

## **The cognitive-algebraic nature of alertness judgments**

Mairesse, O., (VUB) Neu, D. (Brugmann Sleep Lab VUB-ULB), De Valck, E. (VUB) and Cluydts, R. (VUB)

In everyday life, individuals make assumptions on how alert they will be in a particular situation (e.g. planning a car trip, pulling a whole-nighter before an exam, .). Often this revolves around how much sleep is needed to function adequately during the day, how a bad night's sleep will affect daily activities or at what time of the day one will be more likely to experience sleepiness. Disruptions in the ability to infer on one's own alertness or in the cognitive structure of self-evaluations of sleep determinants may lead to an exacerbation of pathological patterns (e.g. insomnia) or in unintended dozing behavior, with possible tragic outcomes (e.g. dozing off while driving). However, despite the familiarity sleep researchers have with subjective sleepiness/alertness judgments (e.g. ESS, KSS, ...), little is known about how different aspects of wake and sleep combine into single alertness judgments.

In this paper we discuss a series of studies aimed at uncovering the tacit cognitive structure behind everyday alertness judgments. By means of a set of factorial judgment tasks we investigated the algebraic relation of homeostatic and circadian processes, sleep quality, posture, physical and mental activity and daily life events in the self-evaluation of alertness. Our results show a complex, nonlinear relationship between homeostatic and circadian processes in alertness judgments and a compelling resemblance with data from experienced alertness in sleep-deprivation settings. Also, we found that sleep quantity and sleep quality operate in a magnifying (multiplicative) way when alertness judgments are conveyed. These results suggest that both components are unable to fully compensate each other to generate sufficiently high subjective alertness levels. With respect to interindividual differences, we found that the cognitive structure underlying daytime alertness judgments is similar in long sleepers, short sleepers and normal sleepers, in sleep apnea patients and healthy controls. However, we found that sleep apnea patients are more sensitive to situational effects than healthy controls, whereas they are less affected by a restriction of sleep. Shift workers, night workers and day workers showed markedly different integration patterns, suggesting that their perception of homeostatic and circadian determinants of sleepiness is altered by their usual sleep-wake schedule. Finally, we found that the effect of physical and mental activity and the effect of posture is largely independent of the quantity of sleep. In addition to these results, the experimental set-up allowed for the validation of subjective sleepiness scales as linear measures and the calculation of empirical weight and scale parameters for subjective alertness judgments.

It is concluded that studying the cognitive-algebraic relation of determinants of alertness judgments has important implications in naturalistic and clinical settings. This line of research allows for the understanding of how non-sleep disordered individuals make assumptions about sleep-related daily functioning such as risk-taking, activity planning, etc. Also, it is promising in offering insight into the qualitative differences in the perception of sleep-related processes in sleep-disordered individuals.