

Memory consolidation protects against interference in generalisation of language learning

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01 INTRODUCTION

In an artificial language learning paradigm where participants learn novel words and affixes we have begun to chart the mechanisms that allow newly acquired episodic memories to become part of semantic memory (Tamminen et al., 2012, Merx et al., 2011).

One hallmark of semantic memory is the ability to generalise. Tamminen et al. (2012) showed that newly learned affixes become context-independent and able to be generalised to new linguistic contexts only after memory consolidation.

If consolidation is critical for the emergence of generalisation, it might be important in allowing multiple, potentially mutually interfering, meanings to be associated with new affixes. This is supported by the finding that sleep protects against interference in paired associate learning (Ellenbogen et al., 2006).

Aims of the current experiments:

- 1 Can participants learn multiple meanings for novel affixes and still form generalised representations?
- 2 If the competing meanings interfere with each other, can memory consolidation overcome the interference to allow generalisation?

02 DESIGN

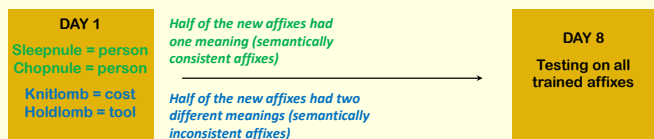
We teach participants novel words, formed by a stem and a novel affix (e.g., -nule):

"sleepnule is a participant in a sleep experiment"
"chopnule is the cook who chops all the vegetables"

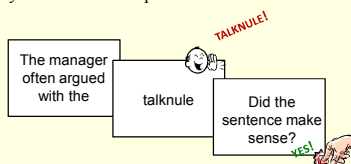
Each novel affix is encountered in multiple novel words, and each novel affix can refer to one or multiple semantic concepts (persons, tools, places, or costs).

03 EXPERIMENT ONE

Can we acquire new affixes with inconsistent meanings (i.e. affixes with more than one meaning)? Will the competing meanings interfere with each other?



24 participants learned 64 novel words that carried 8 new affixes, testing took place one week later. Main test was **sentence priming**, participants read aloud a novel word that formed a congruent or incongruent ending to a sentence presented on screen. We measured reading latency and asked for explicit decisions on whether the word was congruent or not.

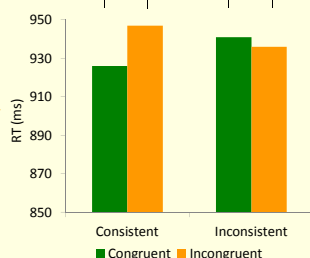


The novel word was always presented as an untrained stem + trained affix combination. Therefore we were testing **generalised affix knowledge**.

In Sentence Priming reading latencies we see

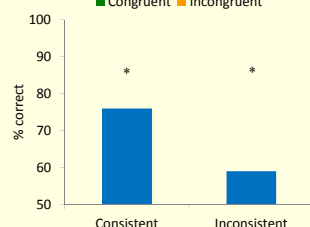
- No main effect of priming
- Significant interaction between Congruency and Consistency, $p = .02$
- Priming in the consistent condition, $p = .01$
- No priming in the inconsistent condition

Participants failed to generalise affixes with multiple meanings in this speeded task.



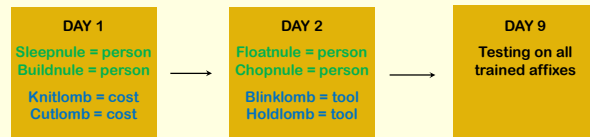
In the Explicit Congruency Decision task

- Accuracy rates are significantly higher than chance (50%) in both conditions = **generalisation can be achieved in this non-speeded task even when affixes have multiple meanings.**
- Accuracy is significantly lower in the inconsistent condition = generalisation is less successful when an affix has multiple meanings.



04 EXPERIMENT TWO

Can we acquire multiple affix meanings if we allow one meaning consolidate before introducing a second meaning?



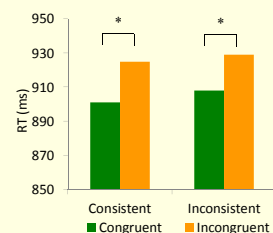
One of the meanings in inconsistent affixes is allowed to consolidate overnight before adding a second meaning

24 participants learned 64 novel words that carried 8 new affixes over two days, testing took place one week after training. Test session was identical to E1.

In Sentence Priming reading latencies we see

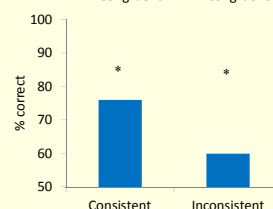
- Main effect of priming, $p < .001$
- No significant interactions
- Priming in the consistent condition, $p = .01$
- Priming in the inconsistent condition, $p = .03$

Participants successfully generalised affixes with multiple meanings in this speeded task.



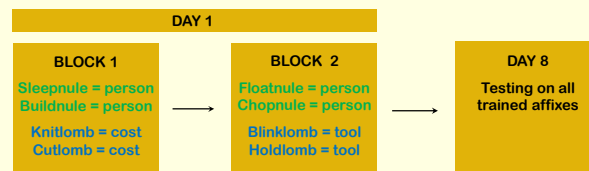
In the Explicit Congruency Decision task

- Accuracy rates are significantly higher than chance (50%) in both conditions
- There is a significant difference between the conditions. This replicates the pattern seen in Experiment 1.



05 EXPERIMENT THREE

Can we acquire multiple affix meanings if we block the training by training one meaning first, followed by the second meaning?

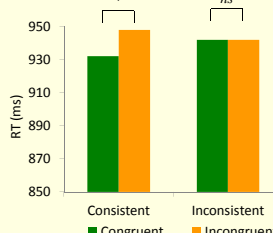


24 participants learned 64 novel words that carried 8 new affixes in one session but blocked as in E2, testing took place one week after training. Test session was identical to E1 and E2.

In Sentence Priming reading latencies we see

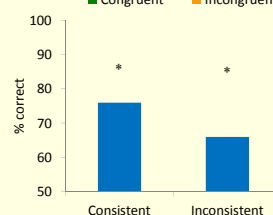
- No main effect of priming
- Marginal interaction, $p = .12$
- Priming in the consistent condition, $p < .001$
- No priming in the inconsistent condition

Participants failed to generalise affixes with multiple meanings in this speeded task.



In the Explicit Congruency Decision task

- Accuracy rates are significantly higher than chance (50%) in both conditions
- There is a significant difference between the conditions. This replicates the pattern seen in Experiments 1 and 2.



06 CONCLUSIONS

- Experiment 1 suggests that competing affix meanings interfere with each other if trained simultaneously, preventing the formation of generalised affix representations. Some degree of generalisation can occur in a non-speeded task, although it is less reliable.
- Experiment 2 showed that this interference can be overcome if one affix meaning is allowed to consolidate overnight before adding a second meaning.
- Experiment 3 showed that a consolidation opportunity is critical, simply separating the two meanings by blocking is not sufficient.