**Subject:** Thesis Defense - Madinah Azizi, MS Biology
**Date:** Tuesday, July 7, 2026 at 4:10:08 PM Eastern Daylight Time
**From:** SSB Faculty List on behalf of Diane St. Germain
**To:** SSB-FACULTY-LIST-L@LISTSERV.GMU.EDU

Thesis Defense Announcement
To: The George Mason University Community

**Candidate:** Madinah Azizi

**Program:** M.S. in Biology

**Date:** July 22, 2026

**Time:** 01:00 PM Eastern Time (US and Canada)

**Location:** In Person, KB 229, Krasnow Institute for Advanced Study, Fairfax Campus VA 22030

and via Zoom

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**Committee Chair:** Dr. Holger Dannenberg

**Committee members:** Dr. Parag Chitnis, Dr. Nadine Kabbani, Dr. Aman

Ullah

**Title**: Acetylcholine Release in Hippocampal CA1 is Correlated with Spatial Novelty and Exploratory Behavior

## Abstract:

Cholinergic signaling within the septo-hippocampal circuit is essential for memory, attention, arousal, and locomotion-related processing of sensory information. In the hippocampus, acetylcholine (ACh) has been implicated in memory encoding, retrieval, and consolidation, with elevated ACh proposed to facilitate the encoding of new information and novel experiences and lower ACh levels supporting memory retrieval and consolidation. Consistent with this framework, human studies have shown that muscarinic cholinergic receptor blockade impairs memory encoding and is associated with disruptions in hippocampal theta oscillations necessary for learning. In parallel, animal studies demonstrated that the activity of cholinergic projection neurons in the medial septum/diagonal band of Broca is strongly correlated at behaviorally relevant timescales with an animal's movements and with exploring novel object locations. However, these studies did not directly measure hippocampal acetylcholine (ACh) release, leaving unanswered to what extent sub-second ACh release dynamics are correlated with animal movement, behavior, and spatial novelty encoding. Here, we used a genetically encoded ACh sensor (GRAB-ACh3.0) combined with fiber photometry to record ACh release dynamics in CA1 of 3–7 months old female mice alongside 3-D kinematic tracking of mouse behavior to identify and quantify correlations between sub-second ACh release dynamics during free-foraging, novel environment exposure, and an object location memory (OBLOM) task. Consistent with previous GCaMP studies, CA1 ACh release was strongly correlated with the logarithm of running speed. Additionally, acetylcholine signaling exhibited sustained elevations during exploratory and attentively engaged behaviors, including rearing, and sustained suppression during grooming and eating; behaviors associated with lower exploratory demands. Furthermore, ACh release increased during exploration of objects in novel locations relative to familiar locations, suggesting that phasic ACh release contributes to the encoding of novel object-place associations. Lastly, exploration of a novel arena induced a sustained increase in CA1 ACh release across the entire running speed range. Notably, the positive correlation between ACh release and movement speed was preserved under both conditions, indicating that environmental novelty enhances cholinergic activity independent of locomotion speed. Together, these findings show that hippocampal ACh release is correlated with exploratory behavior and spatial novelty encoding. By directly measuring acetylcholine release in CA1, this work provides insight into how cholinergic signaling regulates hippocampal

information processing during exploration and memory formation. These findings also provide a foundation for future studies of how cholinergic dysfunction may contribute to memory impairment in cognitive and neurodegenerative disorders such as Alzheimer's disease.

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