Overnight memory transformation in the human brain

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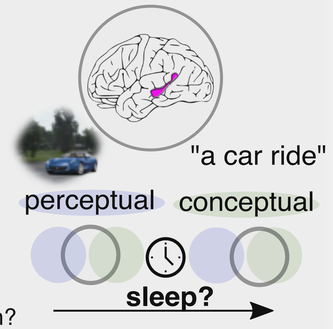
introduction

Episodic memory traces are thought to undergo transformations as they are consolidated in the brain[1,2].

Sleep is implicated in memory consolidation[3], but its impact on putative memory transformation has not been explored.



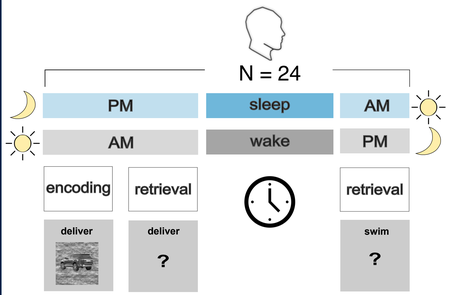
aims

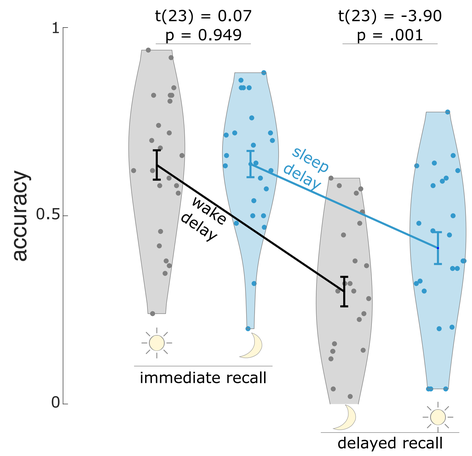
1) Does sleep play an active role in memory consolidation?
2) How is sleep involved in memory transformation?
3) What neural content is prioritised by sleep-dependent consolidation?

experiment 1

sleep-dependent memory consolidation?

- word x object/scene association task (e.g. "deliver" & car image)
- sleep vs. wake delay (counterblanced within-subject design)



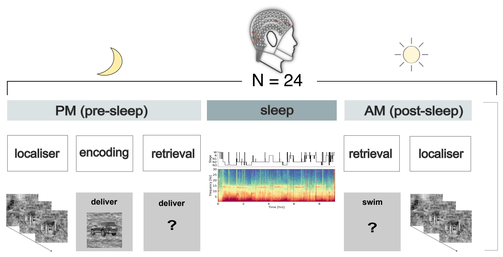


Conclusion #1:
Memory consolidation is sleep-dependent

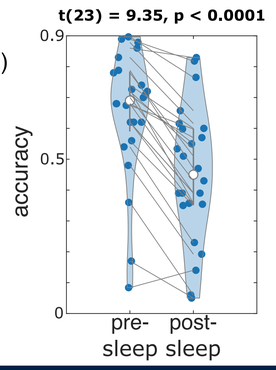
experiment 2

sleep-related memory transformation?

- high-density EEG (64 electrordes) + Polysomnography (PSG)
- word x object/scene association task (e.g. "deliver" & car image)



behavioural performance

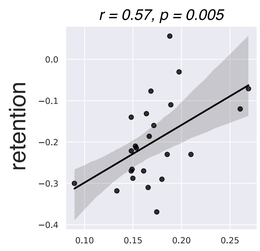


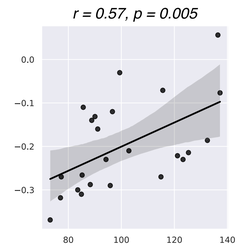
experiment 2: EEG

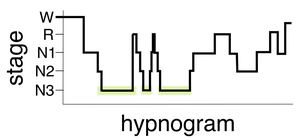
a) sleep results

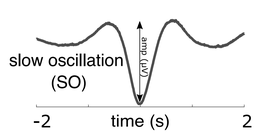
correlation between sleep and memory retention

- 24 nights of sleep EEG recordings sleep-scored (automated + manual)









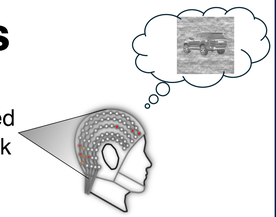
time spent in N3 correlates with memory retention

slow oscillation amplitude (0.3-1.25Hz) correlates with memory retention

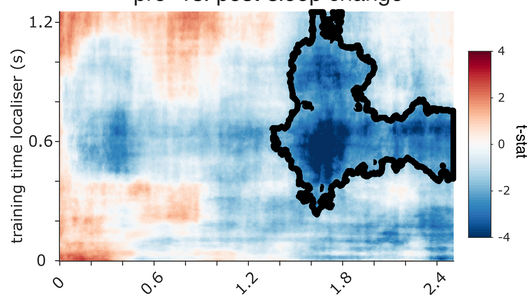
b) memory results

target category decoding

LDA classifier (object vs. scene), trained on localiser and tested on retrieval task

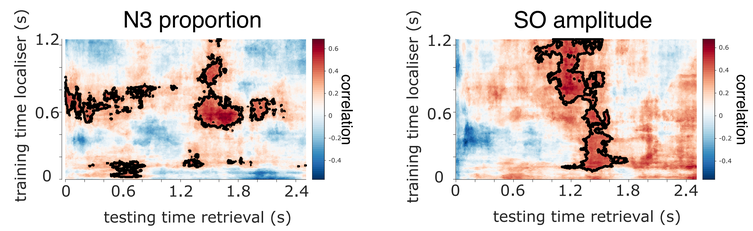


pre- vs. post-sleep change



greater reinstatement of target category during post-sleep retrieval

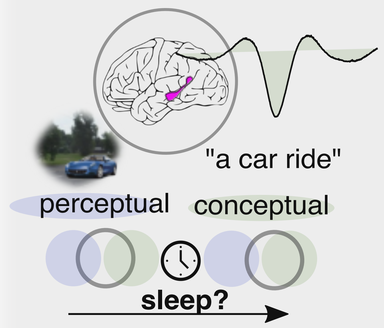
target category decoding in the morning: correlation with sleep



* time spent in N3 and SO amplitude modulate neural category decoding during morning retrieval

Conclusion #2:
Sleep (specifically N3 & SOs) plays an *active* role in the consolidation of memory traces

Conclusion #3:
Sleep (particularly SOs) transforms the content of memory traces during post-sleep retrieval



summary

- **Behavioural evidence for sleep-dependent memory consolidation.**
- **Particular role of N3/SO-amplitudes in memory consolidation.**
- **Post-sleep recall shows enhanced reliance on conceptual-level reinstatement.**
- **Potential role of SOs in creating higher-level 'gist-like' memory traces.**

references

1) Baddeley, A. (1988). Cognitive psychology and human memory. Trends in Neurosciences, 11(4)
2) Antony, J. W., Ferreira, C. S., Norman, K. A., & Wimber, M. (2017). Retrieval as a fast route to memory consolidation. Trends in Cognitive Sciences, 21(8)
3) Rasch, B., & Born, J. (2013). About sleep's role in memory. Physiological Reviews, 93(2)

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