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Original Article

Readiness to change and commitment as predictors of therapy compliance in adolescents with Delayed Sleep-Wake Phase Disorder☆

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ABSTRACT

Objectives: Recent evidence indicates that adolescents' motivation to change sleep-wake patterns is low, despite significant impact of adolescent sleep problems on many areas of daytime functioning. The aim of the present study is to evaluate components of adolescents' motivation, and subsequent changes in behaviour.

Methods: Fifty-six adolescents, aged 13–23 (M = 15.8 ± 2.3 y; 38% m) diagnosed with Delayed Sleep-Wake Phase Disorder (DSWPD) underwent three therapy sessions involving bright light therapy to phase advance sleep patterns. Adolescents were instructed to advance wake-up times by 30-min daily. Motivation ratings of desire, ability, reason, need and commitment to change sleep patterns were taken at baseline. Sleep diaries were taken at the end of treatment session 1, with sequentially earlier wake-up times in 30-min intervals indicating compliance.

Results: At the outset of therapy, adolescents indicated strong desire, reasons and need, yet moderate ability and commitment to advance their sleep-wake patterns. Following therapy, sleep-onset times were significantly advanced, total sleep time increased and sleep latency decreased (all $p < 0.05$). Therapy lasted 6–27 days (M = 13.9 ± 4.5) and clients complied for approximately half the time (between 3 and 15 days; M = 8.8 ± 2.7). Commitment was associated with ability ($r = 0.66$, $p < 0.001$) but not desire, reason or need (all $p > 0.05$). Adolescents' desire to change ($r = 0.30$, $p = 0.03$) and commitment ($r = 0.30$, $p = 0.03$) were positively correlated with behaviour change, but their need, ability and reasons were not. A mediation analysis showed that ability and desire were important in predicting behaviour change, by total effects through commitment (ie, indirectly and directly).

Conclusion: Our findings suggest that the total effects of ability (ie, confidence) and desire to change are the best predictors of behavioural changes, thus clinicians should focus on these components of the readiness to change model when undertaking treatments with sleep-disordered adolescents.

Delayed Sleep-Wake Phase Disorder (DSWPD) is a sleep disorder common in young people, and is characterised by an inability to go to sleep and wake up at a socially accepted time [1]. For example, most adeolescents fall asleep between 10pm-midnight and awaken by 6–8am in order to meet daytime obligations [2]. However, those with DSWPD may be unable to fall asleep until 2–6am and wake from 10am to 2pm, for example. This clearly conflicts with social and occupational functioning in adolescents (eg, attending school). If the young person nevertheless rises at a socially-acceptable time, they experience severe and chronic sleep restriction [3]. Due to this insufficient sleep, individuals suffer daytime impairments such as excessive sleepiness, fatigue, memory deficits as well as other behavioural and cognitive dysfunctions [1,4–6]. Therefore, this sleep disorder typically leads to negative lifestyle consequences (eg, substance use, truancy, poor grades, etc. [7–9]); and is associated with an impaired quality of life [10].

Abbreviations: DSWPD, Delayed Sleep-Wake Phase Disorder; LOT, Lights Out Time; OOBT, Out of Bed Time; SE, Sleep Efficiency; SOL, Sleep Onset Latency; SOT, Sleep Onset Time; TIB, Time in Bed; TST, Total Sleep Time; Tx, Treatment; WASO, Wake after Sleep Onset; WUT, Wake-Up Time.

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It is thought that DSWPD arises due to a delay in one's biological body clock (ie, 24-h circadian rhythm; [1,11]). The biological body clock is regulated via secretion of melatonin, thus in addition to social obligations to awaken early, circadian and melatonin secretion delays contribute to a delay in feeling sleepy. Circadian rhythm timing is linked with sleep patterns, thus a delay in circadian timing also delays sleep patterns. Sleep timing is also influenced by chronotype, which is a person's natural inclination or preference toward the times of the day, when they prefer to sleep or feel most alert and energetic. There is inter-individual variation in chronotype, analogous to the normal distribution, such that some people are generally morning- and others evening-types. The extremes of a morning or evening preference generally meet classification for circadian rhythm disorders, and DSWPD is commonly associated with extreme eveningness [1,11]. Evening chronotype and circadian rhythm timing delays are particularly common during adolescence and young people seem most susceptible to DSWPD, showing the highest prevalence rates of any age group (ie, 7–16%, [1,8,12–14]). More relaxed bedtimes [15,16] and increased school and social obligations compound adolescents' risk of developing a delayed 24-h circadian rhythm [12]. Given this developmental period is associated with the greatest social and emotional changes that form a person's identity [17], the aforementioned negative consequences can have long-term impacts on young people throughout their lifespan [5,18,19].

Empirically-supported treatments that phase shift sleeping patterns to an earlier time include light therapy, exogenous melatonin administration, and maintaining early rise times [20–22]. Bright light therapy requires the individual to get up 30-min earlier each morning for 2–3 weeks and obtain adequate post awakening light exposure [3,23]. In addition to adolescents' pre-existing low motivation to change sleep patterns [7,23], light therapy is associated with poor compliance because of the need to structure activities (eg, school classes, sports, socialising, etc.) around the timing of daily light exposure [24].

Many young people may seem apathetic to changing their sleep [7,25–27], warranting the need to address the motivational aspects of treatment [23,28]. Recent empirical evidence indicates that adults with DSWPD show significantly lower conscientiousness scores on personality measures compared to good sleepers [29,30]. These personality types are said to be less motivated to deal with their problems [31]. Adolescents may not be motivated to get out of bed earlier as this behaviour change also entails going to bed earlier, and thus implies less time for leisure, extracurricular activities and communicating with friends in the late evening [32]. This lack of motivation might account for the inefficacy of current programs aimed at changing adolescents' bedtime [6,33]. However, to date and to the authors' knowledge, studies have not specifically measured motivation in DSWPD nor adolescence, nor its predictive capacity toward therapy commitment and behaviour change.

Several studies advocate the use of therapeutic procedures such as motivational interviewing to produce better treatment outcomes for adolescents in general [34] and in DSWPD [3,23,28,30,35,36]. Motivational Interviewing (MI) has been effective in motivating behaviour change, especially when used in conjunction with another intervention (eg, cognitive-behaviour therapy) [37–39]. Evaluation of clients' readiness to comply with therapy instructions is used to assess their commitment and, ultimately, behaviour change. Readiness includes their desire, ability, reason, and need (ie, DARN) to change behaviour. DARN has been shown to predict commitment in therapy sessions (ie, "*I will …*"), and has been associated with compliance to therapy instructions [40].

The present study evaluates associations between adolescents' motivation and subsequent behavioural change (ie, therapy compliance). We aim to discover how desire, ability, reason and need relate to adolescents' commitment and ultimately behaviour change. We initially hypothesise that adolescents will show significant pre-to post-therapy improvements in sleep (eg, sleep onset latency, sleep onset time, total sleep time, etc.). It is also predicted that the relationship between desire, ability, reason and need, and the outcome variable of therapy compliance (ie, behaviour change as reflected by waking earlier each day) will be mediated by commitment [40].

1. Methods

1.1. Participants

Parents and/or caregivers of 455 adolescents contacted the Child & Adolescent Sleep Clinic at Flinders University. They responded to advertisements in school newsletters, public advertisements and flyers distributed at various school and community events. Eighty three adolescents attended an initial Clinical Sleep History Interview with a psychologist to confirm DSWPD diagnosis ([1]; see Appendix). Of those, 60 adolescents aged 13–23 yrs ($M = 15.9 \pm 2.3$ yrs; 38% m) were recruited for the present study. This age range was chosen as adolescents and young adults have a biological tendency toward late chronotype [14]. Details of participant characteristics are available in Ref. [41] and a CONSORT diagram is presented in Fig. 1. All adolescents and their caregivers provided informed consent, and ethics approval was granted by the Southern Adelaide Clinical Human Research Ethics Committee.

1.2. Design

A prospective-correlational study design was used to determine whether aspects of readiness to change (desire, ability, reason and need) were related to commitment and behaviour change (ie, compliance to therapy). Baseline sleep data were collected at the assessment appointment and the week between assessment and first therapy session. Motivation data were collected immediately after the delivery of the first therapy session, at which point compliance data collection commenced and ceased when each individual reached a 6am wake-up time.

1.3. Outcome measures

1.3.1. Motivation Scale

Adolescents completed a 10-pt Likert scale assessing their desire, ability, reason, need and commitment to change, that was developed by the researchers based on previous reports of motivation and commitment [42,43]. Questions were asked at the end of the first therapy session, immediately after outlining each adolescent's tailored, step-by-step, light therapy program for the upcoming week. Each item was rated from 1 = "*Not at All*" to 10 = "*A Lot/Extremely*" and include the following items: (Desire) "*How much do you **want** your body clock to be at a time that doesn't conflict with school/uni?*"; (Ability) "*How **confident** are you that you can keep your body clock at a time that doesn't conflict with school/uni?*"; (Reasons) "*How significant are your **reasons** to keep your body clock at a time that doesn't conflict with school/uni?*"; (Need) "*How **important** is it for you to have a body clock that fits with your school/uni times?*"; and (Commitment) "*How much **will** you keep your body clock at a time that doesn't conflict with school/uni?*".

1.3.2. Compliance to therapy

Therapy compliance or "behaviour change" was calculated by adding the number of mornings the adolescent woke up 30-min earlier across the duration of bright light therapy (ie, up to three weeks), and dividing it by the number of therapy days (ie, [number

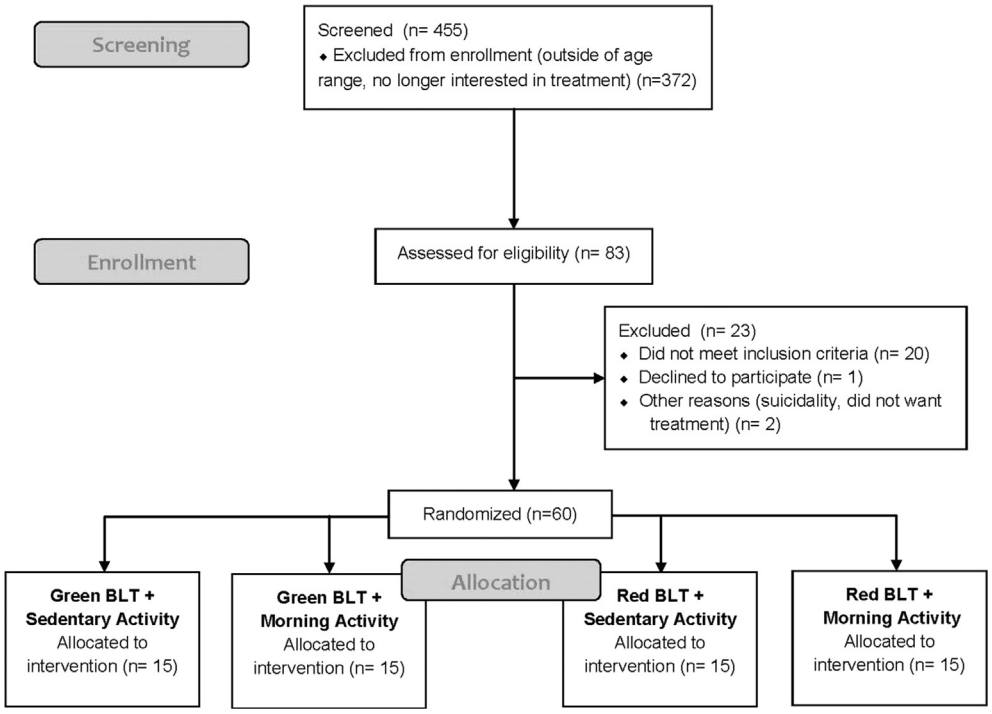

Fig. 1. Participant flow through the randomised controlled trial, taken from Ref. [41].

of days woke up 30-min earlier/number of days involved in therapy] × 100), to take account of individual differences in each adolescent's sleep pattern (see Treatment below). These data were taken from sleep diaries, and confirmed with wrist activity monitors (see Measures below).

Online Sleep-Wake Diary. The sleep diary is a daily, subjective record of adolescents' sleeping patterns, including: bedtime, sleep onset latency (SOL), sleep onset time (SOT), waking after sleep onset (WASO), wake up time (WUT), out of bedtime (ie, treatment compliance variable of interest, OOBT), and time of light exposure. Total sleep time (TST) and total time spent in bed (TIB) were also estimated to calculate sleep efficiency (SE = [TST/TIB] × 100). Online sleep diaries have been used in previous interventions with adolescents [3,26], and show high sensitivity (92.3%) and specificity (95.6%) when compared to gold-standard polysomnography recordings [44,45].

Actigraphy. The wrist actigraph (Micromini-Motionlogger Actigraph, Ambulatory Monitoring Inc., NY, USA) is a non-invasive portable device that provides an objective indication of one's daily sleep-wake pattern across a 24-h period in 1-min epochs. Adolescents wore an activity motion monitor throughout therapy. Motionlogger Analysis Software Package [Action W-2, NY, USA] was used to download and process recorded data. Adolescent sleep onset and offset times were scored using an algorithm validated for adolescents (AMI-Sadeh, Action 4, Ambulatory Monitoring Inc, Ardsley, NY). These data were analysed and compared with sleep diary data to ensure consistency in the treatment compliance variable (out of bedtime). Discrepancies between sleep diary and wrist actigraphy were noted at sleep onset times, however both tools were reliable measures of sleep offset [46]. Ultimately, sleep diary data were used to calculate treatment compliance (ie, out of bed time) as actigraphy has been shown to reliably detect sleep timing (ie, sleep onset/offset) [47] rather than out of bed time. Furthermore, although actigraphy devices are sufficiently sensitive to detect sleep, they have poor specificity to correctly classify states of wakefulness [45,48]. However, as they can reliably detect sleep timing, the devices are commonly used in the evaluation of circadian rhythm disorders [47].

1.4. Procedure

Eligible adolescents' parents completed a brief screening via phone or email. The DSWPD diagnosis was confirmed from data derived from a semi-structured Clinical Sleep History Interview [3], and the sleep diary and actigraphy. The objectives of the treatment program were to improve adolescents' sleep and daytime functioning by using bright light therapy (via portable LED glasses [49]); to re-time adolescents' sleep timing to an earlier time [41]. Adolescents were randomised to receive either green (active) or red (control) bright light, as well as either performing physical activity (motion-sensing video game) or sedentary activity (watching TV; [41]). While adolescents' sleep outcomes improved over time (see Table 1), there were no statistically significant interaction effects between treatment groups and time for all outcome variables ($p > 0.05$; [41]), thus all adolescents were grouped together for the present study.

Adolescents' first therapy session covered psychoeducation, including information about 24-h circadian rhythms, delayed circadian rhythms, and the use of bright light to phase advance delayed circadian rhythms. Individualised therapy plans were collaboratively developed between the psychologist, adolescent, and their parent, to create a plan for when to wake-up and get out of bed for the following week. On the first day of therapy, adolescents were instructed to sleep-in until their natural wake-up time (eg, 11:30am), and thereafter wake up 30 min earlier each morning, for up to three weeks of therapy, until they achieved a 6am wake-up time [3,23]. Adolescents were provided with their LED glasses and instructed to wear these 30–60 min per day, within the first 10 min upon waking up. They were also instructed to perform their set activity (motion-sensing videogame or sedentary activity [eg, watch TV]) for the same amount of time. Parent and the adolescent were asked report for how long they completed the activity and

Table 1
Outcomes of sleep variables at pre-treatment relative to post-treatment in adolescents with DSWPD.

	N = 56				
	Mean [95% CI]		ME [95% CI]	Cohen's *d*[a]	*p* value
	Pre-treatment	Post-treatment	Pre to Post treatment		
Bedtime	23:17 [22:54, 23:52]	22:46 [22:19, 23:13]	31 m [0.14, 0.89]	0.31	0.008
Lights out time	23:56 [23:26, 24:28]	23:29 [23:01, 23:57]	28 m [0.06, 0.85]	0.26	0.024
Sleep onset latency	98 m [72, 123]	52 m [37, 66]	45 m [26.87, 64.73]	0.61	<0.001
Sleep onset time	01:35 [01:20, 02:41]	00:21 [23:56, 01:00]	1 h 14 m [0.93, 2.17]	0.59	<0.001
Wake up time	09:07 [08:37, 09:37]	08:20 [07:22, 08:58]	47 m [0.33, 1.24]	0.39	0.001
Out of bedtime	09:35 [07:43, 08:58]	08:38 [08:00, 09.28]	57 m [0.52, 1.39]	0.45	<0.001
Time in bed	9 h 38 m [9 h 14 m, 10 h 3 m]	9 h 10 m [8 h 40 m, 9 h 38 m]	29 m [-0.01, 0.98]	0.29	0.056
Total sleep time	7 h 11 m [6 h 41 m, 7 h 41 m]	7 h 52 m [7 h 26 m, 8 h 17]	41 m [-1.12, −0.25]	0.41	0.003
Sleep efficiency (%)	75 [70, 80]	86 [83, 89]	11 [-14.13, −8.00]	0.77	<0.001
Wake after sleep onset	16 m [10, 22]	7 m [1, 14]	9 m [2.23, 15.63]	0.40	0.010

Notes: **ME**: Mean Error; **CI**: Confidence Interval.
[a] Cohen's d Size of effect: $d > 0.20$ = small; $d > 0.50$ = medium; $d > 0.80$ = large.

wore the glasses each day at the end of each week (ie, during each treatment session).

Adolescents were asked to continue wearing the actigraphy monitor and record their sleep using the online sleep diary. At the end of session 1, they completed the Motivation Scale with respect to what they thought will occur over the next three weeks. Sessions 2 and 3 consisted of reviewing and monitoring light therapy progress. Once a 6am wake-up time was reached, adolescents ceased using the LED glasses, and were asked to maintain a regular rise time.

1.5. Statistical analyses

All data were analysed using the IBM SPSS Statistics Software version 25, in which descriptive statistics including means, confidence intervals, effect sizes, inferential statistics and zero-order correlations were derived. The results of zero-order correlations merited the use of mediation analyses [50]. Hence, the PROCESS for SPSS macro [51] was used to assess direct and indirect effects (indicating mediation) of desire, ability, reason and need (DARN) to change, on commitment and ultimate behaviour change. Age, gender, severity (greater severity = later pre-treatment WUT on weekend) and chronicity (how long adolescents experienced the sleep problem) were firstly assessed as potential covariates of the model using zero-order correlation analyses. However, none were significantly related to the outcome variable ($p > 0.05$, see Supplement Table 1). Thus, behaviour change was entered as the dependent variable, DARN were the predictors and commitment was the mediator. The effect between the predictor and the dependent variable is termed the 'direct effect', and an 'indirect effect' is that of the predictor on the dependent variable, via the mediator. The 'total effect' is the sum of both the indirect and direct effect of the predictor on the dependent variable [51]. The *b* values are unstandardized regression coefficients. Number of bootstrap samples for bias corrected bootstrap confidence intervals is 10,000 and 95% confidence intervals are used. Cohen's *ds* were derived by calculating the mean difference between groups and dividing the result by the pooled standard deviation [52].

2. Results

2.1. Sleep outcomes

Adolescents' sleep improved in all areas, with the exception of a trend for reduced time in bed (Table 1). Of 60 adolescents who attended the first treatment session, 56 attended all three treatment sessions, with only four dropping out of therapy, hence data for these participants was excluded from the final analyses. Of the four participants who withdrew from the study, two adolescents did not complete the motivation scale during this first therapy session hence were excluded from the present study. One adolescent ceased treatment due to travel, and the last withdrew due to low compliance and potentially low motivation.

2.2. Motivation and compliance descriptives

Overall, adolescents indicated a strong desire (8.9 ± 1.8; out of 10), need (8.5 ± 1.8), and reason (8.9 ± 1.1), yet moderate ability (6.4 ± 1.8) and moderate-to-strong commitment (8.0 ± 1.2) to advance sleep-wake patterns.

Bright light therapy lasted 6–27 days (M = 13.9 ± 4.5), depending on the number of days adolescents took to achieve a 6am wake-up time, and they complied between 3 and 15 days (M = 8.8 ± 2.7). Compliance percentage (ie, [number of days adolescents woke up earlier/number of days of therapy] × 100) ranged from 31.6%–100% with a mean of 65.9% ± 19.3% compliance. Adolescents were also instructed to wear the LED glasses for 30–60 min, adolescents reported wearing the glasses for $M = 26.1 \pm 11.2$ min (range: 0–55 min) and engaged in their set activity for 23.3 ± 13.3 min (range: 0–60 min). There were no statistically significant differences in self-reported daily light exposure, $F(3,50) = 0.15$, $p = 0.93$, nor self-reported daily activity duration between groups, $F(3,52) = 0.97$, $p = 0.41$, adding further justification for analysing motivation data for the combined sample.

2.3. Readiness to change, commitment and compliance

When the individual items of motivation were summed to obtain an overall motivation score, adolescents' overall motivation ratings were significantly associated with their compliance percentage ($r = 0.40$, $p = 0.003$). Thus, a further investigation into DARN model was warranted and clinically useful, in order to examine whether individual components of motivation could predict commitment to therapy and ultimately, therapy compliance. Mediation analyses were used to assess the relationship between DARN, commitment and therapy compliance. Prior to the analyses, zero-order Pearson's correlations were used to examine relationships between individual components of the readiness to change model, commitment to therapy and ultimate behaviour change (ie, compliance to therapy). Results show that commitment to therapy was not associated with desire, need and reason, but strongly correlated with ability (Table 2). Clients' desire to change and commitment was also positively correlated with compliance,

Table 2
Zero-order correlation analyses of desire, ability, reason, need, verbal commitment and behaviour change.

	1	2	3	4	5	6
1. Desire		−0.07	−0.21	**0.37****	0.12	**0.30***
2. Ability			−0.26	0.02	**0.66****	0.26
3. Reason[a]				0.15	0.30	0.30
4. Need					0.12	0.18
5. Commitment						**0.30***
6. Behaviour Change						

**<0.001, *$p < 0.05$.
[a] $n = 16$ valid cases as the terminology of this question was invalid for the first 40.

yet their desire, need, and reason was not associated with compliance.

There was a significant total effect of desire and ability to predict behaviour change directly and indirectly through commitment (see Supplement Table 2). However, there were no statistically significant direct effects of desire, ability, reason or need to predict behaviour change. Likewise, there were no statistically significant effects of desire, ability, reason or need to affect behaviour change indirectly through commitment (Supplement Table 3). There was a potential trend to suggest that desire may have a direct effect on behaviour change, however this was not statistically significant ($p = 0.07$, Fig. 2).

3. Discussion

Adolescents have a reputation for low motivation to change health behaviours [34], including those that may improve their sleep health [26,32,53]. In the present study, we assessed how adolescents' with DSWPD desire, ability, reasons and need related to their commitment to behaviour change during bright light therapy, as well as their actual changes in behaviour (ie, treatment compliance). The original readiness to change model proposed that desire, ability, reason and need are predictors of commitment, and this in turn is a pathway for influencing behaviour change [40]. The present study found desire and ability related to their willingness to make a change, and actually comply with therapy instructions. Although we did not find significant associations with reasons and need to change, this is not to say that these aspects of motivation are not important in this field (as discussed below).

One of the most validated treatments for DSWPD in adolescent populations is bright light therapy [10,20,22]. Bright light therapy involves the adolescent gradually getting up earlier each day and exposing their vision to bright light, which assists in phase advancing their circadian rhythm and sleep timing [3,6,33,54]. 'Getting up early' is a typically unpleasant behaviour for adolescents who, on the whole, prefer to sleep-in when given the chance (ie, weekends; [9,55]), and hence delay the timing of such light exposure (or avoid bright light altogether). At the end of the first treatment session, where adolescents were provided psychoeducation and a tailored behavioural change plan, they rated their desire (I *want* to change…), reasons, and need (It is *important* to change…) to change as high, yet these were not ultimately related to their commitment (I *will* change…). Instead, their ability (ie, confidence) was a significant predictor of commitment and their actual behaviour change (ie, getting up 30-min earlier each morning as instructed). Adolescents' rating of their ability was found to be important in terms of both what they say they will do and what they actually do (in terms of complying to a gradually earlier wake-up schedule). Part of motivational interviewing is to explore a client's desire, ability, reasons and need to change their current behaviour [38]. Therefore, clinicians working to help adolescents change their behaviours around sleep could initially believe that the adolescent's high ratings of desire, reasons and need will mean they will comply with treatment instructions. However, our findings suggest that clinicians may wish to focus on adolescents' modest ratings of confidence and to a lesser extent, desire. These results are supported by similar clinical research in other areas (eg, eating disorders and social anxiety disorder), where confidence to change (ie, self-efficacy) is the strongest motivational predictor of change, when clients are ambivalent toward changing their behaviour [56–58].

We speculate that up to and including the first treatment session, adolescents had experienced significant consequences of their sleep disorder, which may have boosted their ratings of why it was important to change and why they needed to make a change. Notably, previous studies have shown that when adolescents are provided with psychoeducation about sleep, they still voice apprehension about their ability to maintain behavioural sleep changes, and this may be especially so when they feel they need to do this alone [53]. That is, our previous research has shown that adolescents state that they need support in making changes to their sleep, which could be in the form of assistance from parents, and/or access to bright light (eg, exercise, [53]). In the present study, we did not perform any adjunct motivational interviewing in conjunction with bright light therapy. However, treatment session attendance and compliance were good. We posit that the inclusion of a parent in our therapy to support the adolescent in making behavioural changes [34] could have overcome their modest ratings of confidence, which in turn led to treatment compliance, and ultimately improved sleep. Likewise, the LED light glasses provided

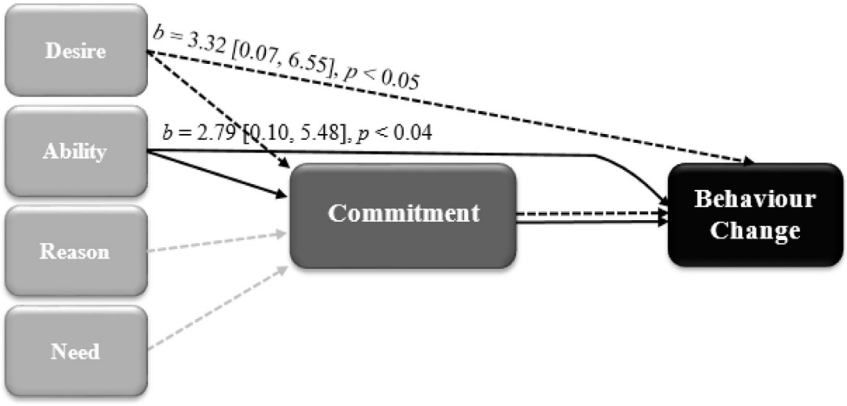

Fig. 2. The "DARN Model" for adolescents with DSWPD. Desire, Ability, Reason and Need as predictors of commitment and behaviour change. Desire predicted behaviour change directly and indirectly through commitment (black perforated lines). Ability predicted behaviour change directly and indirectly through commitment (black solid lines).

adolescents with access to bright light. Indeed, adolescents enrolled in a motivational interviewing based school intervention obtain improved sleep health when provided access to bright light glasses and/or supported by their parents (compared to controls; [59]). Thus, we recommend clinicians attempt to enhance access to bright light and engage parents in sleep interventions in order to address adolescents' moderate confidence in changing their sleep behaviours.

DSWPD clients' lower conscientiousness scores on personality measures relative to controls [29,30], suggest that they may be less motivated to deal with issues or may prioritise enjoyment and leisure (prolonging evening activities; sleeping-in, etc.) over necessary behaviour change [32]. Motivational Interviewing (MI) has been found to be effective in motivating behaviour change especially when used in conjunction with another intervention [38,39]. MI is aimed at stimulating and reinforcing clients' motivation by reducing resistance and encouraging commitment to change [38]. Five therapeutic guidelines that govern MI rely on collaboration, and include: (a) expressing empathy; (b) guiding clients to identify discrepancies between current behaviour and ambitions or life goals (c) avoiding argument and confrontation (d) "rolling with resistance" (ie, seeking to reinforce accurate perceptions versus correcting misperceptions); and (e) supporting self-efficacy [60]. While all five components are equally important for MI, findings of the present study suggest that 'supporting self-efficacy' should be an initial focus for clinicians treating adolescents with DSPWD, in order to augment beliefs in their ability to succeed and accomplish their goals. It is reasonable to assume that clients with persistent behaviours that negatively impact their lives have previously attempted to change (ie, prior to help-seeking) and have been unsuccessful. Clinicians who express dependable belief in their clients' capability to change and highlight client strengths, are likely to foster the clients' confidence thus improving therapy outcomes [61].

It is important to note that while the total shared variance of ability and desire individually predicted behaviour change, the direct and indirect effects of these factors separately were not predictors of behaviour change. It is likely that other factors may impact on clients' desire and ability to change their behaviour and not necessarily mediated by clients' commitment to therapy. Nevertheless, commitment to therapy may still predict clients' eventual behaviour change. Hence, our study showed significant variance is shared between desire, ability and commitment in determining clients' behaviour to change and together these three factors are important for gauging clients' efficacy to treatment. Moreover, due to the design of the study, it is slightly unclear how changes in aspects in motivation affect commitment and behaviour change. Whilst temporal precedence is an important factor in mediation models. Technically, adolescents reported on their desire, ability, reasons and need to change their sleep behaviours, moments before rating their commitment to change – and these ratings occurred within 24 h of them performing their first prescribed behaviour (ie, waking up the following day). Hayes [62] stipulates that mediation analyses can be conducted even if causality cannot be clearly established, so long as a strong theoretical reason exists for testing in the given direction. This holds true in the present study, given the limitations of the research design. Nevertheless, future studies in this area will likely need to measure DARN, commitment and behavioural compliance within a 24-h period, therefore we recommend attempting to space out the timing of these measurements (eg, measure commitment to change after the treatment session).

Potential ceiling effects for some variables (ie, desire, reason, need) and an absence of using a validated scale to measuring adolescents' motivation to change their sleep behaviour are further limitations that should be considered when interpreting the findings of the present study. For ceiling effects, we assume adolescents who engage in help-seeking behaviour (ie, attending weekly sessions) are highly motivated (ie, high desire, need and reason), but usually have tried several approaches without success (relatively lower ability). We predict that the levels of motivation in the present study are likely to be replicated in future studies with such a subsample of this population, yet will likely differ with other samples (ie, those involved in school-based sleep interventions; [59]). Future research is needed to validate measurement in this specific field. To the authors' knowledge, such validated questionnaires do not exist.

A randomised control trial delivering sleep treatment, with or without MI, to adolescents is warranted to examine if motivational enhancement leads to more favourable outcomes. Future work in this area will benefit from evaluating other factors that contribute to sleep-disordered adolescents' response to therapy. For example, supports and barriers in the teenagers' lives may augment or hinder their commitment and progress during therapy, respectively [63]. In addition, clients are often expected to come already prepared with sufficient motivation for change. This may not be the case for adolescents in general, who may be guided by their parents' motivation to seek treatment, and not their own.

4. Conclusion

Adolescence is a turbulent developmental stage, marked by significant changes across psychological, behavioural, and physiological domains. Paradoxically, it is also a time when young clients may be most resistant to change [34]. Results of the present study have important implications for sleep therapy, suggesting that adolescents' subjective reports of 'motivation' may not predict compliance. What we know from the present study is that adolescents' confidence can predict the likelihood of their sleep treatment compliance. Evidence for the use of MI in therapies for adolescents has only recently begun emerging. Our findings may support the use of motivational strategies in therapies for sleep-disordered adolescents, to enhance their commitment and compliance to therapy, ultimately leading to favourable outcomes in sleep and other well-being domains.

Author contributions

GM was involved with recruitment, therapy delivery, data analysis, and write-up of the manuscript. CR (2) had responsibility for day-to-day administration and supervision of the entire project, recruitment, screening and scheduling of participants, participation in data collection, data management, and drafting of this manuscript. MG had primary supervisory role for the project, overall planning, supervision of therapists and students, and manuscript preparation. KB, NZ, CR (5) were involved with recruitment, therapy delivery, and drafting of this manuscript. BM assisted with data collection and quality, as well as drafting of this manuscript.

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Conflicts of interest

The authors declare no personal or financial conflicts of interest relating to the subject matter of this paper, with the exception of Michael Gradisar who has received consultancies from the Australian Psychological Society, Johnson & Johnson, Little Brown Book Company, is a shareholder in ResMed, and previously received partial project funding from Re-Time Pty Ltd [8]. No industry sponsorship (funding, equipment) was provided for the present study.

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: https://doi.org/10.1016/j.sleep.2018.12.002.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.sleep.2018.12.002.

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