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The Influence of Sleep on Relearning and Long-term Retention of Verbal Items

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Introduction

- The effect of sleep on consolidation of newly learned information is well known (Rasch & Born, 2013). For declarative memories, many studies have shown better retention of verbal information when learning is followed by a period of sleep rather than an equivalent wake period (Gais et al., 2006; Plihal & Born, 1997; Schönauer et al., 2014).
- The spacing effect literature has shown that spaced sessions of repeated learning leads to better long-term memorization than massed sessions (Cepeda et al., 2006). The sleep episodes that occur between the learning sessions in the spaced condition could be responsible for the spacing benefit.
- Mazza et al., (2016) did show that a sleep period between learning and relearning provides better post-learning retention, faster relearning of forgotten information, and better long-term memorization.
- To reach the demanding relearning criterion used in Mazza's study (recapitulative, i.e., all 16 items recalled correctly in a row), their participants practiced the material intensively, which could have led to over-relearning.

- In the present study, we wanted to know whether the sleep effects observed in Mazza's study **could have been due to this intensive recapitulative type of relearning**. We used an eliminatory relearning criterion in which participants had to recall the 16 items once each.
- We hypothesized that **eliminatory type of relearning would not lead to sleep effect** on neither relearning speed or long-term memorization.



Method

Participants

- French young adults aged 18 to 30 years (N = 23)
- 2 experimental groups (Sleep (N = 12) vs Wake (N = 11))
- Matched on various variables (sex, quality of sleep, sleepiness, circadian rhythms)

Learning and relearning criterion

- 1 correct answer per word-pair
- Participants had to recall the french word
- Each correct word-pair recall was no longer presented

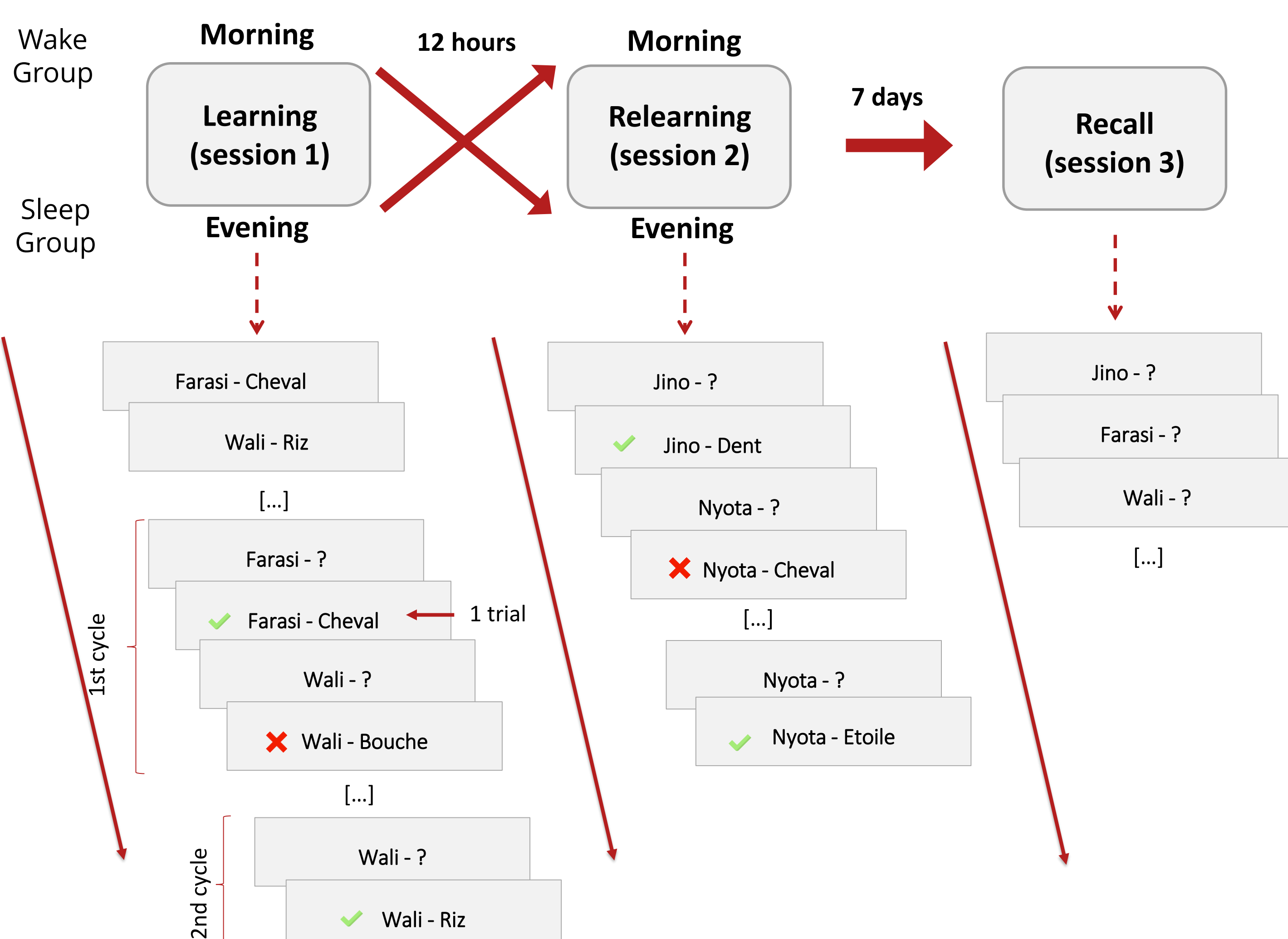
Material & Method

- Computerized procedure
- 16 word-pairs of french and swahili words

- Session 1** : Display of the 16 word-pairs, then cued-recall of the Swahili word followed by feedback until participants reach learning criterion
- Session 2** : Cued-recall of the Swahili word followed by feedback until participants reach relearning criterion
- Session 3** : cued-recall of the 16 word-pairs once

Word-pairs

Farasi – Cheval	Ngurume – Cochon
Wali – Riz	Kiniwa – Bouche
Nyota – Etoile	Maziwa – Lait
Mkono – Main	Mwezi – Lune
Ndizi – Banane	Nyanya – Tomate
Panya – Souris	Ngombe – Vache
Wingu – Nuage	Jino – Dent
Sikio – Oreille	Theluji – Neige



Results

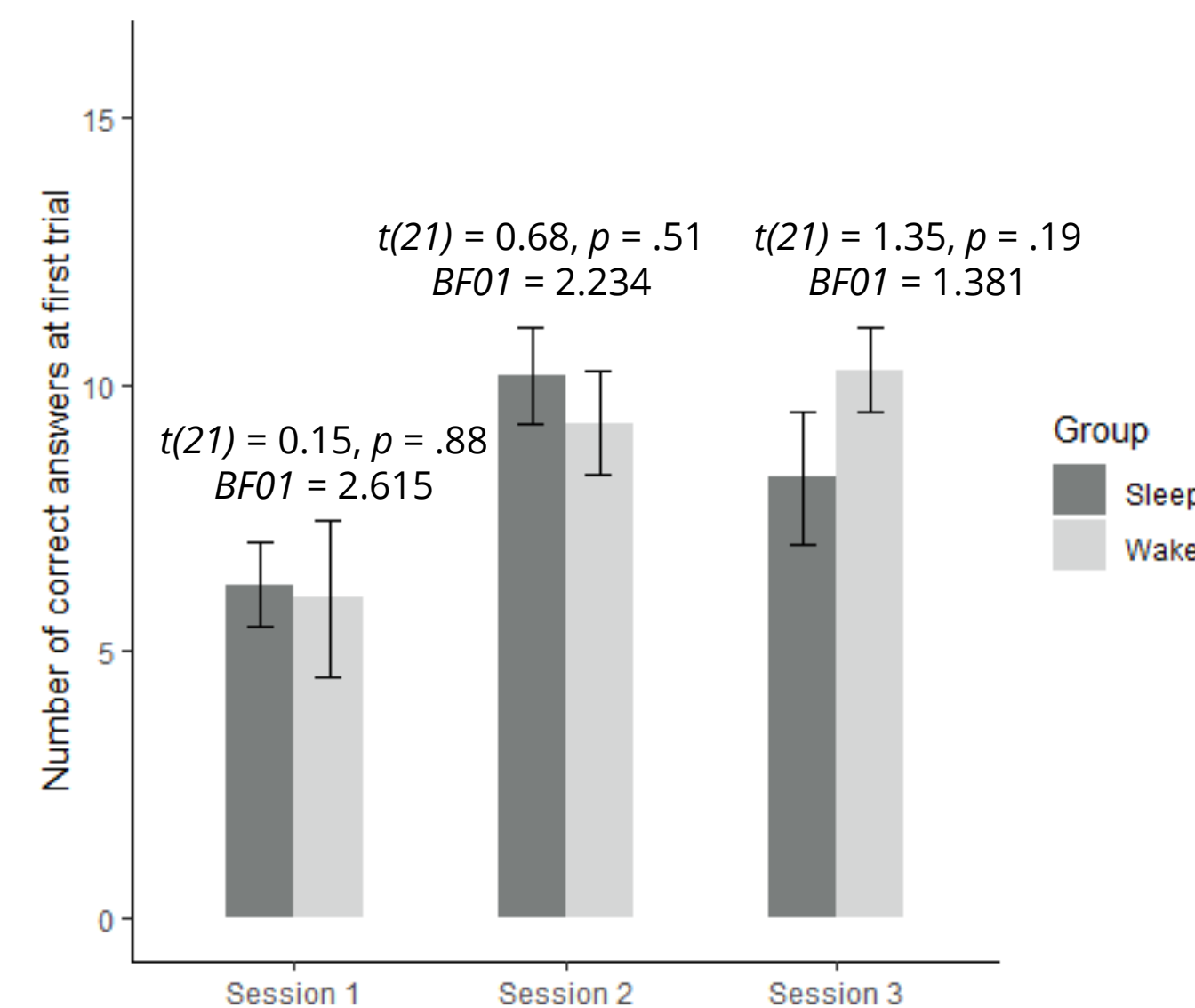


Fig. 1 Number of correct response given at first cycle of each session for Sleep and Wake groups (error bars represent Standard Errors)

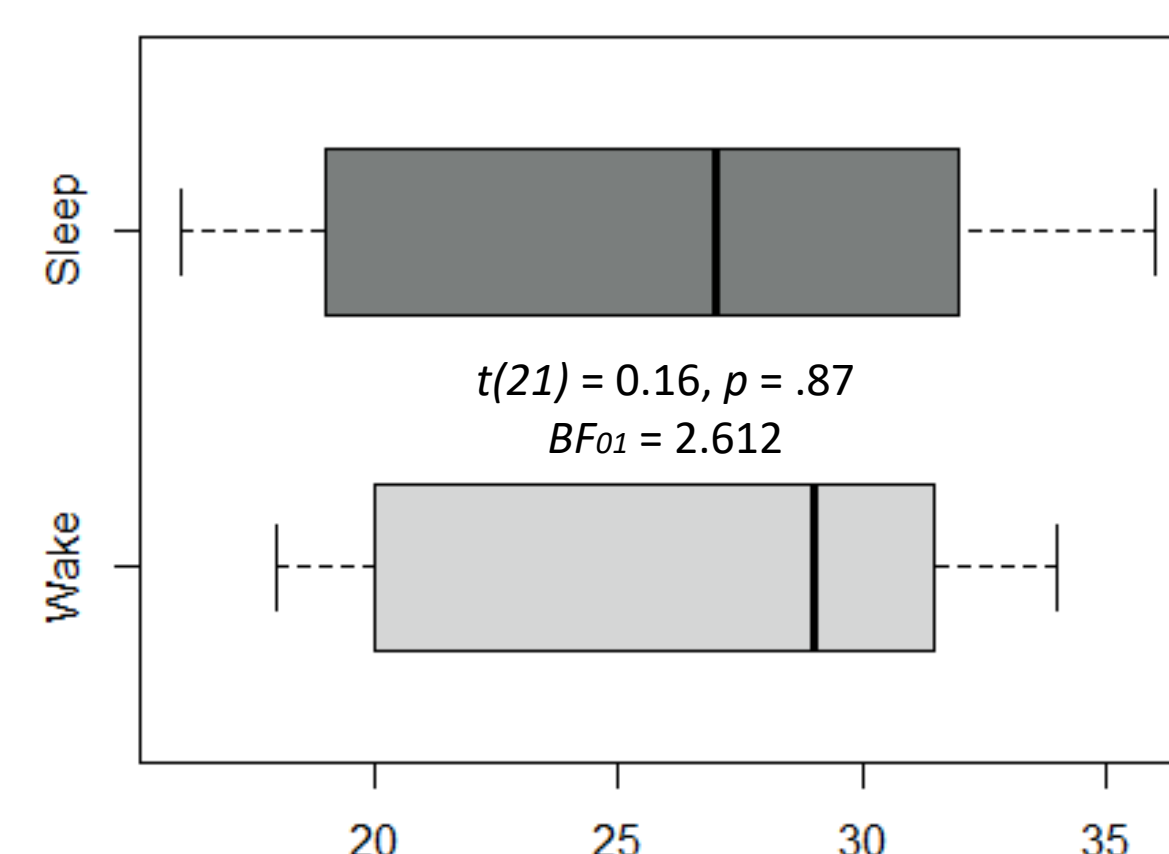


Fig. 2 Number of trials required to reach the criterion during the relearning session, for Sleep and Wake groups

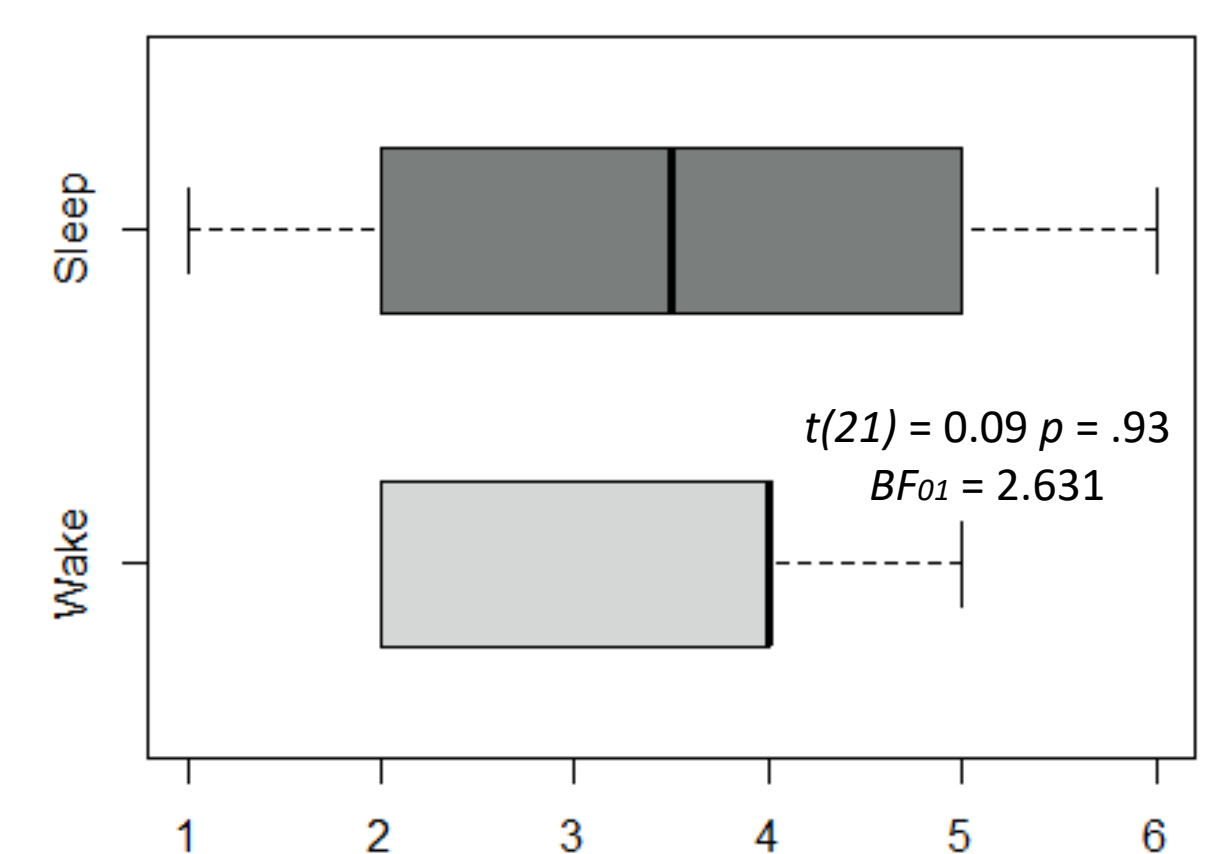


Fig. 3 Number of cycles required to reach the criterion during the relearning session, for Sleep and Wake groups

- Both groups performed equally in Session 1 (learning).
- No significant difference between the two groups for the number of good response at first cycle of relearning (Fig. 1)
- No significant difference between the two groups for the speed of relearning (number of cycles and trials) (Fig. 2 & 3)
- No significant difference between the two groups concerning the long-term memorization (7 days), and slight advantage for the Wake group (Fig. 1)



Conclusion

- No difference at the beginning of relearning (no classical effect of sleep) (session 2)**
 - This null result is quite surprising because the Sleep group was expected to perform better at first cycle of relearning.
 - The smaller sample size in comparison to Mazza's study could induce a lack of statistical power, and then hide the effect.
 - Additional data are being collected, and the final results should indicate whether sleep effect is really affected by the type of learning.
 - No difference on relearning speed after a night of sleep or similar wake period (session 2)**
 - Our results do not show evidence for a greater relearning speed after sleep. Notwithstanding statistical power potential issue, this could mean that participants could not benefit from the eliminatory type of learning (in contrast to the study by Mazza et al.)
 - No difference between the groups for the 7-day recall (session 3)**
 - However, the slight (although non significant) advantage for the Wake group could suggest that sleeping sooner after relearning could produce better long-term consolidation than sleeping later (Sleep group). In contrast, the recapitulative type of learning in Mazza did not lead to an increase in performance in their Wake group.
 - Therefore, it is possible that the less demanding eliminatory type of learning might allow a delayed sleep-dependant consolidation.
- **Conclusion** : The effect of sleep on relearning observed by Mazza et al. using recapitulative type of learning cannot yet be generalizable to other learning procedures for instance based on eliminatory cycles.



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