

# **The whole is more than the sum of its parts: Elucidating the link between sleep quality and well-being by integrating cross-modal networks**

## **ABSTRACT:**

### **Background**

Good sleep is pivotal for our daytime functioning and mood. By understanding the psychophysiological mechanisms underlying this link, we can promote well-being and resilience through good sleep. While hundreds of variables across psychological, psychophysiological, and brain imaging modalities have shown to influence the link between sleep and mood, their influence may be indirect. We must thus go beyond these individual associations and integrate modalities.

### **Aims**

We aim to understand the multivariate landscape of factors that influence the link between sleep quality and well-being by developing and estimating cross-modal network models.

### **Method**

First, we review network approaches across modalities, based on which propose ways forward to integrate these levels. Second, we apply these methods to (i) integrate psychophysiological and psychological measures; (ii) investigate propagation of interventions through the network by including behavioral and cognitive process measures; and (iii) link mood to individual affect trajectories over time.

### **Results**

We introduced three methods to integrate modalities using network analysis: multilayer networks, integrated networks, and network-based regressors. Using integrated networks, we could reveal that (i) anxiety is a potential bridging-factor between sleep bruxism and sleep problems; (ii) different cognitive and behavioral elements of a system can be targeted using various interventions; and (iii) characteristics of the individual networks comprising mood and affect predicted longer-term outcomes.

### **Conclusions**

Concertedly, these studies show that understanding the pathways through the complex system of sleep quality and mood may offer new ways to facilitate well-being.

### **Keywords**

Sleep, Mood, Network analysis, Cross-modal networks

### **Published Work:**

Blanken, T. F., Bathelt, J., Deserno, M. K., Voge, L., Borsboom, D., & Douw, L. (2021). Connecting brain and behavior in clinical neuroscience: A network approach. *Neuroscience and Biobehavioral Reviews*, *130*, 81-90. doi: 10.1016/j.neubiorev.2021.07.027

Chattratrai, T., Blanken, T., Lobbezoo, F., Su, N., Aarab, G. & Van Someren, E. (2022). A network analysis of self-reported sleep bruxism in the Netherlands sleep registry: Its associations with insomnia and several demographic, psychological, and life-style factors. *Sleep Medicine*, *93*, 63-70. doi: 10.1016/j.sleep.2022.03.018

Lancee, J., Harvey, A., Morin, C., Ivers, H., van der Zwerde, T. & Blanken, T. (2022). Network intervention analyses of cognitive therapy and behavior therapy for insomnia: Symptom specific effects and process measures. *Behaviour Research and Therapy*, *153*: 104100. doi: 10.1016/j.brat.2022.104100

### **Researcher's Contacts:**

Tessa Fee Blanken  
Department of Psychological Methods  
University of Amsterdam  
Nieuwe Achtergracht 129-B  
1018 WS Amsterdam  
The Netherlands  
Email: [t.f.blanken@uva.nl](mailto:t.f.blanken@uva.nl)