Correlation between mood during daily life and autonomic nervous system activity during sleep

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Sleep is one of the most important activities in our life. Surveys conducted by the National Sleep Foundation reveal that 60 percent of adults report having sleep problems a few nights a week or more [1]. There are many possible reasons for sleeping poorly. Those are mental state (mood), shift work, pain, illness, drugs, and so on. It is known that parasympathetic nervous system activity dominates sympathetic nervous system activity during deep Non-REM sleep [2]. Brosschot et al. showed that daily worry is associated with high heart rate and low heart rate variability (sympathetic dominance) during the subsequent nocturnal sleep period [3]. To our knowledge, there are no other studies that had investigated the relationship between various types of mood other than worry during daily life and the autonomic nervous activity during subsequent sleep. In this study, we examine how eight types of mood during daily life affects the activity balance of autonomic (parasympathetic and sympathetic) nervous system during the subsequent nocturnal sleep.

39 male subjects participated in experiment after provided their informed written consents. The experiment was approved by the Ethical Committee in National Institute of Advanced Industrial Science and Technology. Subjects wore wearable device that measures heart rate variability (RR-interval) and body acceleration signal during daily life including sleep for 72 hours intermittently except when taking bath or shower. Subjects answered to visual analog scale (VAS) questionnaire every hour during waking. The questionnaire scales subjects' eight types of mood level. Those are happiness, tension, fatigue, worry (anxiety), depression, anger, vigor, and confusion. We estimated the activity balance of parasympathetic nervous system and sympathetic nervous system from heart rate variability signal. This was done by calculating HF/(LF+HF), where HF and LF denote the powers of heart rate variability signal in high frequency band (0.2-0.5Hz) and low frequency band (0.04-0.15 Hz), respectively. We determined the timing when subjects had gone to bed (denoted as GBT) by their subjective report and body acceleration signal. We calculated the mean values of each mood measured from six hours before GBT to GBT. We also calculated the mean values of HF/(LF+HF) measured from GBT to three hours after GBT. In order to reduce the inter-individual difference effect, we normalized the values of mood level and HF/(LF+HF) before taking their mean values, and moreover, we took the difference of the mean values in the second night from those in the first (reference) night, before comparing mood level and HF/(LF+HF). The correlation coefficient between depression level from six hours before GBT to GBT and HF/(LF+HF) from GBT to three hours after GBT was -0.59 (see Figure 1 (a)). Moreover, the correlation coefficient between worry (anxiety) level from six hours before GBT to GBT and HF/(LF+HF) from GBT to three hours after GBT was -0.50 (see Figure 1 (b)). These results imply that both depression and worry (anxiety) before sleep shift balance of autonomic nervous system towards sympathetic dominance during sleep.

References

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3. Brosschot, J.F., Van Dijk, E., Thayer, J.F. (2007) Daily worry is related to low heart rate variability during waking and the subsequent nocturnal sleep period. *International Journal of Psychophysiology* **63**, 39-47.

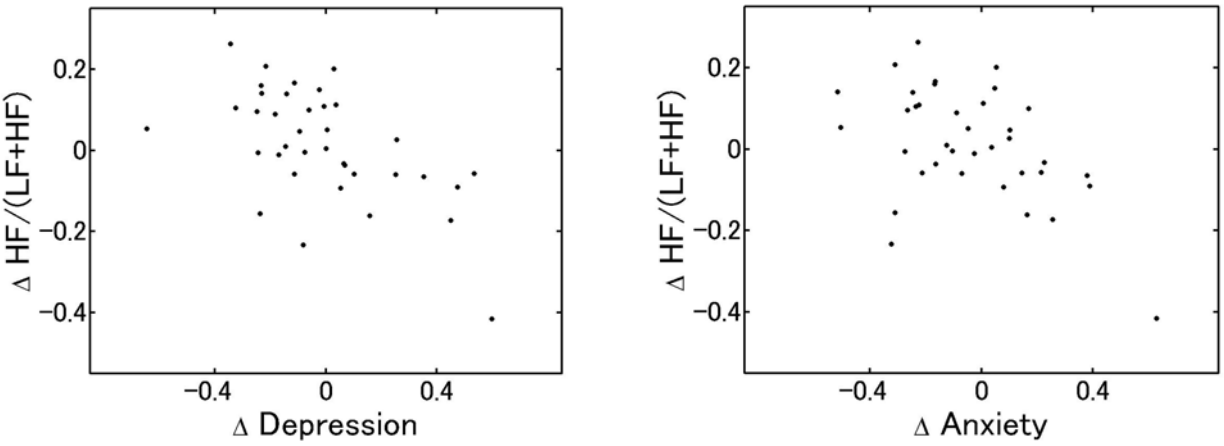

Figure 1. *Correlation between autonomic nerve activity balance index HF/(LF+HF) and mood states, (a) vs. depression, R=-0.59, (b) vs. worry (anxiety) R=-0.50.*