Personality and Individual Differences 86 (2015) 164–167

Contents lists available at ScienceDirect

Personality and Individual Differences

journal homepage: www.elsevier.com/locate/paid

Short Communication

Napping to modulate frustration and impulsivity: A pilot study☆

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ARTICLE INFO

Article history:
Received 19 February 2015
Received in revised form 23 May 2015
Accepted 5 June 2015
Available online 24 June 2015

Keywords:
Wakefulness
Frustration
Impulsivity
Persistence
Inhibition

ABSTRACT

Recent research has shown that napping can increase positive mood, and improve immune functioning, demonstrating the additional benefits of naps beyond reducing sleepiness and fatigue. Because prolonged wakefulness is becoming more common, it is becoming increasingly important to identify effective approaches to decrease resultant cognitive deficiencies. The present study aimed to examine the impact of a brief, midday nap on an aspect of executive functioning, emotional control. 40 subjects were randomized into a nap or no-nap condition, and emotional control was measured with a self-report impulsivity measure and frustration tolerance task. Results revealed that nappers showed a decrease in self-reported impulsivity and increased tolerance for frustration, while those in the no-nap condition showed the opposite pattern. These results indicate that emotional control may become impaired from wakefulness that builds across the day, and that napping may be an effective countermeasure.

1. Introduction

Understanding the benefits of napping for those who regularly experience prolonged wakefulness is crucial as the number of individuals who experience sleep loss or sleep disturbance is widespread. Currently, at least 28% of Americans get insufficient sleep (Pleis, Lucas, & Ward, 2009) while approximately 14% perform shift work which can significantly affect sleep quality (Drake, Kryger, & Phillips, 2005), and extend prior wakefulness. The literature has consistently demonstrated that sleep deprivation impairs cognitive functioning, decreasing cognitive speed and impairing attention and memory (Goel, Basner, Rao, & Dinges, 2013).

Sleep deprivation has also been shown to preferentially affect executive functioning (Durmer & Dinges, 2005). This may indicate that complex behaviors such as emotional control, which plays an important protective role in psychological functioning, may also be at risk. For example, sleep deprivation has been associated with a decreased ability to inhibit impulsive responses to a frustrating obstacle (Kahn-Greene, Lipizzi, Conrad, Kamimori, & Killgore, 2006). Similarly, increased impulsivity related to sleep deprivation also reduces one's ability to delay gratification (Killgore et al., 2008), which is generally related to more negative outcomes. Taken together, these studies provide evidence that one's ability to inhibit or regulate negative emotional responses deteriorate with prolonged wakefulness. What is not currently known, however, is how napping during the course of typical waking hours may affect emotional control.

Presently, the cognitive consequences of sleep deprivation are well understood (Durmer & Dinges, 2005; Goel et al., 2013). As a result, research on effective ways to decrease prolonged wakefulness and resultant fatigue is crucial in order to find ways to help those who are required to maintain high levels of accuracy and attention without attaining a full night of sleep, such as physicians and pilots, to perform properly. Napping has been identified as one of the most effective countermeasures to sleepiness and fatigue (Horne & Reyner, 1996).

Very recent research has also shown that a 30-minute nap can improve immune health that may have been compromised by prior sleep deprivation, indicating that napping provides benefits beyond reducing sleepiness and fatigue (Faraut et al., 2015). Indeed, studies that have examined the direct effects of napping on emotional functioning have generally found that napping increases positive emotions including energy (Taub, Tanguay, & Clarkson, 1976), motivation (Hayashi, Watanabe, & Hori, 1999), and joy (Luo & Inoué, 2000). There has been limited research, however, into how napping affects emotional control, specifically with regard to controlling negative emotional responses. One study recently showed that toddlers who were not permitted to nap showed more negative responses to an unsolvable task than did toddlers who napped (Berger, Miller, Seifer, Cares, & Lebourgeois, 2012), which may provide preliminary evidence that napping can facilitate this kind of emotional control. There is little research, however, on the direct effects of napping on controlling negative emotional responses, including frustration and impulsivity, in adults.

The aim of the present study was to investigate the effects of napping on the regulation of frustration tolerance and impulsivity in a

☆ All authors report no conflicts of interest.

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[1] Completed study design, data analyses, and writing of manuscript.
[2] Provided consultation for study design, data analyses, and writing of manuscript.
[3] Completed all data collection, and initial data analyses.
[4] Provided data analyses support and all edits of manuscript.

http://dx.doi.org/10.1016/j.paid.2015.06.013
0191-8869/

sample of healthy participants. Given that previous research has shown that sleep deprivation decreases the ability to inhibit impulses, we hypothesized that those who did not nap would show decreased tolerance for frustration and increased self-reported impulsivity. On the other hand, napping would increase frustration tolerance and decrease feelings of impulsivity.

2. Methods

2.1. Participants

Participants were recruited by fliers, newspaper ads, and internet recruitment sites in a Midwestern college town. Inclusion criteria included being between the ages of 18–50, the ability to speak and understand English fluently, and the ability to keep a consistent sleep schedule. Exclusion criteria included any history of serious medical disorders, sleep disorders, or pregnancy. All participants gave informed consent prior to the beginning of study. This study was approved by the relevant Institutional Review Board.

2.2. Procedures

This study was part of a larger project designed to examine napping on (i) emotional processing, (ii) attention, and (iii) decision-making. Only the tasks and questionnaires relevant to the present, emotional processing study will be discussed. All participants were instructed to refrain from alcohol and caffeine on the day of participation and were required to keep a consistent sleep schedule for three nights prior to the study, verified by sleep diary and calls to a time-stamped voicemail. On the day of the study, all participants presented at the laboratory at 1 pm. Participants completed computer-based behavioral tasks including the frustration tolerance task. Upon completion of the tasks, participants completed a battery of questionnaires examining state characteristics such as sleepiness, mood, and impulsivity. All participants were then randomly assigned to a 60-minute nap opportunity condition or no-nap condition, where they watched a 60-minute emotionally neutral nature documentary. Research assistants were present to monitor all participants, via two-way mirror, to ensure that participant were awake during the no-nap period or to monitor the sleep EEG to ensure proper recording. Following the nap or no-nap period, all participants completed the battery of state questionnaires, followed by the behavioral tasks.

2.3. Epworth sleepiness scale

The Epworth sleepiness scale (Johns, 1991) measures chronic daytime sleepiness. Participants are asked to rate the likelihood that they would fall asleep in eight situations on a scale from 0 (would never doze) to 3 (High chance of dozing). Total Epworth scores fall in the range of 0–24, where < 10 is considered normal, 10–15 indicates moderate sleepiness, and 16–24 indicates severe sleepiness.

2.4. Stanford sleepiness scale

The Stanford sleepiness scale (Hoddes et al., 1973) is a one-item scale designed to measure present levels of sleepiness. Participants select one of seven statements that most closely describe their immediate level of alertness. Increasing scores indicate increasing sleepiness.

2.5. State-Impulsivity Questionnaire

The State Impulsivity Questionnaire, or STIMP (Wingrove & Bond, 1997) assesses state impulsivity using a set of fourteen statements pertaining to impulsivity measured on a visual analogue scale. Each item is presented to the participant beginning with the statement "Right now…" to emphasize that participants should respond with regard to the present state. Each item of the visual analogue scale is scored from 0–100, and the total STIMP score is the sum of all 14 visual analogue scale item scores.

2.6. Frustration tolerance task (FTol)

Participants completed a computer-based adaptation of Feather's (1961) frustration tolerance task. Four geometric designs are presented successively on a computer screen. Participants are directed to recopy the diagram on a piece of paper, without tracing over any line twice and without lifting the pencil from the paper. Half of each set of designs was unsolvable. Participants were allowed to make as many attempts on each design as they wished. The total time spent on the impossible puzzles is interpreted as a measure of persistence, namely the less time spent, the less the persistence and the lower the subject's frustration tolerance.

2.7. Data analysis

Statistical analyses were conducted on the STIMP and Ftol scores using repeated measures analysis of variance (ANOVA), with condition (Pre and Post-nap) as within-subjects factors and group (Nap and No-nap participants) as between-subjects factor. Additionally, post hoc analyses were conducted for the correlation between these variables, and difference scores, defined as the scores (STIMP or Ftol) at baseline subtracted from the scores (STIMP or Ftol) following the nap/no-nap period. All analyses were performed using the software program IBM SPSS v20.0, with $p < 0.05$ considered significant.

3. Results

In order to determine if the groups were appropriately randomized, age, self-reported total sleep time, habitual sleepiness, and present sleepiness were examined. Results revealed no significant differences on all demographic variable scores between groups. Table 1 displays key demographic variables. Nappers were confirmed to have fallen asleep as indicated by self-report, and at least three successive 30-sec epochs of any stage of sleep.

3.1. Frustration tolerance task

Two extreme outliers were identified according to the Grubbs Test, and were thus excluded from this analysis. Before the nap period, nappers and no-nappers spent equal time on the unsolvable task. The main effect of group was significant, $F(1, 36) = 7.41$, $p = 0.01$. The main effect of time, however, was not significant, $F(1, 36) = 0.10$, $p = 0.76$. After the nap period, however, nappers increased the time spent on the second unsolvable task, while non-nappers decreased time spent, revealed by significant interaction, $F(1, 36) = 5.04$, $p =$

Table 1
Demographic variables and behavioral results of the sample.

	No nap	Nap	Sig.
N (female)	18 (9)	22 (11)	NS
Age	21.31 (1.78)	20.05 (1.79)	NS
Self-reported total sleep time	8:01 (0.03)	7:42 (0.03)	NS
Habitual sleepiness — Epworth sleepiness scale score	14.67 (3.96)	14.95 (3.46)	NS
Present sleepiness — Stanford sleepiness scale score	2.94 (1.21)	2.73 (1.08)	NS
Frustration tolerance — pre (milliseconds)	69,255.13 (29,246.75)	68,622.05 (40,213.99)	NS
Frustration tolerance — post (milliseconds)	48,558.75 (16,036.66)	95,924.73 (59,674.31)	p < 0.01
STIMP score — pre	29.67 (9.90)	31.11 (14.06)	NS
STIMP score — post	33.41 (13.75)	28.53 (14.38)	NS

Means, standard deviations (within parenthesis) and ANOVA results.