The effect of sleep attributes on attention

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Abstract

My experimental research has focused on the qualitative and quantitative aspects of sleep and its consequences – particularly the impact of disrupted sleep on cognitive functions (namely attention) during the next day. In my pilot study I have performed sleep modification experiments in a sample of college students, who were randomly assigned to one of the experimental groups (one for the lowered quantitative and one for the lowered qualitative aspect of sleep). Collected data suggest that there are measurable differences between unaffected sleep and modified sleep, albeit they are not statistically significant. The potential asset of my research could be aimed at the researchers involved in the SleepCog project for inspirational purposes concerning methodological tips for measuring and quantification of cognitive functions.

Introduction

Research focused on the effect of sleep on cognition is widespread and frequent, but mostly limited to specific populations, which suffer from a condition that directly causes impaired sleep quality or quantity (e.g. older patients, autists) [1, 2]. Sleep quality and quantity have been found to be determining factors for cognitive performance in certain cognitive functions (e.g. attention), while others remain unaltered (e.g. working memory) [3]. Some studies suggest that only sleep disturbances (sleep quality) affect cognition, while total sleep time (quantity) is irrelevant [1]. To introduce an innovative aspect to this research field, I decided to study attention (as a cognitive function affected by sleep) on a college students population to find out whether the attributes of sleep affect the level of attention also in healthy individuals without any declared sleep problems or impairment. Based on studied literature [3, 4, 5] I formulated my hypothesis, which predicts impaired attention after modulated sleep (lowered quantity or quality) in comparison with the attention level after an unaffected night's sleep.

Discussion

In this section, we may speculate about the factors determining the outcomes of our research. First and foremost, we must note that this was a pilot study with all the weaknesses and threats immanent to this genre, most notably the low number of participants, which could have distorted the overall results and mainly the results of the statistical tests determining the statistical significance of the differences between the control and experimental groups. The experimental design and its implementation could also be problematic because of the debatable extent of sleep deprivation and the method to ensure lowered quality of sleep. In the future, we would like to repeat measurements with the same or revised experimental setup in an enlarged experimental sample. Furthermore, we would like to revise the methods of measuring attention (e.g. a more suitable custom-made application instead of the CogLab software).

References

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[4] Nebes, R. D. et al. (2009): Self-Reported Sleep Quality Predicts Poor Cognitive Performance in Healthy Older Adults. *The Journals of Gerontology,64B, 2,* 180-187

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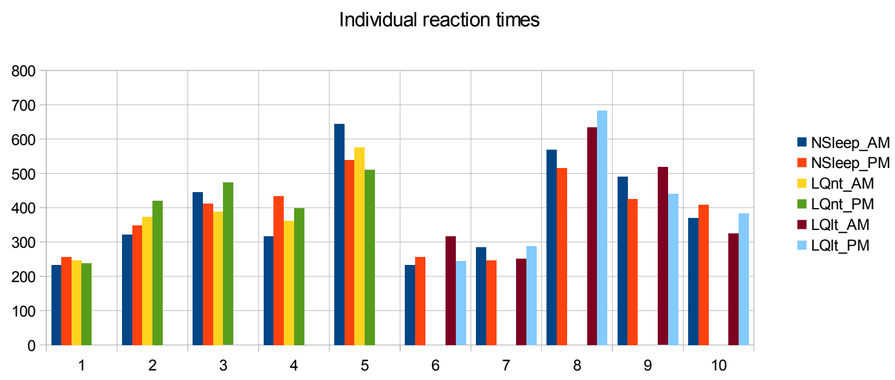
Methods

To incorporate the aforementioned criteria and conditions, I employed an experimental design which consisted of one control (later split in two groups (copying the form of the experimental groups) for the sake of data analysis) and two experimental groups (one for the lowered quantity condition and the other for the lowered quality condition). At the very beginning, there was the need to eliminate potential participants who could be accustomed to long-term sleep deprivation and lowered sleep quality. This was done by a structured interview with questions regarding mean sleep time per night and other related lifestyle issues. Unsuitable participants were eliminated from further research. My final sample comprised of 10 participants (age between 20 and 27 years), who were randomly (but evenly) assigned to one of the experimental groups. The whole sample was instructed to sleep as long as they like during the first night. The next day they were tested by means of the CogLab software – Spatial cueing test, consisting of 80 trials, which assessed attention by measuring reaction time to stimuli in milliseconds. Measurements were realised in the morning and in the afternoon, acting as the control group(s). The first experimental group (which was the first control group before) was then instructed to sleep only 4 hours (lowered sleep quantity) during the next night, while the second experimental group was subjected to lowered qualitative aspect of sleep by frequent sleep disturbances (a simple task of rejecting phone calls made at a constant time interval - sufficient to wake the participants for a very brief moment) during the whole night (while the total sleep duration remained unchanged). The next day, both experimental groups were tested again in the same manner as before, concluding the experiment. Based on the used methods, the conceptual hypothesis can be operationalised as follows: modulated sleep (lowered quantity or quality) will increase the reaction time in milliseconds to presented stimuli in comparison with the unaffected sleep condition.

Results

The raw data in the form of reaction times to stimuli were firstly filtered out so that reaction times over 1000 ms were excluded from further analysis (because there was reasonable doubt that the participant was severely distracted during that trial). The reaction times were then computed into a mean value for every measurement (4 measurements for each participant (normal sleep morning, normal sleep afternoon, modified sleep morning, modified sleep afternoon)). Individual values can be seen in the table. For further statistical analysis, the data were split into 2 groups according to the corresponding experimental group. This was done in respect to the low numbers of participants to be able to compare means always between two personally identical groups so that interindividual differences could be eliminated. In the tables labeled "Statistics" we can see the descriptive statistics for the various groups, which shows us that there are tangible differences between the experimental and control groups. The comparison took place always between two personally identical groups of different conditions (e.g. normal sleep vs. lowered quantity of sleep) measured at the same daytime. Due to the outcome of the normality tests, when all the groups appeared to have the data normally distributed (lowest value of significance p=0,156 (in case of LQnt_AM)), which is rather inconclusive given the low number of participants, we took the cautious approach of running both the paired samples T-test (comparison of means between groups in case the data really are normally distributed) and the nonparametric alternative in the form of the Wilcoxon signed ranks test and the sign test (comparison of medians between groups in case the data are not normally distributed). All statistical tests (the paired samples T-test with the lowest significance p=0,337 for the pair NSleep_PM – LQlt_PM and the Wilcoxon test with the lowest significance p=0,345 for the pair NSleep_PM – LQlt_PM) concluded that there are no statistically significant differences between corresponding normal sleep and altered sleep reaction times, disproving our operational hypothesis.



Statistics[a]		NSleep_AM	NSleep_PM	LQnt_AM	LQnt_PM
N	Valid	5	5	5	5
	Missing	0	0	0	0
Mean		392,40	398,00	389,40	407,80
Median		321,00	412,00	374,00	420,00
Std. Deviation		160,368	104,807	118,471	104,610
Minimum		233	256	247	238
Maximum		645	539	576	510

a. ExpGroupNo = ExpGroup LQnt

Statistics[a]		NSleep_AM	NSleep_PM	LQlt_AM	LQlt_PM
N	Valid	5	5	5	5
	Missing	0	0	0	0
Mean		389,80	370,60	409,00	407,80
Median		370,00	408,00	325,00	384,00
Std. Deviation		140,245	116,210	160,460	171,561
Minimum		233	247	251	244
Maximum		570	516	634	682

a. ExpGroupNo = ExpGroup LQlt