PRESS RELEASE

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Not all memories are created equal: Study by NUS and Duke shows how motivation shapes our memory

Singapore, 21 January 2026 – Researchers from the Yong Loo Lin School of Medicine, National University of Singapore (NUS Medicine) and Duke University have proposed a neuroscience framework explaining how different types of motivation fundamentally reshape what and how the brain remembers. The work, published in the Annual Review of Psychology, reframes motivation not merely as "more effort" but as a set of distinct motivational moods that activate different systems in the brain, shaping memory outcomes in predictable ways.

The study sheds light on two motivational moods—an adaptation-driven "interrogative mood" supported by dopamine, which helps the brain form flexible, relational memories that integrate information; and a goal-driven "imperative mood" supported by noradrenaline, which sharpens a memory's focus on relevant details. These findings offer a scientific basis for tailoring educational environments, enhancing clinical therapies for memory or motivational disorders, and improving public-health communication. While past studies have shown that motivation can enhance learning, the authors explain that not all motivation works the same way. Instead, different motivational states set up distinct neural contexts, which are patterns of coordinated brain activity, that determine what kind of memory is formed.

"Beyond studying whether motivation helps memory, we investigated how it shapes memory," said the study's first author Assistant Professor Poh Jia-Hou, Centre for Sleep and Cognition, NUS Medicine. "Our framework explains that curiosity, stress, deadlines, and rewards result in distinct learning outcomes. This is because each factor induces a different motivational 'mood' which in turn modulates how information is processed."

The review integrates findings across neurobiology, cognitive neuroscience, psychiatry, psychology, and computational modelling, unifying research into the new "Neural Context" model of motivated memory. It explains the two moods of motivation as associated with the following:

1. The interrogative mood, dominated by the motivation to adapt, promotes observation, exploration, and uncertainty-driven learning. It is supported by sustained dopamine activity in the ventral tegmental area (VTA), engaging the hippocampus and prefrontal cortex. This helps with relational and integrated memories, schema formation (mental

frameworks that the brain builds through experiences), abstraction and generalisation, and flexible learning over longer timescales.

2. Imperative mood, dominated by the motivation to act, appears when people perceive urgency such as danger, deadlines, or strong goals. It is supported by burst-like noradrenaline activity from the locus coeruleus (LC), engaging the amygdala and sensory cortices. This helps with high-salience, item-focused memories, rapid sensory processing, and immediate goal-directed behaviour; but often at the cost of broader contextual learning.

Professor R. Alison Adcock, senior author of the study and Director at the Center for Cognitive Neuroscience, Duke University, said, “These neuromodulatory systems, dopamine and noradrenaline, act like switches that tune the entire brain for different kinds of learning. Understanding these switches gives us powerful new levers for designing more effective classrooms and therapies. We hope to help individuals identify these motivational moods and learn to match them to the challenges they face.”

The framework shifts the field toward studying how neuromodulatory systems shape patterns of memory, not just whether motivation improves learning. It emphasises the importance of VTA and LC engagement, as well as sustained and phasic modes of activity, in determining how we engage with information and process it to form memories. The model could potentially inform new treatments for disorders involving impaired motivation or memory, such as depression, schizophrenia, attention deficit hyperactivity disorder (ADHD), and dementia and age-related cognitive decline. Additionally, this work offers new insights into how motivational context can influence behavioural and lifestyle changes.

The researchers are pursuing several experimental directions. These include developing artificial intelligence-driven learning technologies that adapt to a student’s motivational state, and studying how ageing affects neuromodulatory systems and the motivation-memory relationship. Furthermore, they are investigating whether non-invasive neurofeedback can help regulate dopamine and noradrenaline systems to improve memory, and exploring how motivational states influence the balance between exploration and exploitation in decision-making.

“Our long-term goal is to empower people with the ability to tune their own brains for learning,” added Asst Prof Poh. “By understanding how motivation shapes memory, people can learn to harness urgency to focus learning and support efficient action, or engage their curiosity to prepare for flexibility in an unknown future."

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Our multidisciplinary and real-world approach to education, research and entrepreneurship enables us to work closely with industry, governments and academia to address crucial and complex issues relevant to Asia and the world. Researchers in our faculties, 30 university-level research institutes, research centres of excellence and corporate labs focus on themes that include energy; environmental and urban sustainability; treatment and prevention of diseases; active ageing; advanced materials; risk management and resilience of financial systems; Asian studies; and Smart Nation capabilities such as artificial intelligence, data science, operations research and cybersecurity.

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Through a dynamic and future-oriented five-year curriculum that is inter-disciplinary and inter-professional in nature, our students undergo a holistic learning experience that exposes them to multiple facets of healthcare and prepares them to become visionary leaders and compassionate doctors and nurses of tomorrow. Since the School's founding in 1905, more than 12,0000 graduates have passed through our doors.

In our pursuit of health for all, our strategic research programmes focus in innovative, cutting-edge biomedical research with collaborators around the world to deliver high impact solutions to benefit human lives.

The School is the oldest institution of higher learning in the National University Health System. It is one of the leading medical schools in Asia and ranks among the best in the world (Times Higher World University Rankings 2025 by subject and the Quacquarelli Symonds (QS) World University Rankings by Subject 2025).

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