## Daytime naps and motor memory consolidation: A review

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### Introduction

Studies have shown that sleep is important in the process of motor memory consolidation. The importance of sleep has been shown in a variety of different motor tasks (for an overview see King et al., 2017). There is a controversy about which study design is best suited to address questions regarding sleep dependent memory consolidation (Pan & Rickard, 2015). Identified as a suitable study design was the daytime nap design, where the participants learn a motor task with a following period of short sleep, which has several advantages (e.g. control for circadian effects). In this review we extract the main findings on the present research with respect to consolidation effects, task characteristics and sleep parameters.

### Methods

A literature search was conducted to obtain a comprehensive set of empirical research studies on sleep and motor learning with a special focus on daytime sleep. Of the 3772 initial hits 22 studies were scored as relevant and from each study the parameters of interest were extracted (e.g. sleep time) if reported.

### Results

The review reveals that 10 of 22 studies support and 5 partially support the idea of sleep dependent memory consolidation. Mainly the following motor tasks were applied: finger-tapping ($n$ = 10), juggling ($n$ = 2), the serial reaction time task ($n$ = 2) and mirror tracing ($n$ = 2). In average participants spent 80.30 min in bed ($SD$ = 1.71) and showed a high *sleep efficiency* = 81% ($SD$ = 10.87). As expected, sleep stage 2 is dominant during daytime naps and almost no REM sleep is found.

### Discussion

The review demonstrates that day time naps are suitable for the further investigation of sleep related motor memory processes. It was shown that specific sleep events are related to consolidation (e.g. sleep spindles). Furthermore, a nap helps in the protection against interference (Albouy et al., 2016) and has a different effect depending on the age of the participants (Fogel et al., 2014). The results are put in a broader context of sleep science and the importance of nap studies in the consolidation of motor memory. Finally, we will present some preliminary data on day time naps in different settings (consolidation, dreaming) from our own sleep lab and discuss further relevant issues applying a day time nap design (e.g. sleep pressure).