Hi everyone, my name is Augustin Hennings, and I am a 4th year graduate student working in the Dunsmoor and Lewis-Peacock Labs at The University of Texas at Austin.

This project begins with the idea of encoding specificity, which was first introduced by Thompson and Tulving. This is the process in which the neural circuits which encode a memory reactive during retrieval.

Research of learned fear and subsequent extinction has been able to demonstrate this principle to great success in rodents, and we now know that fear and extinction memories exist as stable and separable engrams in rodents.

How can we study these processes in humans? We don’t have access to the level of circuits that engrams have been observed in rodents, but we can use an analogous approach called encoding- retrieval similarity.

Instead of individual neurons, we can correlate spatial patterns of activity as measured by fMRI, from encoding to retrieval. This correlation is the degree to which these two states overlap.

We have a very specific hypothesis of where we expect neural reinstatement of fear and extinction memories in the human brain. Previous research in animal models suggest that different areas of the PFC code for memories of opposite valance, and there is converging evidence from human research that suggests the same is true in humans. Specifically, the dorsal anterior cingulate cortex (dACC) codes for fear memories, and the ventro-medial prefrontal cortex codes for extinction memories. However most of the work in humans has only used univariate measures, and has not looked for neural reinstatement.

This brings us to our specific research question – are associative emotional memories organized the same way in humans as in rodents?

Our specific hypotheses are that there will be a double dissociation of emotional memory reinstatement in the PFC.

And 2nd, individuals with PTSD will display dysregulated reinstatement of emotional memories, consistent with PTSD phenotype of being unable to recall extinction memories.

In order to test our hypotheses, we employed an episodic-associative hybrid task. In this task, participants form an emotional association to a sematic category, either animals or tools. However, each individual stimulus is a unique category exemplar, for example, there is only 1 type of dog shown. This means that each stimulus is encoded in a distinct emotional context, based on the type of associative learning taking place.

The task starts with a baseline phase, in which participants are passively viewing the stimuli. During fear acquisition, 50% of the images from one category are paired with a mild electric shock to the wrist. Extinction immediately following fear acquisition, during which no shocks are delivered. The following day, participants are placed back in the scanner and complete a surprise recognition memory test for the items they saw the previous day.

The end result of this task is that each episodic memory has 1 implicit emotional association (none,fear, or safety).

In order to measure the amount of neural reinstatement, for each item we correlate patterns of activity from encoding to retrieval. We are interested in the amount of emotional reinstatement, we take the difference of CS+ and CS- items to control for the amount of reinstatement elicited by seeing the same stimulus twice.

This brings us to the main results. First looking at healthy adults. One the y-axis is CS+ - CS- neural reinstatement, and the x-axis is the encoding phase. As a sanity check, we can see that in both the dACC and vmPFC there is no significant emotional neural reinstatement for baseline items. For fear acquisition, there is significant emotional reinstatement in the dACC, and not in the vmPFC. The opposite is true for items encoded during extinction. We see significant emotional reinstatement in the vmPFC, but not in the dACC.

The story is not the same for individuals with PTSD. There is significant emotional reinstatement for items encoded during fear acquisition in the dACC – however there is no significant reinstatement for any encoding phase in the vmPFC.

Jumping to the group comparisons, we see that healthy adults are exhibiting significantly more selective emotional reinstatement in the vmPFC for items encoded during extinction.

So in conclusion, we observed that healthy adults exhibit a double dissociation of associative emotional memories in the PFC, and individuals with PTSD display dysregulated selective emotional reinstatement in the PFC. We hypothesize that this distinct organization of emotional memories in the PFC may be adaptive in healthy adults, such that it may prevent memories from being overwritten.

IF you have any questions or would like more information, please feel free to send me an email, or to use the live chat function during the poster session.