Learning to Fear

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Like most people, Elizabeth Phelps is afraid of sharks, and rightly so — some species like the Great White (Carcharodon carcharias) are aggressive and will attack without provocation. But many of us have never come in contact with a shark in the wild, and visiting the aquar-ium is as close as we will ever get to a live one. How then, do we develop a fear of something without ever having experienced it?

This is one of many questions that Phelps, a professor of psychology and neural science at New York University, is trying to answer in her research. Phelps studies the cognitive neuroscience of emotion, learning, and memory, and she is particularly interested in the mechanisms underlying fear learning and fear extinction. In a talk at Emory University entitled "Social Learning of Fear" she discussed the role of the amygdala in the social learning of fear, how the mechanisms of fear are influenced by social groups, and how fears can be diminished once they have been learned.

"Fear is a universal survival mechanism," Phelps said in her talk. "Some of the most important things we can learn in life are what situations and events represent danger or threat. In humans, this type of information is often communicated through social interaction."

Fear Factors

Fear can be learned through direct experience with a threat, but it can also be learned via social means such as verbal warnings or observ-ing others. Phelps's research has shown that the expression of socially learned fears shares neural mechanisms with fears that have been acquired through direct experience.

This topic has been extensively studied in animals such as rats, using a paradigm known as fear conditioning. In fear conditioning, a neutral stimulus such as a tone is paired with an aversive event like a shock; after a few trials the rats will exhibit an emotional response to the tone. APS Fellow Michael Davis, a Robert W. Woodruff professor of psychiatry and behavioral sciences at Emory, and other research-ers have shown that when the amygdala is damaged, the rats will no longer exhibit a fear response to the tone.

Phelps has adapted this paradigm to study human fear conditioning and has demonstrated that the amygdala is critical for the physical expression of a fear response in humans as well as animals. She also has taken this one step further and shown that the amygdala responds when people exhibit fear learning through instruction (i.e., "the shock will follow the blue square, but not the yellow square") or through observation of someone else receiving the shock in a fear-conditioning paradigm. These findings demonstrate that the amygdala is in-volved in learning fear even without direct experience with the aversive event.

"This suggests that the cognitive and social means of fear learning may take advantage of phylogenetically older mechanisms of fear conditioning," said Phelps.

These same mechanisms also seem to be present in certain social-group biases, when these biases are assessed explicitly (consciously) as compared to implicitly (unconsciously). To assess whether or not the amygdala plays a role in race bias, Phelps conducted a study in which white males were shown pictures of unfamiliar white and black male faces while their brains were being scanned. Subjects with higher levels of implicit bias showed greater activity in their amygdala when they viewed faces of another race. No such relation was found between explicit biases and amygdala activity. However, when subjects were shown pictures of familiar black and white faces, the relation between implicit race bias and amygdala activity disappeared, suggesting that familiarity can reduce race bias and the response of the neural systems that support it.

Additional research in Phelps's lab has demonstrated that there may be a learned "preparedness" to fear people who are dissimilar to us.

In traditional studies of prepared fear learning, subjects exhibit a fearful response to pictures of natural threats (for example snakes) that persists even when the aversive stimulus is no longer paired with such pictures — a period called extinction. The tendency to maintain a fearful response is thought to be a result of the fact that we are evolutionarily predisposed to fear snakes, spiders, or other things that might endanger us. Phelps and her colleagues have shown that the tendency to maintain a fearful response also transfers to social groups: Sub-jects will continue to express fear to other-race faces during extinction. But Phelps suggests that this type of preparedness to fear out-group individuals may result from sociocultural learning of stereotypes and other biases, rather than from genetics.

Fear Itself

It is clear that people are quite adept at acquiring fear, but what mechanisms can we use to successfully diminish fear once it has been learned?

In a series of studies, Phelps has investigated this question in two ways: through extinction and through emotional reappraisal. The re-sults of the extinction study showed that the amygdala is involved in both acquisition and extinction of fear. The study also showed that an area in the middle of the prefrontal cortex, known as the ventromedial prefrontal cortex (VmPFC), is primarily involved in the retention of extinction in humans. These results parallel animal studies, suggesting that extinction mechanisms may be similar across species.

Remarkably, just instructing people to reduce an emotional reaction by reappraising how a stimulus makes them feel also seems to rely on mechanisms similar to that of extinction. When participants in Phelps's study were not regulating their emotional response to an aver-sive stimulus, the amygdala was active. However, when they were instructed to reappraise (reduce) their emotional response, the VmPFC and other prefrontal regions were active, and the amygdala response was reduced. The mechanisms of diminishing fear appear to overlap both across species and among strategies.

Although there are different routes to acquiring fear — we can learn to fear things not only through experience but also through in-struction and observation — Phelps's work has demonstrated that all of these mechanisms seem to rely on similar, phylogenetically older neural mechanisms. This knowledge may eventually lead to the development of better therapeutic treatments for patients who suffer from phobias or emotion dysregulation. By bridging the gap between animal models and human functioning, Phelps has provided essential in-sight into how we learn to fear, and how we can learn to reduce it. Just don’t ask her to watch Jaws with you before going to the beach.