Summary:

Every memory we encode affects how we process future events, even memories we no longer know we have. How forgotten memories continue to interact with and affect new experiences remains unclear. Memories are initially encoded in a fragile state in a population of neurons called a memory engram, before undergoing consolidation into a more stable form with proper rest or sleep. Hippocampal memory engrams encode episodic memories, and recall said memories upon reactivation. The novel object place recognition (NOPR) paradigm is a hippocampal-dependent task, whereby animals learn the locations of identical objects in a familiar environment. I tracked the persistence of the NOPR memory and identified a time-dependent state transition of the hippocampal engram from a spontaneously retrievable (vocal) state, into a mute state that retains a silent memory trace that is only retrievable by artificial engram stimulation. I added a weaker, modified episode at either the vocal or the mute time points of the initial memory and found that only the mute engram induced the consolidation of the weak memory. This effect required the internalization of synaptic glutamate receptors. I bidirectionally manipulated the NOPR engram across its transition point, successfully inducing a loss and gain in its ability to consolidate the weak event's memory when vocalized or inhibited, respectively. My study shows that the hippocampus retains a mute trace of forgotten memories that affects processing of future events, causally unveiling a previously unknown cognitive effect of forgetting.