Prevalidation of a new drowsiness quantification system based on ocular parameters using polysomnography and performance measures

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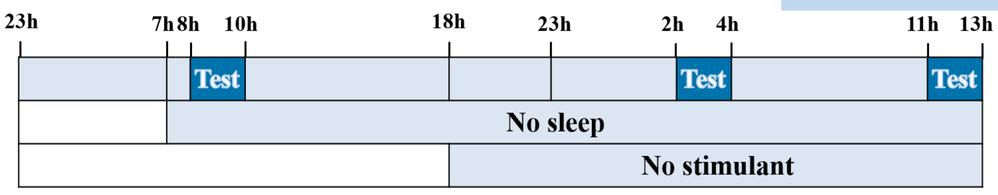
OBJECTIVES

Drowsiness is a major cause of accidents [1] and oculography seems to be the most sensible approach to reliably and objectively assess drowsiness in practice. We have thus developed a new drowsiness quantification system that uses images of the eye to automatically determine a level of drowsiness. In order to prevalidate our system, we need to show that the level of drowsiness determined by our system is well "correlated" with:
(1) the level of drowsiness obtained by analyzing polysomnographic (PSG) signals (considered to be the "gold standard") and
(2) the level of performance of these subjects in the accomplishment of a task.

EXPERIMENTAL DESIGN



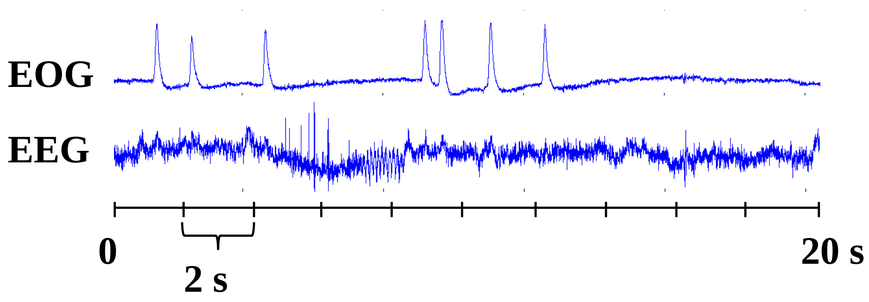
- **27 participants (12 M, 15 F, mean age 24.3, range 19-32 years)**
- **Test = Reaction Time (RT) test (duration of 15 minutes)**
- **Approval by ethics committee**

ARCHITECTURE OF OUR SYSTEM

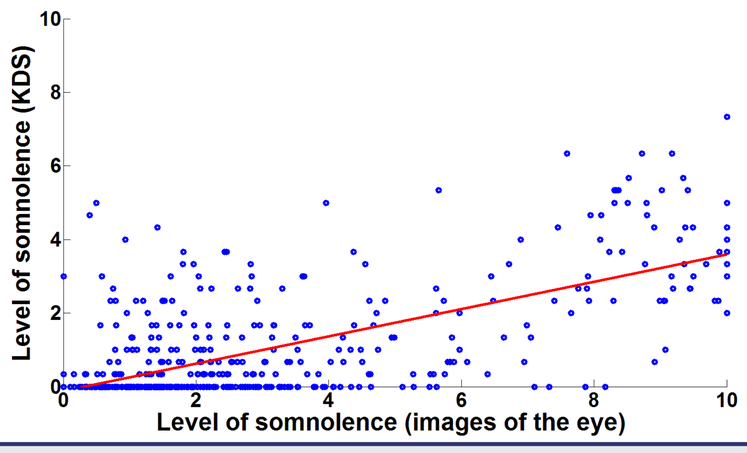
Acquisition → ***Images*** → **Extraction** → ***Parameters*** → **Conversion** → ***Level of drowsiness***

RESULTS - POLYSOMNOGRAPHY

For each minute of test, we computed a level of drowsiness which is the mean of Karolinska Drowsiness Scores (KDS) [2] determined on 20 second windows of PSG signals.

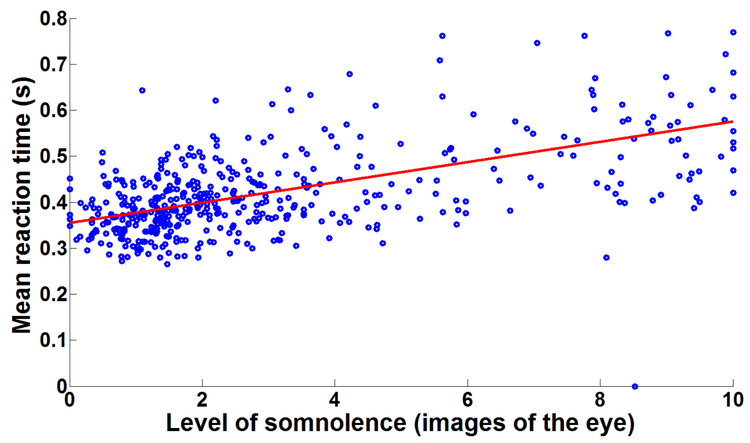


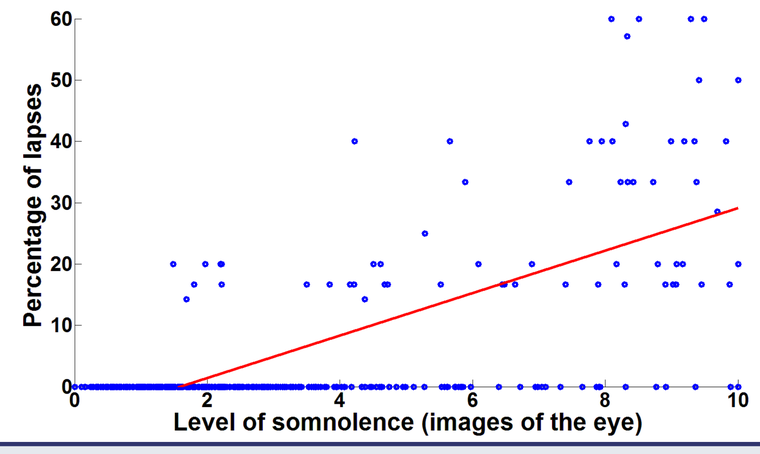
In each 2 second section: if there is presence of α rhythm and/or θ activity and/or slow eye movements, then Score = Score +1, else Score = Score.



RESULTS – REACTION TIME TEST

For each minute of test, we computed:
- **the mean reaction time**
- **the percentage of lapses (= RT > 2s or no answer).**





CONCLUSION

Our new drowsiness quantification system is well correlated with both references and has the following advantages
- **noninvasive and usable in any condition**
- **no intervention required from the subject.**

It thus has significant potential for reliably and objectively quantifying the level of drowsiness of a subject accomplishing a task.

ACKNOWLEDGMENTS

- **Financial support: Région Wallonne (Belgium)**
- **Sleep Laboratory (CETES), University Hospital of Liège (Belgium)**

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[2] M. Gillberg, G. Kecklung, T. Åkerstedt, "Sleepiness and performance of professional drivers in a truck simulator – comparison between day and night driving," *Journal of Sleep Research*, vol. 5, 1996, pp. 12-15.

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