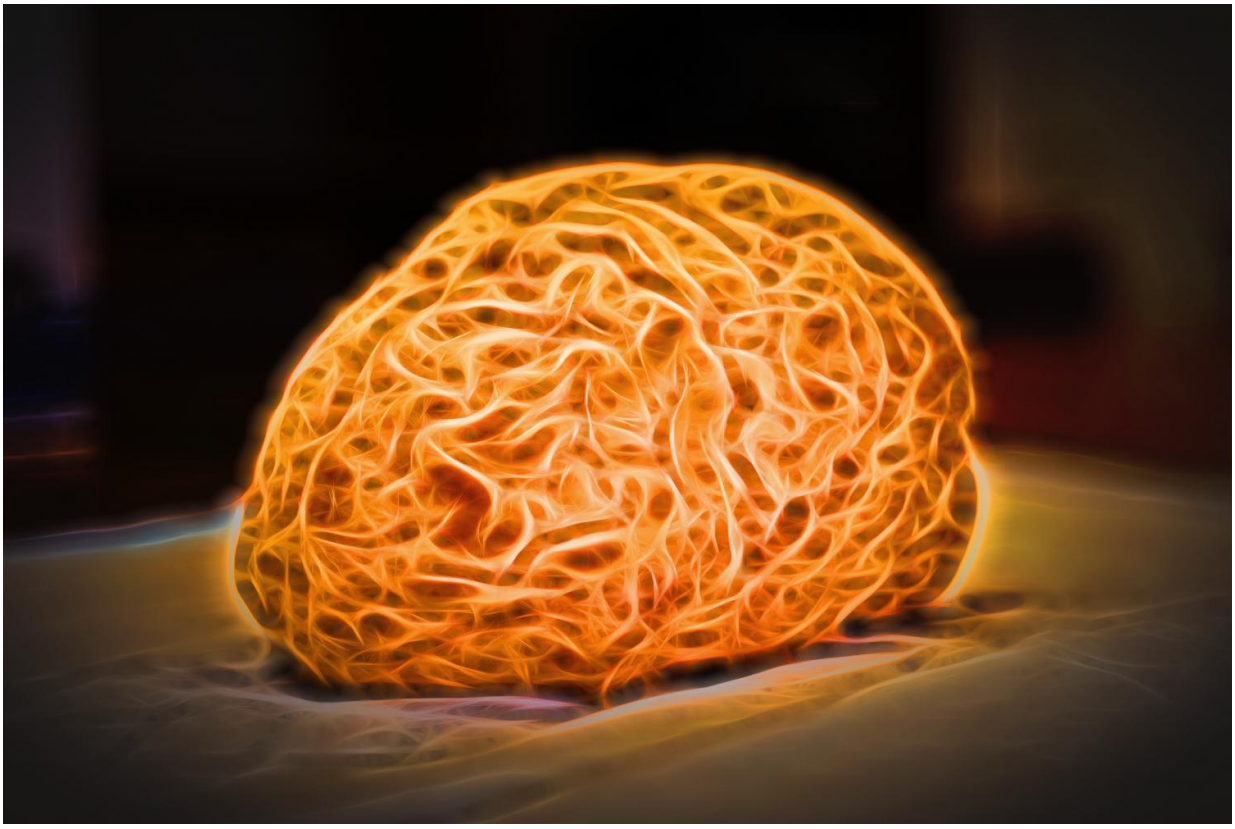
Neuroscientist studies connection between PTSD and alcohol abuse

December 1 2016, by J. Ryne Danielson



A real human brain, photographically enhanced to illustrate the relationship between alcohol exposure and PTSD. Psychologist Justin Gass believes repeated alcohol exposure stregthens the connections between neurons responsible for storing traumatic memories. Credit: Justin Gass

As families gather for the holidays this year, many will reminisce,

sharing fond memories as they break bread and pass the cranberry sauce. They are the lucky ones. Others who carry memories too painful or too horrific to share will do whatever they can to forget, including turning to alcohol as a coping mechanism.

Many who have been to war, experienced abuse or lived through a traumatic event struggle to cope with life-altering anxiety and depression afterward. Approximately eight million people in the United States live with post-traumatic stress disorder, according to the National Center for PTSD, and nearly 75 percent of them report abusing alcohol at one time or another.

Justin Gass, Ph.D., a researcher in MUSC's Department of Neuroscience and Alcohol Research Center, said alcohol may work for a night, tricking the brain with a flood of short-lived endorphins, but that ultimately it just makes things worse.

"People often learn early in life that drinking can ease a hard day or make you feel better. It's a coping mechanism," he explained. "But when someone develops PTSD, they often start drinking more and more. Our working theory is that repeated alcohol use makes fear memories worse, which in turn leads to more alcohol consumption. It's a vicious cycle."

Gass' new $1.7 million grant from the National Institute on Alcohol Abuse and Alcoholism, part of the National Institutes of Health, will allow him to pinpoint which areas of the brain are involved in processing fear memories and learn just how alcohol affects them. He hopes he may even identify possible treatments that can break the cycle of dependency and help PTSD sufferers overcome their traumatic memories.

"We don't really know a lot about what goes on in the brain and how alcohol and traumatic memories interact with each other," Gass said. "Our current findings suggest that alcohol strengthens the consolidation

of negative memories and makes those memories stronger and more difficult to deal with."

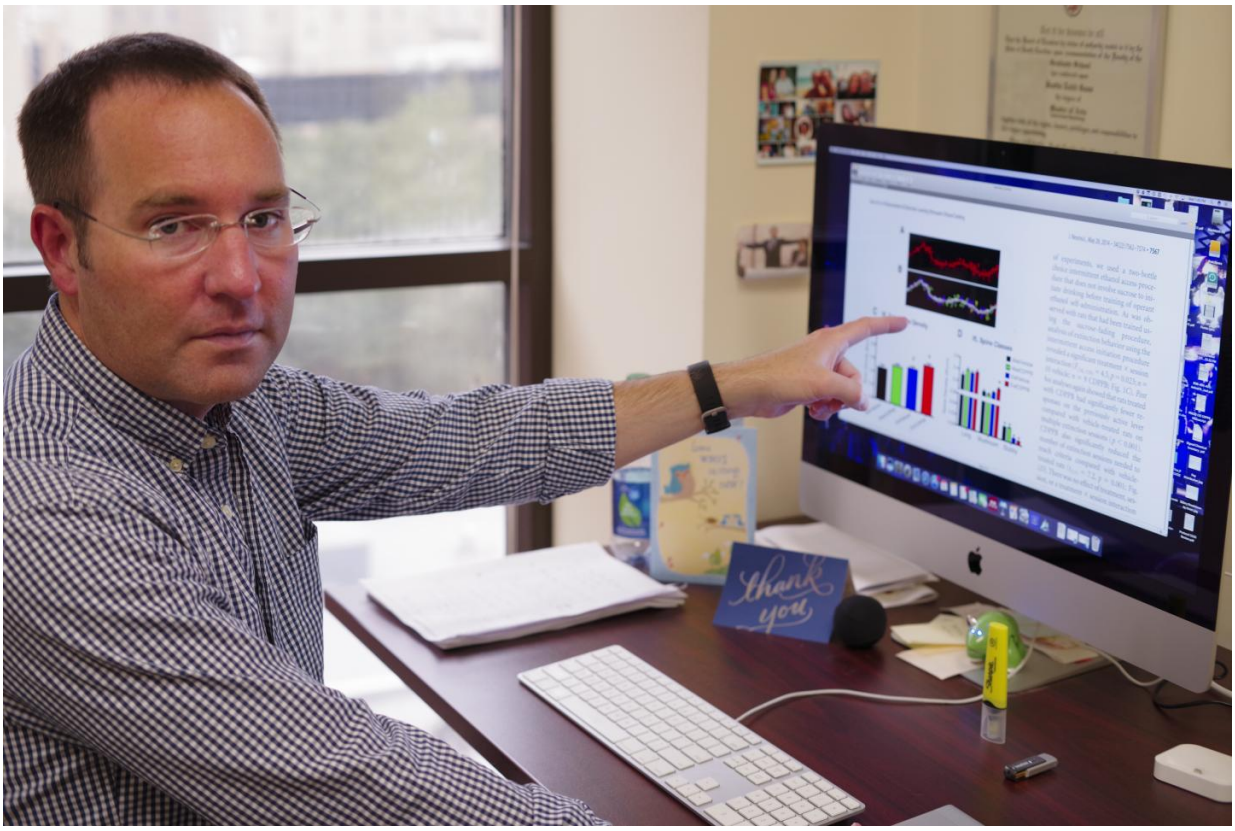
Psychologists have been studying how memories are formed and stored since the late 1800s, and they still understand very little of how the process works.

"We know that whenever a memory is formed, new synapses, or connections, are created between neurons," Gass said.

Neurons are brain cells that "talk" by generating electrical signals and releasing chemicals called neurotransmitters. The connections they form with other neurons are the basis of everything you remember, from your first kiss to how to tie your shoes.

"Think of an elephant," Gass continued. "It has a lot of different characteristics. It has a trunk. It likes peanuts. It's big. It's gray. Once the memory of the elephant is created, all of those characteristics get sent to different regions of the brain for long-term storage, and a region of the brain called the hippocampus reforms the memory into a coherent idea whenever you think about an elephant."

The more you think about elephants, the stronger the connections that are formed between neurons become and the stronger the memory, he explained. As short-term memories are consolidated into long-term memories, the physical structure of the brain actually changes.



Dr. Gass explains how neurons change in response to different stimuli, for example, repeated alcohol use or traumatic memories. His research may help break the vicious cycle between PTSD and alcohol abuse. Credit: J. Ryne Danielson

"Whenever you recall a memory from long-term storage, there is a window of time in which it can be altered," Gass said. "And that's our opportunity to fix it, disrupt it, or change it before it gets reconsolidated into long-term memory."

While that might just mean updating a memory of one's spouse to include a new haircut, for someone with PTSD, it could be the key to treatment. By recalling a traumatic memory in a safe environment, it can be reconsolidated into long-term memory in a less impactful way.

"When you recall a memory, it opens a window for treatment," Gass said. "Either we can try to build new memories that compete with and eventually supplant the traumatic memory, or we can attempt to disrupt the reconsolidation of the traumatic memory, lessening its impact."

Gass and his team are using these methods to investigate novel ways to potentially treat alcohol/PTSD comorbidity. A type of treatment known as exposure therapy has been used since the 1950s to tackle phobias and anxiety disorders. A new spin on this traditional treatment is the use of cognitive enhancing drugs to speed up the process by decreasing the time it takes to form new memories to compete with the old ones. Whichever memory is stronger will win out, Gass said. Another type of treatment that attempts to alter fear memories is newer and more revolutionary. By injecting a genetically engineered virus into a specific region of the brain to make neurons light-sensitive, lasers can be used to temporarily shut those regions down. By shutting down the region of the brain responsible for consolidating or reconsolidating fear memories, those memories can be weakened.

"We think there's one brain region that plays a major role in driving fear expression," Gass explained. "By shining a laser at the brain region that motivates PTSD symptoms, and shutting it down for a short period of time, we can decrease those symptoms dramatically in rodents."

While the technique is non-destructive - it doesn't harm brain cells, it just alters their activity - it is not approved for use in humans. Certain drugs like beta blockers, which have been traditionally used to treat heart arrhythmias and hypertension, can also affect the same areas of the brain and disrupt memory formation. They may be one key to treating PTSD in humans.

Another key is to break the vicious cycle of post-traumatic stress and alcohol abuse. Repeated exposure to alcohol, Gass said, interferes with

both types of treatment by causing memories to grow stronger rather than weaker over time. No one is yet sure exactly how or why, but he thinks it may involve the connections between neurons in the brain. Solving that mystery is one of the major goals of his grant.

Gass believes a big question in science at the moment is how to translate pre-clinical work like his into treatments that can help patients.

MUSC, he said, offers a unique opportunity on that front.

"There are a lot of clinical researchers on campus working on the same ideas," Gass said. "We are talking about our data with each other all the time and getting new ideas to try. They may discover a new compound with promising findings and consult with me to test pre-clinically what brain regions are involved in the effects they're seeing."

Identifying the relevant brain regions and tailoring drugs to precisely target them is important to avoiding harmful side effects, he explained.

As more soldiers return every year from the war in Afghanistan, America's longest war, and an increasing number of Americans report abuse at one time or another in their lives, Gass hopes his work will be an important first step toward breaking a vicious cycle that traps too many in a downward spiral of alcohol abuse, anxiety and despair.

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