How the brain keeps emotions at bay

September 20 2006

Daily life requires that people cope with distracting emotions--from the basketball player who must make a crucial shot amidst a screaming crowd, to a salesman under pressure delivering an important pitch to a client. Researchers have now discovered that the brain is able to prevent emotions from interfering with mental functioning by having a specific "executive processing" area of the cortex inhibit activity of the emotion-processing region.

The findings also offer insight into how sufferers of post-traumatic stress disorder (PTSD) or depression are unable to control emotional intrusion into their thoughts, said the researchers, Amit Etkin, Joy Hirsch, and colleagues, who reported the discovery. They published their findings in the September 21, 2006, issue of the journal *Neuron*, published by Cell Press.

Their studies were based on previous findings that specific parts of an area of the brain called the anterior cingulate cortex (ACC)--a center for so-called "executive" control of neural processing--are connected to the amygdala. The amygdala is the brain's major center for processing emotional events.

The experimental challenge for Etkin, Hirsch, and colleagues was to determine whether this region of the ACC was responsible merely for "monitoring" conflict between cognitive and emotional processing or for actively "resolving" that conflict.

To distinguish the two processes, Etkin and colleagues designed

experiments in which volunteer subjects were asked to indicate by pressing a button whether a face image was happy or fearful. The subjects were instructed to ignore labels of "fear" or "happy" written across each face.

These labels might be either "congruent" (e.g., happy face, "happy" word) or "incongruent" (e.g., happy face, "fear" word) with the image. Incongruent face-word combinations constituted a response conflict between emotional and cognitive stimuli. The researchers found that subjects could "resolve" this conflict more readily if an incongruent image was preceded by another incongruent image. This resolution represented an anticipation by the subjects' brains from the first image that they could resolve the conflict depicted in the second image

As the researchers scanned the subjects' brains with functional magnetic resonance imaging (fMRI), they presented the subjects with a series of such images designed to reveal what parts of the brain were active during such conflict resolution. The technique of fMRI involves using harmless magnetic fields and radio waves to measure blood flow in brain regions, which reflects brain activity.

Etkin, Hirsch, and colleagues found that the emotional stimuli activated the amygdala as expected. Importantly, they found that when presented with the "incongruent" images this activity was inhibited by specific activation of the "rostral ACC" in a manner that indicated this region was exerting inhibitory control over the amygdala.

"Our experiments on healthy subjects were carried out in order to understand what role the rostral cingulate normally plays in nonpathological emotional conflict," wrote the researchers. "But the data also allow us to better understand a variety of psychiatric disorders in which patients experience exaggerated interference from emotional distracters." They pointed out that people with PTSD, as well as those

whose depression is resistant to treatment, show lowered rostral cingulate activity during emotional processing. "Indeed, lower rostral cingulate activity prior to treatment actually predicts a poor response to antidepressant therapy," they wrote.

"Taken together, these findings suggest that elevated amygdalar activity and exaggerated behavioral interference may be due to deficient amygdalar inhibition by the rostral cingulate, which leads to an inability to deal with emotional conflict," concluded Etkin and colleagues. "The capacity for recruitment of the rostral cingulate may thus determine how well an individual can cope with the intrusion of negative emotional stimuli or mental content," they concluded.

Source: Cell Press