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Does Oral Breathing Disrupt Memory Consolidation During Wakeful Rest?

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Introduction

- Wakeful rest studies, whereby passive rest is compared with an active task, have shown benefits for declarative memory during short wakeful rest periods measured by free recall (Dewar et al., 2014). This benefit is argued to occur via increases in slow oscillations, considered a prerequisite for memory formation (Kitanishi et al., 2015). Arshamian et al. (2018) found nasal respiration while passively resting for 1-hour led to an advantage for the consolidation of olfactory memory compared with oral breathing. This is argued to occur via the disruption of slow oscillations during oral breathing, but whether this occurs with declarative memory or is limited to olfactory memory is unknown.
- Here we investigate if oral breathing also impairs declarative memory consolidation. We predict that oral respiration should disrupt the slow oscillations in wakeful rest compared to oral breathing, and hence lead to worse declarative memory consolidation during wakeful rest, but have no effect on an active condition.

Apriori Power Analysis

Previous experience informs practical aims of n =75. A within-subjects design of n = 75 provides 80% power to detect an 1df contrast effect size of d = .38. A meta-analysis of waking rest (Humiston et al., 2019) found an effect size of d = .325, 95% CI [.118, .532] whereby waking rest led to enhanced recall performance. The nasal effect found by Arshamian et al. (2018) has an effect size of dz = 0.59, 95% CI [-0.00, 1.18]. Thus, the study should be of sufficient power to detect main effects of this magnitude.

Fig 1. ***Left***: Tape used to direct airflow via the nose ***Right***: Clip used to direct airflow via the mouth

Procedure

2 sessions (approx. 60 minutes), 7 days apart, will consist of counterbalanced oral or nasal consolidation periods. Participants will learn 15 concrete nouns followed by an immediate free recall task. Participants will then attach the apparatus (Fig 1) for redirection of airflow. For the active condition participants will complete 15 minutes of Tetris, a visual spatial task. For the waking rest condition participants will rest with their eyes closed and minimal movement for 15 minutes. Apparatus will then be removed. Regardless of condition a 5-minute distractor task of Tetris will occur, followed by a free recall task. Following a short (2 min) break within the session participants will experience the procedure again with the remaining rest or active condition in a counterbalanced order. The same will occur for the second session with the remaining respiratory condition. At the end of the second session questionnaires on mind wandering and rehearsal will be used. See Fig 2. for an overview of the methods.

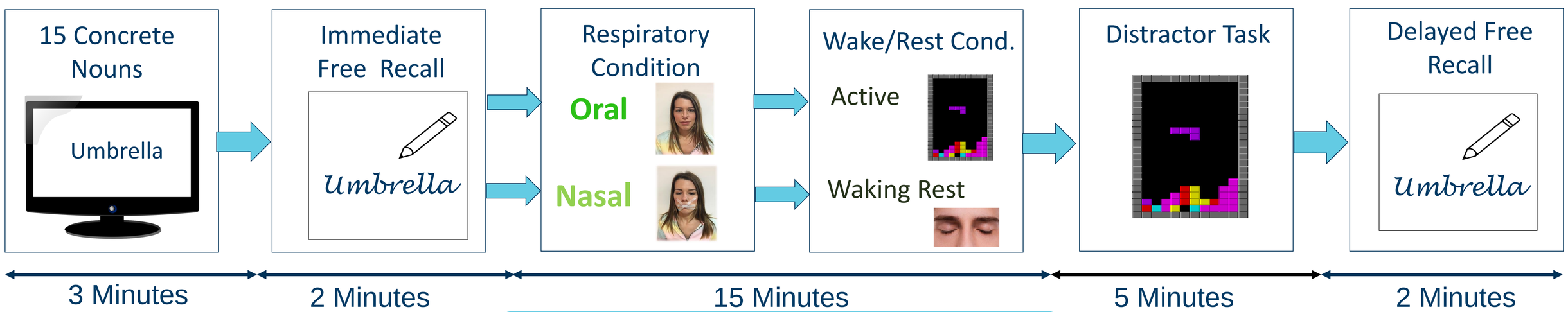

Fig 2. Graphic of procedure for each session

Planned Analysis

A 2x2 ANOVA will investigate main effects of Respiratory pathway and rest using retention scores (the change in scores between immediate and delayed test). Fig 3. shows a predicted interaction. We predict that oral respiration during rest will be equal to that of an active condition. Nasal respiration during wakeful rest will have significantly better recall performance in comparison to active conditions and oral respiration during waking rest. This would provide evidence that oral respiration disrupts memory consolidation equal to that of an active task.

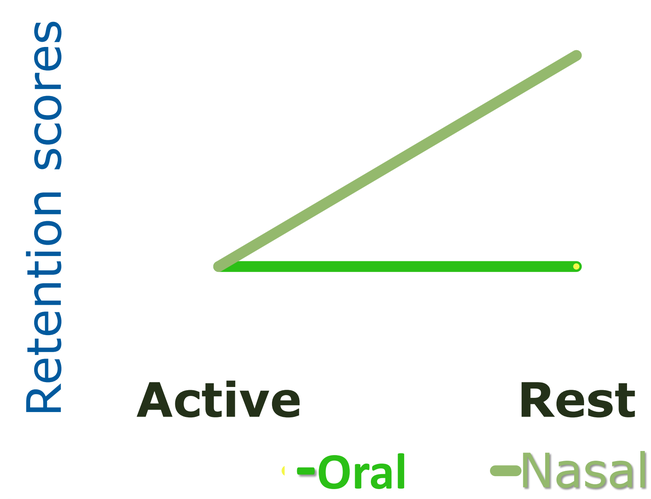

Fig 3. Idealistic representation of a predicted interaction

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