Behaviour Research and Therapy 92 (2017) 51–56

Contents lists available at ScienceDirect

Behaviour Research and Therapy

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

Attention to beds in natural scenes by observers with insomnia symptoms

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ARTICLE INFO

Article history:
Received 11 May 2016
Received in revised form
8 February 2017
Accepted 8 February 2017
Available online 10 February 2017

Keywords:
Attention
Insomnia symptoms
Natural scenes
Eye movements
Fixation

ABSTRACT

Attention biases to sleep-related stimuli are held to play a key role in the development and maintenance of insomnia, but such biases have only been shown with controlled visual displays. This study investigated whether observers with insomnia symptoms allocate attention to sleep-related items in natural scenes, by recording eye movements during free-viewing of bedrooms. Participants with insomnia symptoms and normal sleepers were matched in their visual exploration of these scenes, and there was no evidence that the attention of those with insomnia symptoms was captured more quickly by sleep-related stimuli than that of normal sleepers. However, the insomnia group fixated bed regions on more trials and, once fixated on a bed, also remained there for longer. These findings indicate that sleep stimuli are particularly effective in retaining visual attention in complex natural scenes.

1. Introduction

Insomnia is common, with 6–10 percent meeting the criteria for insomnia disorder in the general population (LeBlanc et al., 2009; Morin & Benca, 2012). The condition negatively impacts on cognitive functioning (e.g., Kyle, Espie, & Morgan, 2010; Kyle, Morgan, & Espie, 2010) and mental health (e.g., Baglioni, Spiegelhalder, Lombardo, & Riemann, 2010; Baglioni et al., 2011). Theories of insomnia suggest that attention biases towards disorder-relevant stimuli play a key role in its maintenance, by potentiating cognitive arousal and driving sleep intention and effort (Espie, Broomfield, MacMahon, Macphee, & Taylor, 2006; Harvey, 2002). Evidence of such biases comes from experimental tasks in which sleep-related words and objects are presented in attention orienting paradigms. For example, such biases have been demonstrated in change detection paradigms, in which two near-identical images flicker back and forth while one scene element is changing (Jones, Macphee, Broomfield, Jones, & Espie, 2005; Marchetti, Biello, Broomfield, MacMahon, & Espie, 2006). In this paradigm, observers with insomnia detect changes to sleep-related items, such as a bed or a pillow, faster than good sleepers. Similar effects have been observed in studies using modified Stroop (e.g., Spiegelhalder, Espie, Nissen, & Riemann, 2008) and Posner tasks (e.g., Woods, Marchetti, Biello, & Espie, 2009).

While previous studies have demonstrated attention biases to sleep-related items in insomnia, these paradigms rely on highly controlled visual displays (e.g., Spiegelhalder et al., 2008; Woods et al., 2009) or contrived visual scenes (e.g., Jones et al., 2005; Marchetti et al., 2006). Consequently, it remains unresolved whether observers with insomnia also allocate attention to sleep-related items in more natural displays, comprising scenes that might be encountered in everyday life outside of the laboratory. In addition, previous studies are limited in that the methods employed provide only a "snapshot" of the dynamic attentional process (Armstrong & Olatunji, 2012), by terminating measurement upon participants' responses. The current study therefore investigated whether similar attention biases are observed with natural scenes, and the technique utilised allowed us to address whether these biases persist over more extended intervals.

For this purpose, participants with insomnia symptoms and normal sleep viewed a series of indoor scenes while their eye-movements were recorded in a free-viewing task. Images of living rooms, offices and kitchens served as filler items, while we examined the extent to which observers fixated sleep-related content in bedroom scenes. The aim here was to determine

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http://dx.doi.org/10.1016/j.brat.2017.02.001
0005-7967/

whether those with insomnia symptoms would show increased attention towards sleep-related stimuli, as indexed by earlier and more frequent fixations on beds. In particular, we hypothesised that there would be an attentional bias in the insomnia symptoms group, evidenced by a greater number of fixations to beds (mean total number of fixations; fixations to first look; percentage trials on which regions of interest (ROIs) fixated; percentage fixations on ROIs; percentage revisits to ROIs) and time spent on these regions (time to first look at ROIs; retention time on ROIs) of scenes in comparison to the normal sleepers group.

2. Method

2.1. Participants

This study was approved by the Ethics Committee of the School of Psychology at the University of Glasgow. Forty-one volunteers from the University's participant pool, which includes student and non-student volunteers, participated in return for a small fee. The group of normal sleepers (N = 21) and those with insomnia symptoms (N = 20) were of similar mean age (22.3 years, SD = 3.9 vs. 23.1 years, SD = 4.2) and sex composition (15F/6M vs. 13F/7M).

2.2. Pre-screen and scene free-viewing task

Participants responded to an email sent to the School of Psychology research participant pool. We recruited participants who reported insomnia symptoms and normal sleep, which was assessed by the screening question “Insomnia is a difficulty with getting to sleep, maintaining sleep, early morning awakenings, or non-restorative sleep, which adversely affects your daytime functioning. Do you think that you have insomnia?”, as well as by responses to two screening questionnaires (see Sleep Measure subsection for cut-offs). Participants were then invited to the laboratory to take part in an eye-tracking experiment on scene perception, but were kept naïve to the full purpose of the experiment until the end. To record observers' natural interest in sleep-related content in scenes, a free-viewing paradigm was used so as not to constrain spontaneous eye movement patterns. Thus, participants were simply instructed to view a set of scene images as they naturally would (for similar approaches, see Attard-Johnson, Bindemann, & O Ciardha, 2016; Bindemann, Scheepers, & Burton, 2009).

Photographs of 48 indoor scenes served as stimuli for this eye-tracking task. These scenes were photographed by the authors or taken from internet image searches and comprised 12 pictures each of bedrooms, living rooms, offices and kitchens. These photographs were presented at a size of 1024 (W) × 768 (H) pixels at a screen resolution of 66 ppi on a 21 in. monitor. Living room, office and kitchen scenes served as filler items to disguise the task aims, whereas bedroom scenes served to measure visual interest in beds, which functioned as sleep-related target items. Example stimuli are depicted in Fig. 1.

These stimuli were displayed in a randomised order using SR-Research ExperimentBuilder software (version 1.1.0) at a viewing distance of 85 cm, which was held constant by means of a chinrest. Eye movements were tracked with an EyeLink 1000 desk-mounted eye-tracking system running at 500 Hz sampling rate. Viewing was binocular, but only the participants' left eye was tracked, which was calibrated using the standard Eyelink procedure. Thus, participants fixated an initial series of nine target points on the display monitor. Their accuracy was then validated against a second series of nine fixation targets. Calibration was repeated if poor measurement accuracy was indicated (i.e., a gaze position accuracy of <0.5 °).

In the experiment, each trial began with a central fixation dot, which allowed for drift correction. This was followed by a scene stimulus, which was displayed for 5000 ms. This display duration is similar to other eye-tracking studies with static scene images (e.g., Attard-Johnson, Bindemann, & O Ciardha, 2016) and allows for approximately 15 fixations (based on an average fixation duration lasting 200–300 ms, see Rayner, 1998), which is sufficient time to scan the entire scene.

2.3. Sleep measures

The two sleep groups (normal sleepers and insomnia symptoms) were confirmed via two pre-test questionnaires:

1 The Pittsburgh Sleep Quality Index (PSQI) measures sleep quality over the past month, with scores ranging from 0 to 21 (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). The PSQI is widely used to reliably measure sleep quality and validity has been demonstrated in various populations including healthy controls, patients with cancer, patients with depression and patients visiting sleep clinics (Carpenter & Andrykowski, 1998). A score of 7 or higher was used to define insomnia symptoms, while normal sleepers were defined by a score of 6 or less. This cut-off score is associated with improved balance of sensitivity to specificity (Backhaus, Junghanns, Broocks, Riemann, & Hohagen, 2002); and a recent study finds >6 to be optimal in detecting sleep complaints in students (Manzar et al., 2015).
2 The Insomnia Severity Index (ISI) (Bastien, Vallieres, & Morin, 2001) is commonly utilised to reliably detect cases of insomnia, and reliability and validity have been reported in insomnia populations. The ISI was used to quantify participants' level of insomnia symptoms on a 0–21 point scale. In line with previous studies, scores below 8 were used to identify normal sleepers, and participants with insomnia symptoms identified as those scoring 8 or higher (Ellis, Gardani, & Hogh, 2010; Ree, Pollitt, & Harvey, 2006).

After the eye-tracking task, a series of sleep-related measures were also administered to confirm the two sleep groups (normal sleepers and insomnia symptoms):

1 The consensus sleep diary, developed by expert consensus (Carney et al., 2012) was used to assess participants' sleep on test days, and is the “gold standard” for sleep assessment. Descriptively, this measure confirmed that participants had achieved at least five hours time in bed on test days.
2 The sleep disorders algorithm from the British Association for Psychopharmacology consensus statement (see Wilson et al., 2010) was used to screen for sleep disorders other than insomnia (e.g., narcolepsy, sleep breathing disorder, parasomnias). None of the participants had evidence of any other sleep disorder, but all insomnia symptom participants endorsed an insomnia complaint.
3 The Morningness-Eveningness Questionnaire (Horne & Ostberg, 1976) assesses diurnal preference with scores of 70–86 indicating a definite morning type, 59–69 a moderate morning type, 42–58 neither type, 31–41 a moderate evening type, and 16–30 a definite evening type.
4 The Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983) was used to assess levels of anxiety and depression symptoms amongst both groups. Reliability, validity and factor structure of the measure have been confirmed (Bjelland, Dahl, Haug, & Neckelmann, 2002). Scores of 0–7 are indicative of no significant mood disruption, 8–10 suggest subclinical mood disruption, and 11 or higher indicate clinical levels of mood disruption.