The effects of wearing an eye mask on cognitive functions and sleep architecture

Viviana Greco[1], Ralph Andrews[2], Elena Schmidt[3] , Damiana Bergamo[4], Paola Cuoccio[5], Penelope Lewis[1]

[1]CUBRIC, [2] University of Sussex, UK, [3]University Cologne, Germany, [4]IMT School for Advanced studies Lucca, Italy, [5]University of Padova, Italy.

Introduction:

Light is the primary Zeitgeber that entrains the circadian clock:

- Timing and intensity of light exposure affect sleep quality, sleep macro-architecture, duration and timing of sleep. [1 -2]
- the lack of photic input in totally blind individuals results in a blind free-runners (BFRs) rhythm. [3]

The use of an **Eye mask** has been demonstrated beneficial in patients in the Intensive Care Unit (ICU):

- All the aspects of sleep quality improved significantly [4]

CARDIFF AREA: No shutters and Early sunrise

- Has the eye mask have a potential impact on **sleep architecture**?
- Does the eye mask improve **sleep quality / Memory Consolidation / Alertness** ?

Study Design

- 95 participants (34 male)
- 18-35 years old (21.08±2.76)
- Summer (end of June – end of September)
- Within-subject design
- Counterbalanced order: ambient light blocked or not blocked during sleep

FIVE HABITUATION NIGHTS EYE MASK WEEK

FIVE HABITUATION NIGHTS NO MASK WEEK

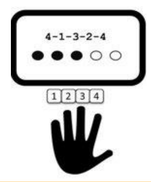
Day 6 (8 – 10 am):

❑ Paired Associate Learning (PAL) [5]
80 semantically word pairs to assess declarative memory

1. Learning: RIVER – BOAT
2. Recall & Feedback: RIVER – ??
3. Final Recall: BOAT

❑ Psychomotor Vigilance Task (PVT)
10 min reaction time task [6]

❑ Finger Tapping Task (FTT) [7]
reproduce a fixed five-digit sequence with the non-dominant hand



Day 7 (8 – 10 am):

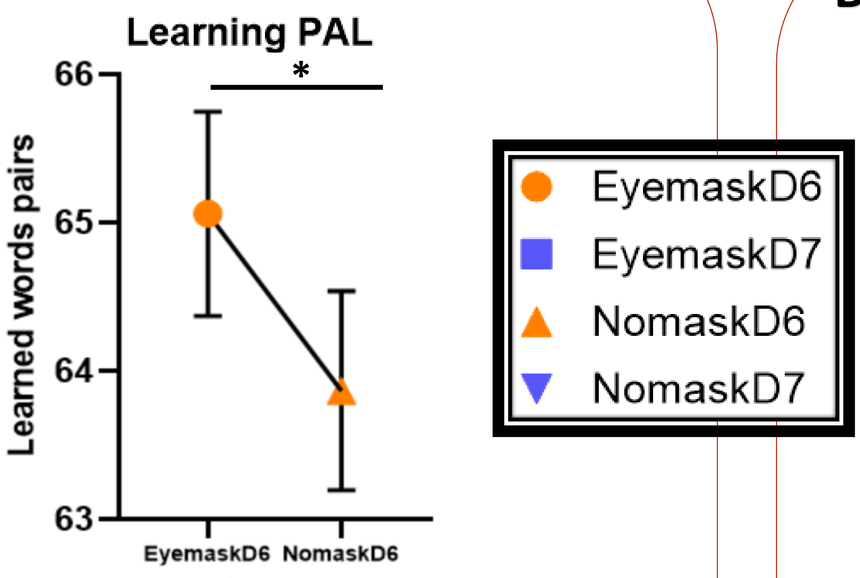
❑ Final Recall
Paired Associate Learning (PAL)

❑ Psychomotor Vigilance Task (PVT)

❑ Finger Tapping Task (FTT)

❑ Dreem headband

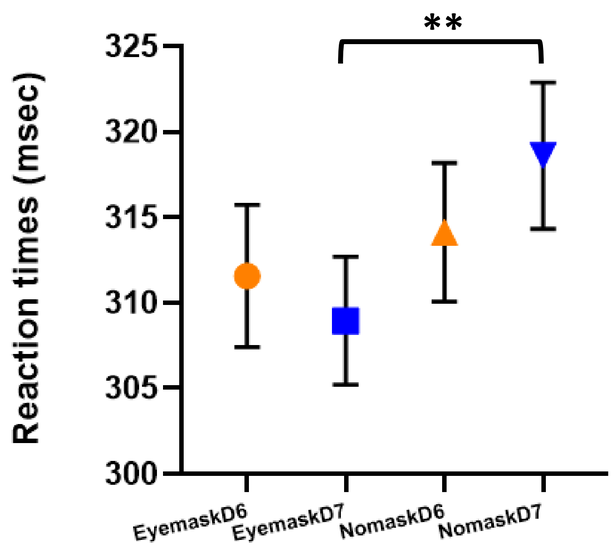
A. Paired Associate Learning



✓ Learning performance increases in the eye mask condition **t(82) = 2.306, p = 0.024**

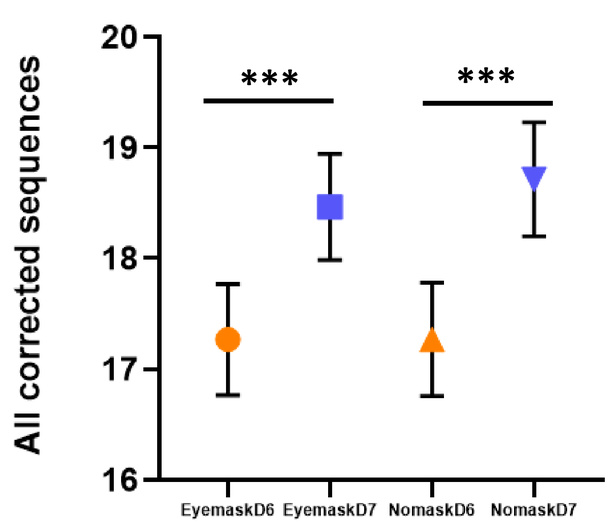
✓ No significant difference in overnight change of correctly recalled pairs. **Z = -0.909, p = 0.363**

B. Psychomotor Vigilance Task



✓ Faster reaction times in the eye mask condition on the second testing day **Z = - 3.140, p = 0.002**

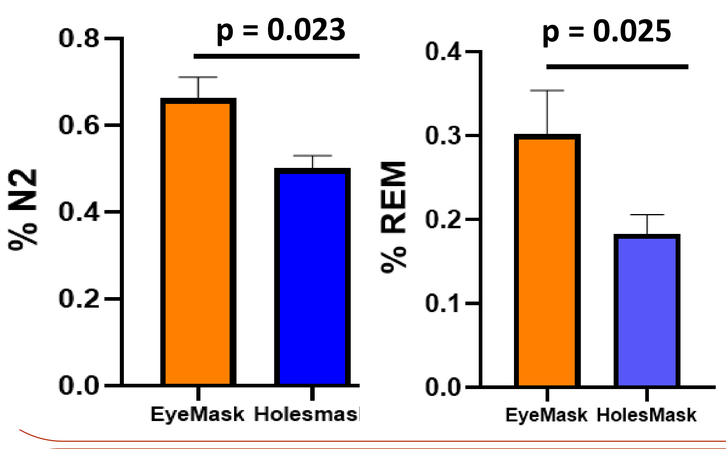
C. Finger tapping task



✓ Better performance in both conditions: Eye mask: **t(85) = -4.148, p= 0.000;** No mask: **t(85) = -6.204, p = 0.000**

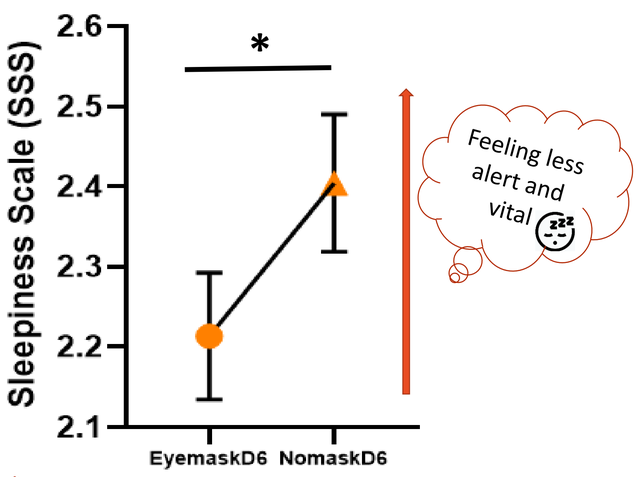
✓ No significant difference in overnight change of correctly typed sequences. **Z = - 0.909, p = 0.363**

D. Dreem Headband



- N=16
- An eye mask with two big holes was used as a control instead of no mask
- Percentage of N2 and REM sleep was higher in the eye mask condition.

E. Sleep quality – Stanford Sleepiness Scale



- During the eye mask week people felt more vital and less alert in the morning [8]
  Z = - 2.085, p = 0.037

Conclusions:

Blocking the ambient light with the use of an eye mask:

1. Beneficial effect on the learning of declarative memories (PAL)
2. Beneficial effect in terms of vigilance (PVT)
3. No effect on procedural memories (FTT)
4. Increased time spent in N2 and REM sleep
5. Beneficial effect in terms of alertness (SSS)

[1] Wams, E. J., Woelders, T., Marring, I., van Rosmalen, L., Beersma, D., Gordijn, M., & Hut, R. A. (2017). Linking Light Exposure and Subsequent Sleep: A Field Polysomnography Study in Humans. *Sleep*, *40*(12), zsx165. [2] Bjorvatn B, Pallesen S. (2009). A practical approach to circadian rhythm sleep disorders. *Sleep Med Rev*. 13(1):47–60. [3] Emens, S.J., Lewy, J.A., Lefler, J.B., & Sack, L.R. (2005). Relative coordination to unknown "Weak Zeigebers" in Free-Running Blind individuals. Journal of biological rhythms, 20: 159-167. [4] Bani Younis, M.K., Hayajneh, F. A., & Alduraidi, H. (2019b). Effectiveness of using eye mask and earplugs on sleep length and quality among intensive care patients: a quasi-experimental study. *Int. J. Nurs. Pract.* 25:e12740. [5] Ngo HV, Martinetz T, Born J, Mölle M. Auditory closed-loop stimulation of the sleep slow oscillation enhances memory. *Neuron*. 2013;78(3):545–553. [6] Dorrian, J., Rogers, J.N., & Dinges, F.D. (2005). Psychomotor vigilance performance: neurocognitive assay sensitive to sleep loss. In C. A. Kushida (Ed.), *Sleep deprivation: Clinical issues, pharmacology, and sleep loss effects* (pp. 39–70). New York, NY: Dekker. [7] Walker MP, Brakefield T, Morgan A, Hobson JA, Stickgold R. Practice with sleep makes perfect: sleep-dependent motor skill learning. *Neuron*. 2002;35(1):205–211. [8] Hoddes, E., Dement, W., & Zarcone, V. (1972). The development and use of the Stanford sleepiness scale (SSS). *Psychophysiology*, *9*, 150.

GrecoV1@Cardiff.ac.uk

@vivianagreco19

CUBRIC

CARDIFF UNIVERSITY
PRIFYSGOL CAERDYDD

School of Psychology
Ysgol Seicoleg