NON-LINEAR SUSCEPTIBILITY TO INTERFERENCES IN DECLARATIVE MEMORY FORMATION

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INTRODUCTION

After encoding, memories are in a labile state followed by a stabilization process known as consolidation[1]. Once consolidated they can enter a new labile state after the presentation of a reminder (cue) of the original memory, followed by a period of re-stabilization (reconsolidation)[2] . In both processes, once stabilization/re-stabilization is accomplished the memory cannot be modified[3]. Currently there are studies that show a rapid stabilization after 30 min[4,5], while others studies show that stabilization occurs after 6h[3]. However, there are no studies evaluating short and long delays simultaneously. Knowing that there are spontaneous waves of destabilization (without the re-exposure to keys linked to learning) on which the consolidation and memory persistence depends[6], here we investigate whether declarative memories in humans go through spontaneous labilization/stabilization processes after learning or if they only pass through a single time window of lability.

METHODS

Online Experiment: Basic Protocol

DAY 1		DAY 3
Training	Interference Task	Testing

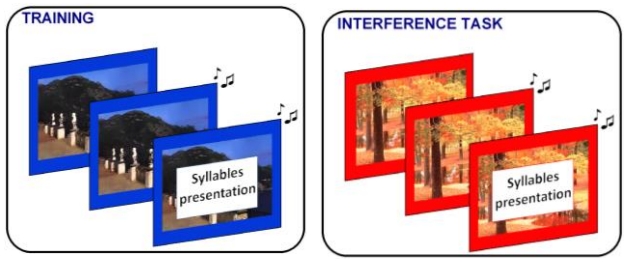
TRAINING (L1-memory). 10 trials: In the first trial 5 pairs of syllables were presented and in the following 9 trials participant had to complete them.

INTEFERENCE (L2-memory). 10 trials similar to training. The L2 was formed by a five different pairs of syllables.

DEPENDENT VARIABLES

Memory Change = N° Correct responses Trial 1Testing – N°Correct responses Trial 10Training

We used the Gorilla Experiment Builder (www.gorilla.sc) to create and host our experiment.



- Beck Depression Inventory-II (Test BDI-II)[7]
- State-Trait Anxiety Inventory (Test STAI)[8]
- Pittsburgh Sleep Quality Index (PSQI)[9]
- Morningness–Eveningness Questionnaire (MEQ)[10]

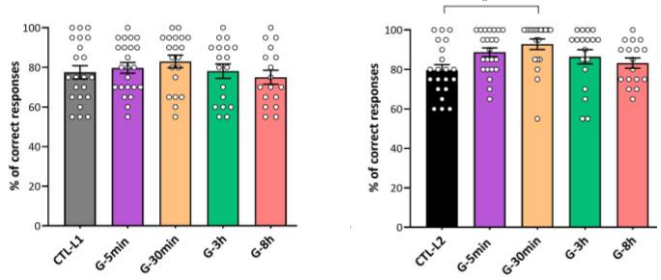
An impaired performance at L2-testing is attributed to Retrieval- Induced Forgetting effect (RIF). It shows that the act of remembering L1-memory can temporarily block a late retrieval of L2-memory[11].

Low decay of memory change L2-Memory	Higher decay of memory change L2-Memory
NO RIF EFFECT	RIF EFFECT
IMPAIRED L1-Memory	INTACT L1- Memory

RESULTS

GROUP	DAY 1			DAY 3
G-5min	Training	5 min	Interference task	Testing
G-30min	Training	30 min	Interference task	Testing
G-3h	Training	3 hours	Interference task	Testing
G-8h	Training	8 hours	Interference task	Testing
Control L1-memory	Training			Testing
Control L2-memory	Interference task			Testing

Day 1. TRAINING



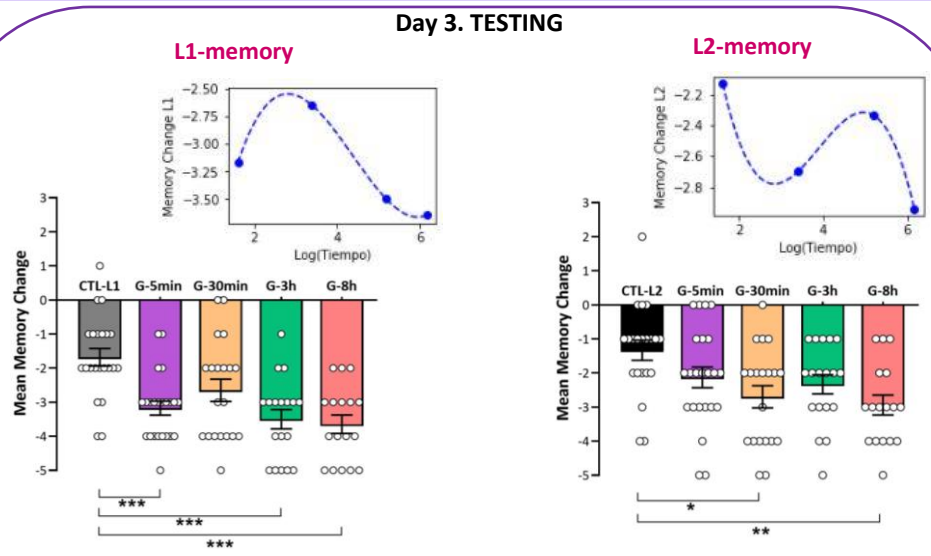
There are significant differences beetwen groups for List 2 training. So, we use a new dependent variable: Memory Change

TEST AND QUESTIONNARIES

	BDI II	STAI: TRAIT	STAI: STATE	PSQI	MEQ
CTL-L1	38.36 ± 2.06	41.09 ± 2.56	14.27 ± 2.23	7.68 ± 0.79	43.64 ± 2.29
CTL-L2	37.71 ± 1.69	43.00 ± 1.96	13.71 ± 2.27	6.19 ± 0.68	44.86 ± 2.08
G-5min	38.22 ± 1.66	39.70 ± 1.87	12.96 ± 1.37	6.61 ± 0.69	45.83 ± 2.21
G-30min	37.80 ± 1.31	38.60 ± 1.63	12.10 ± 1.44	7.70 ± 0.78	47.50 ± 1.83
G-3h	35.67± 1.52	35.72 ± 2.46	10.72 ± 1.40	6.06 ± 0.59	43.28 ± 2.64
G-8h	35.47± 1.65	40.06 ± 1.52	10.29 ± 1.54	7.12 ± 0.88	46.24 ± 2.54
p value	p= 0.58	p= 0.25	p= 0.74	p= 0.45	p= 0.78

There are no significant differences between groups at the evaluated variables.

Day 3. TESTING



L1- Memory: The memory shows a higher decay when the interference task was presented immediately after, 3 hours after or 8 hours after learning. The group that received the interference task after 30 min of learning showed a similar performance that the "CTL-L1" group.

L2- Memory: We observed an intact RIF effect after 8 h as well as after 30 min, indicating successful stabilization of List 1 memory in both conditions. On the contrary, the RIF effect was absent after 5 min and 3 h, suggesting the List 1 memory was not yet stabilized at this time and thus, it was sensitive to disruption by interference learning.

We found a new time window, shortly after acquisition, where the memory became rapidly protected against interference

DISCUSSION

We showed that the dynamics of declarative memory consolidation seems not to be an all or nothing process. We found a new time window, shortly after acquisition, where the memory became rapidly protected against interference. The short time window after acquisition, where the declarative memory seems to be transiently protected against interferences, matches to the early consolidation processes that take place within about 30 minutes and induce a fast increase in synaptic strength independent of protein synthesis[12,13], possibly resulting in protection of these memory traces against interference at short-term. However, these early changes are transient and decay after about 90 minutes[14]. Nevertheless, this does not explain the results underlying absence of simultaneous retrieval interferences on List 1 for the "G-30min". We suggest that not only synaptic consolidation would be involved, but also that a rapid system consolidation process could be initiated during learning or shortly after acquisition has ended[15,16]. Considering that consolidation and reconsolidation share similar molecular mechanisms it would be of great interest for the clinical field to study this short time window where the memory is protected against interference. Further experiments should be conducted to understand the consolidation and reconsolidation dynamics.

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