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: a focus on attentional and interpretative biases**

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The face of tiredness in Insomnia from the self-perspective: a focus on attentional and interpretative biases

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The extent to which an individual has slept may influence how their physical appearance is perceived by others and oneself. The poor nature of one's sleep can be observed through a number of dermatologic characteristics (e.g. wrinkles/fine lines and bags around the eyes, dropped corners of the mouth, and heavy eyes) pertaining to tiredness (Knoll et al., 2008; Sundelin et al., 2013). Further, research concurs that facial photographs of sleep-deprived individuals are rated as less attractive, less healthy, more tired, and less sociable when compared to well-rested (Axelsson et al., 2010; Sundelin et al., 2017). As such, it appears that limited sleep may lead to dermatologic changes in the face which subsequently may influence the perception of others, inherently leading to psychosocial implications relating to partner and workplace interaction(s), and with health care providers (Gupta et al., 2015). There may be a number of mechanisms promoting these physiological changes, for example, tiredness can result in the relaxing of the muscles, which would inherently alter one's facial expression (Enoka and Stuart, 1992). Moreover, sleep promotes blood flow to the skin and changes in skin blood coloration occur with lack of sleep leading the face to appear paler (Kräuchi and Wirz-Justice, 2001) which could act as a contributing factor to an increased perception of tiredness (Sundelin et al., 2013).

Insomnia by definition encompasses subjective reports of poor sleep (American Psychiatric Association, 2013), and whilst the experience of tiredness is commonly reported (Balter and Uhlenhuth, 1991), this population often display objectively better sleep than what is subjectively reported (Perlis et al., 2001; Tang and Harvey 2004, 2006; Van den Berg et al., 2008). Considering the aforementioned research, which focuses largely on studies of extreme sleep-deprivation, it would be reasonable to assume that those with insomnia might not actually appear physically tired to the same extent, perhaps falling somewhere in-between *sleep sated* and *sleep deprived*. As such, people with insomnia may not necessarily be judged as negatively by others as a person who has experienced a transient bout of severe sleep-deprivation may be.

However, a different picture emerges if we examine how individuals with insomnia perceive themselves. In an article published in the *Journal of Sleep research*, data from our group demonstrated that when using a visual task where participants indicated when a continuously morphing image of their face, varying in degrees of tiredness and alertness, represented their current level of tiredness, individuals with insomnia displayed an interpretive bias such that they misperceived their own face as appearing more tired than they physically were (Akram et al., 2016a). Conversely, this bias did not extend to the perception of other people's faces which were more accurately perceived (Akram et al., 2016b). When asked to explore and examine their own and other people's faces, a follow-up study in the *Journal of Sleep research* (Akram et al., 2017a) determined that people with insomnia were quicker to direct initial attention to and maintain overall attention towards areas of the face associated with tiredness (Knoll, et al., 2008; Nguyen et al., 2009; Sundelin et al., 2013). Further, it has also been evidenced that the self-reported severity of insomnia symptoms is related to reduced ratings of expression intensity for tired facial photographs of other people (Akram et al., 2017b). It is relevant to note however that these studies used samples of a relatively young age (compared with other research in insomnia). Whilst this was to account for changes to sleep continuity and increased sensitivity to early signs of skin aging (Akram et al., 2017a), these outcomes cannot be extrapolated to older adults experiencing insomnia. Despite this, it seems that whilst individuals with insomnia

display an equivalent level of attention toward both their own and other people's facial features relating to tiredness (Akram et al., 2017a), only their own facial attributes of tiredness are interpreted in a manner consistent with the physical presence of an objective sleep disturbance (Akram et al., 2016a, 2016b).

This may be explained from a cognitive perspective, specifically in terms of biases of attention, which may consequently influence interpretation. Individuals with insomnia report selectively attending to, and monitoring, bodily sensations on waking and throughout the day for signs of a poor night's sleep, fatigue, and tiredness (i.e. sore head, heavy eyes, poor facial complexion), which has been evidenced as mediated by the extent of sleep-related monitoring on awakening (Akram, 2017; Semler and Harvey, 2004). As the face is used in social perception to portray one's internal state to others (Allison et al., 2000), we may theorise that those with insomnia attend to other people's facial attributes of tiredness, evaluating these features and drawing comparisons to their own. Certainly, if this is the case, comparisons of this nature (e.g. 'I look exhausted compared with everybody else'), may serve to heighten pre-existing worry, arousal and distress as described in cognitive models of insomnia (Espie et al., 2006; Harvey, 2002).

From a clinical perspective, one must ask two questions: firstly, can we correct these biases of attention and interpretation, and secondly would this alter reported insomnia symptomology? Tentatively, research suggests that providing feedback regarding the accuracy of how individuals with insomnia perceive their own faces in terms of tiredness served to positively influence subsequent interpretations, such that participants later interpreted themselves as appearing less tired (Akram et al., 2016a). However, whilst initiation of a more accurate self-perception could theoretically eliminate one source of maintenance in insomnia by extinguishing the tendency to interpret ambiguous cues as consistent with a poor night's sleep, attention precedes interpretation. With that in mind, recent studies have examined the efficacy of delivering attentional bias modification (ABM) immediately prior to bed as a treatment for individuals displaying poor sleep quality (Clarke et al., 2015; Milkins et al., 2016). Promising data from these studies determined that poor-sleepers provided with ABM displayed improved subjective sleep quality, reduced pre-sleep arousal, and reduced sleep onset latency relative to poor-sleeping controls. Unpublished data from our group has determined that individuals with insomnia display a sleep-related attentional bias for physical facial cues pertaining to tiredness, specifically showing difficulty in disengaging attention away from such cues. As such, targeted attentional modification tasks using sleep-related facial stimuli may be one option for reducing attention to facial tiredness cues.

As previously mentioned, if people with insomnia attend to other people's facial attributes of tiredness to then evaluate these features and draw comparisons to their own, this occurrence provides a possibility critical focus for intervention. However, and more importantly I would like to highlight that: i) research in this area is in an early and limited stage, and; ii) more specifically limited to a number of specific research groups who either examine this from the perspective of insomnia or sleep-deprivation. Considering the salience of tiredness (and its outward expression) in the interpersonal environment for individuals with insomnia, it is vital that research in this area is moved forward. Before considering intervention, the extant research to date should be replicated by other research groups seeking to both address limitations of such work (i.e. using more representative sampling inclusive of older adults) and to clarify a number of unanswered questions. Specifically,

whether self/other comparisons are indeed made in terms of facial tiredness judgments, and whether comparisons of this nature are made on a conscious level. This latter question may be explored by pairing self-report and experimental research or using qualitative methods to gain patient level insight. By further understanding the mechanisms at play, we may pave the way for interventions which target and correct attentional and interpretive biases in the context of facially expressed tiredness amongst individuals with insomnia.

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