# Nightmares and homeostasis: When bad dreams fail to protect HPMood from anxiety

Lindsay Tunbridge & Melissa Weinberg

Melbourne, Victoria, Australia

*Summary*. A genetically fixed, object-free, positive mood, defined as homeostatically protected mood, is the dominant influence for individuals evaluating generalized questions designed to measure subjective wellbeing. A core characteristic of subjective wellbeing is the stability of homeostatically protected mood. Under normal conditions, a process known as homeostasis defends mood from threat by accessing internal and external buffers. Consequently, the system typically maintains SWB scores around 75% ± 2.5. However, under extreme conditions, the system fails to regulate itself and homeostatic breakdown occurs resulting in subjective wellbeing falling below its normal range. Heightened anxiety threatens homeostatically protected mood. This study is the first to explore the relationship between bad dreams, nightmares, and anxiety in the context of homeostasis theory. Specifically, if homeostasis enlisted bad dreams as additional cognitive buffers to protect mood. In addition, the study investigated the presence of nightmares as possible evidence of homeostatic breakdown. Participants ($n$ = 487) completed an online questionnaire to measure components of subjective wellbeing and sleep. Respondents included 376 females (77%) and 97 males (23%) with a mean age of 28.5 years ($SD$ = 10.50). The analysis of the data set included standard regression, chi-square test for independence, two-way between-subjects ANOVA, multivariate analysis of variance, and a discriminant function analysis. Results obtained provide evidence for the possible role of bad dreams as additional cognitive buffers protecting HPMood, and nightmares "signposting" homeostatic breakdown. The findings have therapeutic implications for individuals experiencing high levels of anxiety. These include treatment plans promoting sleep quality in support of homeostasis during dreaming.

*Keywords:* Nightmares, bad dreams, homeostasis, subjective well-being, anxiety

## 1. Introduction

The scientific community adopted the phrase Subjective Wellbeing (SWB) in order to avoid ambiguities associated with the word "happiness" (Cummins, 2010). The capricious usage ranges from ancient Hebrew texts equating happiness to "fullness in life" to koine Greek manuscripts that describe happiness in terms of the rich who are "free from the normal cares of life" (Bromiley, 2003). Modern linguistics connects happiness to a transitory emotion concomitant with a pleasant experience (Kesebir & Diener, 2008). In order to understand happiness within the context of SWB in modern science, Diener's (1999) summary regarding three decades of research on SWB is informative. He suggested two broad categories of phenomena that interact to produce SWB. These are *cognitive evaluations* and *affective reactions*. Cognitive evaluations include domain satisfactions such as work, family, leisure, and life satisfactions that include appraising the dissonance between desired and actual perceptions of life (Diener et al., 1999). The affective reactions include pleasant and unpleasant affect.

These affective reactions represent the "on-line" evaluations of events in people's lives that produce pleasant and unpleasant stable moods and ephemeral emotions (Cummins, 2010). Conversely, Diener's model locates happiness within the cluster of general pleasant affects alongside joy, elation, and contentment. However, Cummins (2010) suggests the form of happiness most associated with SWB is not emotion, but rather a stable trait mood, reflecting a combination of general contentment and positive arousal. Furthermore, Cummins departs from Diener by rejecting the equivalent influence of cognitive evaluations and effective reactions on SWB when asked, "How satisfied are you with your life as whole?" Cummins (2010) suggested that a genetically set, object-free, positive mood, initially defined by Russell (2003) as *core affect* and more recently by Cummins as *homeostatically protected mood* (HPMood), is the dominant influence when evaluating generalized questions designed to measure SWB (Davern, Cummins, & Stokes, 2007).

There is agreement in the literature regarding certain characteristics associated with SWB. A core characteristic of SWB is that feelings of positivity are stable and genetically determined. Braungart (2009) identified predictable levels of positivity emerging in infants and Lykken (1996) reported stable positivity in adults as "set-point" levels of happiness. Secondly, the emergence of *set-point theory* elucidates the stability of SWB. According to the theory, people move above or below their baseline level of SWB, depending on the nature of experienced events, and over time return to their genetically determined SWB set-point (Diener et al., 1999). The theory emerged from a seminal study in which paraplegics returned to prior levels of SWB over time (Brickman & Campbell, 1971). Cummins (1995), presented further evidence for the stability of SWB scores across a range of Western and non-Western contexts. Consequently, he established a "gold standard" for SWB expressed as 75% ±

Corresponding address:
Dr Lindsay Tunbridge, 3 Echidna Road Eltham, 3095 Melbourne, Victoria, Australia
Email: ltu53235@bigpond.net.au

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2.5 for Western countries (Cummins, 1995). The Australian Unity cross-sectional study has subsequently provided additional support for the stability of SWB scores. Each year since 2001, the Australian Unity Wellbeing Index measured how satisfied Australians were with their lives. Seven domains, measured on a scale of 0-10, record the SWB of Australians. Results from 53,910 Australian adults surveyed by the International Wellbeing Group (2013) confirm that the national average clusters around the 75% mark ($M$ = 75.23, $SD$ = 12.43). *Homeostasis theory* provides an explanatory model for these characteristics associated with SWB.

Proponents of homeostasis theory suggests that a psychological balance system acts to defend underlying HPMood by holding SWB within a narrow ideal range (70-80%), analogous to biological equilibrium (Cummins, 1998; Headey & Wearing, 1989). Headey's model suggested that environmental pressure might initiate a temporary departure from the set-point either positively or negatively. Under these circumstances, homeostatic mechanisms would act to return the system to within its normal range. Cummins (1998) first used the phrase *homeostasis* in reference to the restorative process. Although HPMood is the central constituent of SWB, other psychological mechanisms associated with homeostasis include external and internal buffers.

Researchers suggest the most substantial external buffers associated with homeostasis include relationships and money (Cummins, 2000). These provide an effective defence of SWB under a range of challenging circumstances (Henderson, 1977). In addition, internal cognitive buffers such as high levels of optimism, self-esteem, and perceived control, minimize the impact of personal failure on our positive view of self by defending SWB with strategies such as *social comparison* and *goal disengagement* (Stiegelis et al., 2003). In combination, these external and internal buffers defend SWB through an adaptive process (Cummins, 1998).

The process of adaption is integral to the homeostatic model accounting for occasions when the system fails to regulate itself under extreme conditions. An extreme condition includes negative experiences of a sufficiently strong nature and/or duration (Cummins, 2010). *Homeostatic breakdown* describes regulatory failure under these conditions. According to Cummins (Cummins, 2010), homeostasis works hardest at or around the edges of the positive mood range (70 – 90%) to restore equilibrium preventing SWB from falling below its set-point (Cummins, Gullone, & Lau, 2002). In addition, Cummins (Cummins, 2010) showed that individuals who recorded SWB levels below 50% had increased correlations between SWB levels and psychopathology. Under these conditions, homeostatic breakdown may also correlate with a range of other factors contributing to "ill-being" such as anxiety.

Anxiety is either an adaptive or an abnormal response to a perceived threat. The physiological symptoms associated with heightened levels of anxiety include numbness, increased startle response, hypervigilance, and some difficulty concentrating (House & Stark, 2002). Autonomic experiences associated with anxiety include feeling "hot", diaphoresis (sweating), and elevated heart rates (Grant, 2012). Rajagopal (2012) established a link between anxiety and SWB in a study of 44 first year nursing students who each participated in 21 consecutive days of directed meditation. The results confirmed significant reductions in anxiety along with corresponding increases in SWB associated with the meditative technique.

Recent research has also identified a number of important relationships between anxiety and SWB that are relevant to homeostasis theory. In 2002, a survey by the Australian Unity Wellbeing Index asked 2000 respondents whether the general situation in Iraq made people feel anxious. The timing of the question took place shortly after the death of 88 Australians in the terrorist bomb attack in Bali on October 12 in 2002. The data indicated no significant relationship between anxiety and SWB as measured by the PWI (Cummins et al., 2003). According to Cummins (Cummins, 2010), the results are indicative of a system's homeostatic resistance to change in the face of a potential threat such as anxiety. In this case, the level of anxiety was insufficient for homeostatic breakdown to occur, as the act of terrorism was not part of the personal life-space for most people. Researchers then contrasted these findings against the impact of anxiety on the SWB of individuals under the comparatively more adverse personal conditions such as stuttering in social interactions. In this context, Cummins (2010) found elevated anxiety levels were higher and resulted in homeostatic breakdown and decreased SWB levels outside of normal range. In addition to the negative correlation between SWB and anxiety, Nielsen (2012) reported a positive correlation between anxiety, bad dreams and nightmares.

Nightmares are distinguished from bad dreams by Halliday (1991) and Blagrove, Farmer, and Williams (2004) who defined nightmares as disturbing dreams that awaken the sleeper, whereas bad dreams may be very disturbing but do not wake the sleeper. Although bad dreams are common, nightmares occur in just 4-10% of the population and are significantly associated with age, gender, anxiety, psychopathology and dispositional traits (Levin & Nielsen, 2007). The emotional content of these dreams include anger, disgust, and grief (Zadra, Donderi, & Mathieu, 2006), however, there is general agreement that the primary emotion experienced by individuals during nightmares and bad dreams is fear (Rhudy et al., 2010; Zadra & Donderi, 2000). This observation lends support to theories describing the function of bad dreams and nightmares as an emotionally adaptive mechanism for fear extinction (Nielsen & Levin, 2007).

The theory of *fear extinction*, as well as a recent explanatory model referred to as the *affective network dysfunction* model (AND), explains the presence of nightmares as an indication of the breakdown of the adaptive process. Support for the distinction between bad dreams and nightmares comes from studies where nightmares are more frequently associated with pathological symptoms such as anxiety than bad dreams alone (Nielsen, 2000). A large number of studies have identified an increase in nightmares associated with escalations in life stress (Belicki, 1992; Nielsen & Levin, 2007).

The neurocognitive AND model integrates recent theories by Hartman (1998), Revonsuo (2000), Fisher (1970), and Kramer (1993) in an attempt to explain nightmare production. The neurophysiological description of the model's processes builds on the *amygdala, medial prefrontal cortex, hippocampus, and anterior cingulate cortex* model (AMPHAC). It accounts for a broad range of dysphoric dream imagery including bad dreams and nightmares. Of relevance to the present study, AND has demonstrated that high affect loads induce temporary bad dreams (Nielsen & Levin, 2007). At its core, the model stipulates that bad dreams are a mechanism for resolving the negative affect accumulated from anxiety and stress by reducing impact

on waking states by "living out" the negative affect during sleep (*fear-memory extinction*). Nightmares result from the failure of the neural and cognitive networks to extinguish extant fear from the system.

Evidence associating elevated levels of negatively valenced emotion with bad dreams was shown in a landmark study conducted by Wood (1992). In this case, it was found that nightmare frequency was twice as high immediately after the 1989 earthquake in two San Francisco groups compared to an Arizona sample. Further, those who were closer to the earthquake's epicentre scored higher on nightmare frequency. The AMPHAC and Affective Network Dysfunction model might explain these observations. According to Levin (2007) this theory suggests that dreaming regulates increased affect load through three distinct processes of fear extinction. These are memory-element activation, recombination, and emotional expression.

The first stage of fear extinction deconstructs memory into smaller elements during dreaming. The second stage of the process reintroduces the original elements into a new context. The result is a new coherent stream of dream imagery containing the initial anxiety in a context safely removed from its original setting (Levin & Nielsen, 2007). This occurs during REM and activates the limbic system in ways that mirror an individual's state of wakefulness. The third and final stage of the regulatory process employs attentional resources to down-regulate the negative emotional stimulation. The result is lower extant anxiety levels within the emotional system. This default function of REM sleep suggests a possible explanation of bad dreams. Failure of the system to down-regulate the negatively valenced emotional content results in awakening and thus the nightmare experience (Levin & Nielsen, 2007). Individuals reporting nightmare frequency therefore also report higher levels of extant anxiety and lower self-reported levels of SWB (Blagrove et al., 2004; Kothe & Pietrowsky, 2001; Ohayon, Morselli, & Guilleminault, 1997).

Continuing to explore the relationship between anxiety and SWB using the homeostasis framework is important as it may identify other buffers that defend the homeostatic system from defeat. Identifying these buffers may assist in developing targeted interventions for individuals who, because of elevated anxiety levels, are at the lower end of the positive mood range. These interventions may increase resistance to pathology. In addition, due to the association between anxiety and fear (perceived threat) and Nielsen's (2012) suggestion that dreams are adaptive mechanisms for resolving anxiety, the current study suggests that homeostasis employs dreams and bad-dreams as additional internal buffers to protect HPMood. Further, within the homeostasis framework, nightmares are indicative of homeostatic defeat.

In order to explore the relationship between bad dreams, nightmares and anxiety under the homeostasis framework, it was hypothesised that anxiety would significantly predict the frequency of bad dreams. Further, when considered categorically there would be a significantly higher probability of participants in the high anxiety group experiencing nightmares than those in the low anxiety group. In addition, it was hypothesised that that there were differences in SWB between the nightmare group and people who had bad dreams as a function of anxiety. Finally, it was hypothesised that there is an effect of dream type on anxiety and PWI in combination.

## 2. Method

### 2.1. Participants

The current study included a sample of 487 participants who self-selected involvement via online social media websites. The sample included 376 females (77%) and 97 males (23%) with a mean age of 28.5 years (*SD* = 10.50). Fourteen individuals in the sample did not indicate their gender. Ethics criteria for selection and exclusion required all participants to equal or exceed 18 years of age.

### 2.2. Measurement Instruments

The online questionnaire contained a range of instruments to assess sleep and wellbeing (Appendix A). The present study was part of a larger study investigating these constructs, so only the instruments salient to the current study are described here.

**Personal Wellbeing Index.** According to the International Wellbeing Group (2013) the Personal Wellbeing Index (PWI) measures subjective experiences of wellbeing in accordance with homeostasis theory. It is a psychometrically sound measure with a Cronbach's alpha range between 0.70 and 0.85 in an international context, along with moderate inter-domain correlations at 0.30 to 0.55 and item-total correlations of at least 0.50. In addition, Lau (2005) reported an intra-class correlation coefficient across 1-2 weeks of 0.84 . The index is a subjective measure of satisfaction with life based on the Comprehensive Quality of Life Scale and represents a first level deconstruction of the abstract question "How satisfied are you with your life as a whole?" (International Wellbeing Group, 2013). The PWI measures satisfaction with 7 domains of life: Standard of living, Health, Achieving in life, Personal relationships, Safety, Community connectedness, and Future security. Participants rated their satisfaction with each domain on an 11-point Likert scale, ranging from 0 (not satisfied at all) to 10 (completely satisfied). Scores are averaged to provide a total PWI score, projected onto a 0-100 scale.

**The Depression Anxiety Stress Scale.** The anxiety subscale of the DASS-21 assessed anxiety over the past week. Participants rated how much each item applied to them on an 11-point Likert, ranging from 0 (not at all) to 10 (extremely). The DASS-21 demonstrates good internal consistencies with a Cronbach's alpha for the anxiety scale at 0.90 (95% CI = 0.89 – 0.83).

**Bad dream frequency.** A single item assessed the frequency of bad dreams. The question asked, "How often do you have bad dreams?" Response options were never, rarely, occasionally, once a fortnight, once a week, 2-3 times a week, and almost every night.

**Nightmares.** A single item question assessed the occurrence of nightmares, by asking participants whether they had woken up because of a bad dream in the past week. This criterion distinguished bad dreams from nightmares.

### 2.3. Procedure

The Deakin University Human Research Ethics Committee approved the study. A subsequent invitation extended via social media recruited participants who completed the questionnaire over a four-week period in July 2013. The questionnaire was accessible within a Facebook event via a URL. The plain language statement read by all participants

*Table 1*. Descriptive Statistics for PWI and Anxiety

| Variable | N | Mean | Std. Deviation | Min | Max |
|---|---|---|---|---|---|
| SWB | 470 | 68.07 | 16.90 | 17.67 | 100 |
| Anxiety | 464 | 23.33 | 22.90 | 0.00 | 92.68 |

before taking the survey outlined confidentiality, anonymity, and the voluntary nature of the survey. Participants consented to participation by selecting "yes" to the question "Do you wish to continue?" and proceeded to the questionnaire. The software program Qualtrics collected the data, and subsequently transferred to SPSS for analysis.

## 3. Results

### 3.1. Data Preparation

The online collection of data controlled for anomalies in the data collection as all scores collected were within specified ranges. In addition, data preparation included deleting cases reflecting an acquiescent response bias on four or more variables (n = 4).

Furthermore, all scores were converted to the percentage of their scale maximum for standardisation and ease of comparison (International Wellbeing Group, 2006). Univariate outliers (n = 25) were recoded to within three standard deviations from the mean to minimise their impact on subsequent analyses, and the critical chi-square criterion of 31.26 (df = 11, $p < .001$) was used to identify multivariate outliers. Two cases that exceeded this criterion were deleted following recommendation from Tabachnik and Fidell (2007). Finally, a normality check via a Kolmogorov-Smirnov test revealed that all relevant scales violated the assumption of normality. Due to the nature of the variables (e.g. PWI scores were expected to be negatively skewed due to studies consistently finding PWI scores are most common between 70% and 100%) and the large sample size, non-normality will not detrimentally influence subsequent analyses.

### 3.2. Descriptive Statistics

Descriptive statistics for the continuous variables in the present study are shown in Table 1. Table 1 shows the mean for SWB fell below the expected range of 75% ± 2.5. Comparatively, and as anticipated, general levels of anxiety were lower.

Table 2 reveals that most people remembered their dreams. The majority had pleasant dreams and approximately a third of the sample reported experiencing nightmares.

### 3.3. Hypothesis Testing

A regression analysis was conducted to test the hypothesis that anxiety would significantly predicted the frequency of bad dreams. The analysis revealed that anxiety was a significant predictor of bad dream frequency, $R^2 = 0.20$, $F(1, 461) = 113.31$, $p < .001$ (adjusted $R^2 = 0.19$). Approximately 20% of variance in the frequency of bad dreams was explained by anxiety.

A chi-square test for independence was conducted to test the second hypothesis, that there would be a significantly higher probability of participants in the high anxiety group who experience nightmares than those in the low anxiety group. Three separate groups were created based on the frequencies of scores on the anxiety measure. Participants were assigned to high (anxiety ≥ 51), moderate (32.87 < anxiety < 50), or low (anxiety ≤ 32.86) anxiety groups based on their scores relative to the rest of the sample, such that each group represented a third of the participants. The analysis revealed a significant association between anxiety group membership and the frequency of nightmares ($\chi^2(n = 432) = 21.90$, df = 2, $p < .001$). Specifically, participants in the high anxiety group reported a experiencing more nightmares than those in the low anxiety group. Figure 1 shows that from the 150 participants reporting high levels of anxiety, 43.3% were experiencing nightmares compared to the 134 people reporting low anxiety, from which only 18.7% were experiencing nightmares.

A calculation of the odds ratio revealed the odds of having a nightmare are 3.33 times higher for people in the high-anxiety group than for those in the low-anxiety group (95% CI = 2.01, 5.70). The study provided evidence that the odds of having a nightmare are significantly higher for those people experiencing high levels of anxiety compared to those with low levels.

To examine the third hypothesis, that there were differences in SWB between the nightmare group and people who had bad dreams as a function of anxiety levels, planned comparisons (three main effect contrasts, and one for interaction effect contrasts) using a two-way between-subjects ANOVA examined the differences in SWB between the low, medium and high anxiety groups. The results are reported as standardized mean contrast differences estimated by Bonett's delta, with 95% confidence intervals calculated by the statistical program, XECI (RMHI edition).

The nightmare group reported significantly lower PWI scores than those who had bad dreams, delta = -0.86, 95% CI = (-1.08; -0.64). The low-anxiety group reported significantly higher PWI scores than the high-anxiety group, delta = 5.65, 95% CI = (5.15; 6.16). For the interaction contrasts, the difference observed in the PWI scores between the nightmare group and those who had bad dreams in the last week was significantly higher for the high-anxiety group than the low-anxiety group, delta = 1.50, 95% CI = (1.20; 1.74). This effect was over and above the main effect differences reported.

Finally, in order to test the hypothesis that there was an effect of dream type on anxiety and PWI in combination, a one-way multivariate analysis of variance (MANOVA) was conducted. Using Pillai's trace, the MANOVA generated a significant multivariate main effect for dream type, $F(6, 920) = 5.01$, $p < .001$. In addition, separate univariate analyses on the outcome variables revealed significant main effects of dream type on PWI, $F(3, 460) = 6.10$, $p < .001$, and anxiety, $F(3, 460) = 8.40$, $p < .001$. Post hoc pairwise comparisons identified significant mean differences between the pleasant-dreamers and the nightmare group on PWI (M =

*Table 2*. Frequency by Dream type

| Variable | *N* | % |
|---|---|---|
| Pleasant dream | 236 | 50.20 |
| Bad dream | 63 | 13.40 |
| Nightmare | 134 | 28.5 |
| Do not remember | 37 | 7.90 |
| Total | 470 | 100 |

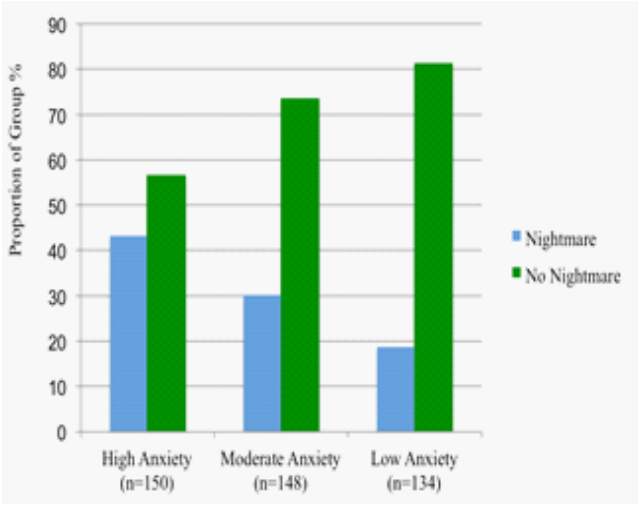
7.67, p < .001), as well as between the pleasant-dreamers/bad-dream, and pleasant-dreamers/nightmare groups on anxiety (M = -8.68, -11.70; p = .036, p = <.001).

To further analyze group differentiation within dream type on the composite of PWI and anxiety, a discriminant analysis revealed two discriminant functions. The first explained 93% of the variance, canonical R2 = 0.06, whereas the second function explained only 7.0% of the variance, canonical R2 = 0.01. In combination these functions significantly differentiated the dream type groups, $\lambda = 0.93$, $\chi^2$ (6) = 30.28, p < .001. The discriminant function plot revealed that the first function discriminated the nightmare group from the other groups. The standardized canonical discernment function coefficients revealed that function 1 was positively related to anxiety (0.74), and negatively related to PWI (-4.0). The model accurately predicted 91.1% of pleasant-dreamers, 78.7% bad dreamers, and 71.2% of nightmare group membership. A comparison of the cross-validated results to the original results indicated the new model was robust, with a difference of only 0.5% between the scores.

## 4. Discussion

The major finding from this study is that in order to avoid regulatory failure, homeostasis may employ bad dreams to protect HPMood from elevated anxiety levels. In addition, nightmares may indicate regulatory failure of the system to extinguish anxiety accumulated throughout the day. The present study was designed to explore the relationship between bad dreams, nightmares, and anxiety in the context of homeostasis theory. The first hypothesis, that anxiety predicts the frequency of bad dreams, was supported. These findings are consistent with earlier research that identified elevated levels of personal anxiety with increased bad dream frequency (Belicki, 1992; Nielsen, 2000; Nielsen & Levin, 2007). The second hypothesis, that when considered categorically, there would be a higher proportion of participants in the high anxiety group would experience nightmares than those in the low anxiety group, was supported. The study provided evidence that the odds of having a nightmare are significantly higher for those people experiencing high levels of anxiety compared to those with low levels. The third hypothesis, that there were differences in SWB between the nightmare group and people who had bad dreams as a function of anxiety levels, was also supported. This hypothesis extended prior dream and SWB research by distinguishing between the different dream types and their relationship to increased anxiety and decreased SWB. The final hypothesis, that there would be an effect of dream type on anxiety and PWI in combination, was supported.

*Figure 1*. Association between Nightmare and Anxiety level




The finding that anxiety was significantly correlated with the frequency of bad dreams is informed by homeostasis theory. During times of threat, the system recruits psychological buffers to defend HPMood, holding SWB within a narrow ideal range (70-80%). Perhaps during sleep, bad dreams constitute a further cognition enlisted by the system to defend HPMood. Specifically, as rising anxiety threatens HPMood, homeostasis would recruit bad dreams in order to maintain SWB within its set-point range. This may be accomplished by extinguishing fears accumulated during the day through a process referred to by Nielsen (2007) as fear extinction.

The theory of fear extinction in the context of the AND model not only accounts for the presence of bad dreams, but describes nightmares as evidence of failure by neural and cognitive networks to extinguish extant fear (Nielsen & Levin, 2007). Homeostasis could provide an "umbrella" perspective that integrates the AND model with the findings from the second hypothesis, that the odds of having a nightmare are significantly higher for individuals with high levels of anxiety compared to participants with low levels of anxiety. Specifically, homeostatic breakdown in the presence of elevated anxiety levels may result in the regulatory failure of bad dreams to maintain SWB within the normal range evidenced by increased nightmare production. The results from the second hypothesis, showing there is a higher probability of experiencing nightmares if an individual has elevated levels of anxiety, lends support to the recommendation being made in the study, that regulatory failure can be identified by the presence of nightmares.

The finding that that there were differences in SWB between the nightmare group and people who had bad dreams as a function of anxiety levels may reveal a synergy between homeostasis and the AND model, confirming not only the failure of bad dreams to regulate high anxiety levels within the system, but the impact of regulatory failure on SWB. Individuals in the high anxiety group, who also experienced nightmares, had significantly lower SWB compared to participants in the low anxiety group who had bad dreams and no nightmares. In addition, the sample collected for this current study showed lower than expected SWB levels and higher than expected anxiety levels. If bad dreams are em-

ployed by the system to extinguish anxiety levels accumulated during the day and nightmares are an indication of homeostatic breakdown, it is expected that the sample would have a higher than average frequency of nightmares and bad dreams. Comparing the current sample to other non-clinical samples confirms there is a higher than expected extant bad dream and nightmare frequency (Schredl & Reinhard, 2008). This general observation, along with the third hypothesis test result may suggest that regulatory failure is associated with the presence of nightmares and lower SWB levels.

In order to avoid regulatory failure, homeostasis may employ bad dreams to protect HPMood from elevated anxiety levels. Anxiety modestly correlates with SWB (-0.52) therefore the deployment of bad dreams within the system may also impact anxiety and SWB in combination. The final hypothesis tested the impact of bad dreams on this combination of variables. The significant result may suggest the functioning of bad dreams within the system in response to elevated anxiety. The effectiveness of this possible response in maintaining SWB requires further research. Elevated anxiety was associated with higher frequency of bad dreams. However, if the systemic deployment of bad dreams effectively lowers extant anxiety, it would be reasonable to expect minimal elevations of anxiety recorded during waking hours for those participants experiencing bad dreams. This was not demonstrated in this current study. Further research is required to confirm bad dreams significantly reduce anxiety levels.

The usefulness of the current study in therapeutic contexts requires an explanatory model that is robustly predictable. The purpose of the discriminant function analysis was to test the model's ability to predict cases where homeostatic breakdown had occurred, and assess how closely the predictions matched the original groupings. The results suggest that at the time of taking the questionnaire, if participant anxiety levels were high, their subsequent PWI level was low. Therefore, function 1 may represent participants who were highly anxious with low levels of positive mood. The comparison of the cross validation results to the original results suggests the model may be a robust predictor of regulatory failure and a useful addition to therapeutic contexts.

Three limitations to the study include the disproportional number of females (77%) to males (23%), average age of respondents (28.50), and the lower than expected SWB mean (68.07). These factors require consideration when interpreting the results. In relation to gender and age, Nielsen (2012) collected over 28,000 online responses to a questionnaire that demonstrated recall frequency increases during adolescence and decreases in both male and female participants after the age of 30 years. However, the subsequent decrease in recall was significantly lower for females compared with males. In light of these findings, the greater number of females and lower average age of the sample may enhance the findings of the study.

The greater number of younger females contributing to the data set enhances the accuracy of measured dream recall. The collection of dream data required participants to "remember" significant aspects of their dreams. Watson (2003) reported the average adult experienced 4 – 6 REM periods of sleep over the course of a typical night. When woken from REM periods, individuals recall their dreaming 80 – 85% of the time. However, upon awakening in the morning and asked to remember their dreams, individual recall varies from almost every day to no dream recall at all. Nielsen (2012; 2007) and Levin (1994) identified a number of individual differences associated with an individual's likelihood to remember dreaming. These included gender and age. Young females were more prone to accurately remember dream frequency and content. This group is a majority demographic in the present study. Based on these characteristics, it might be reasonable to expect that the current data set include a level of specificity obtained from younger females on dream recall that exceeds those obtained from a more representative sample improving the reliability of the self-report questions referencing dreaming.

The final limitation is the lower than expected SWB scores. The International Wellbeing Group (2013) reported lower SWB scores associated with young adults and adolescent groups. Therefore, the lower average age of the sample may account for the lower than expected SWB mean. In addition, SWB negatively correlates with anxiety, which, may account for the higher than expected anxiety scores. This combination of characteristics associated with the current data set provided the opportunity to examine the homeostasis response to anxiety in a larger sample of individuals experiencing elevated anxiety levels. The demographic characteristics of the sample add a measure of confidence to the self-report data relating to dreaming and afford an opportunity to research homeostasis functioning close to its lower threshold. However, because of the specific characteristics of the sample, a moderate level of caution is recommended when generalising findings of the study.

In conclusion, the model suggested by this study indicates that bad dreams may buffer anxiety and protect HPMood through homeostasis. It also posits that nightmares are indicative of regulatory failure. In addition, the findings provide evidence for the possible role of bad dreams as additional cognitive buffers protecting HPMood, and nightmares "signposting" homeostatic breakdown. The implications of these findings are twofold. Firstly, future research designed to identify the specific level of anxiety associated with homeostatic breakdown may prove beneficial in a therapeutic context. Screening measures for elevated anxiety could include a question relating to nightmare frequency to assess the potential threat to HPMood, further enhancing diagnosis. In addition, the study is indirectly suggestive of the importance of sleep in relation to homeostasis and general SWB. Treatment plans for individuals with elevated anxiety may benefit from focused attention to sleep related issues in order to enhance the quality of sleep. Improving sleep quality may provide favourable conditions for bad dreams during the REM cycle to extinguish accumulated daily anxiety. The present study's findings inform the relationship between anxiety and SWB, and suggest that consideration of sleep-related factors is important for further understanding.

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## Appendix A: Sleep and Wellbeing Questionnaire

Thank you for your involvement in this survey. This is a confidential questionnaire so please ensure that you do not type your name, or any other comments that may identify you. By submitting the questionnaire, you are consenting to take part in this research as explained in the Plain Language Statement. The intention of this study is to investigate the association between sleep and general wellbeing.

Please read each question carefully before selecting your answer and make sure that you have provided an answer for every question.

**Personal Wellbeing (PWI)**
Thinking about your own life and personal circumstances, please indicate the number that best represents how satisfied you feel with your life.

1. How satisfied are you with your life as a whole?

The next questions are about your satisfaction with different areas of your life.

2. How satisfied are you with your standard of living?
3. How satisfied are you with your health?
4. How satisfied are you with what you are achieving in life?
5. How satisfied are you with your personal relationships?
6. How satisfied are you with how safe you feel?
7. How satisfied are you with feeling part of your community?
8. How satisfied are you with your future security?

Scale: 0-10
Anchors: 0 – 'Not at all satisfied'; 10 – 'Completely satisfied'

**How you generally feel (Mood)**
Please indicate how each of the following describes your feelings when you think about your life in general.

9. Thinking about my life in general, I feel… happy
10. Thinking about my life in general, I feel… content
11. Thinking about my life in general, I feel… excited
12. Thinking about my life in general, I feel… alert
13. Thinking about my life in general, I feel… active

Scale: 0-10
Anchors: 0 – 'Not at all'; 10 – 'Extremely'

**How you cope with life (Mastery)**
Please indicate how much you agree or disagree with the following statements.

14. I have little control over the things that happen to me
15. There is really no way I can solve some of the problems I have
16. There is little I can do to change many of the important things in my life
17. I often feel helpless in dealing with the problems of life
18. Sometimes I feel that I'm being pushed around in life

Scale: 0-10
Anchors: 0 – 'Strongly disagree'; 10 – 'Strongly agree'

**The kind of person you are (Personality)**
How much do you agree with the following statements?

19. I see myself as outgoing
20. I see myself as enthusiastic
21. I see myself as anxious
22. I see myself as easily upset
23. I see myself as reserved
24. I see myself as quiet
25. I see myself as calm
26. I see myself as emotionally stable

Scale = 0-10
Anchors: 0 – 'Strongly disagree'; 10 – 'Strongly agree'

**Over the past week (Depression, Anxiety, Stress)**
How much did these statements apply to you over the past week?

27. I found it hard to wind down
28. I was aware of dryness in my mouth
29. I couldn't seem to experience any positive feelings at all
30. I experienced breathing difficulty (eg. excessively rapid breathing, breathlessness in the absence of physical exertion)
31. I found it difficult to work up the initiative to do things
32. I tended to over-react to situations
33. I experienced trembling (eg. in the hands)
34. I felt that I was using a lot of nervous energy
35. I was worried about situations in which I might panic and make a fool of myself
36. I felt that I had nothing to look forward to
37. I found myself getting agitated
38. I found it difficult to relax
39. I felt down-hearted and blue
40. I was intolerant of anything that kept me from getting on with what I was doing
41. I felt I was close to panic
42. I was unable to become enthusiastic about anything
43. I felt I wasn't worth much as a person
44. I felt that I was rather touchy
45. I was aware of the action of my heart in the absence of physical exertion (eg. sense of heart rate increase, heart missing a beat)
46. I felt scared without any good reason
47. I felt that life was meaningless

Scale: 0-10
Anchors: 0 – 'Not at all'; 10 – 'Extremely'

**Your sleep habits (Sleep Quality)**
These questions relate to your sleep habits during the past week only. Your answers should indicate the most accurate reply for the majority of days and nights in the past week.

48. During the past week, when have you usually gone to bed at night?
49. During the past week, how long (in minutes) has it usually taken you to fall asleep each night?
50. During the past week, when have you usually gotten up in the morning?
51. During the past week, how many hours of actual sleep

did you get at night? (This may be different to the number of hours you spend in bed).

For the next questions, please check the one best response.

52. During the past week, how often did you have trouble sleeping because you…
    a. Could not get to sleep within 30 minutes
    b. Woke up in the middle of the night or early morning
    c. Had to get up to use the bathroom
    d. Could not breathe comfortably
    e. Coughed or snored loudly
    f. Felt too cold
    g. Felt too hot
    h. Had bad dreams
    i. Had pain

Scale: Not in the past week, Once, Twice, Three or more times

53. During the past week, how would you rate your sleep quality overall?

Scale: 0-10
Anchors: 0 – 'Very bad'; 10 – 'Very good'

54. During the past week, how often did you take medicine (prescribed or "over the counter") to help you sleep?
55. During the past week, how often did you have trouble staying awake while driving, eating meals, or engaging in social activity?

Scale: Not in the past week, Once, Twice, Three or more times

56. During the past week, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

Scale: 0-10
Anchors: 0 – 'not a problem at all'; 10 – 'a very big problem'

**More about your sleep (Sleep Hygiene)**
The following questions are about your sleep habits in general, not just over the past week. Please indicate how often each of the following questions applies to you.

57. I take daytime naps lasting two or more hours
58. I go to bed at different times from day to day
59. I get out of bed at different times from day to day
60. I exercise to the point of sweating within 1 hour of going to bed
61. I stay in bed longer than I should two or three times a week
62. I use alcohol, tobacco, or caffeine within 4 hours of going to bed or after going to bed
63. I do something that may wake me up before bedtime (for example: play video games, use the internet, use a smartphone)
64. I go to bed feeling stressed, angry, upset, or nervous
65. I use my bed for things other than sleeping or sex (eg. watch television, read, eat, or study)
66. I sleep on an uncomfortable bed (eg. poor mattress or pillow, too much or not enough blankets)
67. I sleep in an uncomfortable bedroom (eg. too bright, too stuffy, too hot, too cold, or too noisy)
68. I do important work before bedtime
69. I think, plan, or worry when I am in bed.

Scale: 0-10
Anchors: 0 – 'Never'; 10 – 'All the time'

**Your dreams (Dreams/Nightmares)**
The following questions are about your dreams, including bad dreams and nightmares. Please answer each question to the best of your ability.

70. Do you ever remember your dreams? Y/N
71. Do you ever have recurring dreams? Y/N
72. When you wake up at the end of your sleeping period, how refreshed do you feel?

Scale = 0-10
Anchors: 0 – 'Not refreshed at all'; 10 – 'Completely refreshed'.

73. Do your dreams typically involve any of the following themes? You can choose as many as you like.
    Being chased or pursued, sexual experiences, school-teachers-studying-work, trying again and again to do something, arriving too late (eg. Missing a train), a loved person to be dead, being frozen with fright, eating delicious food, falling, flying or soaring through the air, other (please specify).
74. How often do you have bad dreams?
    Never, Rarely, Occasionally, once a fortnight, once a week, 2-3 times a week, almost every night
75. How often do you wake up because of your bad dreams?
    Never, Rarely, Occasionally, once a fortnight, once a week, 2-3 times a week, almost every night

**Demographic questions**

76. Gender – male/female
77. Age _____
78. Which of the following categories best describes your relationship status?
Never married, de facto/living together, married, separated, divorced, widowed
79. Do you have any children under the age of 5?
80. Which of the following best describes your work status?
    FT work, FT study, FT home duties, PT work, PT study, Casual work, unemployed
81. Have you worked a night shift in the last week? Y/N
82. What is your annual household income before tax?
    Less than $15000, $15-30K, $31-$60K, $61-$100K, $101-$150K, $151-$250K, $251-$500K, More than $500K.