An Investigation of Interpretive Bias in Insomnia: An Analog Study Comparing Normal and Poor Sleepers

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Study Objectives: Cognitive theories state that psychological disorders are associated with, and are possibly maintained by, interpretive biases, which are tendencies to make threatening interpretations of ambiguous stimuli. Recent models of insomnia have highlighted the importance of cognitive processes. The aim of this study was to empirically evaluate whether an interpretive bias is present in poor sleepers.

Design: A mixed-design analysis of covariance was employed with group (normal sleepers vs poor sleepers) as a between-subjects variable and sentence type (insomnia-related vs anxiety related) as a within-subjects variable. The dependent variables were the extent to which participants interpreted insomnia-related and anxiety-related sentences as having a threatening meaning. Sleepiness was used as a covariate.

Setting: Treatment and research clinic at a university department of psychiatry.

Participants: Forty-one normal and 34 poor sleepers.

Measurements and Results: A set of ambiguous scenarios were administered to participants who gave open-ended and forced-choice interpretations of the scenarios. Each scenario could be interpreted in a threat (insomnia or anxiety)-related or neutral manner. Even after controlling for sleepiness, poor sleepers were found to make significantly more threat-related interpretations of ambiguous scenarios than did normal sleepers.

Conclusions: These findings suggest that there is a bias toward threat-related interpretations among poor sleepers and that the exploration of biased interpretations may be an important avenue for future research among individuals who meet full diagnostic criteria for insomnia.

Keywords: Insomnia, cognitive processes, interpretive bias, maintaining factors

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INTRODUCTION

CHRONIC INSOMNIA IS A HIGHLY PREVALENT DISORDER THAT IS ASSOCIATED WITH SIGNIFICANT IMPAIRMENT AND DISABILITY (E.G., SEE REFERENCE 1). There has been growing interest in the role of cognitive processes that maintain insomnia (e.g., see references 2-6). However, to date, a role for interpretative bias has not been investigated

What is an interpretative bias? Many everyday events are ambiguous and can be interpreted in more than 1 way. Individuals with psychological disorders display a disproportionate tendency to make biased interpretations of ambiguous material, and this bias has been implicated in their maintenance.[7,8] An interpretive bias in insomnia would be evident if individuals with insomnia interpreted ambiguous information in an insomnia-consistent manner. For example, the sentence "Melinda thought with anticipation about going to sleep that night" could be interpreted as Melinda worrying about her sleep (an insomnia-consistent interpretation) or awaiting her bedtime eagerly (not an insomnia-consistent interpretation).

The present study aims to begin the process of determining whether an interpretive bias exists in poor sleepers. Because this is the first exploration of interpretative bias in the context of insomnia, it was deemed appropriate to use an analog sample. An analog sample in this context refers to a sample that does not include patients, but which includes an approximation of them; in this case., a group of poor sleepers. The rationale for taking this approach is (1) it is plausible that the process of interest exists on a continuum whereby patients who meet full diagnostic criteria for insomnia and poor sleepers both exhibit the process but that the process is present in a stronger form among insomnia patients (e.g., see Flett et al[9] for evidence pertaining to this assumption in the depression literature) and (2) the ease of recruiting an analog sample, relative to a patient sample, render more complex experimental designs with larger samples achievable.[10] We suggest that this is a reasonable first step on the basis that every science needs an analog to test and hone new hypotheses in a timely and resource-efficient manner.[10] Having said that, if the results produced from our poor-sleeper sample are promising, it will be essential to recruit a sample that meets full diagnostic criteria for insomnia to check the generalizability of the findings. The prediction tested was that the poor-sleeper group, relative to the normal-sleeper group, would show an enhanced tendency to interpret ambiguous material in an insomnia-consistent manner. Given the potential for normal- or poor-sleeper status to be confounded with anxiety, trait anxiety was included as an independent variable. This allowed for the contribution of insomnia and anxiety on interpretation bias to be independently assessed. A subsidiary aim of the current study was to assess the specificity of interpretive bias in insomnia. To achieve this aim we included ambiguous anxiety-related material in addition to ambiguous insomnia-related material. This permitted us to examine whether any interpretive bias observed is specific to insomnia or also present for anxiety-related information.

METHODS

Participants

The participants were 75 people who responded to advertisements for individuals interested in sleep research. Ages ranged from 18 to 58, with a mean of 22.4 years. There were 25 men and 50 women, all of whom spoke English as their first language. The majority of the participants (n = 66) were undergraduate students; others were interested members of the general community.

Normal sleepers (n = 41) were those participants with an Insomnia Severity Index (ISI)[11] score below 8 (mean ± SD) (2.98 ± 2.22), and poor sleepers (n = 34) were those with an ISI score of 8 and above (11.76 ± 3.63), which is the cutoff for subthreshold insomnia.[11] The normal- and poor-sleeper groups differed significantly on the ISI ($t_{1,73} = 12.34$, p < .01) but did not differ on age (Poor Sleepers; 21.44 ± 6.24; Normal Sleepers mean = 23.17, 9.09; $t_{1,73} = 0.94$, p = .35).

Anxious participants (n = 38) were those with a score of 41 or more on the trait scale of the State-Trait Anxiety Inventory[12] (STAI) (50.68 ± 6.46). Nonanxious participants (n = 37) were those with a STAI trait scale score of below 41 (34.32 ± 5.24). The high and low trait anxiety groups differed significantly on the STAI trait scale ($t_{1,73} = 12.03$, p ≤ .01) but did not differ on age) high STAI; 21.37 ± 6.54; low STAI; 23.43 ± 9.10; $t_{1,73} = 1.13$, p = .26).

Materials

The tasks administered to participants consisted of 3 sections: (1) personal details; (2) sleeper status assessment (normal vs poor sleeper), sleepiness and anxiety assessment; and (3) an interpretation task. The personal-details section inquired about the participant's age and sex. The sleeper status (normal vs poor) was assessed using the ISI.[11] Sleepiness at the time of completing the questionnaire was indexed with the Stanford Sleepiness Scale.[13] Trait anxiety was assessed with the STAI.[12] Each of these measures has demonstrated sound psychometric properties. The interpretation task comprised 54 ambiguous sentences, each with 2 possible interpretations. For 27 of these, 1 possible meaning was related to insomnia and the other was not. The other 27 held 1 anxiety-related and 1 neutral meaning. The latter set was taken from a set established by MacLeod and Cohen.[14]

The creation of the ambiguous insomnia-related sentences involved the development of a pool of 38 sentences that was inspected by 6 independent psychology graduate student or clinical psychologist raters. Raters were presented with the ambiguous sentence, followed by 2 words that guided the interpretation of the sentence (e.g., James had a draining problem to fix; plumbing, tiring). This sentence could be interpreted as James has a plumbing problem to fix or James had a tiring problem to fix. Ratings were conducted to ensure that (1) the 2 interpretations accompanying each sentence were equally probable and (2) 1 of the interpretations of each ambiguous sentence was related to insomnia and 1 was not. The raters were first asked to estimate the likelihood of each interpretation, expressed as a percentage. Sentences judged to have 1 unlikely interpretation (mean probability rating of less than 25%) were discarded. The raters were also asked to rate, on a 7-point scale (1 = not related to insomnia, 7 = very related to insomnia), how related each interpretation was to insomnia. The difference in insomnia relatedness for each interpretation was calculated. Sentences with mean difference scores below 3 were also discarded because these sentences were not considered to have clearly differentiated insomnia and neutral interpretations. Eleven sentences were discarded on the basis of the above ratings. The likelihood of the final selection of 27 sentences being interpreted in an insomnia-related manner was 49.77%, indicating that, across the sentences, the raters believed the insomnia and noninsomnia interpretations of the target sentences were equally likely. The mean difference score for insomnia relatedness for the final set of 27 sentences was 3.85, indicating that the 2 interpretations of each sentence differed in their relatedness to insomnia.

The final set of 54 sentences was randomly ordered, the only condition being that there were no more than 5 consecutive items of the same type (i.e., either insomnia or anxiety related). Each sentence was presented on a separate page, with a space below for the participant to write his or her interpretation of the sentence (this will be referred to as the open-ended response). The following page presented 2 possible interpretations; the participant was required to choose which she or he thought was more likely (referred to as the forced-choice response). These alternative interpretations were created by expanding the original interpretation guiding words into explanatory sentences, and, thus, 1 was anxiety or insomnia related, whereas the other was neutral To ensure that there was no order effect, the neutral interpretation appeared first in half of the items and second in the other half. Below are 2 example sentences;

Angela worried about how she would make it to work the following day.
What is happening here?
(new page) Which do you think is more likely?
a) Angela was exhausted and was worried about making it to work.
b) Angela had a problem with her car, so did not know how she would get to work.

It was snowing heavily when the wreath was put in place.
What is happening here?
(new page) Which do you think is more likely?
a) It was snowing when the Christmas wreath was hung on the front door.
b) It was snowing during the funeral when the wreath was placed on the coffin.

PROCEDURE

The protocol of this study was approved by the Research Ethics Committee, University of Oxford, UK. Once participants had provided informed consent to the study, the ISI, the Stanford Sleepiness Scale, the STAI, and the Interpretations Task were administered. Participants were instructed to write down the first explanation that came to mind for each ambiguous sentence before looking at the next page and to be as specific as possible in their answer. They were informed that there were no right or wrong answers and were asked to not go back and change answers. A subsequent example sentence made the format clear. Participants were then asked to work through the 54 sentences in their own time but to not spend too long thinking about each sentence.

RESULTS

Reliability of Coding the Open-Ended Responses

The second author, blinded to group membership, coded each

Table 1—Mean Number of Threat-Related Interpretations For Open-Ended and Forced-Choice Sentences

Sentence type	Low Anxiety			High Anxiety		
	Normal Sleepers n = 23	Poor Sleepers n = 14	η^2	Normal Sleepers n = 18	Poor Sleepers n = 20	η^2
Insomnia open-ended	9.78 ± 3.18	12.07 ± 2.46	.37	11.83 ± 3.85	12.50 ± 3.93	.09
Anxiety open-ended	10.22 ± 3.46	12.36 ± 3.52	.29	11.83 ± 3.45	12.60 ± 3.41	.11
Insomnia forced-choice	12.09 ± 2.66	14.00 ± 2.83	.33	13.28 ± 3.39	14.50 ± 3.87	.16
Anxiety forced-choice	9.83 ± 3.69	12.50 ± 3.52	.35	11.33 ± 3.63	12.60 ± 3.72	.17

Data are presented as mean ± SD unless otherwise indicated. Eta Squared (η^2) effect sizes were calculated in SPSS by dividing the sum-of-squares for each effect by the sum-of-squares total.

open-ended response as threat consistent or threat inconsistent. In the case of the insomnia sentences, this referred specifically to whether or not the interpretation was sleep threat consistent (i.e., threatening interpretations that were not directly relevant to sleep were coded as nonthreatening). A second independent coder analyzed a random sample of 20 (26.7%) of the responses and coded the open-ended responses as threat consistent or neutral. These ratings were then compared with those of the primary coder. Overall agreement was good (95%). However, 1 item had an agreement of only 14 out of 20[a] and was thus judged as an unreliable item. It was removed from further analyses, resulting in an agreement between coders for the final set of 53 items of 96%.

Open-Ended Responses to Ambiguous Insomnia and Anxiety Sentences

Analyses were carried out using a mixed-design analysis of covariance. Trait anxiety (high vs low) and Group (poor sleeper vs normal sleeper) were entered as between-subjects factors and Sentence Type (anxiety vs insomnia) as a within-subjects factor. Sleepiness was entered as a covariate. The mean values are displayed in the Table. Variance accounted for was assessed via eta squared (η^2) effect sizes that were calculated in SPSS by dividing the sum-of-squares for each effect by the sum-of-squares total.

There was a significant main effect for Group, $F_{1,69} = 4.45$, $p = .04$ ($\eta^2 = .06$). As can be seen in the Table, poor-sleeper participants selected more insomnia-consistent and anxiety-consistent interpretations than did normal-sleeper participants. The interaction between Trait Anxiety and Group was not significant, $F_{1,69} = 0.88$, $p = .35$ ($\eta^2 = .021$). Additionally, there was neither a main effect of Sentence Type, $F_{1,69} = 0.62$, $p = .44$ ($\eta^2 = .01$) or Trait Anxiety $F_{1,69} = 2.51$, $p = .12$ ($\eta^2 = .04$) nor any interaction between Sentence type and Group $F_{1,69} = 0.39$, $p = .53$ ($\eta^2 = .01$) or Sentence Type and Trait Anxiety, $F_{1,69} = 1.50$, $p = .22$ ($\eta^2 = .01$).

Forced-Choice Responses to Ambiguous Insomnia and Anxiety Sentences

An identical analysis was performed with the forced-choice responses as the dependent variable. There was a significant main effect for Group, $F_{1,69} = 7.12$, $p = .01$ ($\eta^2 = .09$). As can be seen in the Table, poor-sleeper participants selected more insomnia-consistent and anxiety-consistent interpretations than

did the normal-sleeper participants. There was no main effect of Trait Anxiety, $F_{1,69} = 1.35$, $p = .32$, ($\eta^2 = .02$) and no significant interaction between Trait Anxiety and Group, $F_{1,69} = 0.88$, $p = .35$, ($\eta^2 = .01$). There was no main effect of Sentence Type, $F_{1,69} = 3.12$, $p = .08$, ($\eta^2 = .04$), although there was a trend toward threat-consistent meanings for insomnia sentences being chosen more often than for anxiety sentences. There was no interaction between Sentence Type and Group, $F_{1,69} = 0.03$, $p = .87$, ($\eta^2 = .00$) or between Sentence Type and Trait Anxiety, $F_{1,69} = 0.00$, $p = .99$, ($\eta^2 = .01$).

DISCUSSION

To the best of the authors' knowledge, the present study constitutes the first investigation of interpretive bias in the context of insomnia. Poor sleepers displayed a disproportionate tendency to make threatening interpretations of all ambiguous sentences, whether insomnia or anxiety related, as compared with normal sleepers. This was the case for both open-ended and forced-choice responses and after accounting for the effect of sleepiness and trait anxiety. These results suggest that insomnia may well be characterized by an interpretive bias, a conclusion that is consistent with previous research findings in the anxiety literature (e.g., see reference 14). The finding that poor sleepers demonstrated a general bias toward threatening interpretations (rather than an insomnia-specific bias) may suggest that sleeping poorly is associated with a more generally negative world view. It was surprising, given previous research, that there was no effect of trait anxiety on interpretation of ambiguous anxiety-related material One possible explanation is that, in the present study, the difference in STAI scores between the high trait anxiety group and the low trait anxiety group was not as large as has been shown in previous studies (e.g., see reference 14). Another possibility is that the anxiety-related ambiguous stimuli did not provide a valid test of an anxiety-linked interpretive bias. This, however, is not supported by previous research that has found an interpretive bias employing identical stimuli.[13]

The present finding, which supports the presence of an interpretive bias in insomnia, needs to be interpreted within the confines of a number of limitations. First, the method adopted is open to demand effects. Participants knew they were participating in sleep-related research and may have guessed the purpose of the study and altered their responses accordingly. Future research could employ methodologies that have been used in the anxiety literature to overcome this possible confound.[8] Second, it is possible that factors other than sleepiness may have influenced the results of the current study. Third, future research should include additional assessments such as diagnostic tools or additional clin-

[a]The second coder coded 20 questionnaires. The 2 coders agreed on this item for only 14.

ical questionnaires (e.g., to assess for depression) in order to more fully characterize the sample.

Theoretically, an interpretive bias in insomnia is supportive of cognitive models of insomnia, which propose a crucial role for cognitive processes in the maintenance of this disorder. The worry experienced in some people with insomnia may be fuelled by an interpretative bias such as the one found in the present study. This worry may, in turn, increase arousal and anxiety, thereby perpetuating the sleep disturbance.[6] Of course, further research is needed to test these predicted consequences of an interpretive bias in insomnia.

Clinically, we know that cognitive behavioral therapy for insomnia leads to significant sleep improvements that are sustained over time.[15] If future research replicates the present findings, there may be utility in developing a new treatment component that assists patients to interpret ambiguous stimuli differently. For the latter, the cognitive therapy methods developed by A.T. Beck and colleagues (e.g., see reference 16), such as Socratic questioning, guided discovery, and the use of behavioral experiments,[17,18] may be well suited to promoting change in this domain.

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