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### Psychologists Link Emotion to Vividness of Perception and Creation of Vivid Memories

ScienceDaily (Aug. 20, 2012) — Have you ever wondered why you can remember things from long ago as if they happened yesterday, yet sometimes can't recall what you ate for dinner last night? According to a new study led by psychologists at the University of Toronto, it's because how much something means to you actually influences how you see it as well as how vividly you can recall it later.

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found that the part of the brain responsible for tagging the emotional or motivational importance of things according to one's own past experience -- the amygdala -- is more active when looking at images that are rated as vivid. This increased activation in turn influences activity in both the visual cortex, enhancing activity linked to seeing objects, and in the posterior insula, a region that integrates sensations from the body.

"The experience of more vivid perception of emotionally important images seems to come from a combination of enhanced seeing and gut feeling driven by amygdala calculations of how emotionally arousing an event is," says Todd.

The researchers began by measuring the subjective experience of the vividness of perception. Taking pictures of scenes that were emotionally arousing and negative (scenes of violence or mutilation, or sharks and snakes baring their teeth), emotionally arousing and positive (mostly mild erotica), and neutral scenes (such as people on an escalator), they overlaid the images with varying amounts of "visual noise," which looked like the snow one would see on an old television screen. The pictures were then shown to study participants who were asked to say whether each image had the same, more, or less noise than a standard image with a fixed amount of noise.

"We found that while people were good at rating how much noise was on the picture relative to a standard, they consistently rated pictures that were emotionally arousing as

"We've discovered that we see things that are emotionally arousing with greater clarity than those that are more mundane," says Rebecca Todd, a postdoctoral fellow in U of T's Department of Psychology and lead author of the study published recently in the *Journal of Neuroscience*. "Whether they're positive -- for example, a first kiss, the birth of a child, winning an award -- or negative, such as traumatic events, breakups, or a painful and humiliating childhood moment that we all carry with us, the effect is the same."

"What's more, we found that how vividly we perceive something in the first place predicts how vividly we will remember it later on," says Todd. "We call this 'emotionally enhanced vividness' and it is like the flash of a flashbulb that illuminates an event as it's captured for memory."

By studying brain activity, Todd, psychology professor Adam Anderson and other colleagues at U of T, along with researchers at the University of Manchester and the University of California, San Diego



Psychologists overlaid images with visual noise to measure perception. After accounting for other features of images that contribute to perceptual vividness, such as contrast, color, and scene complexity, they found emotionally arousing images to be perceived more vividly, and thus contributing partly to more vivid memories of certain images later. (Credit: Rebecca Todd, University of Toronto)

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less noisy than neutral pictures regardless of the actual level of noise," says Todd. "When a picture was rated as less noisy, then they actually saw the picture underneath more clearly, as if there is more signal relative to noise in the emotionally arousing picture. The subjective meaning of a picture actually influenced how clearly the participants saw it."

The researchers used additional tests to rule out other explanations of their findings, such as how 'noisy' a picture seems due to less vibrant colours or a more complex scene. They also used eye-tracking measures to eliminate the possibility that people look at emotionally arousing images differently, causing them to rate some as more vivid.

"We next wanted to see if this finding of emotionally enhanced vividness influenced memory vividness," says Todd. "So, in two different studies, we measured memory for the images, both right after seeing them in the first place and one week later."

In the first study, 45 minutes after they did the noise task, participants were asked to write down all the details they could about pictures they remembered seeing. How much detail they remembered was a measure of vividness. In the second study, participants were shown the pictures again one week later and asked if they remembered them and, if so, how vividly they remembered them from very vague to very detailed.

"Both studies found that pictures that were rated higher in emotionally enhanced vividness were remembered more vividly," says Todd.

Finally, the researchers used brain imaging measures to look at when the brain responded to emotionally enhanced vividness and what regions of the brain responded. Using electroencephalography (EEG) to measure the timing of activity in the cortex to see when the brain is sensitive to vividness, gave them a sense of whether this subjective vividness was more about seeing vividly, or thinking that it was more vivid when you're considering it after the fact.

"We found that the brain indexes vividness pretty quickly -- about a 5th of a second after seeing a picture, which suggests it's about seeing and not just thinking," says Todd. "Emotion alters activity in the visual cortex, which in turn influences how we see."

The investigators also used functional magnetic resonance imaging (fMRI) to look at what brain regions were more active when people look at things that they perceive as more vivid because they're emotionally important. Again, they found amygdala, visual cortex, and interoceptive cortex activity went up with increased vividness.

"We know now why people perceive emotional events so vividly -- and thus how vividly they will remember them -- and what regions of the brain are involved," says Todd. "Knowing that there are going to be differences among people as to how strongly they show this emotionally enhanced vividness and the strength of the brain activation patterns underlying them, could be useful in predicting an individual's vulnerability to trauma, including intrusive memories experienced by people with post-traumatic stress disorder."

Funding for the research was provided by the U.S. National Institute for Mental Health and the Canadian Institutes of Health Research.

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#### Journal Reference:

1. Rebecca M. Todd, Deborah Talmi, Taylor W. Schmitz, Josh Susskind, and Adam K. Anderson. **Psychophysical and Neural Evidence for Emotion-Enhanced Perceptual Vividness.** *Journal of Neuroscience*, 2012 DOI: [10.1523/JNEUROSCI.0155-12.2012](#)



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