biology and animal behaviour, to name a few. But the

range and complexity of the topic makes it a dense read - this is probably not a book you will take to the beach.

It could serve as supplemental reading for a graduate or a very advanced undergraduate course.

Apart from presenting a comprehensive survey of the nature, function, brain mechanisms and pharmacology of emotion, Rolls also presents us with his theory of emotion. As far as the neural bases are concerned, his theory is conceptually similar to that of Joseph LeDoux, although LeDoux focuses almost exclusively on the role of the amygdala, as far as it is concerned with fear, and specific circuitry - subcortical inputs of auditory stimuli to the amygdala and beyond - very different from the areas that Rolls is concerned with.

The central thesis of Rolls's theory of emotions is that emotional states are created by external rewards and punishments. This idea has a long history dating back to the 1920s and 1930s, with John B. Watson's behaviourism and Edward Thorndike's framing his "law of effect" (that is, behavioural responses that are closely followed by a "satisfying" result were most likely to become established) in affective terms of rewards and punishments. Firmly situated in this tradition, Rolls presents his theory, similar to the appraisal theory of emotions developed by N. H. Frijda and others. One way of stating the appraisal theory is that emotions are caused by appraisal, which involves assessment of whether a given goal is to be avoided or desired. Rolls's description in terms of reinforcers and punishers seems to be a more precise and operational specification, especially if primary appraisal is defined with respect to goals.

While Rolls's definition of emotion as states elicited by rewards and punishments works quite well by and large as an operational definition, it is difficult to see how emotions such as feeling respect or (grudging) admiration fit into this scheme, without completely stretching the concepts of reward and punishment. The scheme, of course, can be defended by arbitrarily specifying what constitutes an emotion so as to exclude emotions such as feelings of respect or admiration.

Significant philosophical and psychological disagreement exists regarding what precisely is included or excluded from the class of emotions. But even if one were to take a consensus opinion and include only those mental states that are commonly included in the category classifying them is a significant problem.

Rolls presents a classification scheme, along with some examples of primary reinforcers and the dimensions of the environment to which they are tuned.

In this classification scheme, among taste (gustatory) stimuli, for example, Rolls lists tannic acid as a punisher, stating that it inhibits absorption of proteins. But those of us who enjoy a good Cabernet view that tannin as a reward, especially with protein-laden steak. Not that this presents an insurmountable problem for Rolls's classification, but it does illustrate the arbitrary nature of such schemes in general.

The situation is analogous to the classification of elements. With the advent of the concept that simple substances existed, from which all material bodies are compounded, various classifications schemes were tried, from the theory of elements of the Ancients all the way to pre-scientific chemistry. Finally, Dimitri Mendeleev's periodic table classified them rationally based on atomic mass. Though almost none of the classification schemes for emotion today are neurally based, neuroscientific discoveries about the brain and its mechanisms may yet provide the basis for a satisfactory way to define emotions and classify them. neuroscience is in its infancy but is a growth industry, with books such as this serving an important role.

An intriguing part of Rolls's theory is his argument that emotions have the central evolutionary role of enabling genes to specify the goals (that is, the rewards or punishments that produce emotions) for actions, rather than the actions themselves. They do so by specifying the rewards that are produced by actions. One would have to agree with Richard Dawkins's "selfish gene" or similarly appreciate why genes would specify rewards. The argument goes that they do so to direct the actions of the organism to

ensure their survival into the next generation.

Regardless, it is an intriguing idea that genes specify goals rather than prescribe actions. This allows for a great deal of flexibility in actions.

This idea offers a new slant on the nature versus nurture debate of animal behaviour, where genes do not actually produce or specify a fixed instinctive behavioural response, but allow for a greater repertory of behaviours. Response of an organism to its environment may be gene directed but not gene specified.

Emotional behaviours and their meanings often differ from one culture to another - many of the problems that occur in intercultural encounters can be attributed to these differences. The experience of emotion involves interplay of culture and biology. In the end, it is this experience of emotion that fascinates us the most. Neuroscience will certainly have a lot to say about the mechanisms of emotions, but probably it will have little or nothing to say about the experience - admittedly not something that can be defended with any rigour, but, you know, just a feeling.

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