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Trying to Fall Asleep whilst Catastrophising:

What Sleep-Disordered Adolescents Think and Feel.

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Running head: Adolescents catastrophising before sleep

Survey studies have established up to 43% of school-aged children (<12 years) suffer from sleep disturbance [1,2,3]. This remains relatively unchanged into adolescence, with up to 36% of teens reporting problems sleeping [4,5,6]. In school-aged children disturbances typically comprise a variety of problems including nightmares, difficulty sleeping alone, and sleep walking [7,8,9]. By adolescence, research has demonstrated a key sleep complaint is difficulty initiating sleep [10]. A delay in the circadian rhythm of the teenager often coincides with the onset of puberty and various psychosocial factors (e.g., desire for autonomy, increased school demands), which also occur during this developmental stage [11,12]. In some cases, the delay in the circadian rhythm can represent an extreme delay in the sleep-wake cycle, referred to in a clinical manifestation, as Delayed Sleep Phase Disorder (DSPD). DSPD is a circadian rhythm disorder defined by a delayed circadian rhythm that is mismatched with the individual's schedule (i.e., late bedtime and late-waking time, leading to difficulty waking up for commitments such as school) [12]. Because of this delay the adolescent is often not able to initiate sleep at their desired time [10]. This mismatch between the desired sleep time and the circadian rhythm commonly leads to secondary insomnia-type symptoms, such as increased sleep onset latency, and in particular increased cognitive arousal [10, 13, 14]. Cognitive treatments have been applied to samples of adolescents with DSPD (e.g., cognitive restructuring, mindfulness-based stress reduction) [10,14], however, the field is limited in its understanding of the cognitive aetiological factors associated with DSPD in adolescents [15]. More is known about the cognitions experienced during the transition from wake to sleep in adult sleep-onset insomnia [16-20]. While this provides a valid starting point to understand adolescents' pre-sleep cognitions, there remains a stark paucity of research focused on the adolescent age range [21].

The Role of Pre-Sleep Cognitions

Research with adults has consistently demonstrated dysfunctional cognitions and automatic thoughts about sleep, and the consequences of sleeplessness, are common when experiencing difficulties initiating sleep [18,19,22-27]. Several studies have demonstrated dysfunctional cognitions and automatic thoughts of a repetitive nature are associated with an increased latency to sleep [20, 28-30]. However, little is known about the specific content of these cognitions, making them difficult to target, within an empirical treatment framework, when treating sleeplessness. Wicklow and Espie recorded the spontaneous pre-sleep thoughts of 21 adults with sleep-onset insomnia and reported the most common thoughts were thinking about sleep and its anticipated consequences, as well as rehearsal and planning (i.e., thinking about the past day, the next day, and planning forthcoming events) [20]. While similar pre-sleep thoughts have been documented in children (aged 8-12 years) [23,31,32], additional thoughts, such as nightmares coming true and getting into trouble due to being unable to sleep, have also been voiced [31]. Despite the substantial prevalence of sleep onset problems in adolescence [4], the ruminative pre-sleep thoughts of this developmental period have received little attention. Recently, Noone and colleagues [21] described young adolescent girls' catastrophising themes, which focused on issues related to school, mood, tiredness, and relationships with significant others. Here we aim to extend on evidence from community samples [21, 30, 31] by examining the role of pre-sleep cognitions in a sample of adolescents diagnosed with DSPD – a group who often reports 'mind racing' [10]. Of particular interest to this research was the examination of the associations between catastrophic-thinking, anxiety, and sleep latency in a sample of sleep disordered adolescents.

Catastrophising, Anxiety/Depression, and Sleep

Survey, experimental, treatment and longitudinal studies have demonstrated associations between anxiety and sleep in youth [33-35]. A classic feature of both anxiety and sleep disturbance that can explain this association is heightened arousal, which can occur

during the transition from wake to sleep (i.e., elevated plasma cortisol around the onset of sleep) [36]. Further, research has also demonstrated concurrent and prospective associations between depression and sleep problems during adolescence [37-40]. Similar to sleep problems, the onset of puberty has been identified as a marker for the development of depressive symptoms [41].

Although research has established links between anxiety, depression and sleep latency, little is known about the role of catastrophising, particularly in an adolescent sample. Catastrophising is broadly defined as a repetitive thinking pattern resulting in the rumination of catastrophic consequences (e.g., not being able to function, ruining future functioning) [21, 30]. Catastrophising is associated with anxiety in both clinically anxious- and community- samples of adolescents [42-45]. Similarly, studies have shown modest relationships between catastrophising and depression in community-based adolescent samples [46-47]. Given the significant overlap between emotional disorders and sleep, researchers have hypothesised that anxiety and/or depression may mediate the relationship between catastrophising and sleep disturbance in youth [31].

Gregory et al. tested this hypothesis using a school-based sample of 123 children aged 8-10 years [31]. Children were asked to provide retrospective information about their sleep, anxiety and depression, as well as perform a catastrophising interview. Gregory and colleagues, as we do in this paper, defined catastrophising as those automatically generated responses on the worries associated with potential consequences of sleeplessness (i.e., the *'what if's'* associated with poor sleep). From their community sample, 25% of children reported pre-sleep catastrophisations, with the number of catastrophising thoughts significantly predictive of sleep disturbance. However, the number of catastrophising thoughts were no longer predictive once anxiety and depression were controlled, suggesting an intermediate role of emotional disturbance. Anxiety and depression symptoms also mediated

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the association between catastrophising and sleep disturbance in a sample of 175 children and adolescents from the community (aged 6-17 years) [15]. While this provides interesting insight into the role of catastrophising on sleep, research has thus far focused on community-based samples. As such, before these results can be said to have clinical implications, "replication in a clinical sample is needed [31]."

Current Study

Extending on findings from Gregory and colleagues the current study aimed to expand knowledge on the impact of catastrophising on sleep, with a clinical sample of adolescents [31]. Although an appropriate sample may comprise adolescents diagnosed with primary insomnia, our clinical experience has shown that the most common adolescent sleep disorder diagnosed at our clinic is DSPD. As DSPD has an associated sleep-onset insomnia component [10,12], it provides an appropriate opportunity to examine the role of catastrophising on sleep. Specifically, we assessed (1) catastrophising themes in a sample of adolescents diagnosed with DSPD, and (2) the associations between catastrophic thinking, anxiety, depression, and sleep latency in this sample. It was expected that results obtained from the current sample would mirror those found in earlier studies using community-based samples [15,31]. That is, anxiety and depression would mediate an association between catastrophising and sleep disturbance. It is intended that findings will help to provide a clinical framework for health professionals when assessing and treating adolescents experiencing difficulty initiating sleep. The assessment of catastrophising themes will be particularly useful in providing a framework for clinicians when implementing cognitive and behavioural treatment strategies, including thought challenging, behavioural experiments, and the generation of alternative realistic thoughts, to facilitate sleep onset.

Method

Participants

Participants were 40 (53% male) adolescents ranging from 11 to 19 years of age (M = 15.2, SD = 1.5 yrs). All participants attended an outpatient sleep clinic for treatment of Delayed Sleep Phase Disorder (DSPD). Ethics approval for this research was granted by the university ethics committee, with informed consent received from both the adolescent and parent. DSPD was diagnosed as per the International Classification of Sleep Disorders, 2nd edition criteria (ICSD-2) [12]. Diagnosis was made with a 7-day sleep diary in conjunction with a clinical sleep history interview [10]. The sleep diary demonstrated a delayed yet stable sleep pattern, and the interview established that the sleep pattern caused impairment and/or significant distress, which was primarily of a circadian rhythm misalignment as opposed to another sleep, mental, medical condition or substance use.

Socio-Economic Indexes for Areas (SEIFA) was used as a general indicator of socio-economic status[1]. The majority of participants were classified in the average income range (SEIFA mean=999.9, SD=67.9). Two-thirds of adolescents' parents were married, with approximately half of families (45.0%) comprised of 2 parents and 2 children. One third of adolescents were the eldest child, and one third the youngest.[2] At the initial assessment the parent and the adolescent were asked to disclose any comorbid diagnoses (diagnosed by a medical professional or psychologist). Demonstrating the heterogeneous nature of the sample, thirty-five per cent of the sample (n = 14) reported a current comorbidity. The most common comorbidity was depression (n = 6, 15%). Two adolescents (5%) had a known medical condition, while 2 (5%) had a diagnosis of auditory processing disorder. One adolescent was diagnosed with attention deficit hyperactivity disorder (ADHD; 2.5%), one with social anxiety (2.5%), one with anorexia nervosa (2.5%) and one with obsessive compulsive disorder (2.5%). As full diagnostic assessments were not performed, outside the

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[1] SEIFA scores provide a summary of socio-economic conditions of individuals depending on the area they live and is based upon social/economic information gathered from Australian Census data. Each adolescent was allocated a SEIFA score based on their suburb of residence. The SEIFA score is standardised against a mean of 1000 (SD=100), with the middle two-thirds of SEIFA scores falling between approximately 900-1100.
[2] Remaining adolescents were either an only child, or a middle child.

comprehensive assessment for the sleep disorder, information on comorbidities was collected to provide qualitative information on the sample but will not be used in future analyses.

Given the clinical nature of the sample, describing factors that potentially affect sleep (e.g., sleep hygiene) is needed. Of all adolescents, 56% reported reading in bed, 30% watched television in bed, 28% studied in bed, 30% used their mobile phone is bed, while 25% engaged in 'other' forms of technology use while in bed (e.g., laptop, video-gaming). Sixty percent reported drinking caffeinated beverages during the week (M = 5.5/wk, SD = 8.3), while 12.5% drank alcohol (all occasional weekend drinkers). Two thirds (68%) also reported engaging in frequent clock checking.

Measures

Sleep onset latency. Research has demonstrated the importance of gaining adolescent-derived sleep estimates in this age group [48]. As such, adolescents were asked to complete a 7-day sleep diary for the week prior to their clinical sleep history interview. Sleep diaries provide a repeated measure of sleep that are more resistant to measurement error than questionnaires (e.g., reduced memory recall bias) [49]. Adolescents marked when they first went to bed, when they turned their lights out (i.e., tried to sleep) and the estimated time they fell asleep. From this sleep diary the adolescent's average sleep onset latency (SOL) was calculated, based on the difference between the time they attempted sleep (i.e., 'lights out') and time they fell asleep. SOL was used as the outcome variable due to the specific reference in the catastrophising interview (see below) to what worried the adolescent about not being able to fall asleep until late in the night. Further, it was of primary conceptual interest to this study to assess how catastrophising may impact a sleep disordered adolescent's ability to initiate sleep.

At the clinical sleep history interview, the parent and adolescent confirmed the pattern represented in the sleep diary was 'typical' of the adolescent's sleep problem. Of note, in

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contrast to our clinical experience with children (<12 years old), for adolescents the parent is often asleep long before the delayed adolescent. As such, in this older age range it is primarily the adolescent who is in the best position to provide accurate sleep diary information. Clinically, there were no instances in this sample where the parent did not corroborate the adolescent's reporting.

Catastrophising. Catastrophising was measured via an interview based on work with adults [50] and children [31]. The therapist began by first stating "*you said you've had trouble falling asleep*" followed by questioning "*How much does [the sleep problem] worry you?*" and then "*What is it that worries you about [not being able to fall asleep until late]?*" This was repeated based on the adolescent's response. For example, the adolescent may respond "*Because I'll be late to school*" to which the therapist would ask "*What is it that worries you about being late to school?*" This process continued until the adolescent could no longer provide a response. Responses were coded independently by RH and NL. RH assigned themes at the initial coding phase, derived from the existing catastrophising literature[3] [31] and emergent concepts based on participant report. NL then independently coded the interviews using these themes as a guide. No themes were dropped or added during this coding phase. Adequate inter-rater agreement was determined, with an intra-class correlation of .95 (α = .98).

Anxiety. The Sleep Anticipatory Anxiety Questionnaire (SAAQ) [51] was adapted for use with adolescents (SAAQ-Adolescents; SAAQ-A). The original 10-item scale comprised five questions targeting somatic symptoms (e.g., *"When I try to fall asleep at night my muscles are tense"*) and five targeting sleep cognitions (e.g., *"I worry I won't get enough sleep"*). The SAAQ-A included five additional items targeting non-sleep rehearsal and planning cognitions (e.g., *"I can't stop thinking about what happened during the day"*), based on previous studies with adults [20] and pilot data [52]. This created a 15-item self-report

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[3] Note that coding occurred prior to Noone et al (2013) study [21], thus coders were not influenced by these published results.

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scale where respondents were provided with four possible response options, coded as 0 (*strongly disagree*), 1 (*disagree*), 2 (*agree*), 3 (*strongly agree*). The internal consistency of the revised scale was α = .84, with the three subscales also showing acceptable reliability (somatic, α = .80; sleep cognitions, α = .82; planning and rehearsal, α = .84).

Depression. The 13-item Short Mood and Feeling Questionnaire (SMFQ) provided a self-report of depression [53]. Prior to the clinical sleep history interview the adolescent completed the questionnaire, responding to each item using one of three possible response options (0 = *not true,* 1 = *sometimes,* 2 = *true*; score range 0-26). Example items include "*I felt I was no good any more*", " *I hated myself*", and "*I thought I could never be as good as other kids*". The SMFQ has demonstrated good psychometric properties in adolescents seeking treatment for DSPD (α = .86) [10]. Results from our sample confirmed the strong reliability of the SMFQ (α = .94).

Procedure

Adolescents were recruited to the university Sleep Clinic via school newsletters, self- or health professional referrals. Participants were only excluded at this point if there was a known or suspected obstructive sleep apnea, in which case they were referred onto a suitable medical professional. Otherwise, participants were emailed a sleep diary, anxiety and depression questionnaires. Completed paperwork was provided to a trained sleep therapist at the clinical sleep history interview, where the catastrophising interview was also administered. As such, information on sleep (diary) and anxiety (SAAQ-A) were collected from information provided by the adolescent regarding the week prior to the initial assessment. While information on depression (SMFQ) was primarily collected from reporting on this pre-assessment period, due to low return rates of this questionnaire, in some instances information after 1 week of treatment was used (see Statistical analyses). In the catastrophising interview (administered at the initial assessment) the therapist explicitly refers to the sleep difficulty

reported by the adolescent (based on the sleep diary information provided for the week prior to the assessment) and asks them to report on why the presenting problem (taking a long time to fall asleep) caused them worry. In sum, information primarily pertains to the week prior to the initial assessment, before the adolescent has had contact with the sleep therapist.

Adolescents attended the initial 60-min interview with at least 1 parent. Adolescents in the sample confirmed significant difficulty attempting sleep and waking at conventional times (e.g., during the school week), yet normal sleep, albeit delayed, on free days (e.g., weekends). Their sleep pattern caused significant distress and daytime consequences (e.g., affect school attendance/performance), and was deemed the primary disorder, even when co-morbid conditions existed (e.g., depression). The DSPD diagnosis was confirmed at a consensus meeting following the interview. This meeting was attended by the Clinic director, a registered clinical psychologist with over 10 years experience in the sleep field, as well as the Clinic's sleep therapists, who had been trained by the Clinic director in the assessment and treatment of sleep disorders and had over two years experience in behavioural sleep medicine. All participants were provided with treatment for DSPD (either bright light therapy alone or bright light therapy plus cognitive-behaviour therapy) as part of another study. This treatment was provided after the initial consensus meeting, from the adolescent's second appointment (week 1 treatment).

Statistical Analyses

The average sleep onset latency (SOL) over the pre-assessment week period was used, as catastrophising themes were not localised to school (i.e., friendships on weekends). Catastrophising steps represent the number of steps volunteered by the participant during the interview. Of the 40 interviews, 15.0% of adolescents ($n = 6$) were either unable to identify why their sleep worried them or responded 'Not at all' when first queried as to whether their difficulty falling asleep worried them (despite reported daytime consequences; see Table 1).

For these adolescents, the number of catastrophising steps was coded as a '0.' Sleep diary data were missing for six participants[4] (15.0%), while three were missing for SAAQ-A (7.5%). Eleven participants (27.5%) were missing pre-assessment information from the SMFQ. Missing SMFQ data were deemed random. As this represents a significant amount of missing data the use of SMFQ data from reporting after 1 week of therapy was collected. A paired samples *t*-test showed no significant difference between pre-treatment (*M* = 7.6, *SD* = 6.5) and following week (treatment week 1; *M* = 7.8, *SD* = 7.8) SMFQ scores, $t(14) = -.19$, $p = .86$. Responses from pre-treatment and treatment week 1 were also highly correlated (*r* = .85, *p* < .001). As such, SMFQ scores represent combined SMFQ scores, resulting in seven participants with missing SMFQ data (17.5%). Catastrophising data for all participants were collected.

Catastrophising, anxiety, depression and SOL data were assessed using an INDIRECT SPSS macro that calculated total, direct, and indirect effects between each variable [54]. For the direct effects, tests of significance are based on ordinary least squares regression analyses, but the indirect effects are based on a bootstrapping procedure. Bootstrapping analysis does not presume normal distribution or require a large sample size and is thus considered preferable over procedures such as the Sobel test [54]. A resample procedure of 5,000 bootstrap samples was employed. Bias corrected 95% confidence intervals (CI) were also computed, with an indirect effect considered significant when zero is not contained within the interval (e.g., 0.73 to 12.91; see Table 2). Point biserial correlations were used to assess the strength of the associations between specific items of the SAAQ-A and SOL.

Results

Catastrophising Themes

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[4] For these individuals sleep diary data was obtained by the sleep therapist at a later point to confirm diagnosis.

Six broad themes were generated from coding the catastrophising interviews (Table 1), based on the independent coding by two raters. The largest concern held by adolescents was the effect poor sleep would have on their ability to function academically. The second was the effect poor sleep could have on their ability to attend school *and* the consequences this may hold regarding responses from peers or teachers (e.g., shame, embarrassment).

< Insert Table 1 about here >

Association Between Catastrophising, Anxiety, Depression and Sleep Latency

Sleep onset latency. The average SOL was 78.2 minutes (1.3 hours; *SD* = 54.8 minutes). SOL ranged from 28.6 minutes to 255.0 minutes (4.3 hours).

The role of depression. The original regression model included both depression and anxiety as mediators. However, there was no evidence of a direct relationship between depression and SOL (p = .69; see Figure 1), nor evidence that depression indirectly mediated the association between catastrophising steps and SOL (B = 1.10, SE_B = 3.77, 95% CI, -4.30; 11.96). Results did show a significant positive association between catastrophising and depression scores (p = .02; Figure 1). Thus, despite a significant relationship between catastrophising and depression, depression scores were not predictive of SOL and did not directly or indirectly mediate the relationship between catastrophising and SOL. As such, depression was not included in further analyses.

Catastrophising, anxiety, and sleep latency. Results showed no evidence of a direct effect of catastrophising on SOL (see Table 2). However, bootstrapping analyses showed catastrophising steps to have a significant indirect effect on SOL, mediated through total anxiety. That is, catastrophising was associated with a significant increase in anxiety, which conversely increased SOL (Table 2).

The three sections of the SAAQ-A (*somatic complaints, sleep cognitions, and planning/rehearsal*) were also analysed as separate models. Table 3 shows results of the direct association between catastrophising steps and SOL, along with the indirect associations between catastrophising and SOL through the anxiety subscales. Figure 1 shows results of the specific associations between the variables (IV – Mediator – DV). While there was evidence of a trend for the association between somatic complaints and catastrophising ($p = .07$; Figure 1), somatic complaints were not significantly associated with SOL ($p = .53$). Further, there was no evidence of a direct or indirect association between catastrophising and SOL, through somatic complaints (see Table 2). However, there was evidence of a significant indirect effect mediated by both sleep-related cognitions and the planning/rehearsal items (Table 2). Catastrophising was positively associated with planning/rehearsal anxiety items ($p = .05$) and sleep related cognitions ($p = .01$). Further, planning/rehearsal cognitions were significantly associated with increased SOL ($p = .05$), with a trend evident between increased sleep-related concerns and SOL ($p = .10$). For remaining statistics for these associations see Figure 1. Thus, increased catastrophising was found to be associated with increased scores on the sleep-related cognitions and *non-sleep specific* planning/rehearsal anxiety items. Increased anxiety in these two areas was in turn associated with an increased SOL.

< Insert Figure 1 here>

< Insert Table 2 here >

Rehearsal/Planning and Sleep Latency

Based on evidence of planning and rehearsal cognitions most strongly predicting SOL, correlations were used to assess the strength of the associations between each individual item and SOL. Such analyses would provide clinical insight into sleep-disturbing cognitions. Table

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3 shows results of all correlations. The only item not associated with increased SOL was item

four (*I worry about my relationships (e.g., boyfriend, parents); r* = .09, *p* = .63). All other

items were moderately associated with increased SOL, with item 3 (*I can't stop thinking*

about what happened during the day) most strongly correlated (*r* = .50, *p* < .01). As such,

concerns about what has happened or what will happen, along with friendship concerns

appear to be key cognitions affecting SOL for adolescents.

< Insert Table 3 about here >

Discussion

The present study partially confirms previous results of catastrophising and sleep in

children and adolescents [15,31]. The vast majority of adolescents presenting with Delayed

Sleep Phase Disorder reported catastrophic thoughts when attempting sleep. Although DSPD

has a delayed circadian rhythm as its primary aetiology, this study adds further evidence of an

associated insomnia experience around sleep onset [10]. These pre-sleep thoughts may

initially appear wide and varied across the sample, yet common themes emerged. Seven out of

10 adolescents expressed concerns about school, with about half the sample reporting

thoughts about school performance, and a further 18% catastrophising about interpersonal

aspects of school. Remaining concerns were spread across adolescents' lives, including

effects of sleep on their emotions, quality of life, relationships with family members, as well

as the continuing health of their sleep. This contrasts with the percentages found with non-

clinical children, where concerns around school were minor (i.e., 15% of the sample), yet

major concerns were voiced regarding the health of their sleep (i.e., 50%) [31]. Similarly,

thinking about the consequences of sleep was the second major theme for adults with

insomnia [20]. Interestingly, our themes are not too dissimilar from those reported recently by

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a community sample of young adolescent girls [21]. Young females also catastrophised about school (64%), mood (56%), and friends/social concerns (32%), yet tiredness was a large theme (52%) not identified in our clinical sample. Worth noting is that 21% of young females (11-12 yr old) in the community reported catastrophising thoughts compared to 85% of our clinical sample of adolescents (11-19 yr old). Adolescence is a dynamic developmental period where many 'firsts' are experienced (e.g., romantic relationship, employment, driving, etc.), and there is an attentional shift away from the family environment and towards school friendships [55]. This could go far to explain why adolescents in our sample experience catastrophic thinking about school-related issues across the 7-day week over and above sleep-related concerns, despite seeking treatment for their sleep-onset problems. Although sleep therapists may perceive sleep-disordered adolescents to present with 'sleep cognitions' driving their sleep problem, the data in our sample suggests adolescents' perception of the type of cognitions exacerbating their sleep problem is qualitatively different.

Anxiety Plays a Clinical Role – What about Depression?

Previous studies have found that catastrophising has an effect on sleep disturbance via anxiety in community-based samples of youth (6-17 yrs) [15,31]. Analysis of our sleep-disordered adolescents confirm this pathway from catastrophising to sleep disturbance (in our case, sleep onset latency). More specifically, our data demonstrate that not all anxious thinking explains this pathway. Despite hypotheses of elevated pre-sleep cortisol explaining the role of anxiety in dysfunctional thinking affected sleep [15], self-reported somatic complaints did not significantly relate to either catastrophising nor sleep latency. Supporting the findings of the major catastrophising themes in our sample, our inferential analysis found that although the number of catastrophising steps were related to sleep-related concerns, there was a trend found for the association with sleep latency. Instead, adolescents' anxieties about the present and next day's events were paramount, and mediated the indirect relationship

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between catastrophising and sleep latency. This is somewhat surprising as such rehearsal and planning cognitions are not about sleep, yet sleep latency is more strongly associated with them.

Although it is surprising that anxiety, but not depression, mediated the relationship between catastrophising and sleep, a similar pattern has been shown where childhood sleep problems predict later adult-onset anxiety disorders, but not depressive disorders [55]. Multiple dysfunctional cognitive processes have been categorised in cognition aside from catastrophising, and most research has linked perseverative thinking, or rumination, to depression [56,57]. Although our findings show a relationship between catastrophising and depression, it appears that the depressive cognitions measured in the present study do not play a significant role in our adolescents' sleep-onset problems. Our lack of significant findings with depression may be due to not measuring the appropriate thinking style for this disorder, or a function of our sample. Danielsson et al found a mediating relationship between sleep disturbance, catastrophising and depression, though this was in a community sample [40]. Thus, we do not rule out that depression may play a mediating role between dysfunctional thinking styles and sleep disturbance for adolescents, and encourage researchers to attempt to replicate and/or expand upon our findings with a clinical sample.

Implications for Intervention

Our findings suggest that health professionals interviewing sleep-disordered adolescents should be cognisant of the adolescent's rehearsal and planning thinking, and assess these themes accordingly. The catastrophising interview is not only insightful, but easily administered (<2min), and the adolescent version of the Sleep Anticipatory Anxiety Questionnaire not only provides more clinical information, but allows for quantification that lends to treatment evaluation. The indirect relationship found between catastrophising and sleep latency in our study support the use of cognitive and behavioural strategies in the

treatment of adolescent DSPD. These include, thought challenging, behavioural experiments, and generating alternative realistic thoughts [10,14,58], to target the problematic catastrophising present in adolescents with delayed sleep. Our sample underwent different circadian therapies so it was not possible to evaluate the effect of therapy on dysfunctional thinking, but this is certainly a direction for future studies. Finally, although it was clear that our adolescents diagnosed with DSPD catastrophise during the pre-sleep period, these findings need to be replicated in other clinical sleep disorders, the most relevant being adolescents with an insomnia disorder [59].

Limitations and Future Directions

This is the first study to examine the role of catastrophising in a clinical sample of adolescents; in this case diagnosed with DSPD**.** However, we do not know whether similar themes, and the impact of these on sleep latency, occur in good-sleeping adolescents, nor whether the severity is higher in adolescents with an insomnia disorder. Furthermore, this clinical sample is small (*N*=40) relative to community samples of children (*N*=123;[31]) and adolescents (*N*=115;[21]). Future research could examine whether catastrophising is unique for adolescents with DSPD (compared to adolescent samples with insomnia or anxiety disorders co-morbid with sleep-onset disturbance), and especially on sample sizes comparable to community samples (i.e., *N*>100). Given delayed sleep timing is prevalent worldwide [4], these data require replication across cultures to further understand whether cognition is a common factor accompanying the underlying biological factors (i.e., delayed circadian rhythm) contributing to delayed sleep. Furthermore, post-treatment catastrophising data were not obtained, however this may be a useful avenue to explore, particularly to confirm the usefulness of targeting catastrophic thinking during therapy.

A potential limitation was the self-report nature of our measures contained a retrospective element. As such, all measures would have contained some measurement error

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to varying degrees. Although addition of more objective measures of catastrophising (e.g., *in vivo* audio recordings) and sleep (e.g., wrist actigraphy) would help to confirm pathways from catastrophising to sleep latency via anxiety, these measures also have their drawbacks (i.e., monitoring *in vivo* thinking likely alters the sleep-onset process; measuring the 'attempt to sleep' is difficult with actigraphy). Finally, only catastrophic thinking was examined, yet multiple facets of dysfunctional thinking occur (e.g., cognitive distortion, ruminating, thinking errors, hopelessness, etc.). It remains a challenge to the field to investigate this emerging area that is open to multiple directions of study.

Conclusion

Eight-seven percent of sleep-disordered adolescents reported catastrophic thinking in the pre-sleep period, with concerns about performance and interpersonal aspects of school dominating. More catastrophic thinking was significantly yet indirectly associated with a longer sleep latency, through its association with anxiety. In particular, concerns when reflecting on the day's events and planning for future events, most strongly predicted this association. In our sample depression did not play a mediating role between catastrophising and sleep, although further research is recommended here. The present study's findings have implication for future scientific investigations and current clinical assessment and treatment of sleep-onset problems in adolescents.

References

[1]   Kahn A, Van de Merckt C, Rebuffat E, Mozin MJ, Sottiaux M, Blum D, Hennart P. Sleep problems in healthy preadolescents. *Paediatrics*. 1989; 84:542-546.

[2]   Mindell JA, Owens JA, Carskadon MA. Developmental features of sleep. *Child Adolesc Psychiatr Clin N Am.* 1999; 8:695-725.

[3]   Teng A, Bartle A, Sadeh A, Mindell J. Infant and toddler sleep in Australia and New Zealand. *J Paediatr Child Health.* 2012; 48:268-273.

[4]   Gradisar M, Gardner G, Dohnt H. Recent worldwide sleep patterns and problems during adolescence: a review and meta-analysis of age, region, and sleep. *Sleep Med*. 2011; 12:110-8.

[5]   Mak KK, Ho SY, Thomas GN, Lo WS, Cheuk DK, Lai YK, Lam TH. Smoking and sleep disorders in Chinese adolescents. *Sleep Med*. 2010; 11:268-273.

[6]   Laberge L, Petit D, Simard C, Vitaro F, Tremblay RE, Montplaisir J. Development of sleep patterns in early adolescence. *J Sleep Res*. 2001; 10(1):59-67.

[7]   Anders TF, Eiben LA. Pediatric sleep disorders: a review of the past 10 years. *J Am Acad Child Adolesc Psychiatry* 1997; 36:9-20.

[8]   Keren M, Feldman R, Tyano S. Diagnoses and interactive patterns of infants referred to a community-based infant mental health clinic. *J Am Acad Child and Adolesc Psychiatry*. 2001; 40: 27-35.

[9]   Lam P, Hiscock H, Wake M. Outcomes of infant sleep problems: a longitudinal study of sleep, behaviour, and maternal well-being. *Pediatrics*. 2003; 111: 203-207.

[10]   Gradisar M, Dohnt H, Gardner G, Paine S, Starkey S, Menne A, et al. A randomized controlled trial of cognitive-behavior therapy plus bright light therapy for adolescent Delayed Sleep Phase Disorder. *Sleep*. 2011; 34: 1671-1680.

[11]   Crowley SJ, Acebo C, Carskadon MA. Sleep, circadian rhythms, and

delayed phase in adolescence. *Sleep Med.* 2007; 8: 602-612.

[12]   American Association of Sleep Medicine. The International Classification of Sleep

Disorders: Diagnostic and Coding Manual, 2nd Edition. Westchester, IL: American

Association of Sleep Medicine. 2005.

[13]   Barion A, Zee PC. A clinical approach to circadian rhythm sleep disorders. *Sleep

Med*. 2007; 8:566.

[14]   Bootzin RR, Stevens SJ. Adolescents, substance abuse, and the treatment of insomnia

and daytime sleepiness. *Clin Psychol Rev*. 2005; 25:629-644.

[15]   Alfano CA, Zakem AH, Costa NM, Taylor LK, Weems CF. Sleep problems and their

relation to cognitive factors, anxiety, and depressive symptoms in children and

adolescents. *Depress Anxiety*. 2009; 26:503-512.

[16]   Broman JE, Hetta J. Perceived pre-sleep arousal in patients with persistent

psychophysiologic and psychiatric insomnia. *Nord J Psychiatry*. 1994; 48:203-207.

[17]   Espie C, Brooks DN, Lindsay WR. An evaluation of tailored psychological treatment

of insomnia. *J Behav Ther Exp Psychiatry.* 1989; 20:143-153.

[18]   Harvey AG. A cognitive model of insomnia. *Behav Res Ther.* 2002; 40:869-893.

[19]   Morin C. Insomnia: Psychological assessment and management. New York: The

Guilford Press. 1993.

[20]   Wicklow A, Espie CA. Intrusive thoughts and their relationship to actigraphic

measurement of sleep: towards a cognitive model of insomnia. *Behav Res Ther.* 2000;

38: 679-693.

[21]   Noone DM, Willis TA, Cox J, Harkness F, Ogilvie, Forbes E, Sterr A, Gregory AM.

Catastrophising and poor sleep quality in early adolescent females. *Behav Sleep Med.*

2013. In press.

[22]   Carney CE, Edinger JD, Morin CM, Manber R, Rybarczyk B, Stepanski EJ, Stepanski EJ, et al. Examining maladaptive beliefs about sleep across insomnia patient groups. *J Psychosom Res.* 2010; 68: 57-65.

[23]   Gregory AM, Cox J, Crawford MR, Holland J, Harvey AG. Dysfunctional beliefs and attitudes about sleep in children. *J Sleep Res.* 2009; 18:422-426.

[24]   Harvey AG. Pre-sleep cognitive activity: a comparison of sleep-onset insomniacs and good sleepers. *Br J Clin Psychol.* 2000; 39: 275-286.

[25]   Harvey AG. A cognitive theory and therapy for chronic insomnia. *J Cog Psychother*: *An International Quarterly*. 2005; 19:41-59.

[26]   Morin CM, Blais F, Savard J. Are changes in beliefs and attitudes about sleep related to sleep improvements in the treatment of insomnia? *Behav Res Ther.* 2002; 40:741-752.

[27]   Morin CM, Stone J, Trinkle D, Mercer J, Remsberg S. Dysfunctional beliefs and attitudes about sleep among older adults with and without insomnia complaints. *Psychol Aging*. 1993; 8:463-467.

[28]   Borkovec T, Grayson J, O'Brien G, Weerts T. Relaxation treatment of pseudoinsomnia and idiopathic insomnia: an electroencephalographic evaluation. *J Appl Behav Anal.* 1979; 12: 37-54.

[29]   Kuisk KA, Bertelson AD, Walsh JK. Presleep cognitive hyperarousal and affect as factors in objective and subjective insomnia. *Percept Mot Skills.* 1989; 69:1219-1225.

[30]   Van Egeren L, Haynes SN, Franzen M, Hamilton J. Presleep cognitions and attributions in sleep onset insomnia. *J Behav Med.* 1983; 6:217-232.

[31]   Gregory AM, Noone DM, Eley T, Harvey AG, The STEPS Team. Catastrophizing and symptoms of sleep disturbance in children. *J Sleep Res.* 2010; 19:175-182.

[32]   Ng AS, Dodd HF, Gamble AL, Hudson JL. The relationship between parent and child

dysfunctional beliefs about sleep and child sleep. *J Child Fam Stud.* 2012; 1-9.

[33]   Dahl RE, Harvey AG. Sleep in children and adolescents with behavioral and emotional disorders. *Sleep Med Clin.* 2007; 2:501-511.

[34]   Gregory AM, Sadeh A. Sleep, emotional and behavioral difficulties in children and adolescents. *Sleep Med Rev*. 2012; 16:129-136.

[35]   Leahy E, Gradisar M. Dismantling the bidirectional relationship between paediatric sleep and anxiety. *Clin Psychol.* 2012; 16:44-56.

[36]   Forbes EE., Williamson, DE., Ryan, ND., Birmaher, B., Axelson, DA., Dahl, RE. Peri-sleep-onset cortisol levels in children and adolescents with affective disorders. *Biol Psychiatry.* 2006; 59:24-30.

[37]   Danielsson NS, Jansson-Fröjmark M, Linton SJ, Jutengren G, Stattin H. Neuroticism and sleep-onset: What is the long-term connection?. *Pers Individ Dif.* 2010; 48: 463-468.

[38]   Pigeon WR, Pinquart M, Connor K. Meta-analysis of sleep disturbance and suicidal thoughts and behaviours. *J Clin Psychiatry.* 2012; 73:1160-1167.

[39]   Roberts RE Duong HT. Depression and insomnia among adolescents: A prospective perspective. *J Affect Disord.* 2012; In press.

[40]   Daniellson NS, Harvey AG, MacDonald S, Jansson-Frojmark M, Linton SJ. Sleep disturbance and depressive symptoms in adolescence: the role of catastrophic worry. J Youth Adol, in press: DOI 10.1007/s10964-012-9811-6

[41]   Angold A, Worthman CW. Puberty onset of gender differences in rates of depression: A developmental, epidemiologic and neuroendocrine perspective. *J Affect Disord.* 1993; 29:145-158.

[42]   Davey GC, Levy S. Catastrophic worrying: personal inadequacy and a perseverative iterative style as features of the catastrophizing process. *J Abnorm Psychol.* 1998;

23

107:576-586.

[43]   Garnefski N, Kraaij V, Spinhoven P. Negative life events, cognitive emotion
regulation and emotional problems. *Pers Individ Dif.* 2001; 30:1311 -1327.

[44]   Garnefski N, Legerstee J, Kraaij VV, Van Den Kommer T, Teerds J. Cognitive coping
strategies and symptoms of depression and anxiety: a comparison between adolescents
and adults. *J Adolesc.* 2002; 25:603-611.

[45]   Legerstee JS, Garnefski N, Verhulst FC, Utens EMWJ. Cognitive coping in anxiety
disordered adolescents. *J. Adolesc.* 2011; 34:319-26.

[46]   d'Acremont M, Van der Linden M. How is impulsivity related to depression in
adolescence? Evidence from a French validation of the cognitive emotion regulation
questionnaire. *J. Adolesc.* 2007; 30:271-282.

[47]   Kraaij V, Garnefski N, Jan de Wilde E, Dijkstra A, Gebhardt W, Maes S, ter Doest L.
Negative life events and depressive symptoms in late adolescence: Bonding and
cognitive coping as vulnerability factors? *J Youth Adolesc.* 2003; 32:185-193.

[48]   Short MA, Gradisar M, Lack LC, Wright HR, Chatburn A. Estimating adolescent
sleep patterns: parent report versus adolescent self-report surveys, sleep diaries, and
actigraphy. *Nat Sci Sleep.* 2013; 5:23 -26.

[49]   Buysse DJ, Ancoli-Israel S, Edinger JD, Lichstein KL, Morin CM. Recommendations
for a standard research assessment of insomnia. *Sleep.* 2006; 29:1155-1173.

[50]   Harvey AG, Greenall E. Catastrophic worry in primary insomnia. *J Behav Ther
Exp Psychiatry.* 2003; 34:11-23.

[51]   Bootzin RR, Shoham V, Kuo TF. Sleep anticipatory anxiety questionnaire: a measure
of anxiety about sleep. *Sleep Res.* 1994; 23:188.

[52]   Johnston A, Dohnt H, Gradisar M. (2011). The role of pre-sleep cognitions in
adolescent sleep-onset problems [dissertation]. Adelaide, South Australia: Flinders

University.

[53]   Angold A, Costello EJ, Messer SC, Pickles A, Winder F, Silver D. Development of a short questionnaire for use in epidemiological studies of depression in children and adolescents. *Int J Methods Psychiatr Res*. 1995; 5:237-249.

[54]   Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behav Res Methods*. 2008; 40: 879-891.

[55]   Kaplan PS. Adolescence. Houghton Mifflin Company: New York. 2004.

[56]   Gregory AM, Caspi A, Eley TC, Moffitt TE, O'Connor TG, Poulton R. Prospective longitudinal associations between persistent sleep problems in childhood and anxiety and depression disorders in adulthood. *J Abnorm Child Psychol*. 2005; 33:157-63.

[57]   Rood L, Roelofs J, Bogels SM, Nolen-Hoeksema S, Schouten E. The influence of emotion-focused rumination and distraction on depressive symptoms in non-clinical youth: A meta-analytic review. *Clin Psychol Rev*. 2009; 29:607-616.

[58]   Smith JM, Alloy LB. A roadmap to rumination: A review of the definition, assessment, and conceptualization of this multi-faceted construct. *Clin Psychol Rev*. 2009; 29:116-128.

[59]   Moseley L, Gradisar M. Evaluation of a school-based intervention for adolescent sleep problems. *Sleep*. 2009; 32:334.

[60]   Dohnt H, Gradisar M, Short M. Insomnia and its symptoms in adolescents: Comparison of DSM-IV and ICSD-2 diagnoses. *J Clin Sleep Med*. 2012; 8:295-299.
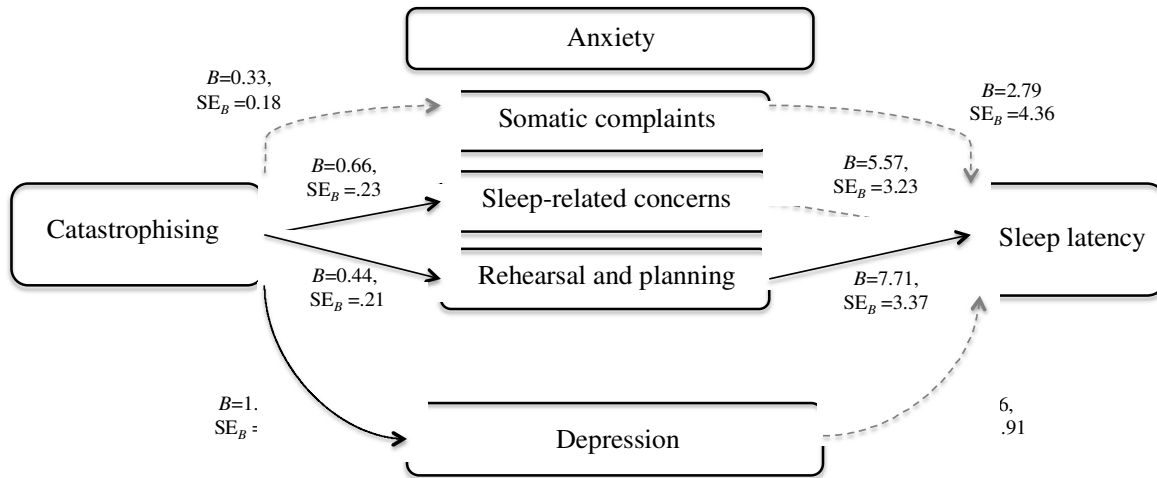
Figure 1. Mediating relationships between catastrophising, anxiety, depression, and sleep onset latency. Solid arrows represent significant relationships, whereas broken arrows are for non-significant associations.

Table 1.

Catastrophising Responses By Theme

Theme	General Content of Interview	Percentage (*n*)
Mood	Concern they will be grumpy or irritable (e.g., "I hate being grumpy")	5.0 (2)
School (performance)	Concern regarding missing school, grades and/or future career prospects (e.g., "I'll miss important information at school", "I won't be able to go to university")	47.5 (19)
School (interpersonal)	Concern regarding being embarrassed in front of teacher or peers (e.g., "I'll be told off by the teacher", "Everyone will look at me")	17.5 (7)
Family	Concern of family conflict (e.g., "I don't want mum to worry", "I don't want to be yelled at")	5.0 (2)
Sleep	Concern they are unable to fall asleep (e.g., "It's not normal to take this long to fall asleep")	5.0 (2)
Life enjoyment	Concern regarding impact on ability to enjoy hobbies or sport (e.g., "I won't be able to play sport as well as I want")	5.0 (2)
Do not know/ no concern	Unable to identify why sleep problem worries them	15.0 (6)

Note. These catastrophising themes were not analysed in inferential analyses, but instead the number of catastrophising thoughts were included in the bootstrapping analysis.

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Table 2.

Results of Bootstrapping Analysis on Direct Effect of Catastrophising on SOL and Indirect Effect of Catastrophising on SOL through Anxiety

	B	*SE*$_B$	*p*	Bootstrap 95% CI
Total Anxiety (Mediator)				
IV - mediator	1.38	.49	.01	-
Mediator – DV	3.23	1.49	.04	-
Direct effect IV on DV	.08	4.49	.99	-
Indirect effect	4.79	3.03	-	(0.74, 13.10)
Anxiety Subscales				
Somatic Complaints				
Direct effect IV on DV	3.58	4.51	.43	-
Indirect effect	.97	2.27	-	(-2.76; 6.97)
Sleep Cognitions				
Direct effect IV on DV	.83	4.62	.86	-
Indirect effect	3.76	2.04	-	(0.98; 9.43)
Planning/Rehearsal				
Direct effect IV on DV	.97	4.20	.82	-
Indirect effect	3.11	2.33	-	(0.07, 10.26)

Note. IV = number of catastrophising steps, mediator = anxiety, DV = average SOL

Table 3.

Association of Specific Planning/Rehearsal Items with SOL

Item	n	r	p
I worry about my school work	31	.32	.08
I can't stop thinking about what I have to do tomorrow*	30	.45	.01
I can't stop thinking about what happened during the day*	31	.50	.004
I worry about my relationships (e.g., boyfriend, parents)	31	.09	.63
I worry about my friendships*	31	.41	.02

Note. * $p < .05$