Language learning can withstand one night of total sleep deprivation

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01 INTRODUCTION

Generalisation, the ability to extract general knowledge from individual experiences, is at the heart of human learning.

This is particularly evident in learning to read: we extract general information about the relationship between letters and sounds by learning to read a large number of individual words.

We seek to better understand what role sleep plays in learning to read in a new artificial script, and how sleep may help extract general knowledge about the letter-sound relationships.
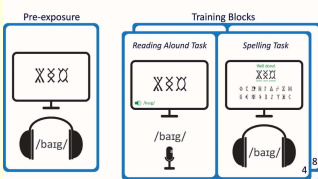
1. **Does sleep deprivation <u>before</u> learning impair participants' ability to extract and use the underlying letter-sound knowledge?**

2. **Does sleep deprivation <u>after</u> learning impair participants' ability to extract and use the underlying letter-sound knowledge?**
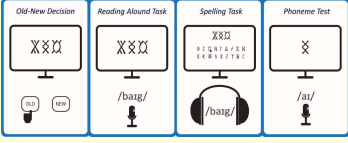
02 EXPERIMENTAL DESIGN
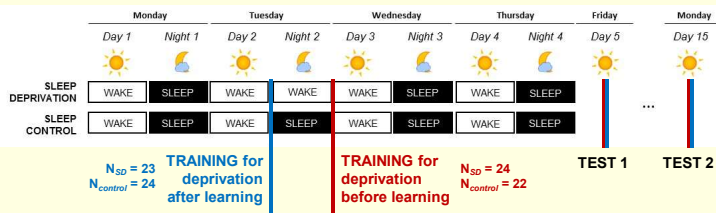
03 TRAINING AND TEST TASKS

Participants had to reach a criterion of at least 70% correct in the spelling task.

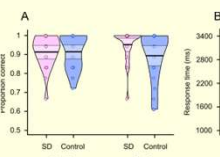Test stimuli included *trained words* (tests episodic memory) and *untrained novel words* (tests generalisation).

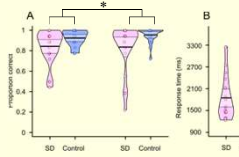Both accuracy and reaction time (RT) measured in all test tasks.

04 RESULTS

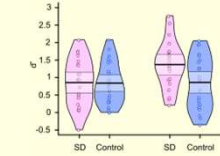### Phoneme test

Main effect of sleep deprivation in deprivation after learning RTs, and in deprivation before learning in accuracy.

Old-New decision
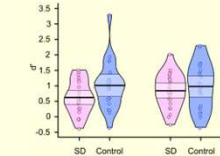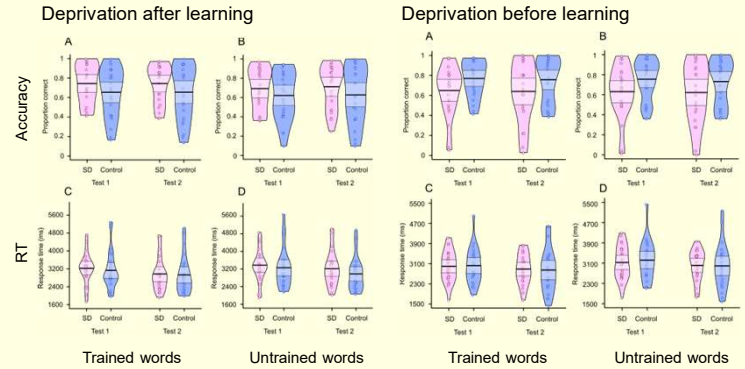

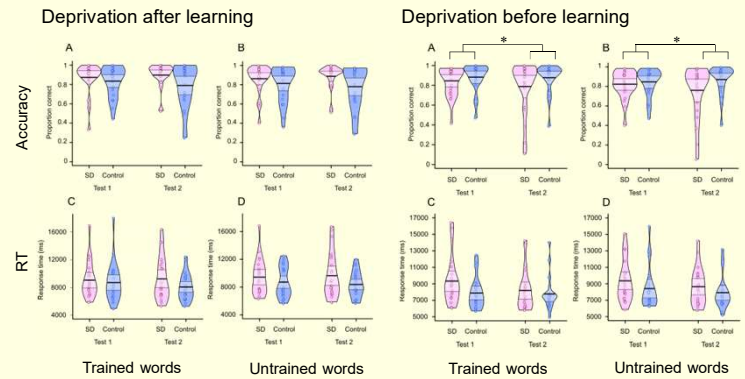*No effect of sleep deprivation.*

No effect of sleep deprivation.

Reading aloud trained and untrained words

No effect of sleep deprivation.

Spelling trained and untrained words

No effect of sleep deprivation in deprivation after learning, but in deprivation before learning controls were significantly more accurate.

05 META-ANALYSIS OF SLEEP DEPRIVATION EFFECTS ON MEMORY

Deprivation after learning

65 studies were selected on the following basis:
- *At least one night of total sleep deprivation after encoding*
- *At least one measure of memory was the primary DV*
- *Sufficient detail reported to calculate effect size*
- *Participants were healthy adults*

The overall effect size was 0.294, **indicating a significant difference from zero** (95% CI [0.186, 0.402], p < .001). Egger's regression test for funnel plot asymmetry indicates no significant funnel plot asymmetry (z = 0.15, p = .88), suggesting that **there is no reliable evidence of publication bias.**

Deprivation before learning

40 studies were selected on the same basis as above.

The overall effect size was 0.632, **indicating a significant difference from zero** (95% CI [0.471, 0.792], p < .001). Egger's regression test for funnel plot asymmetry indicates significant funnel plot asymmetry (z = 4.09, p = .001), suggesting that **there may be some publication bias.**

Taking potential publication bias into account, a trim-and-fill analysis still showed a significant difference from zero though, g = 0.452, p < .001.

06 SUMMARY & CONCLUSIONS

- We found little evidence that one night of total sleep deprivation before or after learning impairs learning or generalisation of a new writing system.
- Our meta-analysis suggests other forms of memory are impacted by sleep deprivation, and that this finding holds even when taking publication bias into account.