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The Puzzle of Paradoxical Insomnia

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Abstract

The current study investigated differences in objective sleep measures and subjective sleep measures between people with paradoxical insomnia and people with accurate perceptions of sleep, finding that sleep onset latency and wake after sleep onset time significantly predicted whether someone would have paradoxical insomnia. There were no significant differences in sleep structure between groups as previous research has suggested. The study also examined differences in personality factors, attitudes toward sleep, and insomnia severity ratings, finding that people with paradoxical insomnia had more dysfunctional beliefs about sleep and higher insomnia severity ratings, but no significant personality differences. Together, these findings suggest that dysfunctional attitudes about sleep and insomnia may play a large role in contributing to the inaccuracy of sleep perceptions for patients with paradoxical insomnia.

The Puzzle of Paradoxical Insomnia

Insomnia is a common problem affecting millions of people, and is viewed as both a symptom and a disorder (Mai & Buysse, 2008). For example, insomnia often is regarded as a symptom of a larger comorbid disorder, but it also is seen as a distinct disorder, which may not have developed from a primary disorder. The definitions of insomnia are numerous, depending on the diagnostic manual used. The *International Classification of Disease* (ICD-10; World Health Organization, 1992) divides insomnia into organic and non-organic cases, based on pathology, while the *Diagnostic and Statistical Manual* (DSM-IV-TR; American Psychiatric Association, 2000) separately identifies Primary Insomnia from other types of dyssomnias, which are disorders of maintaining or initiating sleep, or disturbances in quality, timing, or amount of sleep. Additionally, the *International Classification of Sleep Disorders* (ICSD-2; American Academy of Sleep Medicine, 2005) identifies the most types of insomnia based on etiology, such as adjustment insomnia, psychophysiological insomnia, idiopathic insomnia, paradoxical insomnia, and insomnia due to drug or substance, among others.

Despite the degree of variation in definitions of insomnia, the most widely accepted definition is that insomnia includes symptoms of difficulty falling or remaining asleep and poor quality sleep that is nonrestorative (Zammit, 2007). Insomnia is often associated with impairment in daytime functioning or significant distress, with a wide range in severity of effects from mild to debilitating. Due to the discrepancies in defining insomnia, estimates of prevalence rates have varied (Mai & Buysse, 2008). However, it is generally agreed that the prevalence of chronic insomnia is about 30% in adult

populations (Roth, 2007). Furthermore, it is estimated that about one half of Americans report occasional episodes of insomnia (Zammit, 2007).

Many risk factors have been identified for insomnia, including age, gender, education level, illness, unemployment, body weight, and marital status (Zammit, 2007). It has been found that females have higher rates of insomnia in every age group, and that elderly individuals have disproportionately higher insomnia rates as well (Zammit, 2007). Comorbid disorders also are a significant risk factor for insomnia. Psychiatric conditions are the most common comorbid conditions associated with insomnia, as an estimated 40% of insomnia patients also have psychiatric illnesses (Roth, 2007). Depression and anxiety have been found to be most commonly associated with insomnia, followed by other mood disorders (Zammit, 2007). Insomnia has been found to be both a precursor to depression and to exacerbate depressive symptoms (Zammit, 2007). Precipitating factors of episodes of insomnia have also been studied, and most commonly include psychosocial stressors in family, work or school, and health (Mai & Buysse, 2008).

The consequences of insomnia are numerous, with effects on both the individual and society. Many patients with insomnia are at an increased risk for medical disorders, such as gastroesophageal reflux, conditions that cause hypoxemia or dyspnea, sleep related breathing disorders, restless legs syndrome, and periodic limb movement disorders (Roth, 2007). Taylor, Lichstein, and Durrence (2003) found that people with insomnia were more likely to develop depression, alcohol, and substance abuse disorders and that people with chronic insomnia reported more health problems such as heart disease, hypertension, chronic pain, breathing, and urinary problems. Other studies have

found people with insomnia to be at increased risk for heart disease and heart failure (Mai & Buysse, 2008).

The effects of insomnia on society are also great, as insomnia's costs include lost work productivity, absenteeism, hospitalizations, and accidents. This cost is estimated to be $77-$92 billion each year, a conservative estimate that has likely increased (Stoller, 1994). People with insomnia are twice as likely to miss work, and the cost of absenteeism is a burden on employers (Mai & Buysse, 2008). People with insomnia utilize greater amounts of health care through increased hospitalizations and office visits, as well as medications such as sleep aids. Additional costs seen by those suffering from insomnia include prescription medications, over-the-counter sleep aids, alcohol as self-medication for sleep, and transportation to appointments for insomnia treatment (Daley et al., 2009).

One specific subtype of insomnia identified by the ICSD-2 is paradoxical insomnia, which was formerly known as sleep state misperception. ISCD-2 diagnostic criteria for paradoxical insomnia include symptoms of insomnia for at least one month, with at least one of the following: chronic pattern of little/no sleep, sleep log with a very shortened average sleep time, or a mismatch between objective measure of sleep (polysomnography [PSG] or actigraphy) and subjective sleep estimates; reports of near constant awareness of environment on most nights or reports of conscious thoughts while lying in bed; daytime impairment that is not as severe as expected for the amount of sleep deprivation reported; and a PSG that is typically normal (subjective estimates of total sleep time [TST] are often 50% or less than objectively reported or estimates of sleep onset latency [SOL] are at least 1.5 times those that are objectively measured; American Academy of Sleep Medicine, 2005).

Patients with paradoxical insomnia represent a distinctive subset of insomnia patients who subjectively rate their sleep as poor and inadequate while objective measures of sleep do not support such views and often show normal sleep patterns. Patients with this disorder often inaccurately perceive the amount of time they sleep, overestimating the time it takes them to fall asleep and their number of awakenings during the night, and underestimating their total sleep time (Harvey & Tang, 2012). The frequency of paradoxical insomnia in the general population and the exact causes of paradoxical insomnia are unknown as relatively limited research exists on the topic. The ICSD-2 (American Academy of Sleep Medicine, 2005) estimates that those with paradoxical insomnia account for less than 5% of insomnia patients, but other estimates have been as high as 9% (Manconi et al., 2010).

This group of people has been among the most challenging to understand and difficult to manage clinically. Further research to resolve the puzzle that paradoxical insomnia presents could have important implications for treatment and health consequences as patients may be suffering from real sleep deficit in addition to misperceiving their sleep. It has been suggested that sleep misperception may contribute to and maintain sleep problems because one may worry that they are getting insufficient sleep and that worry or anxiety often interferes with sleep (Tang & Harvey, 2006). It has also been suggested that misperceiving sleep could be considered as a "prodromic or transitional state" to developing a more serious objective sleep deficit (Harvey & Tang, 2012). The numerous adverse effects of insomnia are likely applicable to people with paradoxical insomnia, not just those with objective insomnia. Research has shown people with misperceptions of sleep to suffer consequences such as poorer cognitive function,

greater functional disability, and greater self-perceived impairments compared to normal

sleepers or people with objective insomnia (Harvey & Tang, 2012).

The phenomenon of sleep misperception has been found to be common among

many types of patients, including those with comorbid medical or psychiatric disorders,

those with insomnia as the sole diagnosis, patients with post-traumatic stress disorder,

anxiety disorders, bipolar disorder, substance abuse, depression, chronic pain, rheumatoid

arthritis, juveniles with attention-deficit/hyperactivity disorder, and juveniles with

depression, among other diagnoses (Harvey & Tang, 2012). It is also worth noting that

people with misperceptions of sleep tend to misperceive regardless of the location where

sleep is being monitored, and they tend to misperceive sleep on many nights, whereas

most sleepers accurately perceive their sleep (Harvey & Tang, 2012).

There has been some debate about the utility of the paradoxical insomnia

diagnosis, as there is evidence that misperception of sleep is common across insomnia

diagnoses and subtypes, and that misperception occurs to varying degrees (Harvey &

Tang, 2012). However, the tendency to misperceive sleep is not universal among all

insomnia sufferers. Paradoxical insomnia may represent one extreme of a continuum,

where other individuals with insomnia fall along some point of the continuum, and there

are also a small number of people who report the opposite of paradoxical insomnia

(Harvey & Tang, 2012). These people get worse sleep than what they report and feel little

distress about their sleep difficulties (Edinger et al., 2000). Presently, the clinical

definitions of insomnia rely on subjective reports of sleep, though it is recommended to

include both subjective and objective sleep measures in insomnia research (Harvey &

Tang, 2012). An argument could be made that one does not have to objectively prove a

depressed mood or lack of interest in daily activities in order to be diagnosed with

depression, and the same could be said about many other psychiatric disorders.

Unfortunately, reports of insomnia may be trivialized and undertreated due to focusing on

discrepancies between subjective and objective measures of sleep (Harvey & Tang,

2012).

Paradoxical insomnia has only recently begun to be investigated, and the exact

causes of paradoxical insomnia remain unknown, but several hypotheses have emerged.

Of the current research on paradoxical insomnia, several studies have shown that persons

with paradoxical insomnia have abnormal values on personality assessments such as the

Minnesota Multiphasic Personality Inventory (MMPI). Those with paradoxical insomnia

often have higher scores on measures of neuroticism while persons with objective

insomnia have higher scores on introversion scales (Dorsey & Bootzin, 1997). Similarly,

other studies have found that people who underestimated sleep had elevated scores on the

Hypochondriasis, Conversion-Hysteria, and Psychasthenia scales of the MMPI compared

to matched controls (Vanable, et al., 2000). Consistent personality features of individuals

with paradoxical insomnia have not been identified, but it has generally been suggested

that insomnia subgroups may be differentiated from each other by personality measures

(Dorsey & Bootzin, 1997). The tendency to misperceive sleep may contribute to

escalating anxiety and preoccupation and may also represent a transition state to

developing insomnia in the form of serious objective sleep deficit (Harvey & Tang,

2012). As such, personality testing may help to understand more about the subjective

complaints of persons with paradoxical insomnia.

Several additional hypotheses have been proposed regarding paradoxical insomnia. For example, it has been hypothesized that individuals with paradoxical insomnia display higher cortical arousal and enhanced attentional processing than those with psychophysiological insomnia (Turcotte, St-Jean, & Bastien, 2011). Individuals with paradoxical insomnia may also display more motor activity in bed during sleep and wakefulness as found in PSG studies (Edinger & Krystal, 2003). Similarly, Feige et al. (2008) found that those with subjective complaints of insomnia had increased arousal indexes during PSG, and a correlation existed between misperception of subjective wake time and amount of REM sleep, meaning that people with paradoxical insomnia may inaccurately perceive their REM sleep as time spent awake. On the other hand, Bonnet and Arand (1997) did not find significant differences in sleep stage parameters of people with paradoxical insomnia compared to matched controls. However, Bonnet and Arand reported another type of physiological evidence of paradoxical insomnia, finding that people with paradoxical insomnia had higher metabolic rates (evidenced by higher oxygen consumption) when compared to controls. More research in this area is needed, though.

Additionally, it has been hypothesized that people with paradoxical insomnia may misinterpret sleep as being awake (Harvey & Tang, 2012). Mercer, Bootzin, and Lack (2002) found that if patients with insomnia were woken five minutes after the onset of stage 2 sleep or REM sleep, the participants were more likely to interpret their sleep as wakefulness when compared to good sleepers. Mercer, Bootzin, and Lack also found that the tendency to misinterpret correlated significantly with the discrepancy between subjective and objective sleep estimates. Similarly, it has been suggested that people may

perceive repeated awakenings as continuous wakefulness or that the lighter stages of

sleep are more likely to be perceived as wakefulness (Harvey & Tang, 2012). It has also

been hypothesized that those with paradoxical insomnia have a general deficit in time

estimation ability. However, research has not supported this hypothesis (Tang & Harvey,

2005).

Cognitions such as memory bias and selective attention also may contribute to

paradoxical insomnia. Means, Edinger, Glenn, and Fins (2003) found a positive

relationship between misperception of sleep and dysfunctional beliefs about sleep as

measured by the Dysfunctional Beliefs and Attitudes Scale (DBAS), finding that people

with the most sleep misperception also had the most dysfunctional beliefs. The DBAS

features several themes of dysfunctional beliefs, including misconceptions about the

causes of insomnia, misattribution or exaggerating its consequences, unrealistic

expectations about sleep, decreased sense of control over sleep, and faulty beliefs about

behaviors to promote sleep (Morin, Vallieres, & Ivers, 2007). Correspondingly, Edinger

et al. (2000) found that people with paradoxical insomnia (referred to in text as subjective

insomnia) were more likely to report dysfunctional beliefs about sleep, as well as higher

anxiety and lower mood.

Selective attention and monitoring of sleep-related threats may be another

contributing factor in paradoxical insomnia (Harvey & Tang, 2012). Studies have shown

patients with insomnia to engage in selective attention or monitoring processes such as

monitoring body sensations that are inconsistent with falling asleep or bodily signs of

poor sleep, monitoring of clocks or sleep environment for signs that one is not sleeping,

and monitoring for signs that performance or attention is failing due to inadequate sleep

(Harvey & Tang, 2012). Harvey and Tang further propose that this tendency to engage in monitoring could contribute to misperception of sleep as monitoring for sleep-related threat increases a likelihood of detecting random harmless cues that are then misinterpreted as threats. Corroborating evidence can be seen in a study by Tang, Schmidt, and Harvey (2007) who found that clock monitoring was associated with subjective reports of increased pre-sleep worry, overestimation of SOL, and longer SOL compared to control groups.

The current literature on paradoxical insomnia is limited by small sample sizes, discrepancy in the definitional criteria for paradoxical insomnia, lack of definitive causal evidence for the condition, and lack of longitudinal or epidemiological studies (Edinger & Krystal, 2003). Relatively little is known about the course of paradoxical insomnia or its responsiveness to treatment. It has been suggested that research on paradoxical insomnia needs to further establish the validity of this condition and incorporate multiple measures, including self-report as well as objective measures (Harvey & Tang, 2012). The current study proposed to incorporate several measures to replicate and expand on findings of previous research conducted on paradoxical insomnia. The study hypothesized that differences in quantities of REM sleep, WASO, SOL, and mean number of arousals would significantly predict whether someone has paradoxical insomnia. Additionally, it was hypothesized that there would be differences in scores on measures of anxiety, dysfunctional beliefs, neuroticism, and insomnia severity ratings between people with paradoxical insomnia and people with accurate perceptions of their sleep.

Method

Participants

Adults ages 18-80 were recruited for the study if they had previously completed a

PSG test within the past 18 months, had completed the sleep study questionnaire after

their sleep study, had a complaint of insomnia (including daytime fatigue/sleepiness,

nonrestorative / poor quality sleep, frequent nocturnal awakenings, difficulty falling

asleep, or waking too early) upon intake at the clinic, and had sleep efficiency (as

measured by PSG) of 75% or higher. A sleep efficiency of 75% was used as the cut off in

order to accommodate for any laboratory effect, as research has shown patients often

have decreased sleep efficiency in laboratory PSG studies compared to measures of sleep

efficiency at home (Bruyneel et al., 2011; Kingshott & Douglas, 2000). Patients were

excluded from the study if they had split night sleep studies for obstructive sleep apnea.

Patients were also excluded from the study if they did not have any initial complaint of

insomnia. For example, several people were referred for a sleep study to meet a work

requirement.

Patients were included in the category of having paradoxical insomnia if they

underestimated their TST by at least 75 minutes on the subjective sleep measure.

Accurate perception was defined as a difference between subjective and objective TST

measures of 75 minutes or less. Diagnostic criteria for paradoxical insomnia for research

inclusion has varied and there are no universal standards to discriminate good or normal

sleep patterns from poor / insomnia-type sleep (Edinger et al., 2000). For example,

Edinger et al. (2004) include the following diagnostic criteria for research: PSG shows a

sleep time of at least 6 hours, a sleep efficiency of at least 85%, and daytime impairment

that is less severe than would be expected from the subjective report of sleep disturbance. Doorsey and Bootzin (1997) assigned sleep state misperception (paradoxical insomnia) diagnoses to patients who overestimated their SOL by at least 150%. However, the ICSD-2 does not include specific objective measures in the diagnosis of paradoxical insomnia and there have not been consistent strategies for operationalizing the mismatch between subjective and objective reports of sleep.

To rule out the potential confounding effects of Obstructive Sleep Apnea, the inclusionary criteria of having no sleep apnea was defined as patients exhibiting a Respiratory Disturbance Index (RDI) of less than 15. RDI measures the number of respiratory events per hour, including apneas, hypopneas, and respiratory effort related arousals (RERAS), with an RDI of at least 15 indicative of Obstructive Sleep Apnea, according to the ICSD-2 criteria (Ong, Gress, San Pedro-Salcedo, & Manber, 2009).

The mean age of participants was 42.6 years old ($SD = 13.5$). Participants were from a metropolitan area in the Midwestern United States. The majority (74) of the participants were women and 50 were men. Information on socioeconomic status and ethnicity were not available. Of the 24 participants who responded to the mailed surveys, 14 were female and 10 were male.

Materials

PSG. PSG data from patients who have previously participated in sleep studies was analyzed by the researchers. Data such as sleep onset latency, total sleep time, number of awakenings, time spent after awakening and amount of time spent in each stage of sleep was assessed. PSG includes electroencephalographic (EEG) and

electroocular (EOG) and surface electromyographic (EMG) measures. EEG measures

sleep stages, while EOG measures eye movements to document REM sleep and to note

the onset of sleep. EMG measures assess periodic and other limb movements during

sleep. Reparatory airflow and respiratory effort are measured to determine AHI and RDI.

Additionally, pulse oximetry measures are included in PSG to monitor changes in oxygen

blood levels, which often occur with sleep apnea.

Sleep study questionnaire. An informal questionnaire developed by the

psychologist / sleep medicine specialist to assess subjective ratings of sleep and patient's

perceptions of their sleep. Patients were asked to estimate their SOL, the number of

awakenings throughout the night, the time it took them to fall back asleep if they awoke

during the night (WASO), and the TST achieved during the night of the sleep study.

The Eysenck Personality Questionnaire Revised –Short form (EPQRS). The

EPQRS was administered in a pencil and paper format to participants, and the assessment

takes about 10 minutes to complete. The short version of this assessment includes 48

questions to assess 4 subscales of neuroticism, extraversion, psychoticism, and lying. The

lie scale is a control scale to test for social desirability basis. Questions are answered in a

yes / no format and scored as either 1 or 0, with a maximum of 12 points for each

subscale and higher scores indicating higher levels of those personality traits. The

EPQRS has been used widely and has demonstrated sound reliability and validity

(Torrubia & Muntaner, 1987).

The Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS-16). The DBAS

is a 16-item self-report questionnaire to evaluate sleep-related cognitions. Sleep-related

cognitions, such as faulty beliefs, have been found to play an important role in

exacerbating insomnia, though few instruments have been specifically designed to assess

patient-specific sleep cognitions. Sleep cognitions could be a relevant treatment target for

insomnia, and the DBAS-16 has been shown to have adequate consistency and reliability

in measuring sleep cognitions, with satisfactory internal consistency (Cronbach alph α =

.77 - .79) and temporal stability (r = .83) (Morin, Vallieres, & Ivers, 2007). Participants

rate their level of agreement/ disagreement (from 0 to 10) with a statement regarding

sleep. The DBAS-16 takes about 5 minutes to complete. Higher scores indicate higher

levels of dysfunctional attitudes and beliefs about sleep. DBAS scores have been found to

be significantly correlated with other self-report measures of insomnia severity, anxiety,

and depression (Morin, Vallieres, & Ivers, 2007).

Insomnia Severity Index (ISI). The ISI is a brief 7-item self-report measure that

assesses perceptions of insomnia. Items assess how subjects feel sleep problems interfere

with their lives, their satisfaction with sleep, the severity of insomnia problems, how

worried they are about sleep problems, and how noticeable they believe their sleep

problems are to others. Each item is rated on a 0- 4 scale, with total scores ranging from

0-28. Higher scores indicate more severe insomnia. The ISI has been found to be a valid

and reliable measure to quantify perceived insomnia severity, with adequate internal

consistency and concurrent validity (Bastien, Vallieres, & Morin, 2001). The ISI has also

been found to be sensitive to detecting changes in perceived sleep related to treatment

outcomes (Bastien, Vallieres, & Morin, 2001).

Pittsburg Sleep Quality Index (PSQI). The PSQI is one of the most widely used

standardized measures of sleep quality and has been translated into over 56 languages

(Carpenter & Andrykowski, 1998). The self-report assessment measures sleep quality over the past month, with seven components that include sleep latency, subjective sleep quality, sleep efficiency, sleep duration, sleep disturbances, use of sleep medications, and daytime dysfunction (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). The seven subscales result in a global score from 0-21, with scores over 5 indicating significant sleep disturbances. The PSQI has been shown to be reliable and valid for assessing sleep quality and disturbances and it discriminates well between good and poor sleepers (Bastien, Vallieres, & Morin, 2001). Cronbach's alpha scores have been found to be .80 and above for the global score and .70 and above for sleep disturbance (Carpenter & Andrykowski, 1998).

State Trait Anxiety Inventory (STAI) Trait Scale. The STAI is a self-report assessment designed to measure anxiety, discriminating between the temporary condition of state anxiety and the longer enduring personality trait anxiety. Trait items include statements such as "I feel secure," and "I worry too much about something that really doesn't matter." Items are rated on a 4-point scale (almost never, sometimes, often, almost always) with higher scores indicating higher levels of anxiety. People higher in trait anxiety are more likely to perceive situations as dangerous or threatening compared to people with lower scores (Barnes, Harp, & Jung, 2002). Internal consistency for the STAI has ranged from .86 to .95 and test-retest reliability has ranged from .65 to .75 over a two month period, while there is also considerable evidence of the STAI's construct and concurrent validity (American Psychological Association, 2012). Additionally, the STAI has been found to have satisfactory internal consistency reliability across various populations and a broad range of studies (Barnes, Harp, & Jung, 2002).

Results

A binary logistic regression was conducted to investigate whether quantity of REM sleep, mean number of arousals, WASO, and SOL significantly predicted if someone would have inaccurate sleep perceptions (paradoxical insomnia). It was hypothesized that those with paradoxical insomnia would have increased amounts of arousals and REM sleep compared to participants with accurate perceptions. It was also hypothesized that those with paradoxical insomnia would have increased SOL and WASO, which could accord for their inaccurate perceptions of getting inadequate sleep. The results of the regression indicated that both WASO (β = -.05, p < .01) and SOL (β = -.05, p < .05) significantly predicted whether someone would have inaccurate sleep perception, meaning that the longer it took someone to fall asleep and the more time they spent awake after falling asleep, the more likely they would have inaccurate perceptions of their sleep. Amount of REM sleep and number of arousals did not significantly predict whether someone would have inaccurate sleep perceptions as was hypothesized. These results are summarized in Table 1.

Table 1

Predictors of Accuracy in Perceptions

Predictor	B (SE)	95 % CI for Odds Ratio		
		Lower	Odds Ratio	Upper
REM	.03 (.03)	.98	1.04	1.10
WASO	-.05 (.01) **	.93	.95	.98
Arousals	.02 (.03)	.96	1.02	1.08
SOL	-.05 (.02) *	.91	.95	1.00

Note: R^2 = .18 (Cox & Snell), .26 (Nagelkerke). Model $\chi^2(4)$ = 25.22, $p < .001$. $* p < .05$, $** p < .01$.

Further analysis indicated that the mean underestimation of TST for people with paradoxical insomnia was 156.45 minutes (SD = 75.84), while people in the accurate perception group actually overestimated their TST on average by 3.25 minutes (SD = 27.29). This difference was statistically significant, $t(40.02)$ = 12.47, $p < .001$**.** Similarly, people with paradoxical insomnia overestimated their SOL by an average of 17.93 minutes (SD = 24.89) while people with accurate perceptions overestimated their SOL by an average of only 6.48 minutes (SD = 12.48). This difference was also statistically significant $t(41.14)$= -2.59, $p < .05$**.**

Due to the limited number of survey respondents in the study, a series of *t*-tests was conducted to investigate whether scores on the DBAS, EPQRS, ISI, PSQI, and STAI Trait Scale differed significantly between people with accurate and inaccurate sleep perceptions. These tests were adjusted using Bonferroni alpha levels of .01 per test (.05/5). It was hypothesized that there would be significant differences in scores on each

of these assessments between individuals with inaccurate perceptions and individuals with accurate perceptions.

The results of the independent *t*-tests indicated that people in the paradoxical insomnia group had higher scores on the DBAS ($M = 6.48$, $SD = 1.97$) compared to people with accurate perceptions ($M = 4.28$, $SD = 1.52$), and this difference was significant $t(22) = 2.99$, $p < .01$, $d = 1.27$. Participants in the paradoxical insomnia group also had higher scores on the ISI ($M = 19.38$, $SD = 3.93$) compared to people with accurate perceptions ($M = 10.94$, $SD = 6.19$), and this difference was significant $t(22) = 3.50$, $p < .01$, $d = 1.49$. These results suggest that people with paradoxical insomnia have more dysfunctional beliefs about sleep and view sleep problems as more severe compared to people with accurate perceptions of their sleep.

There was not a significant difference in PSQI global scale scores or on STAI trait scale scores between the two groups, but PSQI scores for both groups were indicative of clinically significant sleep disturbances. Additionally, there were not significant differences for the neuroticism personality subscale of the EPQRS between the two groups as was hypothesized. These results did not support the hypothesis that people with paradoxical insomnia would have higher levels of neuroticism or trait-level anxiety. However, it should be noted that there were very few respondents for the subjective assessments, thus limiting the study's results.

Discussion

The results of this study indicate that people are more likely to have inaccurate perceptions of their sleep by overestimating their sleep onset latency and underestimating

their total sleep time if they spend longer amounts of time falling asleep or awakening

after the onset of sleep. A large effect size was found for the difference in estimation of

TST between groups, as well as a medium effect size for the difference in estimation of

SOL, indicating a significant difference in the accuracy of time estimation for people

with paradoxical insomnia. It is interesting to note that both groups, on average, had a

tendency to overestimate their SOL. This is consistent with previous research, which has

shown that patients with complaints of insomnia often overestimate the time it takes them

to fall asleep (Backhaus et al., 2002). The data did not support the hypothesis that people

with paradoxical insomnia may spend greater amounts of time in REM and perceive their

time spent in REM sleep as time spent awake. Nor did the data support the hypothesis

that people with paradoxical insomnia may have more awakenings (arousals) during the

night, which could account for their sense of decreased total sleep time. The lack of

evidence for differences in objective sleep measures would lend support toward other

theories of the causes of paradoxical insomnia, such as personality differences or

cognitive factors related to sleep.

Regarding the personality assessments, this study did not support the hypothesis

that people with paradoxical insomnia may have greater trait levels of anxiety or

neuroticism as previous research has suggested. However, the results of the present study

were limited by the small number of respondents to this portion of the study ($n = 24$).

Future studies should include larger sample sizes to obtain a more accurate representation

of the personality traits of people with paradoxical insomnia. Similarly, this study did not

compare personality characteristics of people with paradoxical insomnia to regular

sleepers without complaints of insomnia, which could produce different results.

Consistent with previous literature, the current study did find that people with paradoxical insomnia had significantly higher levels of dysfunctional beliefs and attitudes about sleep compared to people with accurate perceptions. For example, people with higher scores on the DBAS tended to view sleep as more unpredictable and uncontrollable and viewed lack of sleep as interfering significantly with daily functioning, one's physical health, and one's ability to enjoy life. People with paradoxical insomnia were also more likely to rate their insomnia problems as more severe (including difficulty falling or staying asleep, waking too early, feeling distress about sleep, and feeling that sleep problems are impairing one's quality of life). Thus, one's cognitions about sleep may play a large role in contributing to misperceptions about sleep quality and quantity, and may also contribute to the maintenance of insomnia. These results may corroborate evidence which has suggested that misperception of sleep can cause one to believe they are not getting sufficient sleep, which fuels worry and anxiety, and can then create sleep disturbances (Tan & Harvey, 2006).

Several limitations of the study should be noted. The small number of respondents to the subjective assessments limits the power of the statistical analyses and the generalizability of the study's results. Also, given the relatively small number of clinic patients available for the study, a more lenient inclusionary criterion for paradoxical insomnia was used to maximize the number of participants for the study. As opposed to previous studies which have used a SOL overestimation of 150% or TST estimation of 50% or less than objective measures and a sleep efficiency of 85%, the current study included participants whose underestimation of TST was at least 75 minutes and whose sleep efficiency was at least 75% to account for laboratory testing effects of the sleep

studies. The present study also excluded participants whose respiratory disturbance index scores were greater than 15 to avoid potential confounding effects of moderate sleep apnea. Future studies could investigate the effect that various levels of sleep apnea (mild, moderate, and severe) have on the accuracy of people's sleep perceptions.

There are several clinical implications to be gleaned from research on paradoxical insomnia. As diagnosing insomnia relies on subjective reports of sleep problems, research on the accuracy of sleep perceptions may guide clinicians' decisions on how to interpret insomnia complaints and how to treat various insomnia patients. For example, a patient reporting symptoms of insomnia who receives a diagnosis of paradoxical insomnia may receive different treatment than another patient who is viewed by the clinician as having "true insomnia." Treatment for the paradoxical insomnia patient may simply focus on correcting inaccurate perceptions instead of treating insomnia, and clinicians should be cautioned against this approach as research has shown people with subjective sleep problems to have objective daytime impairment (Harvey & Tang, 2012).

Relatively little is known about the course of paradoxical insomnia and its responsiveness to treatment. At this time, there is no standard treatment for patients with paradoxical insomnia, though recent research with a small sample size of patients with paradoxical insomnia has shown that sleep education may be a promising treatment (Geyer et al., 2011). Similarly, a study by Tang and Harvey (2004) found that a behavioral experiment where patients with distorted perceptions of sleep were shown the discrepancy in their subjective reports compared to objective measures of sleep (from actigraphy readings) led to more accurate SOL estimation in the patients, as well as less reported anxiety and preoccupation about sleep. As the current study results suggest that

cognitions play a significant role in affecting the accuracy of one's sleep perceptions, treatments that provide education or alter faulty cognitions about sleep, as well as treat the behavioral components of insomnia, may be useful for treating paradoxical insomnia.

Paradoxical insomnia continues to be puzzling to researchers and clinicians, despite a growing body of research on the topic. Current diagnostic systems rely on subjective reports of insomnia and do not provide definitive diagnostic criteria for paradoxical insomnia, which contributes to the difficulty of understanding this phenomenon (Geyer et al., 2011). Also, little definitive information about the etiology of the disorder exists. Future studies will likely need to include multiple measures of sleep, both subjective and objective in nature, to further investigate the causal factors that lead to sleep misperception. Additionally, there is limited research on the role that environmental factors play in sleep misperception, which may provide more insight (Means et al., 2003). Finally, treatment approaches for paradoxical insomnia need to be researched, perhaps using a randomized clinical trial comparing Cognitive Behavioral Therapy (demonstrated to be an effective intervention for insomnia) to sleep education, as suggested by Geyer et al. (2011). Ultimately, a standard treatment for paradoxical insomnia will need to be developed to treat this prevalent subset of the insomnia patient population.

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