ENHANCING MEMORY ACQUISITION IN A HIGH SCHOOL SETTING THROUGH SHORT NAPS

Vanessa Vidal[1,2], Matías R Pretel[1], Lucila Capurro[1], Leonela M Tassone[1], Malen D Moyano[1], Romina Malacari[3], Luis I Brusco[4], Fabricio M Ballarini[5,6] & Cecilia Forcato[1]

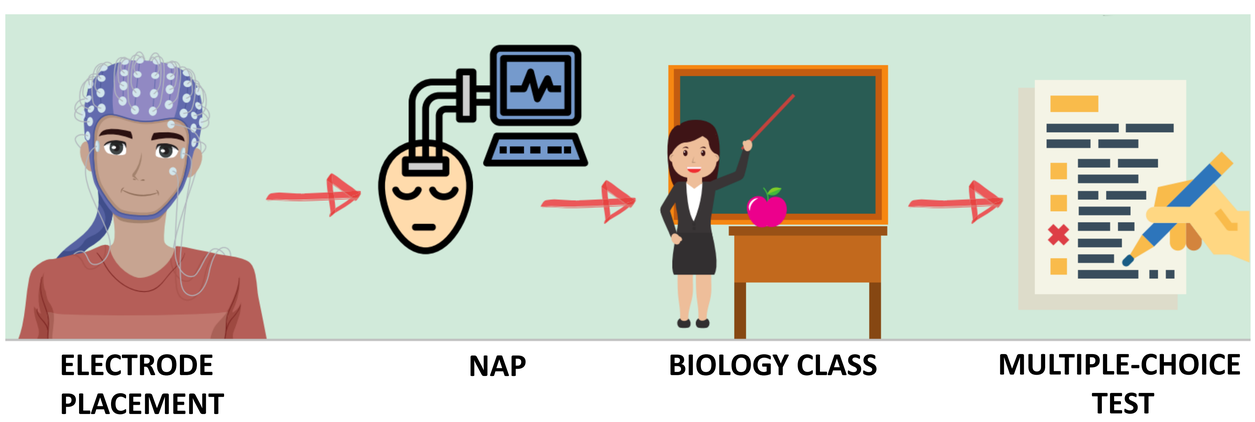
[1] Laboratorio de Sueño y Memoria, Depto. de Ciencias de la Vida, Instituto Tecnológico de Buenos Aires (ITBA).
[2] Consejo Nacional de Investigaciones Científicas y Tecnológicas (CONICET).
[3] Quilmes High School (QHS).
[4] Centro de Neuropsiquiatría y Neurología de la Conducta (CENECON), Facultad de Medicina, Universidad de Buenos Aires (UBA).
[5] Instituto de Biología Celular y Neurociencias "Prof. E. De Robertis" (IBCN), Facultad de Medicina, Universidad de Buenos Aires (UBA).
[6] Departamento de Ciencias de la Vida, Instituto Tecnológico de Buenos Aires (ITBA).

INTRODUCTION

Sleep deprivation is prevalent among high school students, a phenomenon that negatively influences academic performance[1]. Both sleep deprivation and poor sleep quality impair various memory processes, with one of the most affected being memory acquisition. This could be related to a decrease in synaptic downscaling, a process that occurs during sleep and enables the encoding of new information upon waking, with slow-wave sleep playing a fundamental role in this regulation[2]. In this study, we assess whether the implementation of a short nap in the high school classroom environment enhances the acquisition of a Biology class.

METHODS

We conducted a one-day experiment with 78 students aged 15 to 17 years. The Nap group took a 20-minute nap in the library while their brain electrical activity (EEG) was recorded using a portable 1-channel system. Meanwhile, the Control group remained in the classroom with the teacher engaged in a quiet activity. Subsequently, both groups received a Biology class from their own teacher, followed by a multiple-choice exam at the end of the class.



Sleep consists of the cyclical occurrence of Rapid Eye Movement (REM) sleep and non-REM sleep. Non-REM sleep is further divided into slow-wave sleep (SWS) (stages 3 and 4), and lighter sleep stages (stages 1 and 2)[3]. Polysomnographic recordings were scored offline as wake, sleep stages 1-3.

Figure 1. Experimental Procedure. Students in the Nap slept for 20 minutes in the library, while the control group engaged in quiet activities. Subsequently, both groups had a biology class and were immediately assessed with a multiple-choice exam.

RESULTS

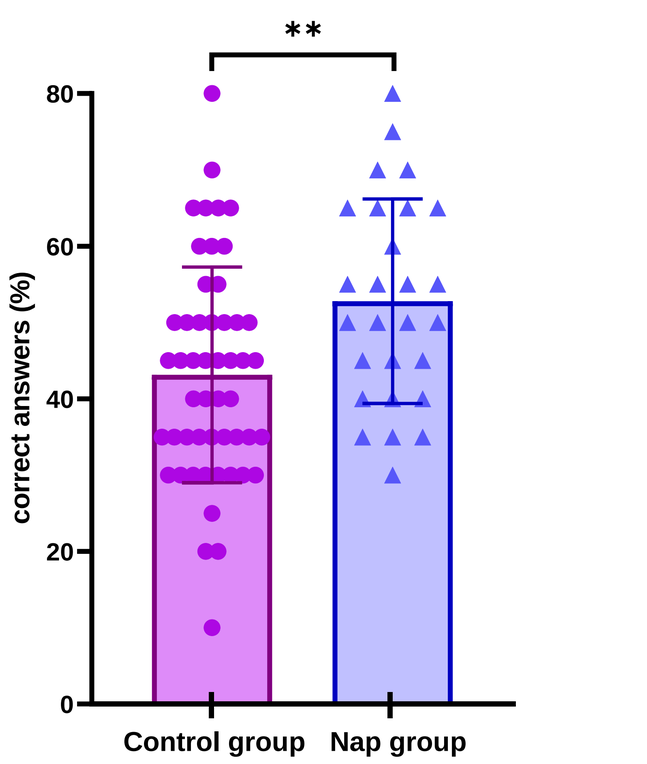


Figure 2. Effect of a Short Nap on Encoding. The Nap group exhibited better performance on the exam compared to the Control group, indicating that a short nap can favor subsequent learning [Nap group: 52.78, Control group: 43.14; two-sample T-test: T(76) = 2.916, p = 0.005)].

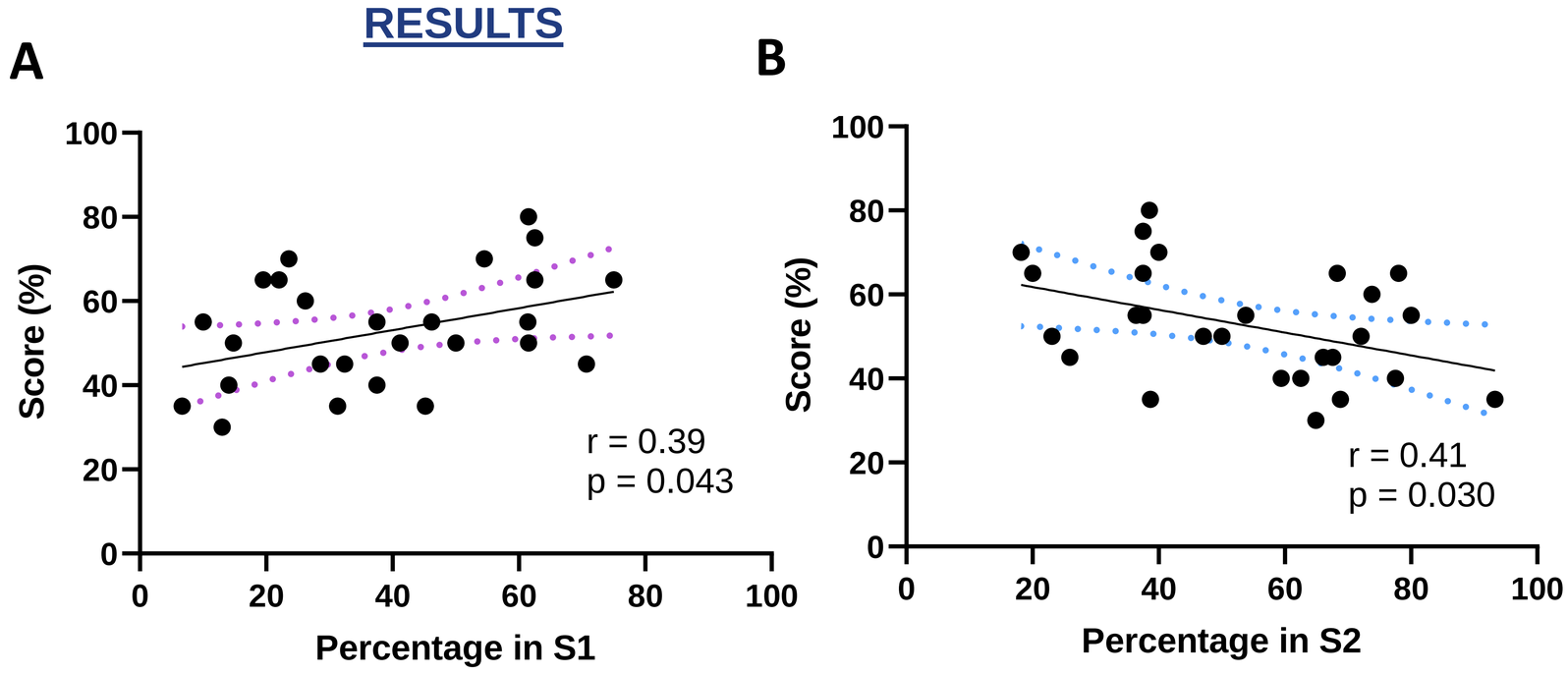


Figure 3. Sleep and Performance in the Assessment. Significant correlations in the Nap group between exam scores and (**A**) the percentage of time in S1, and (**B**) the percentage of time in S2. The improvement in memory could be explained by the percentage of time spent in S1 non-REM sleep. On the other hand, we observed that a higher percentage of time in S2 was associated with lower performance. This may be attributed to sleep inertia, as learning occurred within the 20 minutes following awakening. Thus, students who entered deep sleep would require more time after awakening to avoid sleep inertia.

CONCLUSIONS

Our results suggest that short naps in the classroom may enhance subsequent learning. In the case of implementing 20-minute naps, it is recommended to allow a period longer than 30 minutes before acquiring new information to prevent sleep inertia, thus achieving better results. However, they also indicate that significantly shorter rest periods can favor learning.

REFERENCES

[1] Wheaton AG, Chapman DP, Croft JB. School Start Times, Sleep, Behavioral, Health, and Academic Outcomes: a Review of the Literature. *J Sch Health*. 2016; 86(5): 363-381.

[2] Tononi G, Cirelli C. Sleep and the price of plasticity: from synaptic and cellular homeostasis to memory consolidation and integration. *Neuron*. 2014; 81(1): 12-34.

[3] Rasch B, Born J. About Sleep's Role in Memory. *Physiol Rev*. 2013; 93: 681-766.

CONTACT

vvidal@itba.edu.ar

https://esleepeurope.eu/