Sleep Medicine 16 (2015) 1567–1568

Contents lists available at ScienceDirect

Sleep Medicine

journal homepage: www.elsevier.com/locate/sleep

Editorial

A commentary on the "Functioning of three attentional networks and vigilance in primary insomnia"

As a testament to how much and how little is known about insomnia, there are at least two paradoxes that are apparent when profiling this disorder. The first paradox, and most reliably observed, is the discrepancy between subjective and objective measures of insomnia severity: the frequently observed discordance between subjective and objective measures of sleep continuity (sleep latency, wake-time after sleep onset, and total sleep time). More often than not patients report greater illness severity on these measures than is observable by polysomnography (PSG) [1]. Further, when treated with benzodiazepines or benzodiazepine receptor agonist hypnotics, many patients report greater reductions in illness severity than is observable by PSG. Some view this form of Subjective–Objective discrepancy as simply a reflection of how flawed subjective measures are, others see this simply as a measurement issue, ie, that different measures and methods necessarily produce different values, while still others view the discordance as pointing to the limitations of state classification by EEG/PSG and imply (if not directly say) that the patient assessment is more "accurate," viz. being unconscious [2,3].

The present study points to the second paradox (less well documented): the common occurrence of subjective complaints regarding daytime function in the absence of neuropsychological findings [4]. Some view this form of subjective–objective discrepancy as (once again) a reflection of how flawed subjective measures are, others see this as simply a reflection of how patents perceive illness and/or how expectancy affects the individual's judgments, while still others view the discordance as pointing to the limitations of neuropsychological assessment. Before addressing this issue directly, it should be borne in mind that the diagnosis of insomnia necessarily includes daytime complaints (complaints that are ascribed to reduced sleep quantity or compromised sleep quality) to ensure that (1) the sleep continuity problem is consequential (of sufficient magnitude as to warrant treatment), and (2) a differential can be made between insomnia (as a result of stress, behavioral, and/or cognitive factors) and the phenomenon of short sleep (ie, low sleep ability co-occurring with low sleep need and expanded sleep opportunity). Thus, the incorporation of daytime complaints (or the daytime complaint) into the diagnostic criteria is done with good reason. When assessed, however, with objective measures, patients who meet the diagnostic criteria for insomnia rarely exhibit significant neuropsychological impairments. The authors highlight this phenomenon and take as their point of departure that this form of Subjective–Objective discrepancy may not reflect the absence of such problems but rather the limitations of neuropsychological assessment given that such tests are too related to IQ and that they lack ecological validity. The authors also suggest, as do Orff and colleagues [4], that the Subjective–Objective discrepancy with respect to daytime complaints may be a matter of effort and fatigue and not performance. That is, it may not be that patients perform abnormally on cognitive tasks but rather the effort to perform normally is perceived as excessive and/or results in exceptionally elevated mental and/or physical fatigue. The authors note that the reaction time data from neuropsychological testing and the brain activity data from imaging studies support this point of view and that such data also strongly implicate altered forebrain function and diminished executive function capacity. Finally, there is the possibility that the occurrence of daytime deficits is limited to some types and subtypes of insomnia and that these effects may or may not be observed in generic insomnia.

Given this perspective, Perrier, Chavoix, and Bocca [5] suggested that the neuropsychological approach to the evaluation of deficits might be more successful if tasks that tap sustained executive function were used. Accordingly, an assessment of the functioning of three attentional networks and vigilance was undertaken in patients with primary insomnia using the Attentional Network Test (ANT). The ANT is an easily implemented instrument that can be completed in a short period of time and is available in age-appropriate versions. Performance on the ANT is purported to evince specific attention networks – alerting, orienting, and executive functioning. The ANT is a speeded choice task and outcome measures include reaction time (RT) and error rate (ER). Typical ANT RT scores for each network can be derived via subtraction of RTs on accurate trials. Error rate often goes unreported. Well documented in Macleod et al. [6], the face validity of the ANT is high as it is based on two foundational neuropsychological tests of attention: the Eriksen flaker task [7] and the cued RT test [8]. These two tests are well validated in the literature and reliably assess the integrity of the attention system. In addition, the ANT can isolate (mostly) non-overlapping anatomical brain structures for each type of attention deficit using functional magnetic resonance imaging (fMRI) approaches. Hence, the ANT has become a popular neuropsychological tool for identifying deficits in the attention system, particularly in clinical conditions with prospective disturbances in attention.

Twenty-one patients with primary insomnia (PI) and 16 good sleepers were assessed at 2 pm with an ANT task of 25 minutes in duration. The choice to assess patients with PI (as opposed to Insomnia Disorder) was justified on the grounds that allowing for comorbidity may confound the experimental effort to differentiate between the effects of insomnia and good sleep. The study results were that

http://dx.doi.org/10.1016/j.sleep.2015.08.010

> While PI patients, compared to good sleepers, were found to have a longer overall reaction time and perform more slowly in the incongruent flanker condition (ie, conflict situation) than in the congruent condition, no group effects were observed for the variables representing the three attentional networks (ie, alerting, orienting, and executive function) (p. xx).

The authors concluded that based on the observed interaction (performance in the congruent and incongruent conditions) that conflict resolution may be impaired in PI. The authors recommend (as does Orff et al. [4]) that "simultaneous EEG and fMRI recording during tasks with different attentional demands (eg, ANT and Stroop) in future studies could highlight the attentional demand related to the task in PI patients" (p. xx).

While there is no question that the foundation for the study was well conceptualized and the experiment was well executed, several study specific issues are worth noting. First, the task used, as with so many neuropsychological tasks, lacked ecological validity. The authors directly address this issue saying that using real word tasks may reveal deficits but do so in a manner that does not allow for the specific identification of functional abnormalities. Second, subscale scores or component scores of the ANT have been criticized as not being sufficiently orthogonal [6] and the measures may more reflect state as opposed to trait considerations. Third, the task was administered once, at 2 pm. The issue here is that this experiment (as with most) assumes that the cognitive deficits that stem from, and are typical of, insomnia are trait-like. That is, that the patient group as a whole experiences such deficits and does so (when compared to good sleepers) "all day every day." This may not be so. Since patients with insomnia appear to cycle between good and bad sleep [9], the insomnia related deficits may appear (or only may be robust) following bad nights. Further, the deficits following a bad night's sleep may have a distinct circadian pattern being least evident at the peak of circadian alertness and/or during the maintenance of wakefulness zone, and most evident immediately following a poor night's sleep and/or after a full day's wakefulness. Such possibilities need to be assessed systematically using proper chronobiologic paradigms [eg, multiple measurements within a constant routine, 90 minute day (or related variants), or with forced desynchrony]. Fourth, as noted by the authors, the neutral stimuli in most neuropsychological tasks may not tap specific deficits precisely because they are neutral. As with attention bias tasks, the use of sleep specific stimuli may serve to unmask deficits. An example of such an adaptation is the conduct of the Stroop task with sleep related stimuli [10]. Finally, it may be fruitful to use neuropsychological tasks (ideally within circadian paradigms and with concomitant measures of CNS activity) that directly assay probability evaluations, risk assessment, and impulsivity. Such tasks as the Iowa Gambling Task and The Balloon Analogue Risk Task may be ideal measures for such purposes.

In sum, the present study represents a thoughtful and productive step toward unraveling the paradox that patients with insomnia reliably report problems with daytime function but do so largely in the absence of neuropsychological findings. Future work will likely require the identification of appropriate neuropsychological tasks which are deployed within chronobiological paradigms with concomitant measures of effort (by self-report, reaction time, and central nervous system activation).

Conflict of interest

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: http://dx.doi.org/10.1016/j.sleep.2015.08.010.

References

[1] Carskadon MA, Dement WC, Mitler MM, et al. Self-reports versus sleep laboratory findings in 122 drug-free subjects with complaints of chronic insomnia. Am J Psychiatry 1976;133(12):1382–8.
[2] Mendelson WB. Pharmacologic alteration of the perception of being awake or asleep. Sleep 1993;16(7):641–6.
[3] Perlis ML, Giles DE, Mendelson WB, et al. Psychophysiological insomnia: the behavioural model and a neurocognitive perspective. J Sleep Res 1997;6(3):179–88.
[4] Orff HJ, Drummond SP, Nowakowski S, et al. Discrepancy between subjective symptomatology and objective neuropsychological performance in insomnia. Sleep 2007;30(9):1205–11.
[5] Perrier J, Chavoix C, Bocca ML. Functioning of the three attentional networks and vigilance in primary insomnia. Sleep Med 2015;16(12):1569–1575.
[6] Macleod JW, Lawrence MA, McConnell MM, et al. Appraising the ANT: psychometric and theoretical considerations of the Attention Network Test. Neuropsychology 2010;24(5):637–51.
[7] Eriksen BA, Eriksen CW. Effects of noise letters upon the identification of a target letter in a nonsearch task. Perception & Psychophysics 1974;16(1).
[8] Posner MI. Orienting of attention. Q J Exp Psychol 1980;3(1):3–25.
[9] Perlis ML, Zee J, Swinkels C, et al. The incidence and temporal patterning of insomnia: a second study. J Sleep Res 2014;23(5):499–507.
[10] Taylor LM, Espie CA, White CA. Attentional bias in people with acute versus persistent insomnia secondary to cancer. Behav Sleep Med 2003;1(4):200–12.

Michael L. Perlis *
Behavioral Sleep Medicine Program, Department of Psychiatry, University of Pennsylvania, USA
* *Tel.: +1 215-746-3577; fax: (215) 573-0759.*
E-mail address: mperlis@upenn.edu

David R. Roalf
Neuropsychiatry Section, Department of Psychiatry, University of Pennsylvania, USA

Jaqueline D. Kloss
Department of Psychology, Drexel University, USA

Available online 28 August 2015