

The Influence Of Mood On Dreams: An
exploration of whether pre-sleep mood can predict
the type of dreams experienced during sleep

Bachelor in psychology

at

Norwegian University of Science and Technology

Faculty of Social and Educational Sciences



Candidate number: 10067

Bachelor's thesis in psychology: PSY2900

Spring 2022, Trondheim

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Preface

I would like to thank our supervisor and leader of the research project, Professor Wei Wang. Furthermore, I would like to thank supervisor Torhild Anita Sørengaard, and the student assistants Eline Eyde Lüder-Larsen and Tiffany Lussier.

I would like to thank Professor Wang for leading the project and being of assistance when deciding on an idea and research question. The research question was chosen freely within the framework of the project. Both the research question and following hypothesis, as well as all relevant literature, was developed and found by myself. I would also like to thank the student assistants for helping throughout the entire duration of the project, including applying for approvals from the Norwegian center for research data (NSD), as well as help with the writing process. I would also like to thank the student assistants, as well as my fellow students, for designing the survey. This was a process where everyone on the project was involved, including us students. I would also like to thank the student assistants for translating the survey. Translation of the questionnaires were done by the students themselves, including me who translated the Sexual Dream Experience Questionnaire (SDEQ).

Because of a delay in getting the approval from NSD, the data collection was initiated approximately a month later than originally planned. Therefore, I would like to thank Sørengaard for pre-processing the collected data and creating a dataset that everyone on the project could use in their respective bachelor thesis. This also allowed us to be able to finish the project within the measured time frame. I would also like to thank Sørengaard for helping in choosing the appropriate statistical analyses for the current research question. All the statistical analyses were realized by me. Lastly, I would like to thank Sørengaard for being very helpful in the last phases of the project and giving feedback and constructive criticism on this bachelor thesis.

Abstract

Due to the lack of research on the influence of pre-sleep emotions on dreams, the current project aimed to examine how mood before sleep influences dreaming, and to try to better understand how waking life and mood affects dreams. More specifically the research question was “does low mood before sleep predict the prevalence of negative dreams during sleep?”. The central hypothesis was therefore as follows; low mood predicts nightmares/bad dreams.

The results of the correlation analysis indicates that there indeed is a moderate negative correlation between *average mood before bedtime* and *total nightmares/bad dreams*, $r(66) = -.32, p = .009$, meaning that there could be a measurable correlation between waking-life mood and dream content.

The results from the multiple linear regression analysis indicates that *average mood before bedtime*, *age*, and *gender* explains as much as 18% ($adj. R^2 = .18, p < .001$) of the variance in *total nightmares/bad dreams*. *Average mood before bedtime* was the strongest, and the only significant predictor ($\beta = -0.42, p < .001$).

These results are consistent with the hypothesis, where the assumption was that low mood before bedtime predicts nightmares/bad dreams. It is, however, worth noting that the hypothesis assumed that low mood during the day would predict nightmares/bad dreams the following night, but it did not address whether *average mood before bedtime* predicts *total nightmares/bad dreams*. Furthermore, the regression analysis did not fulfill the requirements of a linear regression analysis. It's therefore important to view the results of the analysis with caution.

1. Introduction

Sleep is essential for brain plasticity and memory consolidation (Baran et al., 2012; Cross et al., 2020; Eichenlaub et al., 2017; Ellenbogen et al., 2006; Fogel & Smith, 2011; Gais & Born, 2004). The different stages of sleep are associated with different functions. NREM sleep is associated with consolidation of episodic memory, including experiences from waking life, while REM sleep on the other hand is closer related to regulation of emotional information and creativity (Malinowski & Horton, 2021). Dreaming takes place in both stages (Chellappa et al., 2011; Oudiette et al., 2012; Siclari et al., 2020), but the dreams can be distinguished by the content. Dreams are often based on images or experiences from waking life, which could be explained by the memory consolidation taking place (Malinowski & Horton, 2014). This indicates that dreams experienced during NREM sleep should be realistic and closely related to waking-life experiences. This also implies that dreams during REM sleep could be experienced as emotional, creative, and not as closely related to reality.

The continuity hypothesis (Barnes et al., 2021; Schredl & Hofmann, 2003) states that dreams are related to waking life, and the experiences we go through. The current study aims to further scrutinize the relationship between waking life and dreams. There have been reported findings supporting emotional carry-over (Barnes et al., 2021), meaning that emotional state before sleep could predict emotional state upon waking. Waking-life concerns has been linked to dream content (Cartwright et al., 2006), and emotional experiences during waking has also been associated with emotional activation during dreams (Eichenlaub et al., 2017). There has also been reported significant correlations between corresponding waking emotions and dream emotions (Gilchrist et al., 2007).

It is obvious that there is some form of relationship between waking-life cognition and emotions, and dreams, but there is still a lot of research needing to be done on this subject. The goal of the current study is specifically to investigate the relationship between pre-sleep mood and the dreams experienced.

1.1 Stages of sleep

Sleep is essential for optimal functioning and restoring the body (Fogel & Smith, 2011). Sleep is also associated with well-being, and good sleepers generally report better well-being (Fogel & Smith, 2011). Lack of sleep, and poor sleep quality over time, is associated with several pathologies and worse well-being (Fogel & Smith, 2011). An adult needs approximately seven to eight hours of sleep per day (Åkerstedt et al., 2021), but there are considerable individual differences in how much sleep a person requires (Kitamura et al., 2016). Sleep can be divided

into two main categories: Rapid eye movement sleep (REM) and non-REM sleep (NREM) (McCarley, 2007). REM sleep is light sleep, and a person is easily awoken from this type of sleep. REM sleep is characterized by rapid eye movement, irregular EEG activity, and a state of muscular atonia that prevents muscles from moving around too much (McCarley, 2007; Siclari et al., 2020). NREM sleep is a deeper sleep characterized by slow heart rate, a drop in body temperature, and slow EEG waves (Berteotti et al., 2015).

Sleep and the meaning behind dreams have fascinated scientists all over the world for centuries. The discovery of REM sleep in the 1950s was the beginning of the more thorough scientific exploration of sleep and dreams in more recent research (Siclari et al., 2020). REM sleep has been considered the stage of most frequent dreams. According to Siclari et al. (2020), results indicate that 74% of people who were awakened from REM sleep reported dreams, compared to 17% of people awakened from NREM sleep. Physiological hallmarks also seem to be consistent with the notion that REM sleep is the stage of most frequent dreams (McCarley, 2007; Siclari et al., 2020), meaning that previous research on REM sleep indicates that this is the stage where most of the dreaming commences. Eyes move as if the dreamer is observing a scene play out, and the EEG activity is desynchronized and reminiscent of a state of wakefulness (McCarley, 2007; Siclari et al., 2020). In addition, the body is in a state of muscular atonia to prevent us from enacting our dreams (McCarley, 2007; Siclari et al., 2020). All these factors indicate that REM sleep is the stage of most frequent dreaming.

However, some people awakened from REM sleep report a lack of dream experience (Siclari et al., 2020). Recently, several studies have reported findings that question the assumptions about REM sleep and dreaming activity. More specifically, the idea that REM sleep is the stage where most dreams take place is challenged by newer discoveries implying that dreaming can occur in both REM and NREM sleep (Chellappa et al., 2011; Oudiette et al., 2012; Siclari et al., 2020). NREM is characterized by high-amplitude, low-frequency EEG (Berteotti et al., 2015), reduced noradrenergic and cholinergic transmissions, and in general reduced neuronal activity (McCarley, 2007; Siclari et al., 2020).

These observations emphasize the subjectivity of dreaming, and that the dreaming experience can be dissociated from sleep stages (Oudiette et al., 2012; Siclari et al., 2020). This implies that dreaming can commence in both REM and NREM sleep, and that whether the REM or NREM dreams are remembered the next morning could depend on individual factors. In general, NREM sleep experiences seems to be more realistic and related to current concerns than REM sleep experiences, contributing to the subjectivity of the dreaming experiences. They are also described as less bizarre, less vivid, less dreamlike, more conceptual, and less

emotional (Siclari et al., 2020). It is however observed that late-night NREM awakenings can yield dream reports that are in every respect indistinguishable from REM reports (Siclari et al., 2020).

1.2 Dream content

Dream experiences can vary from brief pictures or simple impressions to vivid and lifelike stories. Therefore, there is a considerable variation in the definitions of dreams. Some definitions consider all subjective experiences during sleep as dreams, while others only consider the experience a dream if it's a dynamic, complex, and multimodal simulation or spatiotemporal hallucination (Siclari et al., 2020). For the sake of simplicity, in this bachelor thesis, all subjective experiences during sleep are considered dreams. Especially considering the participants filling out the survey may not be aware of this distinction either.

The continuity hypothesis (Barnes et al., 2021; Schredl & Hofmann, 2003) states that dreams are related to waking life, and the experiences we go through. Studies have found that the first few hours of sleep often are more continuous with waking-life activities than dreams occurring in the last few hours of sleep (Malinowski & Horton, 2021). This difference in dream content could be related to the various functions of sleep stages. Dreams are often built on fragments and images of previous waking-life experiences, which could be explained by memory consolidation (Malinowski & Horton, 2014). NREM sleep is associated with consolidation of episodic memory, including experiences from waking life. REM sleep on the other hand is closer related to regulation of emotional information and creativity (Baran et al., 2012; Cross et al., 2020; Malinowski & Horton, 2021). Considering that the first few hours of sleep mainly is dominated by NREM sleep and late night sleep is dominated by REM sleep (McCarley, 2007), this could explain why early night dreams often are more continuous with waking life than late night dreams. This could also indicate a relationship between waking-life emotional experiences, and emotional activation in dreams during REM sleep.

1.3 Emotional aspects of dreams

By studying the patterns of cerebral blood flow and glucose metabolism, one can see important differences between waking cognition and REM dreaming (Schwartz & Maquet, 2002; Siclari et al., 2020). One possible explanation for the emotional aspects of dreaming is the increased activity and blood flow in the limbic and paralimbic areas of the brain, including amygdaloid complexes, hippocampal formation, and anterior cingulate cortex (Siclari et al., 2020; Valli et al., 2008). Dreams are also characterized by a lack of control and insight, which could partly

be explained by the relative inactivity of frontoparietal associative networks (Schwartz & Maquet, 2002; Siclari et al., 2020). Posterior temporo-occipital cortices are also activated, which again is in line with the visual nature of dreams (Schwartz & Maquet, 2002; Siclari et al., 2020).

Emotional experiences at work have also proven to be a predictor of next-morning affect (Barnes et al., 2021). Hindrance stressors are positively related to negative affect the next morning, mostly via effects of negative affect in dreams and rumination (Barnes et al., 2021). The question is then whether negative affect could predict negative/bad dreams. There have been reports indicating a relationship between waking concerns, dreams and dream content (Cartwright et al., 2006), and emotional waking-life experiences and the emotional events in dreams (Eichenlaub et al., 2017). This could be a clear indication that emotional involvement should be included in the continuity hypothesis to better specify the hypothesis itself (Schredl & Hofmann, 2003).

Studies also indicate that dreams are affected by a negativity bias. In other words, negative events are overrepresented in dreams compared to waking life (Barnes et al., 2021; Valli et al., 2008). This could also imply that pre-sleep mood and waking-life experiences don't necessarily predict negative dreams or nightmares, but rather indicate that this type of dream will occur, nonetheless.

When it comes to cognition, studies indicate a link between thought suppression prior to sleep and dreaming of that thought (Bryant et al., 2011). In other words, trying to suppress a thought can actually lead to dream rebound. Moreover, daily life and external factors affecting a person can also contribute to dream content (Eichenlaub et al., 2017). Studies report findings indicating an increased prevalence of nightmares after threatening or traumatic experiences (Eichenlaub et al., 2017; Goncalves et al., 2022), for instance following the COVID-19 outbreak (Goncalves et al., 2022), or the 9/11 terrorist attacks (Eichenlaub et al., 2017). In Brazil the number of participants who reported nightmares 'once a week or more' almost tripled, and five percent of the participants from a study in Portugal reported nightmares with content related to the COVID-19 pandemic (Goncalves et al., 2022). This could also be seen in relation to the emotional magnitude of these events, and the following emotional activation during sleep and dreams the following days/weeks.

A dream's content is influenced by several factors, including waking-life experiences and cognition, and by individual personality traits and mental state (Barnes et al., 2021; Eichenlaub et al., 2017; Siclari et al., 2020). Nightmares are for instance associated with a number of psychopathologies (Roberts & Lennings, 2006). When it comes to sexual dreams

women tend to report less sexual content (Siclari et al., 2020), meaning that men dream of sex more often than women. This could be explained by the notion that people's sexuality in waking-life influence the sexual content of their dreams (Geißler & Schredl, 2020). This also illustrates how waking-life experiences, and probably attitudes towards these experiences, is reflected in dream content.

1.4 Nightmares

According to The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, (DSM-5) "*Nightmares are terrifying or disturbing dreams, usually involving threats to survival, safety or physical integrity, able to awaken the sleeper*" (Hedström et al., 2021). Nightmares can have several causes, ranging from traumatic life events, personality traits, or a genetic predisposition. It is, however, not always possible to determine one specific cause of nightmares in an individual (Roberts & Lennings, 2006). Few studies investigate the genetic influences on dreaming, but twin studies indicate a strong additive genetic influence on nightmares (Hublin et al., 1999; Siclari et al., 2020). Genetic influence can account for as much as 45-51% of the phenotypic variance in childhood, and approximately 37% of the variance in adulthood (Siclari et al., 2020).

A specific pattern of nightmares has also been reported over the course of a lifetime (Siclari et al., 2020; Stenstrom & Levin, 2006). Nightmares in childhood, adolescence, and adulthood correlate significantly, which suggests that a disposition to nightmares is a persistent and stable trait (Siclari et al., 2020). Research has also reported a higher prevalence of nightmares in women than in men (Stenstrom & Levin, 2006; Wang et al., 2021), and also a higher prevalence of nightmare disorder (Wang et al., 2021). In general, women also reported poorer sleep quality, and more anxiety or depressive emotions which were associated with nightmare occurrence (Wang et al., 2021). This, again, indicates a link between emotions during waking life and the dreams we experience during sleep, and more specifically how pre-sleep cognition and emotions are associated with the occurrence of different types of dreams, and in this case nightmares.

Nightmares are commonly associated with psychopathology (Hublin et al., 1999), and in particular anxiety and depression (Roberts & Lennings, 2006). It's still unclear whether nightmares are a contributing factor to psychopathology, or rather a symptom or sign of psychopathology (Hedström et al., 2021). There is, however, often an association between nightmares and psychopathologies. This could again support the notion that dreams, dream content and the types of dreams we experience, reflect our waking life, including cognition and

emotions. There have also been indications of the possibility that nightmares could reflect pre-existing depression (Hedström et al., 2021). Negative and bad mood is a central symptom of depression (Fried et al., 2016). Considering that nightmares often are associated with depression, this could imply that there is a measurable link between pre-sleep emotions and types of dreams experienced during sleep.

1.5 Previous research

It is acknowledged that sleep plays an important role in memory consolidation and brain plasticity (Baran et al., 2012; Cross et al., 2020; Eichenlaub et al., 2017; Ellenbogen et al., 2006; Fogel & Smith, 2011; Gais & Born, 2004). Newer findings also indicate the importance of sleep for consolidation of emotional memories and emotional information, contributing to memory enhancement and preserving emotional reactivity (Baran et al., 2012; Cross et al., 2020; Hu et al., 2006). Further research has also found that REM sleep is especially important for memory consolidation of emotional information (Baran et al., 2012; Cross et al., 2020; Malinowski & Horton, 2021).

The continuity hypothesis (Barnes et al., 2021; Schredl & Hofmann, 2003) states that our waking life affects our dreaming experiences. Previous research supports this notion, for instance by indicating a correlation between thought suppression before sleep and dream rebound (Barnes et al., 2021; Bryant et al., 2011; Geißler & Schredl, 2020; Schredl et al., 2009), and a relationship between waking-life concerns, experiences, and dream content (Cartwright et al., 2006; Eichenlaub et al., 2017; Goncalves et al., 2022). Furthermore, Gilchrist et al. (2007) reported significant correlations between corresponding waking emotions and dream emotions. It would be interesting to further investigate this correlation, and to scrutinize whether pre-sleep mood could predict dream mood and dreaming experience.

The continuity hypothesis is also supported by findings indicating that waking-life sexual activity is reflected in sexual dream experiences (Geißler & Schredl, 2020; Schredl et al., 2009). This is especially found for sexual fantasies (Geißler & Schredl, 2020; Schredl et al., 2009). There is also a measurable gender difference in the frequency of sexual dreams, whereas 11.6% of 500 men's dreams are sexual, only 3.6% of 500 of women's dreams are sexual dreams (Geißler & Schredl, 2020). This could essentially partially be explained by the amount of time spent with sexual fantasies during waking life (Schredl et al., 2009).

Studies have found a direct link between sexual fantasies and sexual dreams (Geißler & Schredl, 2020; Schredl et al., 2009), which could explain why men in general have a higher frequency of sexual dreams than women. Men usually spend more waking time with sexual

urges, fantasies and thoughts (Geißler & Schredl, 2020; Jones & Barlow, 1990), which again could cause them to continue doing so in their dreams (Geißler & Schredl, 2020; Schredl et al., 2019). This adds to the notion that waking-life cognition is reflected in dreams and dream content, and future research should further investigate the emotional aspects of sexual dreams and whether it's related to the emotional experiences during waking-life sexual activities. This could then also be seen in relation to how emotional experiences contribute to emotional events in dreams (Eichenlaub et al., 2017).

The dreams reported during the earliest hours of sleep are often more reality-like and continuous with waking life (Malinowski & Horton, 2021). There is a bigger emotional aspect to the late-night dreams reported, and they are often more vivid and hyper-associative than early-night dreams (Malinowski & Horton, 2021). It is also worth noting that there has already been conducted research on the effects of sleep and emotional carryover on morning mood (Barnes et al., 2021; Cartwright et al., 1998) and waking-life emotional experiences and emotional experiences during dreaming (Eichenlaub et al., 2017).

Some argue that sleep laboratories could be used to collect more precise dream reports (Bryant et al., 2011). By conducting research in a sleep laboratory, the participants' reports would be collected immediately after awakening, which could secure more reliable reports. Relatedly, one can argue that the artificial setting of a sleep laboratory could possibly constrict the dream reports, and making dream reports from a home setting the preferred method for data collection (Bryant et al., 2011). Furthermore, it would be interesting to further investigate the relationship between cognition and emotions prior to sleep to better understand how mindset before sleep affects dreams and dream content. Moreover, it would be relevant for future research to examine the emotional aspects of dreams, and if and how they are related to waking-life emotions and cognition.

1.6 Objectives of the current study

Sleep and dreams are still a quite undiscovered area. To better understand the processes and factors influencing dreaming and dream content, there is a need for systematic studies specifically focusing on participants mood, routines, and activities before sleep, and then sleep content and dreaming during the night. Previous studies support the continuity hypothesis by indicating links between waking-life cognition and sleep content, such as sexual fantasies and sexual dreams, and thought suppression and dream rebound. Previous studies have also addressed the emotional carryover, and the effects of sleep on morning mood. But there are still a lot of undiscovered areas when it comes to the emotional aspects of dreams, and therefore

this study aims to investigate whether mood prior to sleep can predict dreams experienced during sleep. Due to the lack of research on the influence of pre-sleep emotions on dreams, the current project aims to examine how mood before sleep influences dreaming, and to try to better understand how waking life and mood affects dreams. More specifically the research question is “does low mood before sleep predict the prevalence of negative dreams during sleep?”

The central hypothesis is as follows,

Hypothesis 1: Low mood predicts nightmares/bad dreams

2. Method

2.1 Participants

The research question was examined using a longitudinal design composed of a survey that respondents were supposed to fill out every day for 28 days, four weeks. Convenience sampling was used to recruit participants, and the sample was composed mainly of friends and family of the bachelor group in Trondheim, Norway. A total of 87 participants responded to the baseline survey, the first day of surveys, whereas 47 (54%) were female and 40 (46%) were men. The mean age of respondents was 29.27 ($SD = 12.75$, range = 20 – 78). Out of the 87 participants, 48 (55%) responded that they are in a relationship.

2.2 Procedure and design

Recruitment of participants occurred from the end of January until the beginning of March. The participants were recruited mainly using social media and acquaintances to spread the word of the study. Potential participants were given a link to an online form where they could sign up by registering their email. The project was presented as a “dream study” where participants would report their sleep and dreams for four weeks. Information about the data-collection and participants' privacy were then sent out to the e-mails registered through this online form. The survey itself was online which allowed the participants to respond in private and at any given time. The survey was constructed using Nettskjema.no, a secure website for data collection used in research operated by the University in Oslo. This project was reported to and approved by the Norwegian center for research data (NSD), using the notification form 637636. Participants gave their informed consent when they answered the baseline survey.

The data-collection began on the 11th of March and lasted throughout the 8th of April.

On the first day of data-collection, participants received an e-mail containing information about how to respond, and how participants' privacy and anonymity would be maintained. The e-mail also contained a link to the online survey the participants would use throughout the entire data-collection. When the participants first responded to the survey, they were asked to create an anonymous username that they would enter when responding for the rest of the period. The participants only answered questions about their age, gender, relationship status and sexual satisfaction on the first day of the data-collection. The following days of data-collection the participants only answered questions related to their sleep and dreaming.

2.3 Instruments

The survey was first designed in Norwegian, and then translated to English to ensure that all participants would be able to answer in their preferred language. The first survey the participants answered consisted of a few demographic questions including age, gender, relationship status and sexual satisfaction. The remaining parts of the survey were identical to the second survey that were distributed for the rest of the data-collection period. This part of the survey consisted of 12 questions examining the participants' mood, activities before bed, sleep, dreams, and life events. The survey also included a Nightmare Experience Questionnaire (Chen et al., 2014) and a Sexual Dream Experience Questionnaire (Chen et al., 2015) that participants responded to if and when they reported having had a nightmare or sexual dream. These questionnaires were originally translated from Chinese to English, and then from English to Norwegian. They were then back translated to English and refined if necessary.

Average mood before bedtime was reported using a single question, where participants could choose between "good mood", "neutral mood", or "low mood". The participants were instructed to only check the one that best described their mood before going to bed. Participants' average mood before bedtime during the entire period of data collection were calculated into a continuous variable ranging from the value one to three (1 = low mood, 3 = good mood), and used for the rest of the analyses.

Total nightmares/bad dreams were also reported using a single question where participants could choose between "ordinary dream", "nightmare", "sexual dream", "bad dream", and "other". Here the participants were instructed to check all that applied to the previous night. The survey didn't include any definition or instructions as to what should be considered a nightmare or a bad dream. The task of defining a nightmare was therefore left to the participants. Considering that every participant could have their own individual definition and perception of what separates a nightmare from a bad dream, the best alternative with the

limited data was to merge these two variables into one. The participants' total number of nightmares and bad dreams during the entire period of data collection were calculated and then merged into the continuous variable *total nightmares/bad dreams* to simplify the analyses.

2.4 Statistical analysis

A Pearson's correlation coefficient was used between the continuous variables *age*, *average mood before bedtime* and *total nightmares/bad dreams*, and the categorical variable *gender*, to examine the data received from the participants. This specific analytic method was used because of its user-friendliness and because the bachelor project was limited to a single month of data processing and writing. A correlation analysis also provides a good indication as to whether there is a linear relationship between the variables. The prerequisites of a correlation analysis were met for all the variables, except for the categorical (dichotomous) variable *gender*. A correlation analysis requires the variables to be continuous (Field, 2018, p. 344).

Furthermore, the prerequisites of a multiple regression analysis were checked. A multiple regression analysis first requires dependent variables to be continuous, and independent variables to be continuous or dichotomous continuous (Field, 2018, p. 387-388). Furthermore, the sample size needs to be big enough, the variables should be normally distributed, and the independent variables must be checked for multicollinearity, and the independent variables must be checked for a linear relation to the dependent variable (Field, 2018, p. 387-388).

In this regression analysis the independent variables were *average mood before bedtime*, *age*, and *gender*. The dependent variable was *total nightmares/bad dreams*, meaning that the variables met the first prerequisite of a regression analysis. Secondly, the sample size was checked. A rule of thumb is that one should at least have a 10:1 ratio of subjects to predictors (Field, 2018, p. 389; Maxwell, 2000). This must be seen in relation to whether the dependent variable is normally distributed, but it is worth noting that the sample in this analysis was small.

Next, the dependent variable was checked for normality. This was checked by using descriptive statistics, and a test of normality. Both the Kolmogorov-Smirnov and Shapiro-Wilk tests of normality showed statistically significant results. This indicates that one cannot assume a normally distributed variable, meaning that this prerequisite of a multiple regression analysis was not met. This also means that the analysis requires more records per independent variable, so the assumption of sample size was not met.

A multiple regression analysis was then executed to further scrutinize the relationship

between *average mood before bedtime* and *total nightmares/bad dreams*. The data was checked for collinearity before reading the multiple regression analysis. By looking at the correlations, none of these independent variables are multicollinear, meaning that this assumption of multiple regression analysis is met.

Lastly, the data was checked for linearity by using scatterplots. Multiple linear regression prerequisites a linear relationship between the independent variables and the dependent variable, and this assumption was met. After checking for the requisites of a multiple linear regression, the analysis was finally executed. The data was analyzed using IBM Statistical Package for the Social Sciences (IBM SPSS) version 27.

3. Results

3.1 Descriptive statistics and correlations

A correlation analysis, Pearson's correlation coefficient, was used to analyze the variables *gender*, *age*, *average sleep duration*, *average mood before bedtime* and *total nightmares/bad dreams* (Table 1). There was a significant moderate negative correlation between the variable's *average mood before bedtime* and *total nightmare/bad dream*, $r(66) = -.32$, $p = .009$. This supports the central hypothesis of the bachelor thesis.

Table 1

Descriptive statistics and correlation analysis of the variables gender, age, average sleep duration, average mood before bedtime, and total nightmares/bad dreams (N = 64)

	<i>M</i>	<i>SD</i>	1	2	3	4	5
1. Gender	-	-	-				
2. Age	29.27	12.75	.09	-			
3. Average sleep duration	7.26	.63	-.08	-.43**	-		
4. Average mood before bedtime	2.26	.39	-.06	-.07	.21	-	
5. Total nightmares/bad dreams	1.82	1.97	-.16	-.1	.16	-.32**	-

Note. * $p < .05$, ** $p < .01$. Gender was binary (0 = female, 1 = male)

3.2 Regression analysis of average mood before bedtime and total nightmare/bad dreams

A multiple linear regression analysis was performed using *total nightmares/bad dreams* as a dependent variable, and *gender*, *age*, and *average mood before bedtime* as independent variables (Table 2). Adjusted R squared is reported considering the dependent variable was not normally distributed, and because of the small sample size relative to the number of predictors, and because adjusted R squared takes into consideration the number of independent variables. Model 2, using *average mood before bedtime*, *age*, and *gender*, explained 18% ($adj. R^2 = .18$, $p < .001$) of the variance in *total nightmares/bad dreams*, with a significant ($p < .001$) *F*-statistic of 13.72. *Average mood before bedtime* was the strongest predictor of *total nightmares/bad dreams*, $\beta = -0.42$, $p < .001$. *Gender*, $\beta = -0.18$, $p = .124$, and *age*, $\beta = -0.15$, $p = .207$, were not significant. *Average mood before bedtime* was therefore the only significant predictor of *total nightmares/bad dreams*. This also supports the central hypothesis of the bachelor thesis.

Table 2

Regression analysis to predict total nightmares/bad dreams using gender, age, and average mood before bedtime (N = 64)

Variable	<i>b</i>	<i>SE b</i>	β	<i>adj. R</i> ²	ΔR^2
Model 1				.01	-
Gender	-0.6	0.48	-0.16		
Age	-0.02	0.02	-0.12		
Model 2				.18**	.18**
Gender	-0.68	0.43	-0.18		
Age	-0.02	0.02	-0.15		
Average mood before bedtime	-2.08	0.56	-0.42**		

Note. * $p < .05$, ** $p < .01$, R^2 is adjusted

4. Discussion

The results of the current analyses indicate that *average mood before bedtime* correlates with *total nightmares/bad dreams*, meaning that these two variables are related. This, however, does not indicate causality. The results from the multiple linear regression analysis indicates that *average mood before bedtime* explains as much as 18% of the variance in *total nightmares/bad dreams*. In this regression analysis, *average mood before bedtime* was the strongest, and the only significant predictor ($\beta = -0.42, p < .001$) of *total nightmares/bad dreams*. This regression analysis, however, was faulty. It's therefore important to be cautious when drawing any conclusions as to whether there is a dependency between the variables.

The results from the analyses are consistent with the bachelor thesis' hypothesis, where the central assumption was that low mood before bedtime predicts nightmares/bad dreams. It is, however, worth noting that the hypothesis assumes that low mood during the day would predict nightmares/bad dreams the following night, and that the regression analysis did not fulfill the requirements of a linear regression analysis, as will be further discussed. It's therefore important to view the results of the analysis with caution.

4.1 Operationalization

Average mood before bedtime and *total nightmares/bad dreams* were both operationalized to be used in a correlation and regression analysis. Mood was originally a categorical variable and had to be operationalized to a continuous variable, while the frequency of nightmares/bad dreams was continuous. This made it possible to perform a correlation analysis and multiple linear regression analysis, but also yielded some weaknesses to the current bachelor thesis, which will be discussed further.

4.1.1 Average mood before bedtime

Average mood before bedtime was calculated to make a continuous variable that could be used in a correlation analysis. This continuous variable was measured on a scale from one to three (1 = low mood, 3 = good mood). A strength to this method is that a continuous variable is much easier to analyze than a categorical variable, but by calculating the average one also loses the day-to-day reports of mood before bedtime. This makes it hard to evaluate whether daily mood is of importance when it comes to dream content, or whether it's just mood on average that plays a role in the dreams one experiences. The hypothesis anticipates that a low mood before bedtime predicts nightmares/bad dreams. To adequately examine this hypothesis, it would require researching an individual's mood before bed and the following dream content.

Considering this analysis only uses average mood, the only indication these results can give is that low mood in general is related to nightmares/bad dreams.

This finding is, however, not unexpected. Nightmares are, as previously noted, commonly associated with anxiety and depression (Roberts & Lennings, 2006), and some argue frequent nightmares could reflect pre-existing depression (Hedström et al., 2021). Negative and bad mood is a central symptom of depression (Fried et al., 2016). It is possible to anticipate that the mood itself plays a central role in the relationship between depression and nightmares. The finding that *average mood before bedtime* to some extent predicts *total nightmares/bad dreams* is therefore not only predictable, but also consistent with previous research on the topic.

Another weakness worth discussing is the fact that mood was only measured using the alternatives “low mood”, “neutral mood”, and “good mood”. This is a weak measure to base an entire analysis of participants' mood on. “Low mood” could be a number of different affective states. Stress, sadness, anger, and similar emotions could all be categorized as “low mood”. This makes it hard to predict what kind of affective and emotional state that is connected to dream content. A preferred method for measuring participants' affective state before bed would be a scale such as The Positive and Negative Affect Scale (PANAS) (Watson et al., 1988). This is a more reliable measure of participants' mood, and scales and measures like this should be considered for future research on the topic.

4.1.2 Total nightmares/bad dreams

Total nightmares/bad dreams were operationalized as a continuous variable where the participants' total number of bad dreams and nightmares were calculated. The survey did not include any definition or instructions as to what should be considered a nightmare or a bad dream. The task of defining a nightmare was therefore left to the participants. Considering that every participant could have their own individual definition and perception of what separates a nightmare from a bad dream, the best alternative with the limited data was to merge these two variables into one. To ensure as many of the relevant dreams were included in the analysis as possible, this was the best solution at hand. This, however, presents a big weakness to the bachelor thesis. With no clear definitions of what a nightmare or bad dream is, the data is still affected by participants' individual assessments of their dream experiences.

By merging the two variables into one, it's also hard to evaluate whether low mood predicts nightmares or not. The hypothesis did indeed anticipate a relationship between pre-sleep mood and nightmares/bad dreams, but previous research mainly revolves around

nightmares. In other words, there have been very few, if any, studies on the relationship between pre-sleep mood and bad dreams. This may be due to the vague nature of the term “bad dream”. There is therefore no fundamental basis for saying that there exists a measurable correlation between mood and bad dreams. Nor does the results from the analyses address whether mood predicts bad dreams or nightmares, only if *average mood before bedtime* is related to *total nightmares/bad dreams*. In other words, it's impossible to separate bad dreams from nightmares when examining their relationship to *average mood before bedtime*. If one wants to further examine moods predictive value over nightmares, there needs to be a distinction between bad dreams and nightmares, and decide what qualifies as a nightmare, and what is “just” a bad dream, and measure these two separately. Or, one could consider if these two dream types really should be merged into one single type of dream and measured collectively, as done in this bachelor thesis.

A strength to this method, however, is limiting individual differences in defining a nightmare. By merging these two variables, all reported bad dreams or nightmares are included in the analysis. There is a possibility that some participants have reported a bad dream, when this dream qualifies as a nightmare. To ensure that even these cases are included in the analysis, merging bad dreams and nightmares was the best solution available. Even though there is little research on bad dreams, there have been studies examining work stress and emotional carryover (Barnes et al., 2021; Cartwright et al., 1998), and thought suppression and dream rebound (Barnes et al., 2021; Bryant et al., 2011; Geißler & Schredl, 2020; Schredl et al., 2009), and waking-life emotional experiences and emotional experiences during dreaming (Eichenlaub et al., 2017). None of these studies are directly revolving around nightmares, so there is obviously some connection between even low mood and dream content. This could translate to a correlation between low mood pre-sleep and bad dreams. This is however just assumptions based on previous research, and this topic is something that would need more research in the future to further investigate.

4.2 Correlation between average mood before bedtime and total nightmares/bad dreams

The results from the correlation analysis indicate a moderate negative correlation between the variables *average mood before bedtime* and *total nightmares/bad dreams*, $r(66) = -.32$, $p = .009$. In other words, when the value of *average mood before bedtime* went up, the number of *total nightmares/bad dreams* went down. This is a good indication of a relationship between these variables, and that this relationship can be further explored.

Even though this bachelor thesis lacks extensive analyses on the relationship between

average mood before bedtime and *total nightmares/bad dreams*, there are quite a few studies indicating that waking life affects dream content and dream experiences (Barnes et al., 2021; Bryant et al., 2011; Cartwright et al., 2006; Eichenlaub et al., 2017; Geißler & Schredl, 2020; Gilchrist et al., 2007; Goncalves et al., 2022; Malinowski & Horton, 2021; Schredl et al., 2009; Schredl & Hofmann, 2003). There is therefore an extensive basis for assuming that a low score on *average mood before bedtime* will have some sort of predictive value on nightmares/bad dreams. This assumption is also based on the continuity hypothesis (Barnes et al., 2021; Schredl & Hofmann, 2003), stating that waking life affects dreaming experiences.

Previous research on the continuity hypothesis and waking life's effect on dream content usually revolves around experiences during the day. This makes it possible to evaluate experience's influence on dream content. In this bachelor thesis, both measures are computed from the entire period of data collection. This removes the possibility of scrutinizing the day-to-day effect of pre-sleep mood on dream experiences. In other words, by analyzing the current data, the only tendencies one could find is between mood in general and the frequency of nightmares/bad dreams. To fully investigate the predictive value of pre-sleep mood on nightmares/bad dreams it would be necessary to analyze the reported mood before bedtime and the following dream for every single day during the data collection.

However, a general tendency is still an indication of a relationship between the two variables. Further research could focus on the day-to-day effect of pre-sleep mood on dream experiences to see whether changes in mood from one day to another plays a role in the dreams one experiences the following night.

4.3 Does average mood before bedtime predict total nightmares/bad dreams?

The results from the multiple linear regression analysis indicates that *average mood before bedtime* explains as much as 18% of the variance in *total nightmares/bad dreams*. In this regression analysis, *average mood before bedtime* was the strongest, and the only significant predictor ($\beta = -0.42, p < .001$) of *total nightmares/bad dreams*. These results indicate that a lower score on *average mood before bedtime* predicts a higher score on *total nightmares/bad dreams*.

These results are consistent with the bachelor thesis' hypothesis, where the central assumption was that low mood before bedtime predicts nightmares/bad dreams. It is, however, worth noting that the hypothesis assumes that low mood during the day would predict nightmares/bad dreams the following night. The hypothesis did not address whether *average mood before bedtime* would correlate or predict *total nightmares/bad dreams* over an extended

period. However, even when controlling for age and gender, *average mood before bedtime* remains a significant predictor of *total nightmares/bad dreams*, which is in line with the assumptions made in the hypothesis.

Not all the requirements of a regression analysis were met (Sarstedt & Mooi, 2019). The dependent variable was not normally distributed, and considering the small sample used in these analyses, the results of this analysis should be viewed with caution. However, as briefly mentioned previously, there is a basis for assuming that *average mood before bedtime* could predict dream content to some extent. The results from the analyses are still in line with previous research and statements presented in this bachelor thesis. The continuity hypothesis (Barnes et al., 2021; Schredl & Hofmann, 2003) clearly states that waking life and experiences are related to dream content. Furthermore, there has been discussion of an association between nightmares and psychopathologies (Roberts & Lennings, 2006). Knowing that bad mood is a central symptom of depression (Fried et al., 2016), these analyses support the notion that average mood is related to dream experiences. And more specifically, that a low score on average mood could be seen in context to nightmares/bad dreams.

These findings indicate that even with a small sample and limited measures of mood and nightmares/bad dreams, there is still a significant linear relationship between *average mood before bedtime* and *total nightmares/bad dreams*. This regression analysis indicates that mood indeed predicts dream content to some extent, or at least that a low score on *average mood before bedtime* could predict the prevalence of nightmares/bad dreams. Meaning that a lower score on *average mood before bedtime* over an extended period is associated with a higher prevalence of nightmares/bad dreams. This is an interesting finding, and one that could need further research in the future with more in-depth measures of dream experiences and mood.

It is, however, important to point out that nightmares and bad dreams are associated with poor sleep quality (Hess et al., 2020), which again could affect the mood negatively (Gwyther et al., 2022; Hess et al., 2020; Saunders et al., 2015). Considering that the only measure of mood used in this analysis is the *average mood before bedtime* throughout the entire data collection period, it's hard to distinguish whether the average mood affects the dream experiences, or if the dream experiences affect the average mood. Even with the multiple linear regression analysis indicating that *average mood before bedtime* is a significant predictor of *total nightmares/bad dreams*, it's possible to argue that poor sleep quality over a long period could cause a lower score on *average mood before bedtime*. It would therefore be interesting for future research to focus on the effect of poor sleep quality over time, caused by nightmares or bad dreams, and how this affects average mood.

To adequately assess whether *average mood before bedtime* could predict *total nightmares/bad dreams*, it would require a proper regression analysis that fulfills the requirements of the analytical method. This would include using a large enough sample, amongst other things. This could be an interesting direction for future research and could be of great value in clinical practices. Especially when dealing with comorbidity between nightmare disorder and depression or anxiety, to ensure that every aspect of the patients' needs, and challenges are met.

This regression analysis is faulty, and the results should therefore be viewed with caution. It is, however, interesting to see the direction of the relationship between *average mood before bedtime* and *total nightmares/bad dreams*. This regression analysis indicates that mood indeed predicts dream content to some extent, or at least that a low score on *average mood before bedtime* could predict the prevalence of nightmares/bad dreams. It would be interesting to see whether a higher score on average mood could predict the prevalence of positive dreams. Furthermore, future research could also examine whether there is a correlation between affective state and sexual dreams, and whether there is a dependency between the two variables.

4.4 Strengths and weaknesses

One of the weaknesses in this bachelor project is the convenience sampling used to recruit participants. Using friends and family in a self-report study can lead to social desirability, meaning that participants could answer the questions in the survey in a way that projects a favorable image to avoid embarrassment (Fisher, 1993). Even though the survey is anonymous, this could inhibit participants from answering truthfully. However, this could also lead to an increased interest (Sousa et al., 2004), and a feeling of expectation and commitment to report as many times as possible during the period of data collection, which again could work in favor of the project.

Another weakness to the bachelor project is the survey and variables itself. Mood before bedtime is measured using three alternatives: "low mood", "neutral mood" and "good mood". This measure is very limited and doesn't adequately measure the participants mood. Within "good mood", there are a number of affective states and emotions the participants could be feeling, including happy, content, relaxed, etc. By limiting the measures to three alternatives, it's impossible to distinguish the different emotions and how they possibly are related to the dreams experienced.

Furthermore, the definitions and individual experiences of nightmares vary widely. The

survey used to collect the data doesn't define nightmares or bad dreams to any extent, meaning that these variables are left to the participants to individually define. Therefore, bad dreams and nightmares have been merged into one variable. This could again have implications for the analysis, especially contrasts and nuances. There are no nuances to the *average mood before bedtime*, nor whether the participants experienced a nightmare or a bad dream, and therefore it is hard to determine which emotions or affective states are related to nightmares or bad dreams.

In general, the variables used in this analysis aren't optimal. It would have been preferable to have a measure of emotions before sleep, and properly operationalized dream variables. This way, it would be possible to thoroughly examine whether emotional activation before sleep could predict the type of dream experienced. A person suffering from insomnia or nightmare disorder might experience negative emotions related to sleep and bedtime and considering this survey didn't measure affect or emotions in any particular way, it is hard to evaluate what "low mood" actually encompasses. An arguably better measure of pre-sleep mood and affect would therefore be a scale such as PANAS (Watson et al., 1988).

Furthermore, the response rate is another weakness worth discussing. Out of the 87 participants that completed the baseline survey, only 74% ($N = 87$, $n = 64$) reported gender, age, average sleep duration, mood before bedtime and nightmares/bad dreams. A sample this small constitutes low representativeness and therefore low generalizability (Ferguson, 2004). However, even though the sample is small, a strength to this sample is that it consists of people of all ages (range = 20 - 78). It's also worth mentioning that the gender distribution is 54% female ($n = 47$) and 46% male ($n = 40$). This is a quite balanced gender distribution, especially considering convenience sampling was used to recruit participants. This will in turn make the sample more representative of the general population, which could allow higher generalizability (Dickinson et al., 2012; Ferguson, 2004). So even though the sample is relatively small, one can still argue that it's relatively representative of the general population.

A limitation to the current study is the fact that the participants were supposed to report their dreams using a self-report survey. There is a possibility that participants only have reported one or two dreams, when they in fact have experienced several dreams during the night. Early-night dreams are easily forgotten, and considering these often are the dreams that are most consistent with waking life (Malinowski & Horton, 2021; Siclari et al., 2020), this could potentially be an important source of error when studying the relationship between waking-life experiences and dream experiences. On the other hand, late night dreams often have a bigger emotional aspect, and they are often more vivid and hyper-associative than early-night dreams (Malinowski & Horton, 2021). Considering that this bachelor thesis mainly

focuses on the emotional aspect of waking life and dreams, it is possible that the participants remembered and have reported the most relevant dreams for this project.

Previous results indicate a more emotional and vivid nature to dreams experienced during REM sleep (Schwartz & Maquet, 2002; Siclari et al., 2020; Valli et al., 2008), especially considering REM sleep is associated with regulation of emotional information and creativity (Baran et al., 2012; Cross et al., 2020; Malinowski & Horton, 2021). REM sleep is also more common during the late-night sleep phases and is usually closer to awakening (McCarley, 2007). This could have implications for the reports in the survey, because it would naturally be easier to remember the dreams one experience right before awakening.

It is also worth noting that people remember vivid and emotional experiences better than regular experiences (Hamann, 2001). This could also lead to a higher frequency of reported REM dreams in the survey, meaning that most of the dreams reported could be REM dreams. If that is the case, this would give biased data, where emotional and vivid dreams are overrepresented. It is also worth discussing the notion that early night dreams tend to be more related to waking life, and early night sleep is dominantly NREM sleep (McCarley, 2007). This explains the lack of emotional activation during the dreams, considering NREM sleep is characterized by reduced noradrenergic and cholinergic transmissions, and in general reduced neuronal activity (McCarley, 2007; Siclari et al., 2020). But because these dreams usually commence in the early hours of sleep, and the lack of emotional activation, these dreams are most likely not remembered nor reported.

Considering that the central hypothesis of this bachelor thesis focuses on the emotional aspect of waking life and dreams, it is hard to decide whether the dreams during REM or NREM are of importance. One could argue that the REM dreams with more intense emotional activation would be the most relevant dreams, but on the other hand, because of the continuity hypothesis, the NREM dreams are just as relevant because they are more representative of waking-life experiences. In other words, both dreams experienced during REM and NREM sleep is of importance, which means there might have been a loss of important data considering this project used self-report surveys.

One can argue that sleep laboratories could yield more accurate dream reports (Bryant et al., 2011) and therefore be a more reliable method of collecting data because one could retrieve dream reports from both NREM and REM sleep. However, by letting participants fill out the survey when it's convenient, it's easier to recruit participants. This also lets them sleep in their own bed and in a familiar environment. By having participants staying in a sleep laboratory one can argue that the artificial setting could possibly constrict the dream reports

(Bryant et al., 2011). Therefore, using a self-report survey has both strengths and weaknesses. The main reason self-report was used was because of its convenience for the bachelor project and for the participants' own convenience when reporting.

4.5 Implications and future research

The current bachelor project has highlighted the need for more extensive research on the emotional aspects of dreams, and the connection between waking-life affective states and dream experiences. This project has also demonstrated the need for more reliable measures of both mood and dream types. To adequately measure mood in a way that could be of use in analyzing waking life's influence on dream experiences, a scale like PANAS (Watson et al., 1988) would be convenient. Considering this project only examined the relationship between *average mood before bedtime* over the entire period of data collection, and the total number of nightmares/bad dreams, it would be interesting to conduct a detailed analysis on day-to-day mood with proper measures of mood and affective states, and how it correlates with dream content the following night. This is necessary for science to begin to understand the possible predictive value mood has on dream experiences, and whether there is a dependency between waking-life affective states and dream experiences.

Furthermore, it would be necessary to apply clear definitions of what defines a nightmare, and what defines a bad dream. This is important, especially with self-report surveys, to ensure a uniform understanding of what each of these dream types encompasses. By using proper measures of mood and dream types, it could be possible to study whether emotional and affective states before bedtime could predict any type of dream, not just nightmares or bad dreams. This would be an interesting direction for future research to continue upon. It could also be of relevance for clinical practices to further understand emotional activation and its relationship to sleep and dreams.

For future research it would also be interesting to further scrutinize the specific dream content, not only dream types. This is relevant to further develop the continuity hypothesis (Barnes et al., 2021; Schredl & Hofmann, 2003), and examine whether daily life experiences are reflected in the content of dreams. This could also be relevant especially in relation to work stress and emotional carryover (Barnes et al., 2021; Cartwright et al., 1998), to gain a better understanding of how work environment affects employees' sleep and possibly mental health.

5. Conclusion

The results of the correlation analysis indicates that there indeed is a moderate negative correlation between *average mood before bedtime* and *total nightmares/bad dreams*, $r(66) = -.32$, $p = .009$, meaning that there could be a measurable correlation between waking-life mood and dream content. The results from the multiple linear regression analysis indicates that *average mood before bedtime*, *age*, and *gender* explains as much as 18% ($adj. R^2 = .18$, $p < .001$) of the variance in *total nightmares/bad dreams*. In this regression analysis, *average mood before bedtime* was the strongest, and the only significant predictor ($\beta = -0.42$, $p < .001$) of *total nightmares/bad dreams*. These results are consistent with the bachelor thesis' hypothesis, where the central assumption was that low mood before bedtime predicts nightmares/bad dreams. It is, however, worth noting that the hypothesis assumes that low mood during the day would predict nightmares/bad dreams the following night but did not address whether *average mood before bedtime* predicts *total nightmares/bad dreams*. Furthermore, the regression analysis did not fulfill the requirements of a linear regression analysis. It's therefore important to view the results of the analysis with caution.

Future research could focus on extensive measures of mood before bedtime, for instance by using PANAS (Watson et al., 1988). A detailed analysis of the relationship between pre-sleep mood and dream content would also require detailed definitions of what a nightmare and bad dream encompasses, especially when using self-report surveys. Furthermore, it would be interesting to see more in-depth research on moods' predicational value on any type of dream, and to further understand the influence of waking-life experiences on specific dream content.

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