

Electrophysiological changes underlying lapses in memory consolidation

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INTRODUCTION

Memory consolidation is generally conceived as a process whereby new information sequentially moves to successively longer-term stores. In invertebrates and vertebrates, including humans, there are memory lapses during consolidation. We previously found that in the pond snail (*Lymnaea stagnalis*) one-trial appetitive classical conditioning was accompanied by memory lapses at 30 min and 2h after training. Memory consolidation was disrupted when a disturbance is applied during one of these lapse periods but not when presented at any other time periods.

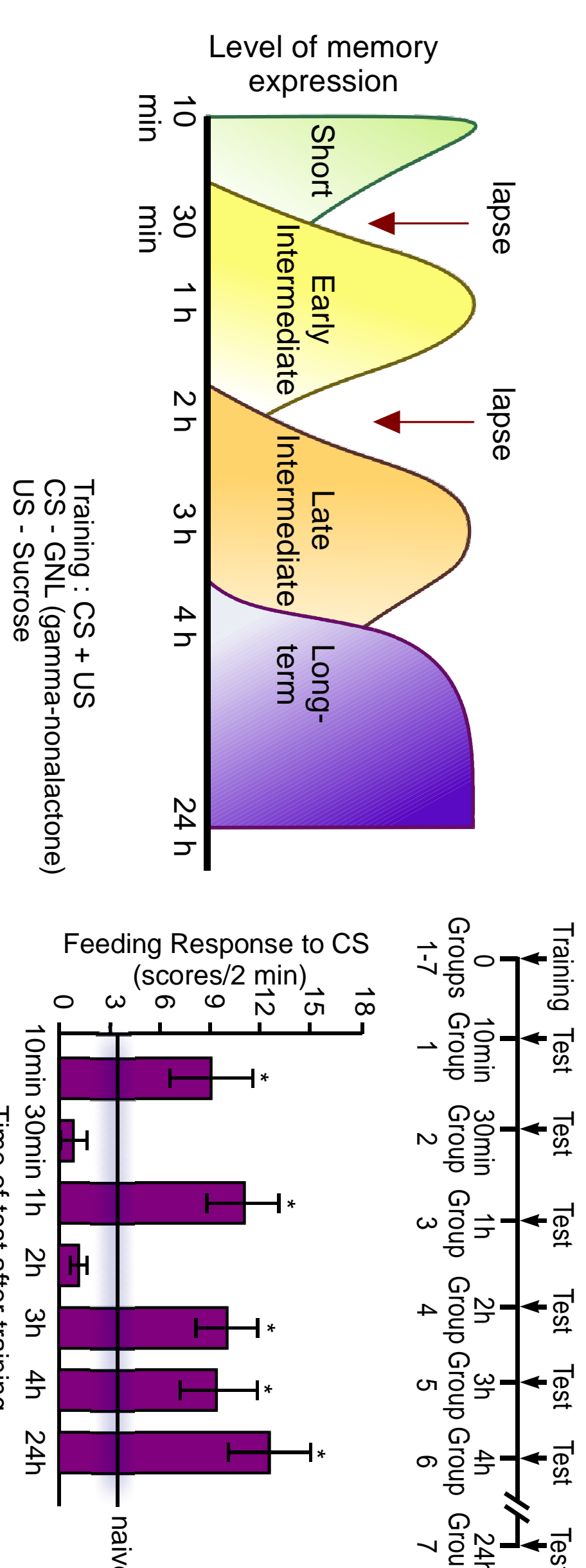
A second training at different times after the initial conditioning showed that training during lapse periods leads to the abolition of the memory induced by the initial training and replacement by the second memory.

Using both intracellular and extracellular (multielectrode array - MEA) we found memory lapses at times (30 min and 2h) corresponding to the times of lapses observed following *in vivo* training.

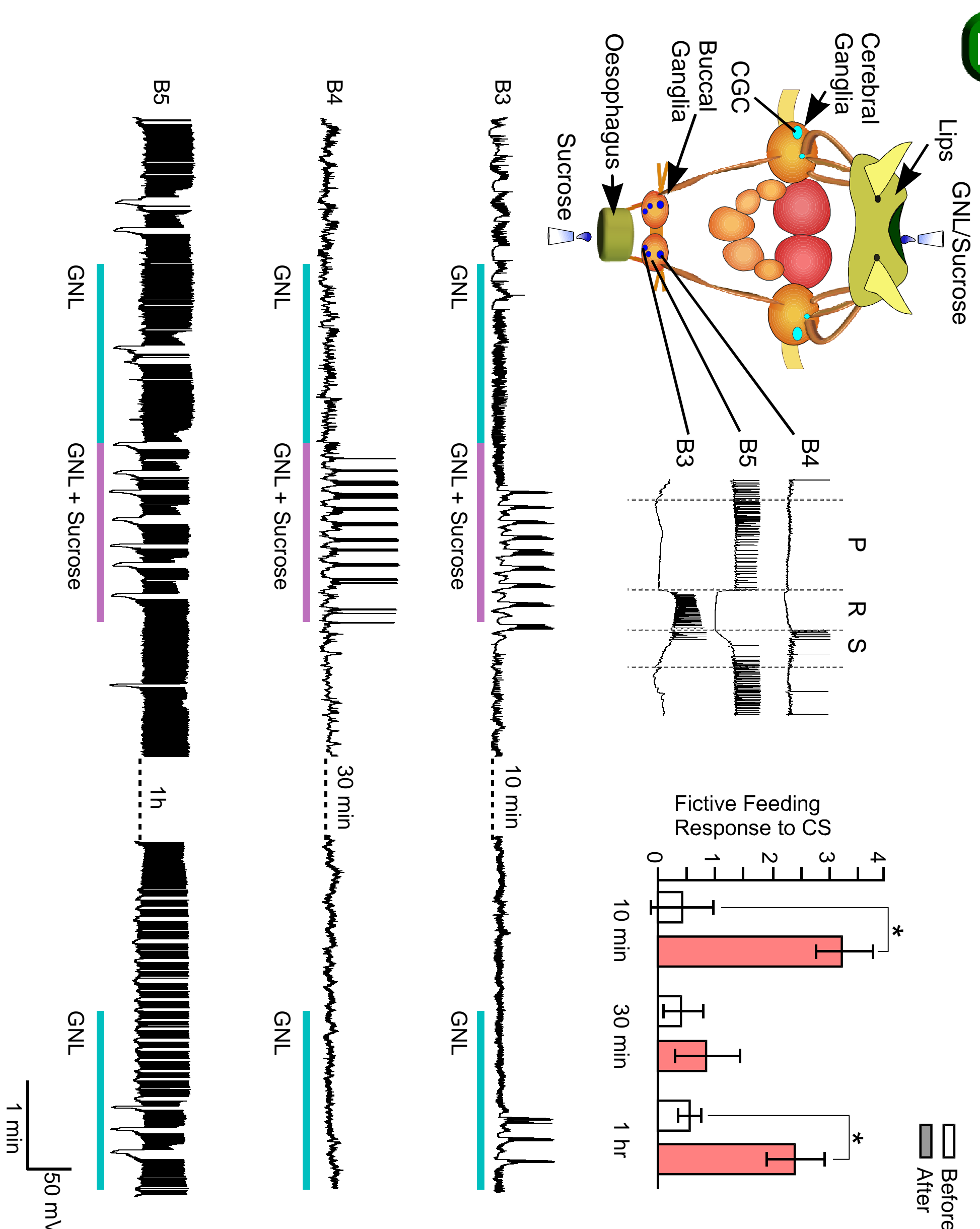
By recording the feeding modulatory CGC interneurons intracellularly we found that a previously described non-synaptic change, characterised by significant decrease in this neuron's membrane potential 24h after the learning is also present after the original memory is replaced by the second memory.

Tactile sensory disturbance applied during the lapse periods however blocked depolarization of the membrane potential when recorded at 24 hours after conditioning suggesting that memory replacement is not due to disturbance.

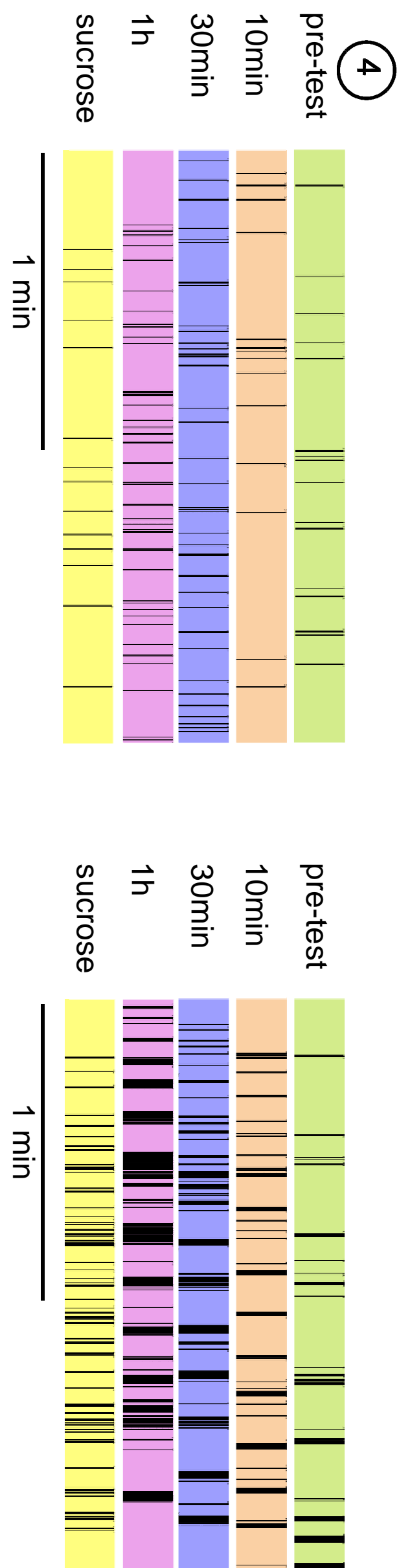
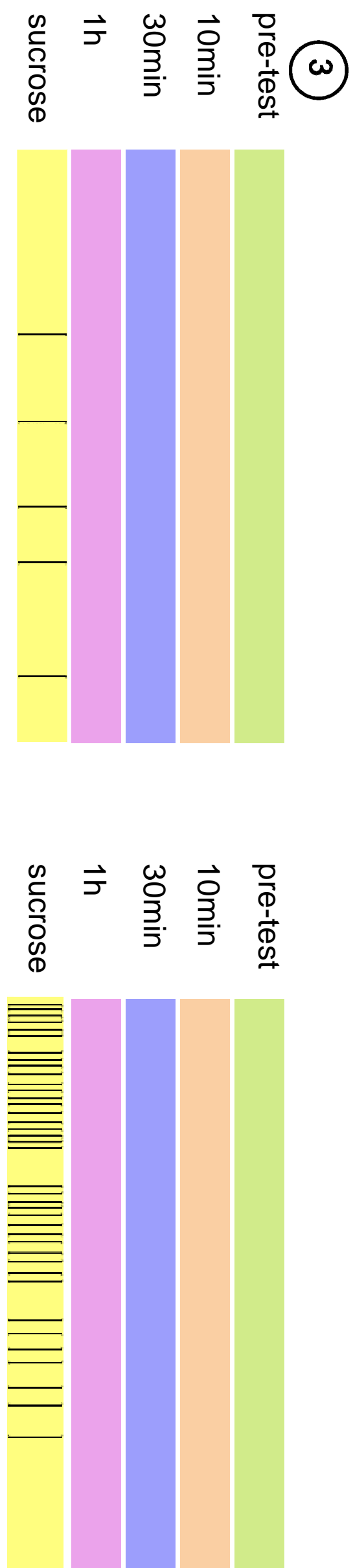
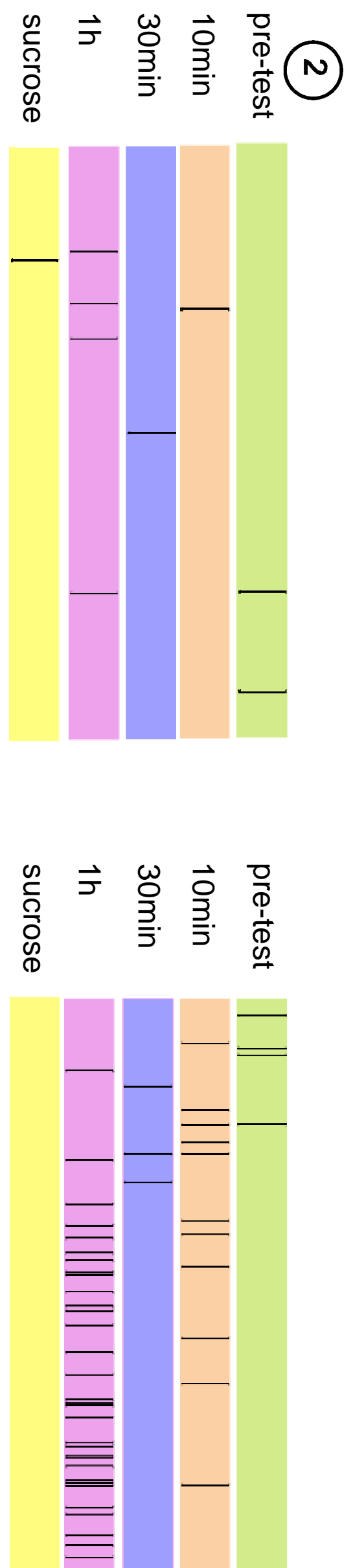
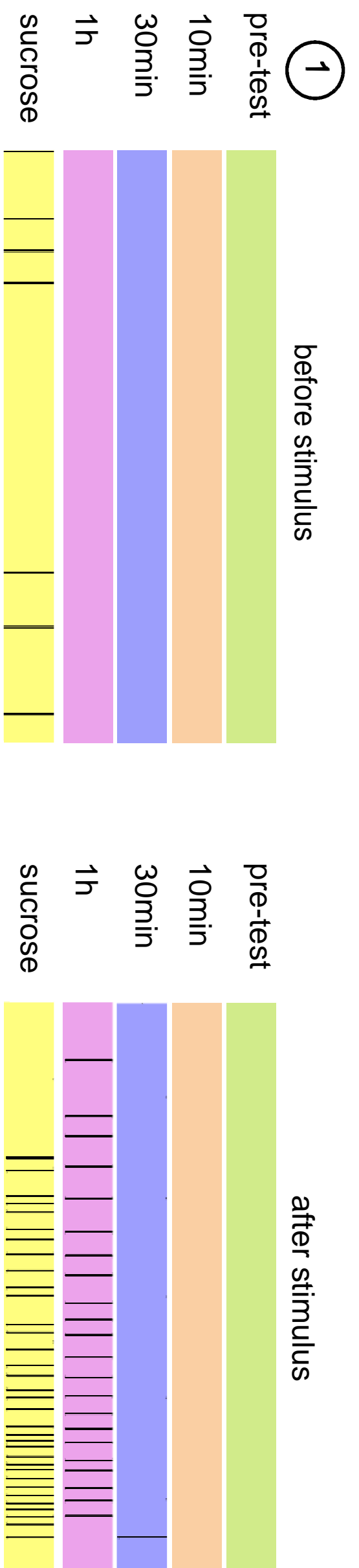
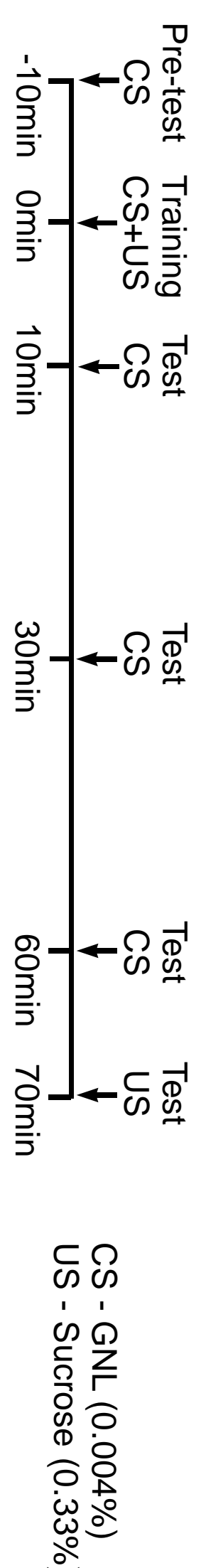
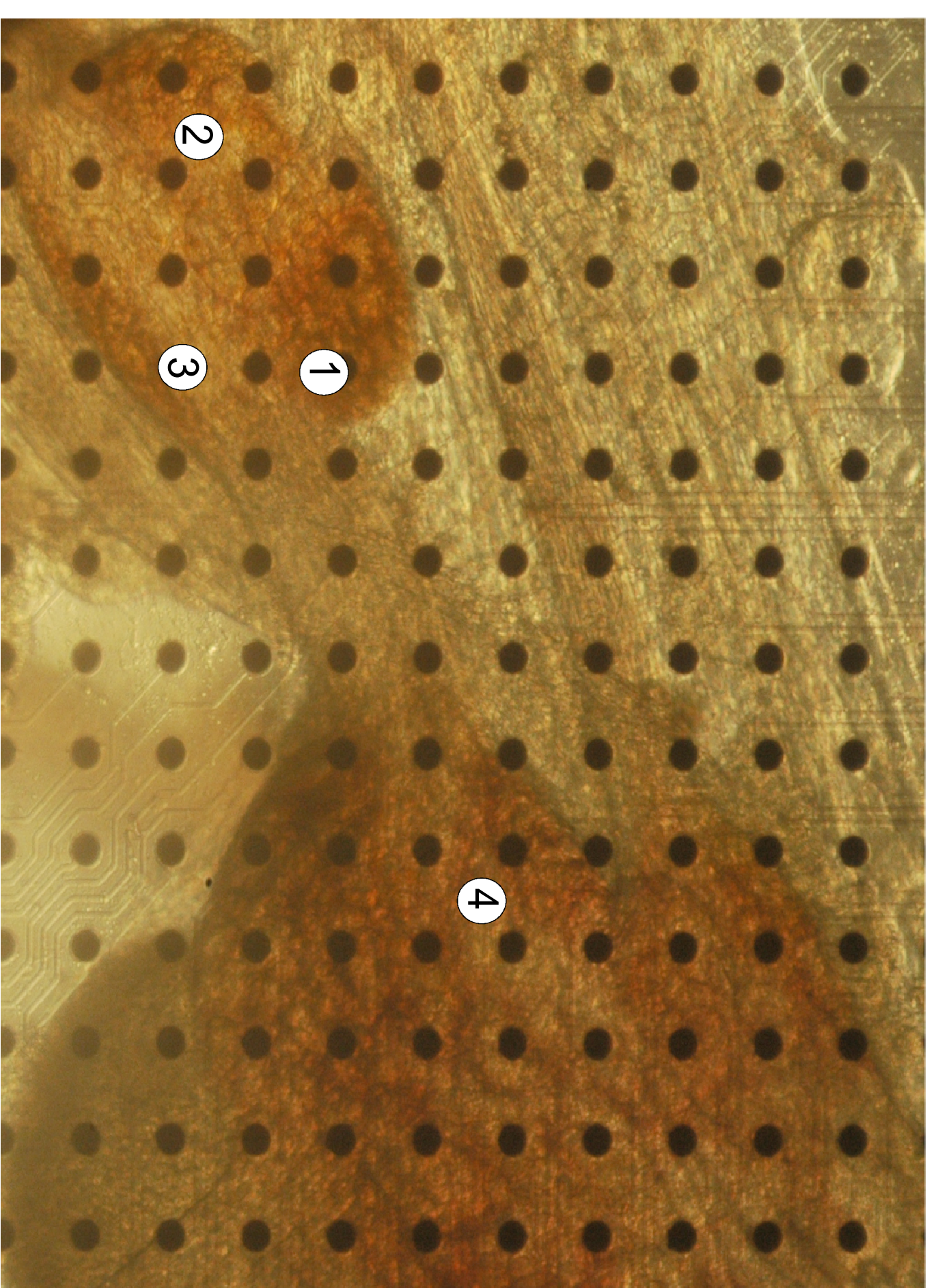
1 LAPSES OCCUR AT 30 MIN AND 2H AFTER SINGLE-TRIAL APPETITIVE CONDITIONING, DURING MEMORY CONSOLIDATION



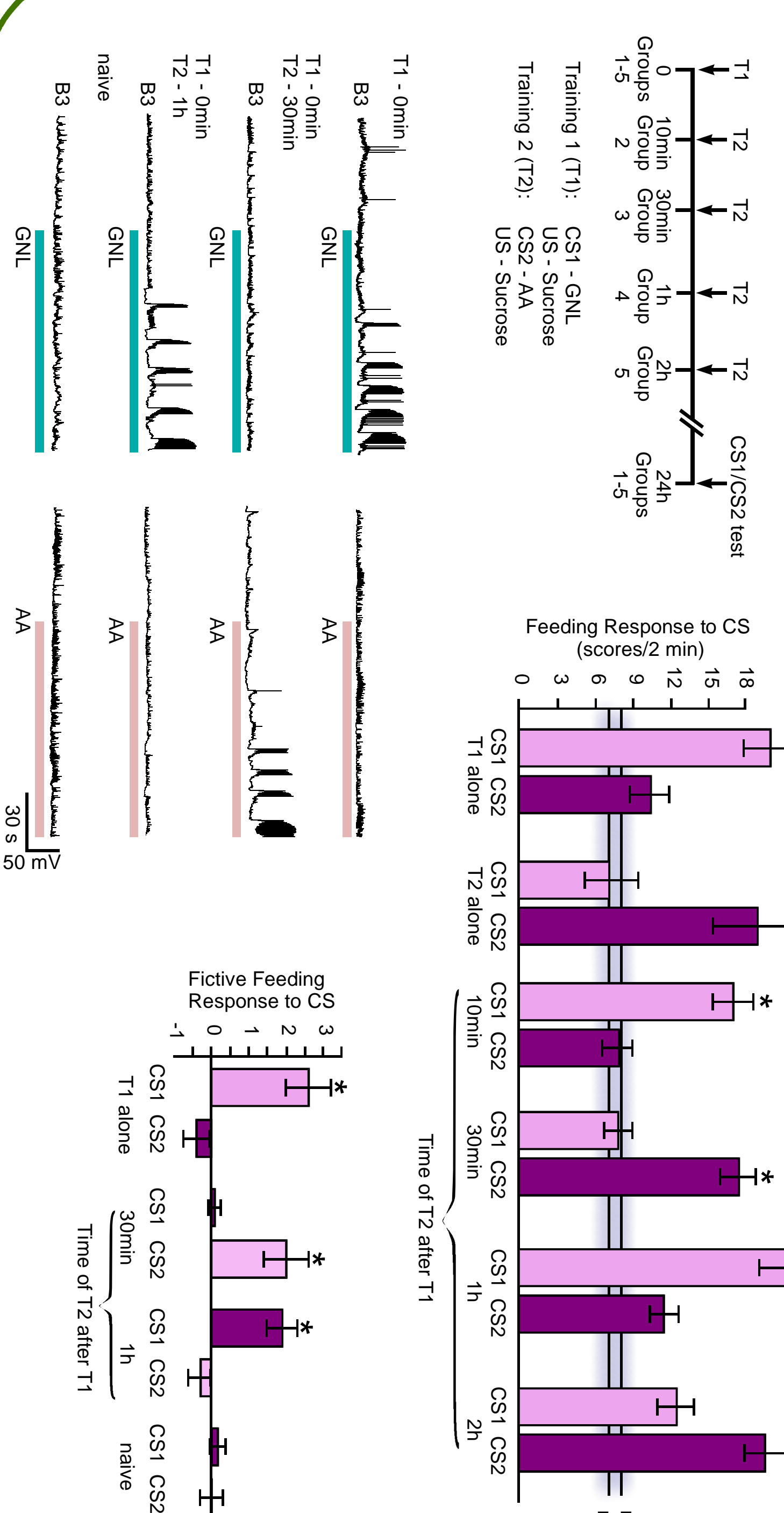
2 MEMORY LAPSES CAN ALSO BE DETECTED AFTER *IN VITRO* TRAINING



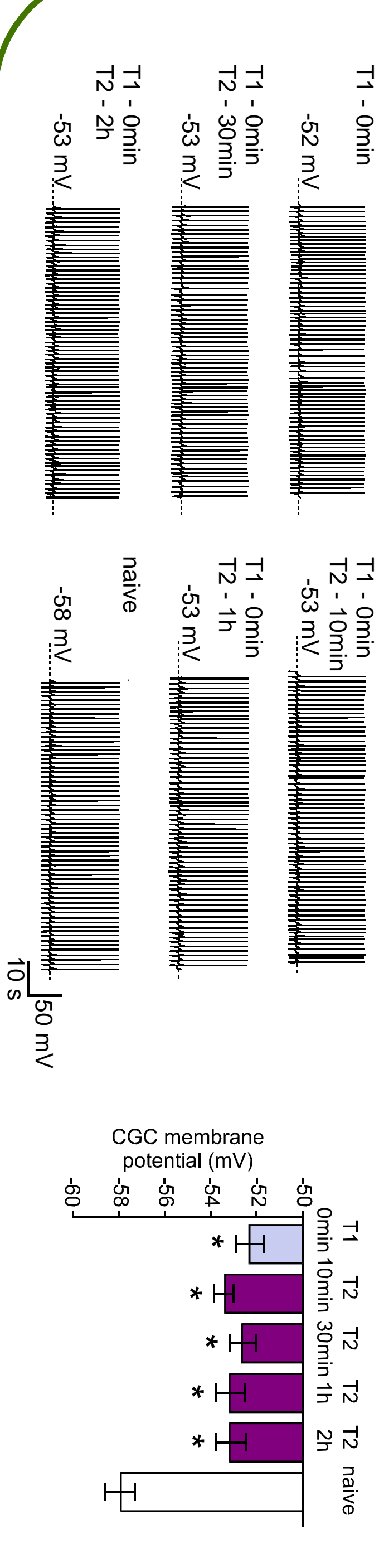
3 POTENTIAL NOVEL NEURONS OF THE MEMORY CIRCUIT IDENTIFIED BY USING A MULTI-ELECTRODE ARRAY (MEA) TECHNIQUE



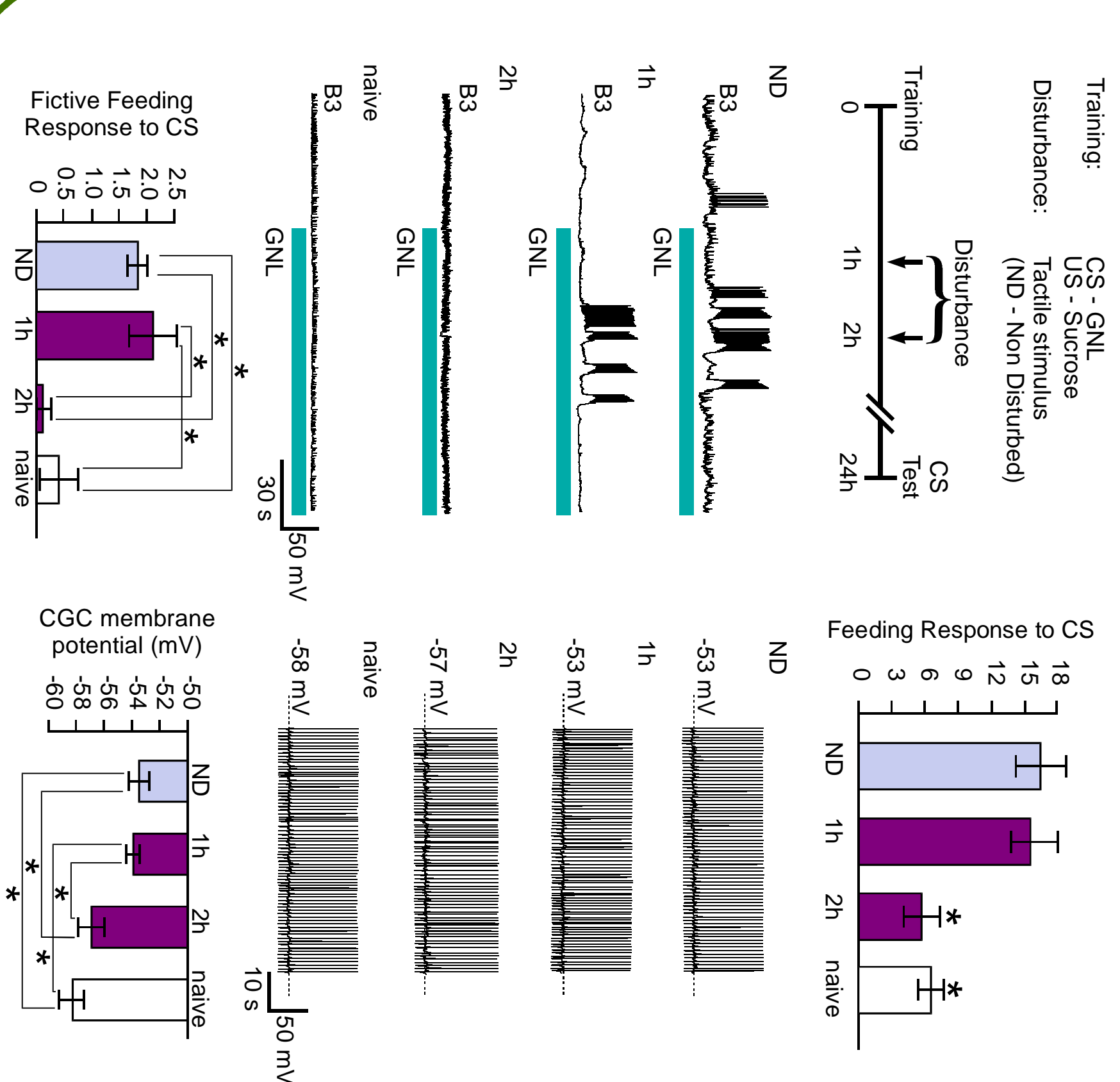
4 MEMORY CAN BE REPLACED DURING LAPSE PERIODS BUT NOT AT OTHER TIMES



5 LONG TERM CELLULAR CHANGES IN A KEY NEURON OF THE MEMORY CIRCUIT OCCUR AFTER MEMORY REPLACEMENT



6 DISTURBANCE AT A LAPSE DISRUPTS MEMORY CONSOLIDATION AND PREVENTS LEARNING INDUCED CELLULAR CHANGES



CONCLUSIONS

Our work on the snail (*Lymnaea stagnalis*) suggests that memory lapses during consolidation are adaptive, allowing consolidation to be regulated so that acquisition and storage are effectively modified by new information.

Reference

Marras V, O'Shea M, Benjamin PR, Kemenes I. (2013) Susceptibility of memory consolidation during lapses in recall. *Nature Commun.* 4:1578

Acknowledgement

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