UTS UNIVERSITY OF TECHNOLOGY SYDNEY

# The relationship between initial context memory completeness, updating, and systems consolidation in hippocampus and cortex

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Thesis submitted in fulfilment of the requirements for the degree of

**Doctor of Philosophy**

under the supervision of **Prof. Bryce Vissel**
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# Certificate of original authorship

I, Weitian Sun declare that this thesis, is submitted in fulfilment of the requirement of the requirements for the award of the Doctor of Philosophy, in the school of life sciences at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise reference or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualification at any other academic institution.

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## Statement of the thesis format

This thesis is written as a conventional thesis.

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# Abstract

We are forming memories every day. The fate of those memories varies depending on many causes, such as the importance of the memory, the time spent informing that memory, or the emotional state. Therefore, some memories are reliable and long-lasting, but others are inaccurate or short-lived. However, it is largely unknown whether those memories undergo the same development or not. A newly formed memory will undergo a process called memory consolidation, by which a labile memory is fixed and converted into a stabilized memory. Previous studies showed that the memories formed with different learning durations varied in accuracy and neural activity. Therefore, in this study, I further investigated whether those memories undergo the same consolidation process.

To address that question, I used context fear conditioning in mice to investigate how learning durations affect memory consolidation. Different learning durations were achieved by controlling the different amount of time that mice spend in the conditioning context prior to shock, i.e. different PSIs (placement shock interval, PSI). This study focused on the two stages of memory consolidation, synaptic and systems consolidation. Firstly, by disrupting protein synthesis, an indispensable process in synaptic consolidation, I found that the short and long PSI memories underwent synaptic consolidation at the same rate. Secondly, I found HPC inhibition significantly impaired the long PSI memory at recent time points but not the short one, suggesting the long PSI memory was contextual and HPC dependent, but the short PSI one might not be. This result showed that the short and the long PSI memories are significantly different in the HPC dependent consolidation. Thirdly, I investigated whether improving a short

PSI memory by updating affects its following consolidation. I found that an improved short PSI memory was still resistant to HPC inhibition. This result can be interpreted in two ways. Firstly, the original memory was not encoded in the HPC, so the improved memory was not HPC dependent either. Secondly, the original memory was encoded in the HPC and resistant to the HPC inhibition. In this case, memory updating did not render it susceptible to inhibition, and presumably, the following consolidation was not affected. However, the two interpretations cannot be delineated in this study.