Brains rely on old and new mechanisms to diminish fear, researchers find

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Humans have developed complex thought processes that can help to regulate their emotions, but these processes are also linked with evolutionarily older mechanisms that are common across species, according to a study by neuroscientists at New York and Rutgers universities. The research appears in the Sept. 11 issue of the journal *Neuron*.

The study was conducted by a team of researchers from the laboratory of NYU Professor Elizabeth Phelps, who co-authored the work with Mauricio R. Delgado, now a professor at Rutgers University in Newark, N.J. The study's other authors were Katherine Nearing, now at the University of Miami's School of Medicine, and Joseph E. LeDoux, a professor in NYU's Center for Neuroscience.

Recent scholarship has sought to translate basic research to the treatment of clinical disorders by exploring techniques and mechanisms for diminishing fear. This research has emphasized two approaches: the extinction of fear, which has been examined in a range of species and involves the repeated exposure to the feared event without negative consequences, or cognitive emotion regulation, which is unique to humans. This study examined the similarities and differences in the neural mechanisms underlying both of these approaches in diminishing fear.

Previous work in rodents and humans has linked the interaction of the brain's amygdala and ventral medial prefrontal cortex (vmPFC) to the

extinction of fear. The researchers in the Neuron study asked if a similar neural circuitry, in addition to brain regions known to play a role in higher cognitive functions, specifically the dorsolateral prefrontal cortex (dlPFC), are linked to the use of cognitive strategies of changing one's thoughts to control emotion.

In conducting the study, the researchers used functional magnetic resonance imaging (fMRI) to compare the patterns of brain activation during extinction and emotion regulation. Prior to each trial, participants were given a written cue that instructed them to either respond to the stimulus ("focus on your natural feelings") or regulate their emotional response to the stimulus ("think of something blue in nature that calms you down, such as the ocean"). Subjects were asked to keep the same mental picture they selected during training throughout the experiment. The study's subjects were then presented with two stimuli, a blue and a yellow square that either predicted or did not predict a mild electric shock. Arousal responses to the blue and yellow squares served as the measure of fear, and its reduction through the use of the cognitive regulation strategy.

The researchers observed that regions of the dlPFC were engaged by the use of cognitive emotion regulation strategies, which also led to diminished responses in the amygdala, a region known to play a role in the expression of learned fears. In addition, the same vmPFC regions that are thought to inhibit the amygdala during extinction were activated. In sum, the findings suggest that there is overlap in the neural circuitry of diminishing learned fears through emotion regulation and extinction. Moreover, the results suggested that vmPFC may play a general regulatory role in diminishing fear across a range of paradigms.

"Our results suggest that even though humans may have developed unique capabilities for using complex cognitive strategies to control emotion, these strategies may influence the amygdala through

evolutionarily shared mechanisms of extinction," explained Phelps.

"Extinction and cognitive emotion regulation may be, in part, complementary in that they rely on a common neural circuitry and, perhaps, similar neurophysiological and neurochemical mechanisms." Delgado added, "This finding is important because it suggests our detailed knowledge of the neural mechanisms of eliminating fears through extinction may also apply to the use of uniquely human, cognitive strategies to control emotion."

Source: New York University