



## **On the Relation of Pre-Sleep Arousal and Sleep**

*Dissertation by Romy Kaden*

Arousal is a continuous physiological and psychological state, ranging from very low during deep sleep to very high in challenging or stressful situations (Duffy, 1957), and affecting body and mind at a cognitive-emotional, cortical, endocrine and peripheral level. Several models of insomnia incorporate some form of arousal as a key element of the disorder (Bonnet & Arand, 1997; Harvey, 2002; Perlis et al., 1997; Riemann et al., 2010). Pre-sleep arousal refers to the arousal-level just before sleep and it has effects on our ability to fall asleep (Wuyts et al., 2012) and perceived sleep quality (Gorgoni et al., 2021). Furthermore, Fernández-Mendoza et al. (2010) suggest that high pre-sleep cognitive arousal is a vulnerability-factor for the development of insomnia. The arousal level before and during sleep seem to be interconnected (Dressle et al., 2023; Pesonen et al., 2021; Wuyts et al., 2012) and thus, reduction of pre-sleep arousal might be an effective strategy to decrease arousal during the whole night. As there are various efficient ways for influencing pre-sleep arousal (non-invasive and non-pharmacological), it is a promising target in this vein. In sum, a better understanding of pre-sleep arousal may help in improving current strategies for insomnia treatment and prevention.

First, I will provide a comprehensive review of the empirical evidence related to pre-sleep arousal and sleep. This includes an overview of measurement-techniques, experimental procedures, and the various predictors of pre-sleep-arousal.

Second, I will conduct an experimental study analyzing inter- and intrapersonal variations of pre-sleep arousal and its relations to sleep quality, including repeated measurements across multiple days in a student sample. Likely, this will include experimental manipulations of pre-sleep arousal. Multiple assessment methods, including questionnaire techniques, sleep diaries, cortisol tests, and ambulant polysomnography, will allow for capturing arousal on a cognitive-emotional, cortical, endocrine, and peripheral level.

Thirdly, I will study changes of pre-sleep arousal during the treatment of insomnia. This is based on the assumption that pre-sleep arousal plays a decisive role in the development and maintenance of insomnia, and thus provides effective pathways for treatment.

## References

- Bonnet, M. H., & Arand, D. L. (1997). Hyperarousal and insomnia. *Sleep Medicine Reviews, 1*(2), 97–108. [https://doi.org/10.1016/s1087-0792\(97\)90012-5](https://doi.org/10.1016/s1087-0792(97)90012-5)
- Dressle, R. J., Riemann, D., Spiegelhalder, K., Frase, L., Perlis, M. L., & Feige, B. (2023). On the relationship between EEG spectral analysis and pre-sleep cognitive arousal in insomnia disorder: towards an integrated model of cognitive and cortical arousal. *Journal of Sleep Research, 32*(4), e13861. <https://doi.org/10.1111/jsr.13861>
- Duffy, E. (1957). The psychological significance of the concept of "arousal" or "activation". *Psychological Review, 64*(5), 265–275. <https://doi.org/10.1037/h0048837>
- Fernández-Mendoza, J., Vela-Bueno, A., Vgontzas, A. N., Ramos-Platón, M. J., Olavarrieta-Bernardino, S., Bixler, E. O., & De la Cruz-Troca, J. J. (2010). Cognitive-emotional hyperarousal as a premorbid characteristic of individuals vulnerable to insomnia. *Psychosomatic medicine, 72*(4), 397-403. DOI: 10.1097/PSY.0b013e3181d75319
- Harvey, A. G. (2002). A cognitive model of insomnia. *Behaviour Research and Therapy, 40*(8), 869–893. [https://doi.org/10.1016/s0005-7967\(01\)00061-4](https://doi.org/10.1016/s0005-7967(01)00061-4)
- Gorgoni, M., Scarpelli, S., Mangiaruga, A., Alfonsi, V., Bonsignore, M. R., Fanfulla, F., ... & Vicini, C. (2021). Pre-sleep arousal and sleep quality during the COVID-19 lockdown in Italy. *Sleep medicine, 88*, 46-57. <https://doi.org/10.1016/j.sleep.2021.10.006>
- Perlis, M. L., Giles, D. E., Mendelson, W. B., Bootzin, R. R., & Wyatt, J. K. (1997). Psychophysiological insomnia: the behavioural model and a neurocognitive perspective. *Journal of Sleep Research, 6*(3), 179–188. <https://doi.org/10.1046/j.1365-2869.1997.00045.x>
- Pesonen, A. K., Makkonen, T., Elovainio, M., Halonen, R., Räikkönen, K., & Kuula, L. (2021). Presleep physiological stress is associated with a higher cortical arousal in sleep and more consolidated REM sleep. *Stress, 24*(6), 667-675. <https://doi.org/10.1080/10253890.2020.1869936>

- Riemann, D., Spiegelhalder, K., Feige, B., Voderholzer, U., Berger, T., Perlis, M. L., & Nissen, C. (2010). The Hyperarousal Model of insomnia: A review of the concept and its evidence. *Sleep Medicine Reviews, 14*(1), 19–31. <https://doi.org/10.1016/j.smrv.2009.04.002>
- Wuyts, J., De Valck, E., Vandekerckhove, M., Pattyn, N., Bulckaert, A., Berckmans, D., Haex, B., Verbraecken, J., & Cluydts, R. (2012). The influence of pre-sleep cognitive arousal on sleep onset processes. *International Journal of Psychophysiology, 83*(1), 8-15. <https://doi.org/10.1016/j.ijpsycho.2011.09.016>