

BEHAVIOURAL NEUROSCIENCE

The good, the bad and the amygdala

File name:

NRN0406_RW2_HL

Word count: 503

Accompanying picture: No, but was thinking we could have a photo of Mr Eastwood with a thought bubble containing the pull out quote??

File name of picture:

Pull out quote:

“individual amygdala neurons code for good or bad”

URLs

Ever feel hungry when you see a picture of a burger? Or annoyed when you see a particular politician? Such conditioning to visual stimuli is key to many aspects of emotion, learning and behaviour. Although a great deal is known about how the brain processes and analyses visual information, we have little understanding of how visual stimuli become linked with positive or negative emotions (value). Reporting in *Nature*, Salzman and colleagues show that, in the brains of monkeys, values associated with visual stimuli are represented in the amygdala — a structure implicated in reinforcement learning — and that

individual amygdala neurons code for either ‘good’ or ‘bad’.

The amygdala is known to receive both inputs from the visual system and reinforcing stimuli from other sensory systems, making it a good candidate for the site of visual stimulus value representation in the brain. To investigate this potential role, Salzman’s team recorded the electrical activity of individual amygdala neurons while monkeys were conditioned to associate particular images with positive or negative outcomes. The monkeys learned to lick in anticipation of the positive outcome, a liquid reward, and to blink in anticipation of the negative outcome, which was an aversive air-puff. To look for neurons that might be value-encoding, rather than just firing in response to visual stimuli, the team switched the outcome for a particular image half way through the trials (images originally associated with reward became associated with a negative outcome and vice versa). They found that more than 50% of amygdala neurons showed a switch in activity, and also that individual neurons showed value-specific activity. Therefore, the amygdala is a site rich in visual value-encoding neurons and, interestingly, these individual neurons encode either positive or negative value.

To investigate the link between neural activity and the conditioned

behavioural response (licking or blinking), the team measured the time taken for both to change, following the switch in image value outcome. Neural activity changed rapidly (after just a few trials) and, importantly, this coincided almost exactly with a change in conditioned behaviour. This tight link strongly argues for the amygdala as a primary brain area for learning the value of visual stimuli. Interestingly, some neurons changed their activity in advance of behavioural changes. The authors therefore suggest that the monkeys are unable to selectively ‘listen’ to individual neurons, but instead must interpret signals from a population.

This important work by Salzman’s group not only confirms that the amygdala is a key brain structure in the representation of the learned value of visual stimuli, but also suggests how this representation is interpreted. The next aim will be to add to our understanding of how the amygdala communicates with other brain structures and plays its part in the complex neural circuitry that controls the learning, emotion and behavioural networks.

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ORIGINAL RESEARCH PAPER Paton, J. J. *et al.* The primate amygdala represents the positive and negative value of visual stimuli during learning. *Nature* **439**, 865–870 (2006)

