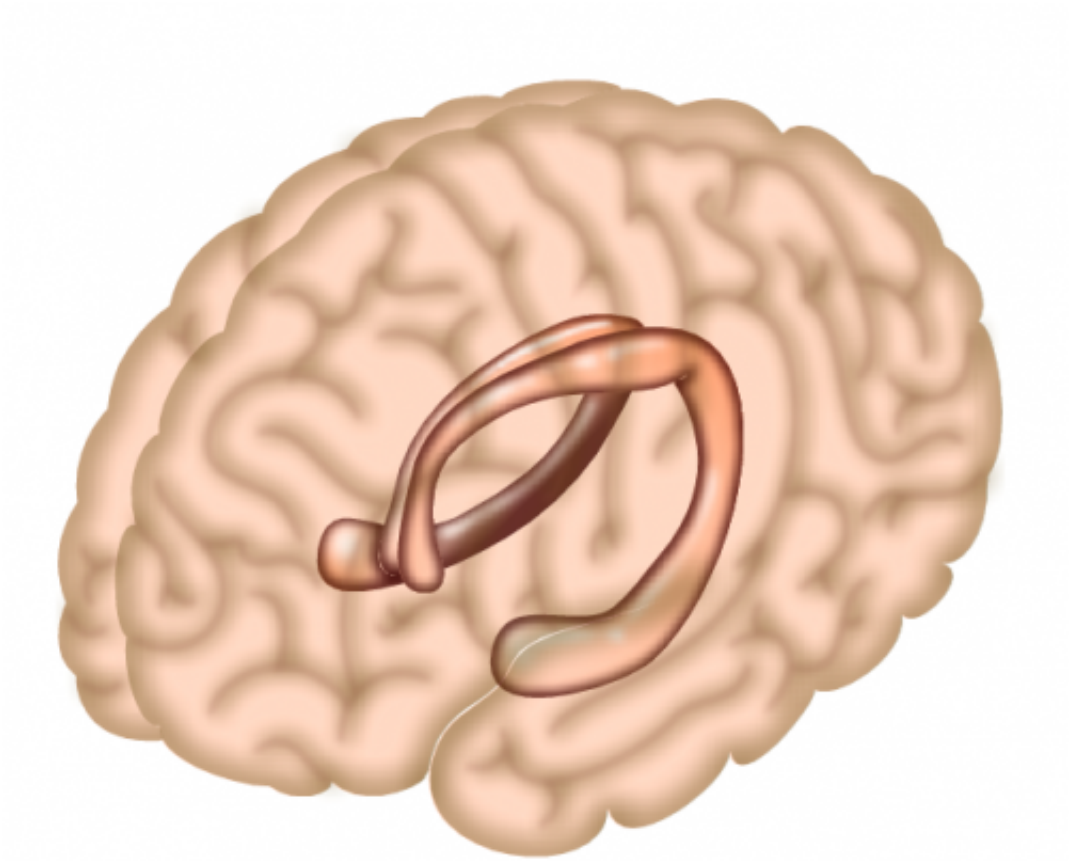
Teen brains facilitate recovery from traumatic memories

May 25 2016, by Geri Clark



The hippocampus is a region of the brain largely responsible for memory formation. Credit: Salk Institute

Unique connections in the adolescent brain make it possible to easily diminish fear memories and avoid anxiety later in life, according to a

new study by Weill Cornell Medicine researchers. The findings may have important implications for the treatment of trauma and anxiety disorders.

In a study of mice, the researchers found that the prefrontal cortex, which controls fear and anxiety, goes through a rearrangement during adolescence where it forms a significant number of new connections with the hippocampus, the region of the brain that controls spatial memory.

"This implies that during this developmental period, there is this strong link between how fear is experienced and remembered and memory of where the fearful event took place," said study author Dr. Francis Lee, professor in the Department of Psychiatry at Weill Cornell Medicine and co-research director for the NewYork-Presbyterian Youth Anxiety Center. "So we wondered if we could use this connection to desensitize adolescent mice to fearful events."

A technique developed by co-lead author Dr. Conor Liston, assistant professor of neuroscience in the Feil Family Brain and Mind Institute at Weill Cornell Medicine, which involved implanting microprisms into the brain, allowed him to image these connections within the prefrontal cortex across adolescence. Using that data, Lee and colleagues devised a simple behavioral intervention that mimics therapy for humans. In a paper published May 24 in *Nature Communications*, they discovered the intervention could suppress fear memories in adolescent mice, even before the mice ever acted fearful.

The researchers, including co-lead author Dr. Siobhan Pattwell, who was a postdoctoral fellow in the Sackler Institute for Developmental Psychobiology, put juvenile, adolescent and adult mice in a chamber and gave them a small shock. When they later put the mice back in the chamber where the shock had taken place, the juvenile and adult mice

showed fear just at being in the space, but the adolescent mice did not. However, if those same adolescent mice were put in the chamber once they reached adulthood, they did display fear. This is similar to how humans exhibit traumas experienced in adolescence, Pattwell said. "We know that teenagers will often undergo a stress or trauma and seem completely fine, even for years," she said. "But many of them will experience anxiety or traumatic memories from that event later in adulthood."

The investigators then did a form of "therapy," called an extinction session, with the adolescent mice. One day after they were shocked, the mice were returned to the chamber and left there for one hour without being shocked. "Essentially, we were trying to teach them that what had been a scary place could now be considered safe," Pattwell said.

Once the mice reached adulthood, they were put back in the chamber again. The mice who received the extinction session showed no fear. If those same mice were shocked again as adults, they displayed the same amount of fear as any adult mouse that had been shocked for the first time. "It was almost is if they had not experienced the trauma in adolescence," Pattwell said. "This suggests that the fear memory was attenuated with just that one therapy session."

The investigators found the "therapy" did not have to take place immediately after the shock. As long as it was done before the mice reached adulthood, the positive effects were the same.

The implications of these findings for humans are potentially significant in several ways, Lee said. First, a child or adolescent who experiences a trauma and seems fine afterward may not be. "What it suggests is that even when they look like they're okay, if they've gone through something scary you should probably intervene because we've shown that those memories can express later in adulthood." The window for that

intervention is quite long, however – the duration of adolescence, while these connections between the prefrontal cortex and hippocampus are being made – and the amount of therapy needed may be very little.

"There is such a stigma around seeing a psychologist or psychiatrist for treatment. We hope that these findings will destigmatize therapy," Lee said. "Dealing with fear is just learning and memory and we have shown that adolescent brains are very good at that – better than those of adults. Future studies in humans will address whether these types of interventions prevent a fearful memory from becoming anxiety later in life."

More information: Siobhan S. Pattwell et al. Dynamic changes in neural circuitry during adolescence are associated with persistent attenuation of fear memories, *Nature Communications* (2016). DOI: 10.1038/ncomms11475

Provided by Cornell University