Varying Amount of Sleep Over 3-weeks Influence Children's Performance

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INTRODUCTION

Regular and longer sleep times are believed necessary for maximizing children's cognitive processing and brain development. However, some sleep loss (restriction) is not avoidable, as in cases when children participate in occasional social activities or work on homework assignments. In contrast, children sometimes sleep longer than usual (extension), as in cases where children sleep in later on weekends. This study examined how varying amount of sleep over 3-weeks influences children's performance on executive function tasks.

RQs:
What are the effects of less versus more sleep on brain function and cognitive performance?
How long might such effects last after resuming regular sleep schedules?

METHOD

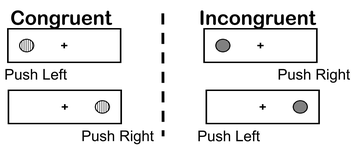
- Participants:

Sixty-four 5-8 years old typically developing children (32 males & 32 females)

- Experimental Procedure:

Each child was randomly assigned to one of following experimental condition:
Control group (normal sleep amount over 3 weeks)
Extension group (1 hour extension in the second week)
Restricted group (1 hour restriction in the second week)
By the end of each week, children came to lab to complete Directional Stroop Task wearing a 128-electrode high-density array geodesic sensor net to record event-related potentials (EGI Inc).

Child use a 128- electrode high-density array geodesic net



Directional Stroop Task (Diamond, 2002)

ANALYSIS AND RESULTS

- ❖ A temporal principal components analysis (PCA) identified 5 regions of the ERP that accounted for approximately 92% of the total variance (see Figure 1).
- ❖ The five independent ANOVAs (one per factor) examined relations between ERPs and performance on the Directional Stroop Task.
- ❖ Factor 3 (80-176 msec) produced a significant week * task * scalp region * electrodes * sleep interaction, F (24, 34) =2.126, *p*=.019 (see Figure 2 & Figure 3).
- For the control group, week 2 brain response to incongruent stimuli is different from week 1 in right frontal, t (23) =2.662, p=.014, in right temporal, t (23) =2.282, p=.032, in left parietal, t (23) =-2.698, p=.013, in central parietal, t (23) =-2.842, p=.009, in left occipital, t (23) =-4.219, p=.000, in central occipital, t (23) =-2.238, p=.035, and there is a significant difference between week 3 and week 1, in left parietal, t (23) = 2.213, p=.037, in central parietal, t (23) =2.244, p=.035, in left occipital, t (23) = 2.307, p=.030 and week 3 and week 2 in right occipital, t (23) = 2.359, p=.027.
- For the extension group, week 3 brain response to incongruent stimuli is different from week 1 in central parietal, t (23) =2.671, p=.017, in left occipital, t (23) = 2.611, p=.020, and different from week 2 in left occipital, t (23) = -2.330, p=.034.
- For the restriction group, week 2 brain response to incongruent stimuli is different from week 1 in right temporal, t (23) =2.344, p=.028, in central parietal, t (23) =-2.218, p=.037, in left occipital, t (23) =-4.219, p=.000, in central occipital, t (23) =-2.238, p=.035, and there is a significant difference between week 3 and week 1, in central temporal, t (23) = -2.347, p=.028, in central parietal, t (23) =2.131, p=.044.

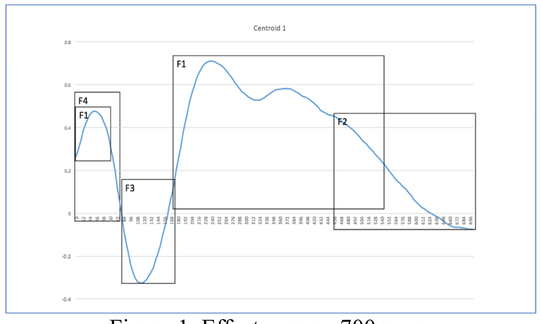
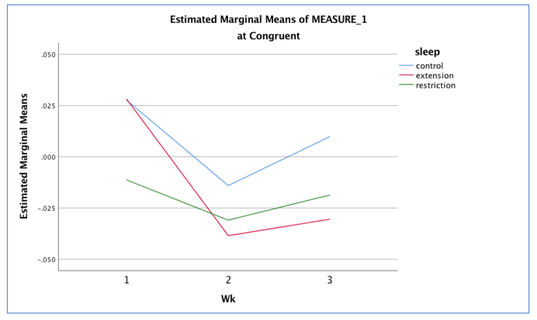


Figure 1. Effects across 700 msec



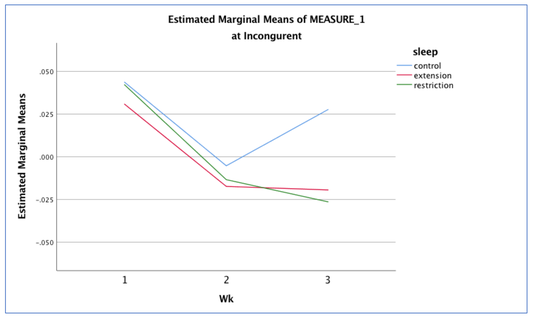


Figure 2 & Figure 3 Sleep *Week* Task Interaction

DISCUSSION

These findings are relevant to academic performance throughout childhood. Data reflected neural processing differences between the two sleep groups, reinforcing the view that adequate sleep is important for school age children. We also noted children perform differently by the end of Week 2 might be due to varying amount of sleep. However, their Week 3 performance did not show as well as Week 1 even though they have been back to normal sleep schedule. It indicated that the mild sleep extension or loss might have a longer effect on different task conditions than we expect!
Parents are encouraged to help children to maintain a regular sleep schedule even on weekends, knowing that only one-hour loss of sleep might slow down the brain's abilities to process information. Irregular sleep on weekend might impact on children's performance on early weekdays. Teachers are encouraged to assign appropriate amount of homework so that student will not have to sacrifice their sleep time to complete assignments. Teachers should also know that students might process information slower on Monday because they have a busy weekend.

REFERENCE

Diamond, A. (2002). Norrnal development of prefrontal cortex from birth to young adulthood: Cognitive functions, anatomy and biochemistry. In D. T. Stuss & R. T. Knight (Eds.). *Principles of frontal lobe function* (pp. 466-503). London. England: Oxford University Press.

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