Sleep-related attentional bias for tired faces in insomnia: Evidence from a dot-probe paradigm

Umair Akram[a,*], Louise Beattie[b], Antonia Ypsilanti[a], John Reidy[a], Anna Robson[a], Ashley J. Chapman[c], Nicola L. Barclay[d]

[a] Department of Psychology, Sociology and Politics, Sheffield Hallam University, UK
[b] School of Psychology, University of Glasgow, UK
[c] Department of Psychology, Faculty of Health and Life Sciences, Northumbria University, UK
[d] Sleep and Circadian Neuroscience Institute, Nuffield Department of Clinical Neurosciences, Sir William Dunn School of Pathology, University of Oxford, UK

ARTICLE INFO

ABSTRACT

People with insomnia often display an attentional bias for sleep-specific stimuli. However, prior studies have mostly utilized sleep-related words and images, and research is yet to examine whether people with insomnia display an attentional bias for sleep-specific (i.e. tired appearing) facial stimuli. This study aimed to examine whether individuals with insomnia present an attentional bias for sleep-specific faces depicting tiredness compared to normal-sleepers. Additionally, we aimed to determine whether the presence of an attentional bias was characterized by vigilance or disengagement. Forty-one individuals who meet the DSM-5 criteria for Insomnia Disorder and 41 normal-sleepers completed a dot-probe task comprising of neutral and sleep-specific tired faces. The results demonstrated that vigilance and disengagement scores differed significantly between the insomnia and normal-sleeper groups. Specifically, individuals with insomnia displayed difficulty in both orienting to and disengaging attention from tired faces compared to normal-sleepers. Using tired facial stimuli, the current study provides novel evidence that insomnia is characterized by a sleep-related attentional bias. These outcomes support cognitive models of insomnia by suggesting that individuals with insomnia monitor tiredness in their social environment.

1. Introduction

Insomnia is a prevalent sleep disorder affecting up to 10% of adults at disorder level (Espie, Kyle, Hames, Cyhlarova, & Benzeval, 2012; Morin, LeBlanc, Daley, Gregoire, & Merette, 2006). Characterized by difficulty with sleep initiation, maintenance and/or early morning awakening, and accompanied by significant impairment to daytime functioning, insomnia often leads to impaired quality of life (Kyle, Espie, & Morgan, 2010). Several theoretical cognitive models have been put forward to explain the mechanisms underlying the development and maintenance of insomnia (e.g. Espie, 2002; Espie, Broomfield, MacMahon, Macphee, & Taylor, 2006; Harvey, 2002). Emphasized in these models is the notion that insomnia is in part maintained by an attentional bias for sleep-related 'threat' cues which may be internal (i.e. bodily sensations) or external (i.e. environmental noises) (Espie et al., 2006; Harvey, 2002). Such 'threats' may be the product of sleep-specific anxiety, which is maintained by a combination of heightened

arousal, distress, negative thoughts concerning sleep and belief that sleep difficulties during the night contribute to impaired functioning during the day. Due to this anxious state, attentional resources are preferentially allocated to the processing of sleep-related threat cues. Once detected, such cues may be interpreted in an insomnia-consistent manner, serving to further increase arousal, distress, and negative thoughts concerning sleep and daytime function: a vicious thought cycle that is partly maintained by the sleep-related attentional bias.

Several studies have examined the presence of a sleep-related attentional bias in insomnia using experimental tasks including the dot-probe, the flicker and the emotional Stroop (Barclay & Ellis, 2013; Beattie, Bindemann, Kyle, & Biello, 2017; Jansson-Fröjmark, Bermås, & Kjellén, 2013; Lundh, Froding, Gyllenhammar, Broman, & Hetta, 1997; Macmahon, Broomfield, & Espie, 2006; Marchetti, Biello, Broomfield, MacMahon, & Espie, 2006; Spiegelhalder, Espie, Nissen, & Riemann, 2008; Spiegelhalder et al., 2016; Woods, Marchetti, Biello, & Espie, 2009; Woods, Scheepers, Ross, Espie, & Biello, 2013; see Harris et al.,

---

2015 for a review). Whilst many of these studies suggest that poor sleepers and individuals with insomnia display an attentional bias for sleep-related stimuli (Barclay & Ellis, 2013; Beattie et al., 2017; Jansson-Fröjmark et al., 2013; Macmahon et al., 2006; Marchetti et al., 2006; Spiegelhalder et al., 2008; Woods et al., 2009), the evidence base suggesting the presence of such a bias in insomnia remains mixed (Lundh et al., 1997; Spiegelhalder et al., 2016; Woods et al., 2013). A possibility for this may stem from methodological differences regarding the specific task or population.

The aforementioned studies largely used sleep-related words and images of objects. Such stimuli could be considered to be distal or abstracted from the insomnia experience, and research is yet to examine whether people with insomnia display an attentional bias for sleep-specific faces. Sleep-specific faces may be more proximal stimuli than words or images of objects, and thus more closely related to the insomnia experience, given the salience of tiredness (and its outward expression) in the interpersonal environment. Indeed, salient and often threatening faces are widely used to examine the presence of an attentional bias in many psychopathologies including anxiety and depression. For example, individuals with anxiety often show an attentional bias for threatening faces which display the expression of anger (Bradley, Mogg, White, Groom, & De Bono, 1999; Fox, Russo, & Dutton, 2002); whereas individuals with depression often show a bias for disorder-consistent faces depicting sadness (Bourke, Douglas, & Porter, 2010). With that in mind, recent research from our group demonstrated that people with insomnia were quicker to direct their initial attention to, and maintain overall attention towards, areas of the face associated with tiredness whilst viewing their own and other people's neutral faces (Akram, Ellis, Myachykov, & Barclay, 2017). Given that neutral facial stimuli were used in this study, the results suggest that areas of the face that are typically associated with threat are being monitored to detect such threat even when threat is absent. Moreover, this outcome also suggests insomnia may be characterised by a propensity to monitor faces for cues focused around the eye and mouth regions which are known to be associated with tiredness. The next logical step is to determine the presence of preferential attention towards faces that depict tiredness (threat) compared to neutral faces.

Using a dot-probe paradigm, the overall aim of the present study was to examine whether individuals with insomnia exhibit an attentional bias for sleep-specific faces depicting tiredness compared to normal-sleepers. Further, the nature of this potential bias, specifically vigilance (i.e. speeding of attention towards salient stimuli) or disengagement (i.e. difficulty in shifting attention away from salient stimuli) was also investigated. Given that experimental research to date has yielded mixed evidence concerning the presence and nature of sleep-related attentional bias in insomnia, the present study is the first to attempt to address this question using more proximal and salient stimuli. As such, we consider this to be an exploratory investigation, with no a-priori hypotheses.

2. Method

2.1. Participants

Participants were recruited from the general population using posters around Sheffield Hallam University, and social media. Participants completed a diagnostic screening questionnaire to determine eligibility to take part and group allocation – insomnia or normal-sleeper groups (see 'Measures and materials' for details). The sample consisted of 41 individuals with insomnia (mean age = 27.97 years, SD = 9.52 years; 65% female), and 41 normal-sleepers (mean age = 25.28 years, SD = 8.31 years; 67% female). The average duration of insomnia within the insomnia group was 32.23 months (SD = 45.58 months), ranging from 3 to 252 months. All participants had normal or corrected-to-normal vision.

2.2. Measures and materials

2.2.1. Screening questionnaire for eligibility and group allocation

A screening questionnaire determined eligibility and insomnia status. Individuals who reported symptoms of a sleep/wake disorder other than insomnia, an existing psychiatric illness, a central nervous system disorder, use of medication that may affect sleep, prior head injury or current shift-work were ineligible to participate. Participants with insomnia met DSM-5 criteria for insomnia disorder (American Psychiatric Association, 2013). Specifically, individuals with insomnia reported dissatisfaction with sleep characterized by either a difficulty initiating or maintaining sleep or early morning awakenings. Insomnia had to be present for three or more nights per week, for at least three months, and cause significant daytime impairment. Finally, these conditions had to be met despite adequate opportunity to sleep. It was a requirement that normal-sleepers reported no problems with sleep and no history of any sleep-disorder. Of note, the SLEEP-50 questionnaire (Spoormaker, Verbeek, van den Bout, & Klip, 2005) was used to ensure the absence of a sleep/wake disorder other than insomnia.

2.2.2. Control measures

A number of measures were included to account for several factors that could influence attentional behaviour. Specifically, symptoms of anxiety and depression and self-reported sleepiness. Symptoms of anxiety and depression were assessed using the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983), consisting of 14 items (seven for both anxiety and depression) scored between 0 and 3, with a maximum score of 21 on both subscales. Higher scores on each subscale represent greater anxiety and depression. Both subscales demonstrated good internal consistency (Cronbach's α = .84 for anxiety, and .76 for depression). The Stanford Sleepiness Scale (SSS; Hoddes, Zarcone, Smythe, Phillips, & Dement, 1973) was administered to assess participants' subjective state sleepiness. The measure consists of a 7 item likert scale ranging from 1 (feeling active, vital, alert, or wide awake) to 7 (no longer fighting sleep, sleep onset soon, having dreamlike thoughts). Higher scores are indicative of greater state sleepiness.

2.2.3. Facial stimuli for dot-probe task

A subset of 12 tired-neutral face-pairs (50% female) previously developed by our group were used for the present study (Akram, Sharman, & Newman, 2017). Specifically, with approval from the authors, facial photographs displaying a neutral expression were taken from the Karolinska Directed Emotional Faces database (Lundqvist, Flykt, & Öhman, 1998). Subsequently, the hair and neckline was cropped from each neutral image, leaving a series of oval shaped neutral facial images. To create the corresponding tired faces, each neutral face was subject to standardized manipulations of: increased pretarsal skin show; upper eyelid depression; dark circles under eyes; and drooped corners of the mouth (see Akram et al., 2017 for details). These specific manipulations have previously been associated with an increased perception of tiredness (Akram, Ellis, Myachykov, & Barclay, 2016; Knoll, Attkiss, & Persing, 2008; Sundelin et al., 2013). This resulted in a series of face pairs comprised of a threating (i.e. tired appearing) and neutral facial expression made by the same person (see Fig. 1).

2.3. Procedure

All participants provided written informed consent prior to participation. Ethical approval was granted by the Sheffield Hallam University Research Ethics committee. The experiment was conducted in a quiet laboratory room in the department. Each participant was seated in front of a computer screen and task instructions were presented in writing on screen and explained orally. The participants then completed eight practice trials, followed by 192 experimental trials