Graduate thesis

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Norwegian University of Science and Technology
Faculty of Social and Educational Sciences
Department of Psychology

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Supervisor: Ingvild Saksvik-Lehouillier
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Preface

Inspiration for this thesis came to after contact with my supervisor, Ingvild Saksvik-Lehouillier. Through discussions she unravelled her insight in the research of sleeping and dreaming and their connection to mood. In addition, the research fields on sleep and dreams have been blooming these last years, but there is still undiscovered ground. This triggered me further, knowing that there is an uncertainty in the functions of dreaming and its relation to the emotional state in people's day-to-day-doings. I wanted to look at affects in dreams and the subsequent mood in the morning, and in this thesis, I elaborate what my exploration culminated in.

This whole process has been an enriching experience from which I have learned a lot. It has not been without its difficulties and challenging moments, but I am very happy that I have managed to see this project through. It is something that I am proud of. But I did not do it alone, and a round of applause and my deepest thanks goes the following important people:

Firstly, I would like to thank my supervisors. Especially my main supervisor, Ingvild. She has been a remarkable resource and support during this year. Thank you for all the great comments, steady guidance, motivational feedback and expertise. Your help definitely made the thesis reach the finishing line. Also, thanks to my sub-supervisor Håvard. You have been invaluable with your feedback and help with in the analyses and structuring the results. I must also extend my thanks to Kyrre Svarva, who helped a lot with administration of the survey and organisation of the data before the analysis process. And sincere thanks to Arnold Goksøyr for providing the Norwegian dictionary and manual for the Linguistic Inventory and Word Count (LIWC) program.

Secondly, many thanks to my fellow psychology student, Lisa, whom I collaborated with during the collection and preparation of the data ahead of the analyses. Further thanks to my twin sister, Trude, for your reflected commentaries, writing tips and general backing. Lastly, an endless thanks to my wonderful boyfriend for all the support you've given me. You have been with me through the highs and lows of this journey and made sure I had all the coffee and chocolate I needed to get it done. A million thanks to you all!

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Trine Iren Svendsen

Abstract

Although sleep and dreaming take up one third of our lifetime, their exact functions are not completely understood as of today. The study's aim was to investigate how the relationship is between emotional and cognitive content in dreams and the post-sleep affective state. A total of 104 Norwegian speaking adults participated. Each morning for seven days participants answered a self-report questionnaire and registered their dreams. The dreams where further analysed by the text analysis program, LIWC. The results indicated that having dreams with positive emotional content were followed by a positive affective state post-sleep, and that many words used to describe a dream also correlated to positive affect. A visible relation was also observed between having negative emotions in dreams and a subsequent negative affective state post-sleep. Limitations of this study concern, amongst others, the methods used and the sample size and characteristics of the participants and dreams. In conclusion, both positive and negative emotions in recalled dreams were related to the affective state the following morning, which is in line with the continuity hypothesis. In future research one should focus further on the intriguing methods and perspectives regarding dreams, their content and relations to the post-sleep affective state.

Keywords: dreams and dream emotions, affective states post-sleep, cognition, continuity hypothesis, LIWC

Introduction

Why do we sleep? What are dreams? How are emotions and cognitive processes involved in these states? Questions like these have been long-standing in psychology (Barrett, 2017; Freud & Cronin, 2013), and the existing research on sleep is extensive. The sleep state is, amongst others, important for a broad range of complementary operations in cognition, memory processing, emotion regulation, and physiological restorative mechanisms (Borbély, Daan, Wirz-Justice, & Deboer, 2016; Foster, 2018; Meerlo, Benca, & Abel, 2015; Moorcroft, 2013; Walker, 2009; Walker & van der Helm, 2009). The research field on dreams, on the other hand, have not experienced the same distinguished focus as sleep research in general, but in recent years there have been some promising studies on dream functions and theories (Schredl, 2000, 2018c; Yu, 2007). An overall definition of dreams is that they are a "*recollection of mental activity which has occurred during sleep*" (Schredl, 2010, p. 137).

The present thesis looked closer at the relationship between dreams and the affective state in waking life. More specifically it investigated the affective state at awakening and how dream content may have an impact on this affective state. The interest for this topic is grounded in the growing research field on dream functions and how they may be influencing and influenced by people's waking life. For example, a study by Schredl (2000) found indications for dreams to influence daytime mood and help solve personal problems. Later studies have found connections between emotional coping and sleep (Talamini, Bringmann, de Boer, & Hofman, 2013), and investigated what brain areas that are activated during dreaming and how they contribute to the processing of emotional and reward-related information (Perogamvros & Schwartz, 2015). Cognitive processes during sleep are also important for waking life (Burke, Scheer, Ronda, Czeisler, & Wright Jr, 2015). It is thought that language expresses underlying mental states, and how people describe their dreams with emotional and cognitive words is of curiosity. Cognitive words include words related to cognitive processing of information and include casual and insight words (Boals, Banks, Valentine, & Schuettler, 2011; Pennebaker, Boyd, Jordan, & Blackburn, 2015).

As of today, there are no complete theory or model that explain the complex and reciprocal relations between sleep, dreaming and post-sleep affective states (Barrett, 2017; Gilchrist, Davidson, & Shakespeare-Finch, 2007; Schredl & Reinhard, 2010). Sleep research has mainly been done in laboratories, which ensures control over procedures, participants and outlying factors. But lab research may be too artificial to measure sleep entirely, since it does not reflect the natural setting in which people are usually sleeping and dreaming. An

experimental way is through sleep restriction in the home environment and using a non-invasive monitoring method, such as actigraphy (Abad & Guilleminault, 2012). Self-report through dream diaries are also widely used (Weinstein, Campbell, & Vansteenkiste, 2018). Administration of tests on neuropsychological abilities between sleep restriction periods, point to significant negative effects on cognitive processes (Lowe, Safati, & Hall, 2017). These methods are valuable tools which will increase the knowledge on functions, relations and consequences of the underlying mental processes in sleep, dream and waking states.

According to Ong, Kim, Young, and Steptoe (2017) there are indications that positive emotions are related to better sleep quality. Still, more research is needed to reach a conclusive understanding of what this connection entails. This lack of understanding also applies to the current explanations of the vital functions of sleep and dreaming, and there are no simple answers in sight. However, there are promising results coming from the research on memory and dreams. One such interesting finding is that the REM sleep state is important for encoding episodic memories to long term memory, and that dreams' associations and reflections of such processes seem to be considerable (Llewellyn, 2013; Moorcroft, 2013; Scarpelli, Bartolacci, D'Atri, Gorgoni, & De Gennaro, 2019; Schredl, 2017a). Thus, studying the continuity between waking and dreaming through both natural and experimental methods is important. The current study hopes to shed some more light on the relation between sleep, dreaming and affect with a self-report approach.

Sleep and sleep stages

A consistent finding is that sleep has regulative and restorative effects on emotions (Tempesta, De Gennaro, Natale, & Ferrara, 2015). This connection is especially shown in studies on sleep deprivations and sleep loss (Krause et al., 2017). For example, sleep difficulties are common symptoms in psychiatric and somatic disorders, like depression, anxiety, trauma, insomnia, and schizophrenia (WHO, 1999). They have a negative impact on both emotional and cognitive abilities (Kanda et al., 2016). And sleep difficulties may in turn affect mood, concentration, alertness, reactivity, enhance the risk of illness, and may cause hallucinations and paranoia (Baglioni et al., 2016; Foster, 2018; Goldstein et al., 2013; Holsten, Pallesen, & Sivertsen, 2011; Palmer & Alfano, 2017; Xie et al., 2013). Findings from studies on sleep deprivation underscore the importance of sleep and the need for more research regarding preventive measures, such as cognitive behaviour therapy (CBT) for insomnia (Barnes, Miller, & Bostock, 2017) and through government health guidelines (Dalgard et al., 2011).

Sleep consists of several physiological processes where the individual is inactive but the mind is in a conscious state with different active brain areas (Foster, 2018; Moorcroft, 2013; Zielinski, McKenna, & McCarley, 2016). Sleep is regulated by internal homeostatic changes and biological processes, and by external circadian cues and cycles, e.g. the time of day, light, temperature and period of wakefulness (Borbély et al., 2016; Foster, 2018; Szymusiak, 2017). Thus, sleep follows as a natural part of the 24-hour cycle of activity and rest. And, in turn, sleep contributes to the survival and thriving of individuals. In sleep studies, polysomnography is often used to measure sleep states (Abad & Guilleminault, 2012). Sleep states are sorted after wavelength and controlled by light sensitive neurons in the suprachiasmatic nucleus, located in the hypothalamus of the brain (Szymusiak, 2017). Brain waves are electrical and range from highest to lowest frequency; gamma (30 – 120 Hz), beta (15 – 30 Hz), alpha (9 – 15 Hz), theta (4 – 9 Hz) and delta (0.5 – 4 Hz). While sleeping one see most of the beta, theta and delta waves.

Sleep is divided into the states of REM and NREM. Aserinsky and Kleitman (1953) discovered the state of rapid-eye-movement (REM) in the 1950s, and since then the research field has bloomed on sleep, dreaming and sleep disorders. The REM state resembles wakefulness and is dependent on complex neurological circuits in the brain stem. REM is hallmarked by fast-frequency and low intensity waves (gamma, beta, alpha and some theta). This involves amongst other things eye movements, activation of brain networks in the cortex, increasing the brain temperature, inhibition of muscle movement and body temperature regulation. This state permits most of the subjective and rich dreaming to happen (Moorcroft, 2013). NREM, or slow-wave sleep, is divided into stage N1 (alpha and theta waves), stage N2 (sleep spindles are short burst of high frequency waves) and stage N3 (delta waves) sleep (Moorcroft, 2013). NREM stages contribute to the conservation of brain energy and facilitates memory consolidation (Brown, Basheer, McKenna, Strecker, & McCarley, 2012). Adequate amount of both NREM and REM sleep are important, because they seem to actively moderate mood overnight (Cartwright, Luten, Young, Mercer, & Bears, 1998).

Dreaming

Dreams constitute a considerable part of the time spent asleep and the brain presents individuals with subjective images and stories of their lived experience and fantasies. It is normal to either remember or forget dreams at awakening (Desseilles, Dang-Vu, Sterpenich, & Schwartz, 2011; Moorcroft, 2013). Dreams are internally generated by sensory, motor, emotional and cognitive input and shared as complete stories (Meerlo et al., 2015;

Niederhoffer, Schler, Crutchley, Loveys, & Coppersmith, 2017). Areas activated in the brain when dreaming are the visual cortex and areas associated with emotion, including the insular cortex (Hobson, Pace-Schott, & Stickgold, 2000). Dreams are characterised by being typical and universal in content, and may involve loved ones, travelling, or taking an exam, but they can also contain bizarre elements (Klösch & Holzinger, 2014; Siclari et al., 2017). Dreams share similarities within different age groups, gender and cultures (Moorcroft, 2013). The similarities are related to, among other things, several emotional themes, positive and negative emotions, and personal experiences. Dreams occur up to 40% of the time in NREM, but takes up about 80% of the time in REM (Moorcroft, 2013; Palagini & Rosenlicht, 2011).

Dreams serve more than one function. For example, dreams seem to be meaningful to self-regulatory and self-reflection processes and mood (Desseilles et al., 2011; Palagini & Rosenlicht, 2011; Stickgold, Hobson, Fosse, & Fosse, 2001; Zielinski et al., 2016). They influence people's certainty, creativity and decisions in the course of their daily lives (Kramer, 2013; Moorcroft, 2013; Weinstein et al., 2018). Dreams may help in solving problems relevant in waking life and to explore different scenarios and new solutions (Klepel, Schredl, & Göritz, 2019; Schredl, 2018b). On the other hand, some researchers claim that dreams are just random biproducts or epiphenomena (Flanagan, 2001; McCarley & Hobson, 1977). Recent research is in favour of dreams being important for illustrating dynamic brain functions like reactivation of memory and enhancing of memory consolidation (Perogamvros, Dang-Vu, Desseilles, & Schwartz, 2013; Schredl, 2017b). Dreams seem to be beneficial for individual's cognitive abilities, for example, reprocessing newly encoded information and storing it in long-term memory, which is relevant for one's optimal waking functioning (Llewellyn, 2013; Watson & Buzsáki, 2015).

The scientific study of dreaming generally encounters methodological issues. The most prominent ones are that third parties cannot observe dreams directly or use technological instruments that accurately depict dreams (Moorcroft, 2013). One way to evade this issue is to wake up the person at different times and ask about dreams right away to get more successful dream recall (Schredl, 2018c). Other difficulties associated with dream collection are the subjective nature of dreams and memory problems regarding forgetfulness (Schredl, 2018b). In addition, research often rely on post-hoc data, self-report questionnaires and diaries. All these methods may be prone to information loss. Observation studies done in laboratories can be too artificial compared with the home environment. One reason is that it affects

individuals' normal sleeping and dreaming patterns. Also, the general lack of a universally accepted dream definition makes research more challenging.

Furthermore, there are difficulties connected to how researchers can accurately influence and interpret dream content, and differentiate between the actual dream effect and the effect of recalled dream (Domhoff, 1996; Moorcroft, 2013; Schredl, 2002, 2018a, 2018b; Schredl & Reinhard, 2010). The subjective experience of dreaming can only be reported if dream recall is successful and this may conceal the objective dream function (Schredl, 2018c). The use of common criteria and norms of all research, regarding large enough samples, control groups and the use of reliable and valid methods, could help bypass some of these problems. This will ensure future research and may further establish the link between dreams and waking life (for an overview see Schredl, 2018c). The use of external language computer programs such as the Linguistic Inventory and Word Count (LIWC) (Pennebaker, Francis, & Booth, 2001), may contribute to an objective interpretation of dream content (Bulkeley & Graves, 2018), but there have been few studies analysing dreams with this program.

A recent study on self-rating versus external rating of emotional content in dreams illustrated differences in rating methods (Sikka, Feilhauer, Valli, & Revonsuo, 2017). Dreams were collected at home and in the laboratory. Findings indicated that self-ratings gave higher emotional scores (97.5%) than the scoring done by external judges using the same scales (47.8%) (Sikka et al., 2017). Results also showed that self-rated dreams were valenced more positively than negatively, in contrast to the external ratings where the same dreams were rated more negatively. The authors concluded that the different rating methods influenced the interpretation of affect in dreams. There have been quite a few studies on how waking life influence dreams, but there is need of more systematic research on how dreams influence daily life (Schredl, 2010).

Further, an investigation of emotional content in dreams revealed differences between self-reported dreams and dreams collected in the laboratory (Sikka, Revonsuo, Sandman, Tuominen, & Valli, 2018). Emotions were present in almost half of the dreams reported at home (45.42%) versus only a third in the early awakening condition in the laboratory (29.31%). This was insignificant in the case for the late-night awakenings in the laboratory. The researchers urged future dream studies to consider where (the setting), when (the time or sleep stage), and how dreams are collected (methods). These perspectives can help reduce methodological issues.

Affect

Affect is an umbrella term for valenced states, positive or negative, and experienced states. Positive affect is a state of satisfied action with the environment that promotes emotions like happiness, joy, enthusiasm, and satisfaction (Ong et al., 2017). Negative affect is characterized by emotions like sadness, tiredness, subjective distress and unpleasantness, and not just an absence of positive affect (Crawford & Henry, 2004; Ong et al., 2017). Together with the cognitive and the behavioural domain, affect is one of the three main components of the mind and great research fields in modern psychology (Gross, 2010; Huitt & Cain, 2005).

Affective states include core affects, moods and emotions. *Core affects* are simple non-reflective feelings in mood and emotions, but also available to consciousness, for example pleasure and displeasure, energy and tiredness (Ekkekakis, 2012). *Emotions* are short lived responses to immediate situations, and they consist of appraisals which influence changes in feelings, cognitive, behavioural and physiological response channels (Ekkekakis, 2012; Levenson, 1999). Anger, fear, pride and joy are examples of short-lived emotions. *Mood* is different in the way that such states last longer, are more global and diffuse than emotions, for example anxiety and irritation, and the cause is not always well understood (Ekkekakis, 2012). Affective experiences in sleep and dreaming states contribute to emotion regulation (Walker, 2009, 2010). New research points to positive affects being important for individuals' complete sleep (Ong et al., 2017). Daily variations in mood are influenced by sleep and circadian processes, and this finding is common on a cultural and global level (Golder & Macy, 2011; Shouse, 2005). The role of sleep in affective regulation and processing is an established finding.

A recent study investigated the relations between affective content in dreams and the subsequent affective states experienced in waking life in a Norwegian population (Johnsen, 2017). The results indicated few but significant relations between negative emotional content in dreams which enhanced both positive and negative post-sleep affective states. Due to the small sample size of dreams, limitations caused by selection of data, and the use of self-report measures, the results were inconclusive. The need for more research was encouraged. For example, less is known about how the dream content or the amount of dreams can influence or be influenced by waking emotions at later times the same day or in the following days.

Emotion regulatory theory of sleep and dreaming

The emotion regulation theory of sleep and dreaming presumes that these states contribute to processing of salient waking-life events and control of emotions during the day (Scarpelli et al., 2019). Emerging evidence and clinical observations support an intimate and causal relationship between sleep and affective brain regulation (van der Helm & Walker, 2012). Regulation of emotions is, amongst others, essential for managing emotional stress in daily life (Palmer & Alfano, 2017; Vandekerckhove & Cluydts, 2010; Vandekerckhove & Wang, 2018). Findings point toward that affective states are influenced by and, in some cases, can modulate the amount and quality of sleep on a daily and long-term level (Tempesta, Socci, De Gennaro, & Ferrara, 2018). For example, individuals with depression and insomnia disorders tend to experience more negative emotions and negative moods in dreams and waking state compared to healthy individuals (Cartwright et al., 1998; Delannoy, Mandai, Honoré, Kobayashi, & Sequeira, 2015). Sleep loss over time is associated with lower empathy compared to people with no sleep loss (Guadagni et al., 2017). Deprivation of REM sleep has been found to reduce evaluation of affective stimuli which suggests that sleep protects the emotional reactivity ability (Lara-Carrasco, Nielsen, Solomonova, Levrier, & Popova, 2009), but this effect is weak and needs more research (Tempesta et al., 2018).

Another finding in support of the emotion regulation theory, is that the active brain regions involved in the daily emotional processes and interpretation of reward-related information, also are activated during sleep (Perogamvros & Schwartz, 2012). This strengthens the importance of sleep for the reprocessing and consolidation of memories, and especially memories with a high affective and motivational relevance for the individual (Wamsley & Stickgold, 2011). The experience of a low level of negative affect in the morning is normal, which indicates that one is emotionally restored after sleep, and underscores this theory (Vandekerckhove & Cluydts, 2010). The relevance of the emotion regulation theory for this study, is that it provides a framework for understanding emotional relations between dreaming, sleeping and waking. This theory is also in accordance with the continuity hypothesis.

The continuity hypothesis of dreaming

The continuity hypothesis postulates that effects of the waking experience will influence dream content, and that dream content, in turn, will influence daytime mood and benefit waking life (Schredl, 2018c). The experiences include everything from a person's internal thoughts and feelings, to the person's external actions and other occurrences with

people and objects. The idea that dreams influence waking life is not new, see for example "*The Interpretation of Dreams*" by Freud (1913). The continuity definition later became established by Hall and Nordby (1972). Recent developments in this field has been done by Schredl and colleges (Schoch, Cordi, Schredl, & Rasch, 2018; Schredl, 2000, 2017b). Their findings strongly indicated a relationship between dreams and the waking state and even discovered a second-order effect of continuity in addition to the continuity effect (Schredl & Reinhard, 2010). This second-order effect implies that dreams affected by experiences the previous day together with the emotional intensity of those experiences, are more likely to affect the person's mood the following day when the emotional intensity is high.

Empirical studies of dreams from people with psychological disorders are in favour for the continuity hypothesis. A reason for this is that patients' symptomatology to a higher degree were reflected in their dreams compared to healthy controls (Schredl, 2010). Schredl and Reinhard (2010) asked how dream emotions were affected by day-time mood and how dream emotions affected subsequent waking life. They found both direct and second-order effects of waking life on dreams and of dream emotions on waking life. Additionally, their results indicated that the intensity of negative effects of daytime events on dream content could predict the effect of that dream on daytime mood. This adds to the finding that the more emotionally intense waking life experiences are, the more likely they are to be incorporated into subsequent dreams. The emotional intensity is a crucial factor that influences the continuity between waking and dreaming (Schredl, 2018c).

Additional research have also demonstrated the continuity effect between waking life and dream emotions (Nielsen, Deslauriers, & Baylor, 1991), and in relation to other factors such as well-being (Gilchrist et al., 2007), subjective well-being (Crawford, 2015), satisfaction and frustration (Weinstein et al., 2018), and across cultures (Sikka et al., 2018; Yu, 2007). The research basis on the effects of dreaming on the post-sleep state is growing. Yet, it is still unclear whether and how dreaming is involved in sleep-dependent memory consolidation, regulation of social relationships and why people dream about things they have never experienced in waking life. This could be a kind of discontinuity between dreams and waking life according to Schredl (2017a). In any case, both the continuity hypothesis and the emotion regulation theory have contributed to this interesting line of dream research. At present, the theories broaden the perspectives on the functions of dreaming.

A complex picture of sleep, dreaming and affects

Knowledge about sleep, dreaming and emotions are important for a diversity of interventions and treatments, but also the health-related benefits of enough sleep. About 10% of the population and about half of all individuals with mental illnesses, have comorbid, and in some cases severe, sleep problems (Holsten et al., 2011). This affects the society because individuals' working capability is reduced (Indregard, Ihlebæk, & Eriksen, 2013). There are indications that sleep problems may increase negative emotions and reduce the positive gains from goal-directed behaviour (Zohar, Tzischinsky, Epstein, & Lavie, 2005). Thus, more knowledge about these topics from research on normal populations could enhance the established and to new treatments for psychological and somatic disorders. Research is important for broadening our understanding of dreams and sleep's functions and how they interact with other facets of our lives (Goldstein & Walker, 2014; Johnsen, 2017).

Dreams definitely have an influence on waking-life, but what important factors behind this continuity still need clarification (Schredl, 2010). Studying dream content may decipher some of these factors. For example, dreams are not that different from waking thoughts, although on average more bizarre than waking thoughts (Rosen, 2018). Studies have also compared dream content to other types of text (Bulkeley & Graves, 2018; Niederhoffer et al., 2017). Niederhoffer et al. (2017) found a low report of cognitive processes, which suggested that dreamers are not in search for meaning when dreaming. The low presence of cognitive processes could be caused by the more common and dominant perceptual nature of dreams. On the other hand, the use of cognitive process words is related to the meaning-making process. One study found this to be negatively related to a narrative coherence in dreams (Boals et al., 2011). This suggests that dreamers are less preoccupied with the question of why they had a specific dream and more interested in explaining what happened.

Research question

The theories, models and research findings mentioned above lead to the following research question:

"*How is the relationship between emotional content in dreams and the post-sleep affective state*?"

Methods

Participants

Participants signed up for this study through a web-site link shared online and on leaflets distributed around the university campus. A total of 119 persons took the initial questionnaire in this study. Of these, 15 were excluded from further analyses due to missing contact information or incomplete answers. In the end, the main sample included a total of 104 people who completed the survey. The main criteria for inclusion were people with ages between 18-35 with Norwegian as their native language, and access to a digital device where they could receive and answer the surveys. A total of 47.1% (n = 49) were between the ages 18 – 25, and 52.9% (n = 55) were between 26 – 35. The sample (N = 104) consisted of 87 females (83.7%), 16 males (15.4%), and 1 (1%) with another opinion of gender. The majority of the participants were women. Amongst the 104 people 72.1% (n = 75) reported that they were students, 51.0% (n = 53) reported having a part-time job, and 26% (n = 27) worked full time.

Samples. The main sample (N = 104) consisted of the overall data from all participants, and all responses collected during the week was included. This made it possible to compare responses between all individuals. The mean response rate was 70 persons each day (SD = 10.29). For further analyses, two smaller samples were made to investigate the relationship between dreams and the affective state, hereafter referred to as subsamples D ("*the dream sample*") and P ("*the participants sample*"). Subsample D consisted of all the reported dreams (n = 156). Each dream got a unique ID number, and this was connected to the respective participants in the analyses. This division allowed for analysis at the dream level. The participants reported between 1-7 dreams each.

Subsample P consisted of the participants who had reported at least one dream (n = 59). This excluded 45 individuals who did not report dreams. The sample was narrowed down to only one dream observation per participant and based on their length the longest dreams were chosen. The analyses were done at the person level. Participants who reported dreams, consisted of 52 females and 7 males. A total of 45.8% were between 18 – 25 year of age, and 71.2% were students. The main sample, subsample D and subsample P, will be reported in the subsequent part of the thesis.

Procedure

This research project was approved by the Regional Committees for Medical and Health Research Ethics in Norway (REK). Recruitment of participants was done by convenience sampling. Information about the study was shared through an online link on social media, such as Facebook and Instagram, and through leaflets on campus at the Norwegian University of Science and Technology. Participation was voluntary and unpaid.

In the first part, the participants had to complete an online background survey, before they consented to join the study on the last page (see Appendix A for an overview). The background survey was created on the website SelectSurvey.net. The background survey informed the participant about the project, asked for demographic information (such as age, gender, occupation, and sleep routines), and contained a short personality questionnaire (Mini IPIP). Participants were notified that their email-addresses served as digital IDs, which enabled connection of the data collected each day to the correct subject. They were also informed about their rights to withdraw the consent without stating any cause, at any time during the week of collection.

In the second part, the main data collection of sleep, dreams and affect, was done through identical questionnaires that had to be answered daily. Through the website Selectsurvey.net the questionnaire where composed and distributed. The participants received a link to the questionnaires by email at approximately the same time each day between six thirty and seven am for a total of seven days. Reminders were also sent out to those who hadn't answered within an hour after the first mail. The questionnaire, called "*The Morning Questionnaire*", would take a few minutes to complete each time, and consisted of five pages with questions about how they slept. For example, sleep habits, if they remembered if they dreamt or not, how they felt when they woke up, items measuring affective state with the PANAS scales, and sleepiness (see appendix B for full description).

Instruments

Background survey. Demographic data was collected with a background survey with 34 items, which was done once. The survey asked for information about age, gender, employment, sleep routines and sleep habits. Morning or evening person-preferences were assessed with the diurnal scale (Torsvall & Åkerstedt, 1980). Then followed a short-form personality measure, the Mini International Personality Item Pool, which consists of 20 items and is based on the five-factor model (Donnellan, Oswald, Baird, & Lucas, 2006). These two instruments were not used in the current study, but for the use in other projects.

Sleep measures. The Morning Questionnaire consisted of 11 items which regarded the participant's sleep routines and habits. Answers to initiate time had to be written as four numbers (e.g. 2145, 0730 etc). These questions are also used by the Norwegian National Institute of Sleep Disorders, and originate from the sleep diary developed by Carney and colleagues (2012). In this study, data on total sleep time and sleep efficiency were used in the analysis. Sleep efficiency was estimated by total sleep time relative to the time in bed. Total sleep time represents the time the participant turned off the light until the time they woke up completely and periods of wakefulness were subtracted from the total time.

Dream measures. There were four questionnaire items about dreams. Participants were asked whether they remembered any dreams last night. If they answered yes, they were prompted with three more questions. The first assessed details in dreams with three alternatives "many", "a little", and "no details". The second measured the participants' subjective experience of emotional content in the dream with a 5-point scale. These two questions were not used in the analyses. Last, participants could write down as much as they could remember from their dreams the previous night in a free textbox. This resulted in 156 descriptions of dreams.

Dream content measures. For a detailed and external analysis of the content in dreams, the program Language Inquiry and Word Count (LIWC, version 2015) was used. LIWC is a program that does psycholinguistic analysis of different types of written text. The background stems from the assumption that people's daily word usage can provide rich information about their beliefs, thinking patterns, social relationships, and personalities (Pennebaker et al., 2015). LIWC is developed by Pennebaker and colleges (Chung & Pennebaker, 2012; Pennebaker, Booth, & Francis, 2007; Pennebaker et al., 2001). The program has been used in a range of topics, i.e. on speeches (Tausczik & Pennebaker, 2010), messages in social media (Golder & Macy, 2011), dream diary study (Bulkeley & Graves, 2018), and in a dream content and structure study (Niederhoffer et al., 2017). The results from these research examples suggest that LIWC can accurately identify emotional words and other grammatical, psychological, and cognitive components in people's language use, both written and spoken (Pennebaker et al., 2015).

The LIWC program utilizes an integrated dictionary which allows the program to search and compare the text data with the dictionary and categorize the words into a range of groups (i.e. grammar, social and psychological concepts). The number that is computed, is given in percent (0 – 100) of the total text. Goksøyr and Moxnes (2019) did the translation

work with the Norwegian dictionary from the English dictionary developed to the 2007 version of LIWC. In the present thesis, the LIWC program with the Norwegian dictionary, were used to categorize all the written dream text in positive words, negative words, and cognitive words. A word count category for each dream was also included. This was done to explore more about the affective and cognitive content in dreams in two of the three samples.

Before the text analysis could be done, every dream had to be corrected for some lesser grammatical errors, spacing, comma and periods, and miswritten words (see Appendix C). The dreams were first separated from the original dataset and linked throughout this process with an ID number. Then dreams were separately copied to a basic notebook application, before they could be analysed with LIWC2015. The program computed a table of results and converted it to Microsoft Office Excel 365 ProPlus and SPSS version 25. The preliminary results of the dreams were categorized in four chosen variables. The average use of words, the dream word count, were 70.57 words per dream (*SD* = 116.83). Positive affect words (Dream PA) made up 2.86% (*SD* = 4.03) of the total word count, and negative affect words (Dream NA) made up 1.76% (*SD* = 8.29), and cognitive process words (Dream Cog) made up 18.36% (*SD* = 10.71) of the total of dream content.

Affect measures. Participants were instructed to describe their baseline level of affect or feelings "*right now*" with the Positive and Negative Affect Schedule (PANAS) instrument, which comprises two mood scales (D. Watson, Clark, & Tellegen, 1988). The state version of the instrument was used in this study, with a 5-point Likert scale consisting of adjectives that describes ten positive and ten negative affective states. Participants rated their affective state using this scale, ranging from "*very slightly or not at all*", "*a little*", "*moderately*", "*quite a bit*", to "*extremely*". This instrument is considered to be a valid and reliable measure of the elements of both immediate and prolonged positive and negative affect (Crawford & Henry, 2004; Talbot, McGlinchey, Kaplan, Dahl, & Harvey, 2010). Higher scores correspond to higher levels of positive and negative affects respectively (Watson et al., 1988). In the main sample, there was higher report of negative affect on the first day (*M* = 14.40, *SD* = 4.82) and fourth day (*M* = 14.17, *SD* = 4.95), and lowest on day six (*M* = 12.66, *SD* = 3.00). Positive affect had the highest report rate on day seven (*M* = 21.18, *SD* = 8.56), and lowest on the second day (*M* = 19.21, *SD* = 6.73).

Statistical analyses

The statistical analyses were conducted using IBM SPSS Statistics (version 25).

The following analyses were performed on the main sample: An independent t-test were used to explore differences in positive affect and negative affect between the participants who recalled dreams and those who did not recall dreams. Bivariate correlations were further done to investigate if there were any significant relations between the sleep and dream items, and positive and negative affect states. First, correlations were done separately for all seven days. Second, the average scores from all days were calculated before the analysis could be run in the main sample.

In subsample D bivariate correlations and linear regression were done. Participants who reported more than one dream would appear more than once in these analyses, but their dreams were treated as separate entries. Bivariate correlations were run to investigate if there existed significant relations between the dream variables, dream positive affect (PA), dream negative affect (NA), dream cognitive process words, dream word count, and the scores on the positive affect and negative affect each morning. Linear regression was done to explore if any of the dream items, sleep length and sleep efficiency could predict any of the variance in positive and negative affect. Age was included as a control variable.

Analyses done in subsample P (n = 59) were bivariate correlations and linear regression. These were done to investigate the effects of dreaming on post-sleep affective states of all the different individuals who had reported their dream. Correlation analyses included age, the dream and sleep items, and positive and negative affect. Linear regression variables included positive affect, negative affect, dream positive affect, dream negative affect, dream cognitive words, dream word count, and sleep length. Fewer variables were included due to the smaller sample size of subsample P, to account for the required observations and the increased possibility for multicollinearity between predictor variables when using linear regression.

Results

Variations in positive and negative affect post-sleep between dream recall and no recall

Table 1 shows the independent t-test results of the differences in affective states post-sleep between participants in the main sample (N = 104) regarding if they dreamt or not. The statistical assumptions were met for this test. This analysis was done on all the separate days (1 – 7) for both positive affect and negative affect. The sample was divided into two groups by the dream recall question, and in Table 1 labelled "*Dream*" and "*No dream*". Responses varied from day to day.

Table 1

Difference in affect for dreamers versus non-dreamers (N=104)

	Positive affect					
	Dream		No dream			
Day	*M (SD)*	*n*	*M (SD)*	*n*	*t*	*p*
1	22.60 (7.20)	32	28.25 (6.62)	33	-3.29	.002**
2	18.62 (7.37)	40	19.79 (6.05)	40	-.77	.441
3	22.20 (10.28)	35	20.03 (8.48)	38	.99	.326
4	20.40 (9.80)	33	21.30 (7.60)	36	-.42	.673
5	20.03 (9.06)	34	20.84 (7.29)	34	-.41	.682
6	22.23 (8.26)	26	19.18 (7.31)	33	1.50	.139
7	21.09 (9.70)	31	21.29 (7.02)	24	-.86	.932
	Negative affect					
	Dream		No dream			
Day	*M (SD)*	*n*	*M (SD)*	*n*	*t*	*p*
1	15.46 (6.84)	32	13.18 (3.67)	33	1.67	.101
2	12.88 (3.60)	40	13.12 (4.98)	40	-.25	.800
3	12.47 (3.71)	35	13.34 (2.90)	38	-1.12	.267
4	14.21 (5.22)	33	14.13 (4.75)	36	.61	.952
5	13.50 (3.30)	34	14.09 (4.95)	34	-.58	.566
6	12.50 (2.56)	26	12.79 (3.33)	33	-.36	.722
7	13.63 (4.24)	31	12.64 (3.45)	24	.92	.361

** $p < .01$

There was a significant difference between dream recall and no recall in positive affect on day 1 (t (63) = -3.29, p = .002). Participants who dreamt expressed lower levels of positive affect (M = 22.60, SD = 7.20), than the "*No dream*" condition (M = 28.25, SD = 6.62). No significant relations existed for the remaining days on positive affect. As is seen in the p-value-column in Table 1 there were no significant differences between the scores on participants dream recall or non-recall and negative affect post-sleep.

Correlations between morning affect, dream content and sleep variables

Bivariate correlation analyses were used in the main sample to compare the average scores across all seven days on positive affect and negative affect post-sleep with age, the dream variables (dream word count, dream positive affect, dream negative affect, and dream cognitive process words), and the sleep variables. The results are presented in Table 2. There was a significant and positive correlation between dream word count and positive affect (r = .57, p < .001). There was a negative and significant relation between sleep length and positive affect (r = -.25, p = .015). Otherwise, no significant correlations between the variables and positive affect, were found. There were no significant correlations between the variables and negative affect.

Table 2
Correlations between age, dream content, sleep, and affect states (N = 58 - 104)

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Age	.								
2. Dream NA	.13	.							
3. Dream PA	-.01	-.12	.						
4. Dream WC	-.02	-.09	.02	.					
5. Dream Cog	.10	.64**	-.20	-.10	.				
6. Sleep length	-.10	.07	-.12	-.26	.03	.			
7. Sleep efficiency	-.12	.02	-.13	-.06	.01	.61**	.		
8. Positive affect	.11	-.18	.22	.57**	-.10	-.25*	-.10	.	
9. Negative affect	-.04	.25	.23	.01	.10	-.13	-.04	.08	.

Note. NA = negative affect, PA = positive affect, WC = word count, Cog = cognitive process words

** p < .05, ** p < . 001*

Correlations between dream content, sleep and affective state on the dream level

Table 3 shows the results from the correlation analysis done on subsample D, which consisted of the 156 reported dreams from all seven days. The included items were age, the dream and sleep variables, and positive and negative affect. Results indicate a significant and positive correlation between dream word count and positive affect (r = .58, p < .001). There was also a positive correlation between positive emotions in dreams and positive affect (r = .23, p = .005), and a significant correlation between sleep efficiency and positive affect (r = .12, p = .010). No other correlations were found on positive affect.

A positive correlation was found between negative emotions in dreams and negative affect (r = .18, p = .023). This indicates a relation between experiencing negative emotions in dream and the negative affect state. There was a positive correlation between cognitive process words and negative affect (r = .17, p = .040). Sleep efficiency had a significant and negative correlation with negative affect (r = -.11, p = .011), which is a small effect (Field, 2013). No other significant correlations were found on negative affect.

Table 3
Correlations between dream and sleep variables, and the affective state post-sleep at the dream level (n=156)

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Age	.								
2. Dream PA	.11	.							
3. Dream NA	.09	-.04	.						
4. Dream Cog	-.06	-.09	.61**	.					
5. Dream WC	-.18*	-.02	-.05	-.03	.				
6. Sleep length	-.02	.04	.10	.03	-.06	.			
7. Sleep efficiency	-.03	.06	.03	.05	.17*	.57**	.		
8. Positive affect	.08	.23**	-.09	-.07	.58**	.04	.12*	.	
9. Negative affect	-.05	.03	.18*	.17*	-.05	-.11*	-.05	-.06	.

NA = negative affect, PA = positive affect, WC = word count, Cog = cognitive process words.
** p < .05, ** p < . 001*

Relations between sleep and dream content and affective states at the dream level

The regression analyses on subsample D investigated how gender and age, the dream and sleep variables, relate to positive affect (Table 4) and negative affect (Table 5). Assumptions were met. The values on both positive and negative affect for linearity and collinearity were within the value thresholds (Tolerance = .60 – .98, and VIF = 1.02 – 1.68). Scatterplot showed no outliers, and the Durbin-Watson test indicated no autocorrelation (negative affect = 1.93, positive affect = 1.97).

For predictors on positive affect, model 1 found no relations of gender and age on positive affect (R^2 = .005, F (2, 138) = .33, p = .722). In model 2 there was a significant effect of the dream items on positive affect (R^2 = .401, F (6, 134) = 14.96, p < .001). The dream variables predicted 40.1% of the variance in positive affect, and dream word count (β = .60, p < .001) and dream positive affect (β = .22, p < .001) had the strongest effect. Model 3 was significant for positive affect (R^2 = .410, F (8, 134), p < .001). The strongest predictors were dream word count (β = .59, p < .001), dream positive affect (β = .22, p < .001), and age (β = .15, p = .035). Adding the sleep variables did not significantly increase the amount of variance explained positive affect (ΔR^2 = .009, p = .356).

Predictors on negative affect are shown in Table 5. Model 1 indicated a small significant effect of gender and age on negative affect (R^2 = .057, F (2, 138) = 4.21, p = .017). Model 2 was significant (R^2 = .124, F (2, 134) = 3.16, p = .006), and the dream items, gender and age stood for 12.4% of the variance in negative affect. Age was the largest contributor (β = -.26, p = .001). The effect of dream negative affect was significant (ΔR^2 = .067, p = .042). Model 3 was significant (R^2 = .160, F (8, 132) = 3.14, p = .003). All included items explained 16% of the variance seen in negative affect. This is a moderate effect (Fritz, Morris, & Richler, 2012). Adding the sleep items did not significantly increase the amount of variance in negative affect (ΔR^2 = .036, p = .063). The significant effect of dream negative affect had a positive relation with negative affect (β = .214, p = .040). Sleep length had a negative impact on negative affect (β = -.23, p = .019).

Table 4

Predictors on positive affect, at the dream level (n = 156)

	Model 1			Model 2			Model 3		
Variable	*B*	*SE B*	β	*B*	*SE B*	β	*B*	*SE B*	β
Gender	-1.99	2.73	-.063	.12	2.16	.004	-.97	2.38	-.03
Age	.37	1.63	.02	2.63	1.34	.14	2.87	1.35	.15*
Dream PA				.51	.15	.22**	.50	.15	.22**
Dream NA				-.10	.10	-.09	-.09	.09	-.08
Dream Cog				.03	.07	.04	.03	.08	.04
Dream WC				.05	.005	.60**	.05	.006	.59**
Sleep length							-.09	.67	-.12
Sleep efficiency							.03	.09	.025
R^2		.005			.401			.410	
F		.33			14.97			11.49	
p to F		.722			.000			.000	
ΔR^2					.396			.009	
p to ΔR^2					.000			.356	

NA = negative affect, PA = positive affect, WC = word count, Cog = cognitive process words

** p < .05, ** p < .001*

Table 5

Predictors on negative affect, at the dream level (n = 156)

	Model 1			Model 2			Model 3		
Variable	*B*	*SE B*	β	*B*	*SE B*	β	*B*	*SE B*	β
Gender	-1.01	1.09	-.08	-1.01	1.08	-.08	-1.68	1.15	-.13
Age	-1.88	.65	-.24*	-2.22	.67	-.28**	-2.05	.66	-.26*
Dream PA				.08	.07	.09	.08	.08	.08
Dream NA				.09	.05	.20	.10	.05	.21*
Dream Cog				.02	.04	.04	.01	.04	.04
Dream WC				-.003	.003	-.10	-.004	.003	-.13
Sleep length							-.78	.33	-.23*
Sleep efficiency							.05	.04	.12
R^2		.057			.124			.160	
F		4.21			3.16			3.14	
p to F		.017			.006			.003	
ΔR^2					.067			.036	
p to ΔR^2					.042			.063	

NA = negative affect, PA = positive affect, WC = word count, Cog = cognitive process words

** p < .05, ** p < .001*

Relations between dream content and affective states on the individual level

Lastly, subsample P was analysed (n = 59), which included the longest dream considering word count per participant. This allowed for a person-oriented measure of the data. The correlation analysis revealed a positive correlation between dream word count and positive affect (r = .50, p < .001) (see Table 6). No other correlations were found on positive affect. Dream negative affect had a positive correlation with negative affect (r = .30, p = .025), and no other correlations were significant. There was a high positive correlation between dream cognitive process words and dream negative affect (r = .84, p < .001), indicating multicollinearity and that these variables were not independent of each other.

Table 6

Correlations between dream content and affects (n = 59)

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Age	.								
2. Dream PA	.07	.							
3. Dream NA	.14	-.06	.						
4. Dream Cog	.09	-.06	.84**	.					
5. Dream WC	.07	.05	-.11	-.03	.				
6. Sleep length	.27*	.72	.16	-.03	.02	.			
7. Sleep efficiency	.07	.13	.16	.07	.26	.56**	.		
8. Positive affect	.22	.19	-.13	-.07	.50**	-.12	.01	.	
9. Negative affect	-.12	.07	.30*	-.12	.25	-.23	-.15	-.06	.

NA = negative affect, PA = positive affect, Cog = cognitive process words, WC = word count

** p < .05, ** p < .001*

Linear regression looked at the predictive values of only three dream items (dream positive affect, dream negative affect, and dream word count) on positive and negative affect (Table 7). The sleep variables were not included because of the maximal required number of observations per variable had been reached, and because of the high multicollinearity between dream cognitive process words and dream negative affect observed in the correlation analysis, dream cognitive process words were not included in the regression. Assumptions were then met. Scatterplot confirmed a linear relationship between the variables. The results of the

Durbin-Watson test were normal (positive affect = 1.80, negative affect = 2.27). Collinearity assumption was met for positive and negative affect. The VIF scores were centred about 1.00, and tolerance was within the threshold values.

The model on positive affect found that the dream items explained 28.2% of the variance (R^2 = .282, F (3, 53) = 6.95, p < .001). Dream word count had the strongest effect (β = .48, p < .001). No other significant relations were seen on positive affect. The model on negative affect was not significant (R^2 = .103, F (3, 53) = 2.03, p = .121). But one of the dream items, dream negative affect, had a significant and positive relation with negative affect (β = .29, p = .030).

Table 7

Dream affect and word count as predictors on affective states (n = 59)

	Positive affect			Negative affect		
	B	*SE B*	β	*B*	*SE B*	β
Dream PA	.39	.27	.17	.11	.16	.09
Dream NA	-.04	.07	-.07	.10	.04	.29*
Dream WC	.57	.14	.48**	-.01	.01	-.09
R^2		.282			.103	
F		6.95			2.03	
p to F		.000			.121	

NA = negative affect, PA = positive affect, WC = word count

** p < .05, ** p < .001*

Discussion

The aim of the present thesis was to explore the relationship between emotional content in dreams and the post-sleep affective state. The results answer the research question and show that there is a relation between dreams' emotional content and waking affects.

Firstly, the dream level analyses in which all dreams reported in the sample were analysed on an individual level yielded several interesting results. Here dreams containing many words and a high number of words classified as positive emotional words were related to a high level of positive affect in the morning. Dreams containing a high number of negative words were associated with a high level of negative affect the following morning. These findings for positive and negative affect were consistent even when controlling for demographic variables and sleep variables. Still, lower age and shorter sleep times were also related to more negative affect in the morning, and were just as important as the content of negative affect words in the dream.

Secondly, looking at dreams on an individual level selecting only the longest dream for each participant most of these results were confirmed. However, here only the number of words were related to morning positive affect, and only emotional content in dreams were related to negative affect, not controlling for demographic variables and sleep variables. Lastly, it was not found any significant differences between participants' affective state compared to if they recalled or did not recall dreams. Overall, these results indicate that there is no major or separate effect caused by the act of dreaming on the affective state in the morning, but that writing longer dreams, possibly with more positive emotional content, are related to positive affect, and dreams with negative content may trigger negative affect in the morning.

In addition, this study also investigated the participants' use of cognitive process words in dreams, and this was not found to directly influence the affective states in the morning. However, there was a tendency for participants when they reported negative emotions in dreams to also use a considerable amount of cognitive process words. There could therefore be some indirect relations between cognitive words and negative affect post-sleep, but the relation between negative emotional content and use of cognitive words was only significant at the dream level. Still, it is worth noticing on the individual level there was a high correlation between the use of cognitive process words in dreams and negative emotional content of dreams, even if cognitive process words had no significant relation with negative affective state the following morning.

The mechanisms behind the relations between dreams and morning affect

The findings concerning positive and negative emotional content in dreams and their relation to the following affective state are in concordance with several previous studies on sleep, dreaming and affect (Cartwright et al., 1998; Johnsen, 2017; Kahn, Sheppes, & Sadeh, 2013; Moorcroft, 2013; Nielsen et al., 1991; Schredl, 2018c; Schredl & Reinhard, 2010; Yu, 2007). For example, in the research by Schredl and Reinhard (2010), they found direct relations of both positive and negative dream emotions on individuals' daytime mood. This study's results and the present one's overall results are in line with the continuity hypothesis, which assumes that waking events and sleeping events have a bidirectional influence on each other. However, the finding of the present study that positive emotions in dreams did not have an unambiguous relation to the positive affective state at the individual level, as it should have had based on the continuity hypothesis, implies that one cannot reach a conclusive answer at this stage.

Furthermore, the causality between dream emotions and affective states may be bidirectional. This indicates that it is possible for negative dreams to trigger a negative mood in the morning, but it may also be that one wakes up in a negative mood and for that reason remember one's dream as more negative, or that one experiences negative mood by the act of writing down the dream in itself. This bidirectional causality also applies to the relation between positive dreams and the following positive affective state. Still, it is notable that the present study found that negative emotions in dreams seemed to trigger a negative affective state the following morning, which is a replication of the findings by Johnsen (2017). In Johnsen's research however, there was no indications for positive emotions in dreams having a relation to positive affect in the morning. In contrast, this relation occurred in the present study at the dream level, where the majority of the participants reported being in a positive affective state in the morning.

The emotion regulation theory of sleep and dreaming provides a basis for interpreting the present results. Experiencing emotions in dreams contributes to emotion regulation processes because the dream state offer a safe context in which to explore exposure to diverse emotional stimuli and an arena for learning (Revonsuo, Tuominen, & Valli, 2015; Schwartz & Perogamvros, 2017; Tempesta, Socci, De Gennaro, & Ferrara, 2019). These facts imply that people who are fully rested at wake-up should have a higher level of positive affect. This is supported by the current findings that longer periods of sleep and efficient sleep were connected to having a higher level of positive affect the following morning. But it is hard to

tell if this level of positive affect was caused by dreaming in itself or other active and restorative brain and memory processes of the REM-stage (Cunningham, Pardilla-Delgado, Alger, & Payne, 2014), or by the diurnal pattern of affective states where positive affect usually has a peak in the morning (Golder & Macy, 2011). These aspects were not considered here. This uncertainty about the exact relations between dreams and affects coincide with the current challenges in understanding the functions of dreams, which is in part due to the undetermined neural correlates of the dreaming state (Schwartz & Perogamvros, 2017).

The association between the higher number of words used by the participants to describe dreams and the high level of positive affect, is interesting. An interpretation of this association could be that experiencing positive affect in dreams brought on a state where the participant felt more comfortable to write and share their dream. Another one could be that the process of writing in itself resulted in the positive affective state post-sleep. However, a demonstratable causal relationship cannot be discovered from the collected data. How much one writes about one's dream and the emotional tone in dreams could also be related to individual characteristics such as coping skills, attitudes and personality traits (narcissism), which have been implicated in previous studies (Gilchrist et al., 2007; Hawkins & Boyd, 2017; Yu, 2014). Further, the average word count of 70 words per dream appears to be a common finding, as it can be placed between the average of 204 words found by Niederhoffer et al. (2017), and 54 words reported by Bulkeley and Graves (2018). With a larger sample of dreams, there would have been a better basis for comparing average dream length. The dreams varied greatly in length, which could be due to emotional content in dreams or other external factors, not easily controllable factors (i.e. individual differences, cultural norms, and non-representative samples).

One aspect that could have had an impact on the recall of dreams and reported emotions is the emotional intensity in dreams. This was not measured in the present study. Emotional intensity is implied in the incorporation of daytime events into dreams, and a higher intensity level, which could come from both nightmares and happy dreams, is associated with better dream recall (Scarpelli et al., 2019). It is also an important aspect of the continuity hypothesis and the emotion regulation theory that people usually feel emotionally restored at awakening (Schredl, 2017a; Vandekerckhove & Cluydts, 2010; Walker, 2009). This implies that if all participants got an adequate amount of sleep each night, they would not experience much negative emotions, since sleep deprivation and sleep loss are connected to a higher level of negative feelings in the morning (van der Kloet, Giesbrecht, & Merckelbach,

2015). There is some support for this assumption in the present study, because a higher number of words in dreams had a positive relation to both positive affect and sleep efficiency at the dream level, whereas sleep efficiency and negative affect were negatively related at the dream level. The analyses at the dream level revealed a positive relation between better sleep efficiency and length of sleep and positive affect post-sleep. This finding is supported by the stud by Ong et al. (2017), who found that positive affect is important for the sleep quality. The negative relation between negative emotional content and the length and efficiency of sleep, is comparable to the notion that poor sleep quality makes people experience more negative feelings and less emotion regulation (Mauss, Troy, & LeBourgeois, 2013).

Together, dream emotions, dream content and dream length had a small to moderate relation to of positive and negative affective states in the morning. This is comparable to the findings by Schredl (2009), where he found a moderate relation between dream recall frequency, positive and negative dream emotions and the daytime mood. The dreams collected in the current study contained between 1.5 – 3% emotional words out of the total word count, which is in accordance with the finding of the low frequency of emotional word use found by dream analysis with the LIWC program (Bulkeley & Graves, 2018). Moreover, the fact that not all recalled dreams contained emotional words is normal and well documented in the literature (Domhoff & Schneider, 2018).

Investigating the presence of cognitive content in dreams was only possible at the dream level, and not at the individual level because this sample contained too few participants which influenced the accuracy of the analyses. At the dream level an association was found between the use of cognitive words and report of negative emotional content in dreams. One interpretation could be that when participants experienced negative affect in their dreams, they used more cognitive words to describe their dreams. Another one could be that cognitive and negative emotional words share similarities which the LIWC dictionary does not differentiate between. Cognitive words were generally more common than emotional words and made up about 18% of the total word count, and is in accordance with other types of texts analysed with LIWC, both in Norwegian samples (Goksøyr & Moxnes, 2019) and English samples (Chung & Pennebaker, 2012). Yet, there have been few dream studies that have used LIWC. However, the study by Bulkeley and Graves (2018) found some common language categories for dreams (e.g. focus on the past, first-person singular words, personal pronouns, authenticity, dictionary words, motion, space and home). The researchers also noted that emotional words were a low frequency category.

There is a range of ongoing mental and physiological processes during sleep that are connected with emotion regulation (Walker & van der Helm, 2009). Dream recall *alone* seems unlikely to influence the affective state in the morning, it is more likely that there are several cooperating factors which influence the affective state. People experience affects independent of having dreamt or not, which also apply this study. Other factors that could have influenced people's ability to recall dreams are stress, sleep deprivation, coping style or other underlying mechanisms (Kahn et al., 2013). These make it hard to determine the exact relations between dreaming and waking, and underscores why the current theories about dreaming lack empirical evidence (Schredl, 2018c). And also, neurological research have yet to establish the precise relationship between emotion processes in sleep and waking (Perogamvros & Schwartz, 2015; Tempesta et al., 2018). It is unclear whether dreaming serves a fundamental function for sleep and waking states. Still, dreaming at least has a supportive function on problem solving, memory consolidation, processing reward-related information and emotions, and the regulation of emotion (Perogamvros et al., 2013; Schredl, 2018c; Talamini et al., 2013).

Limitations and strengths

There are some limitations and strengths of this study which should be mentioned. There are common challenges associated with the use of self-report of dreams. Since it was voluntary to report dreams, some information may have been lost to factors beyond the control of this study's framework. For example, it could be that participants were in a home environment, where other activities may have preoccupied the participant before choosing to answer the questionnaire. Besides, the study did not take place in the regulated setting seen in laboratories. The participants received reminders about answering but, still, the response rate varied during the week. Regarding self-report of dreams, this also has some strengths. An advantage with self-report is that it usually increases the reported emotional content of dreams (Gilchrist et al., 2007; Nielsen et al., 1991; Sikka et al., 2018). Also, the affective questionnaire (PANAS) used here is an established and validated instrument (Crawford & Henry, 2004) that underscores internal validity of the study.

Another limitation concerns the compatibility with the continuity hypothesis. To investigate this hypothesis properly, a better integrated design of the study with measures of pre-sleep affective state, events during the day and systematic collection of dream content, should have been used. This would have provided a basis for comparing which events and feelings that influenced each other. The intensity of emotions in dreams influence dream

recall, but this was not considered. This affects the further discussion of the emotion regulation theory, as one needs to include more variables and measuring instruments such as daily and hourly logs or questionnaires of emotional states to get an in-depth view of how dreams and differences in dream content can contribute to emotion regulation.

There were some shortcomings regarding the samples as well. The total number of participants included in the main sample is of adequate size for this study's research question. Unfortunately, the low number of participants and dreams at the individual level was insufficient for the regression to be able to include all dream and control variables. This issue needs to be evaluated with precaution when interpreting the results at the individual level. The fact that the dreams were chosen based on length, could increase the risk of selection bias and decrease representativeness of the chosen dream sample. With the low number of participants in one of the samples and the possible selection bias in this study, this may influence the generalisability to some extent. However, a strength with having repeated measures for seven continuous days is that it provided multiple observations for each participant. Multiple observations support the internal consistency and enhance the validity and reliability of the included dream and affective measures. The results can then be said to be robust and characteristic especially for this sample.

Another shortcoming is that the sample consisted of very few males and this may not be representative of the larger population, which could affect the generalisability and the external validity of the study. One should include a more diverse sample in future studies of dreams and waking affects. On one hand, the convenience sampling method has an advantage by its convenience for the investigators, as the method is less expensive and there is no need for a list of all population characteristics besides the inclusion criteria. On the other hand, convenience sampling has a drawback because one loses variability in the sample, and biases cannot be measured or controlled for (Acharya, Prakash, Saxena, & Nigam, 2013). It is possible that these facts could have influenced the particular sample at the individual level.

A couple of possible limitations and an advantage pertain to the LIWC program. Some participants wrote only a few words, and this could influence the analysis, because if one submits only one word this will be scored as 100% of the total word input and give a score of 100% negative emotional content if the word is in the negative emotion word category. Also, how the dictionary is compiled in LIWC may influence the results. The Norwegian dictionary has not been used specifically on Norwegian dreams, but on other types of text that dreams can be compared with (Goksøyr & Moxnes, 2019). Moreover, English studies have found

LIWC to be a useful instrument for several different texts including dreams (Bulkeley & Graves, 2018; Tausczik & Pennebaker, 2010). There are known differences of the individual and the external ratings of emotional content in dreams (Sikka et al., 2017), but it is possible to avoid this issue when considering the use an instrumental tool as LIWC to analyse written dreams. The use of this program in the present study is advantageous because one avoided personal interpretation of the collected data.

Future perspectives

Future research should explore the emotional and cognitive processes of dreams and how they relate to the waking state more in depth. The findings here are not unanimous but provide a glimpse of what is up for discovery regarding the relations between emotions in dreams and the affective states post-sleep. A better understanding of these processes could be essential for further refinement of models used to analyse the effects of dreams. There are, for example, still conflicting views about how REM sleep modulates the affective tone in memories, and one answer is that it may be different sleep stages and brain areas that work in collaboration to consolidate information (Cunningham & Payne, 2017). The sleep course, and the REM state in particular, can be influenced by pre-sleep emotional inductions (Delannoy et al., 2015), which is a perspective worth considering together with accurate measurements of emotional intensity in dreams, and affective states and individual events throughout the day.

Another interesting perspective for future dream research is the use of different modern technology methods, such as the LIWC program. In this study only four categories were used of the possible eighty categories of the program (Chung & Pennebaker, 2012). The linguistic approach could be an asset in further research. Also, with a larger sample regarding age and gender, focusing especially on dreams could perhaps reveal more about dreams' nature. The culture perspective could also be worth exploring, as it would be interesting to investigate the diversity of dreaming amongst people in different cultures since the occurrence of dreams seem to vary a great deal (Moorcroft, 2013). Replicability in dream research is made easier with dream content analysis (Schredl, 2018a), but there will probably always be some challenges because of the subjective nature of dreams. Also, the advisements from Sikka et al. (2018) indicate that in all dream research one should adhere to the setting, when, and how dreams are collected. In this study the emotions were only divided into positive and negative affective states, and it could be interesting to investigate more specific emotions that appear in dreams. Events and affective states during the day should also be documented to

further support the continuity hypothesis, and it would be interesting to do this over longer or different periods of time.

In a more general perspective dream studies, such as this one, could contribute to clinical insights and perhaps be used in psychological interventions for improvement of mental health. The effect of emotional stress regulation and general emotion regulation of dreams is not clear, but dreaming seem to have a protective function for the processing of negative emotional events and restoration after an emotional impact (Vandekerckhove & Wang, 2018) . Further dream content and affect research may also be done in combination with the neurobiological perspectives and the current neuroimaging techniques on sleep functions and dreams. The exact relations and patterns of neural activation in the amygdala and other cortical and subcortical areas during dream sleep is of future interest. Perhaps such research could help determine more closely how emotions are dependent on bodily homeostatic processes for optimal restoration and daily functions (Palagini & Rosenlicht, 2011).

Conclusion

In sum, the main findings were that reporting more positive emotions in dreams and dreams containing many words, were related to a higher level of positive affective state the following morning. And that having negative emotions in dreams were related to a high level of negative affect in the morning. These results seem to be in line with and substantiate the current theories, hypotheses and models on the continuity between sleep states, dreams and the experience of waking positive and negative affect. Future research should include larger samples, with more heterogeneity regarding gender, age and culture. However, the present results are interesting and inspiring for further investigations, and the LIWC program has proven to be a useful and promising tool in the dream research field. A deeper understanding of the complex nature of dreams and waking state relations could in the long-term benefit theoretical and clinical developments. This study contributes to the notion that dreams having an important psychological function and meaning for people’s daily life.

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Appendix A – The background survey

NTNU
Kunnskap for en bedre verden

Søvn, drømmer, affekt og motivasjon - Bakgrunnskjema

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Informasjon

Invitasjon til å delta i forskningsprosjektet «Søvn, drømmer, affekt og motivasjon»

Formålet med studien er å undersøke relasjoner mellom søvn, drømmer, emosjonell tilstand og motivasjon. Spørreskjemaene er en del av et prosjekt som gjennomføres ved Institutt for psykologi, Norges teknisk-vitenskapelige universitet (NTNU). Du vil nå få noen korte spørsmål om dine søvnvaner og søvnlengde, samt personlighet. Til slutt vil vi spørre deg om din epost-adresse slik at du kan delta på hoveddelen av studien som vil skje i mars. Hovedstudien vil deretter foregå over en periode på 7 sammenhengende dager. Du vil da få epost med link til et spørreskjema som vi ber deg fylle ut hver morgen rett etter at du våkner, et skjema på ettermiddagen, og et senere på kvelden. Dette skjemaet handler om din søvn og drømmer, og hvordan du har det ved oppvåkning, på ettermiddagen og på kvelden. Det tar ca. 5-10 minutter å besvare skjemaet for hver gang. Du samtykker på deltakelse ved å svare på spørreundersøkelsen.

Les under for mer informasjon om studien og klikk deretter på neste for å delta

Dette er et spørsmål til deg om å delta i et forskningsprosjekt som har til hensikt å undersøke variasjon i motivasjon, følelser, drømmer og søvn på forskjellige tider av dagen og hvordan disse påvirker hverandre. Prosjektet er utformet og drives av forskere og studenter tilknyttet NTNU institutt for psykologi. Ansvarlig prosjektleder er psykolog og førsteamanuensis i psykologi Ingvild Saksvik-Lehouillier, og prosjektet drives av forskningsgruppen Occupation, Psychocardiology and Sleep (OPS) ved Institutt for psykologi.
Hvis du er mellom 18 og 35 år, har gode norsk kunnskaper og ikke har en sykdom som i høy grad påvirker din søvn og dagtidsfungering vil vi gjerne ha deg med i studien.

Hva innebærer prosjektet?
Deltakelse innebærer at du svarer på en elektronisk spørreundersøkelse hvor vi spør om bakgrunnsinformasjon som kjønn og alder, personlighet, motivasjon, følelser, søvnighet og søvn som det tar ca 10 minutter å fylle ut. Detter vil du få en ny kortere undersøkelse hver morgen, samt en som er enda kortere kl 16 og kl 21 i en uke. Disse tar det omtrent 5 minutter å fylle ut. For å koble sammen undersøkelsene ber vi deg om å oppgi din epostadresse. Denne vil vi kun bruke for å koble sammen undersøkelsene og vi vil slette denne og erstatte den med et anonymt kodenummer når data er samlet inn.

Mulige fordeler og ulemper
Gjennom deltakelse i forskningsprosjektet vil du få prøve forskjellige spørreskjema og kanskje bli mer bevisst på din egen søvn. Du vil også kunne bidra til forskning hvor vi håper å lære litt om hvordan studenter har det med søvn og studier på vårt institutt i dag. Du vil imidlertid bli bedt om å fylle ut en god del spørreundersøkelser, som til sammen vil ta litt av tiden din, men siden det er bare fem minutter av gangen vil dette forhåpentligvis ikke være en veldig stor ulempe.

Frivillig deltakelse og mulighet for å trekke sitt samtykke
Det er frivillig å delta i studien. Dersom du ønsker å delta, fyller du ut spørreskjemaet og trykker «send». Når du har trykket «send» regnes dette som samtykke til deltagelse i studien og lagring av dine svar på spørreskjemaet og din e-postadresse. Du kan når som helst og uten å oppgi noen grunn trekke ditt samtykke. Dersom du trekker deg fra studien, kan du kreve å få slettet innsamlede opplysninger, med mindre opplysningene allerede er anonymisert eller inngått i analyser eller brukt i vitenskapelige publikasjoner. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg. Denne studien gjennomføres uavhengig av dine studier på NTNU og vil ikke ha noe å si for videre karakterer,

studieprogresjon eller annet. Dersom du ønsker å trekke deg eller har spørsmål til prosjektet, kan du kontakte prosjektleder Ingvild Saksvik-Lehouillier ved Institutt for psykologi, NTNU, på e-post: ingvild.saksvik.lehouillier@ntnu.no eller telefon: 73 55 08 64.

Hva skjer med opplysningene om deg?
Opplysningene som registreres om deg skal kun brukes slik som beskrevet i hensikten med prosjektet. Du har rett til innsyn i hvilke opplysninger som er registrert om deg og rett til å få korrigert eventuelle feil i de opplysningene som er registrert. Du har også rett til å få innsyn i sikkerhetstiltakene ved behandling av opplysningene.
Alle opplysningene du gir vil bli knyttet sammen med din e-postadresse og bli behandlet konfidensielt. De opplysningene som kan knyttes til deg vil bli kryptert (informasjonen blir omformet og kodet slik at den ikke kan leses av uvedkommende) og oppbevart på passordbeskyttede servere ved NTNU. Prosjektleder har ansvar for den daglige driften av forskningsprosjektet og for at opplysninger om deg blir behandlet på en konfidensiell og sikker måte. Informasjonen om deg vil bli slettet senest fem år etter prosjektslutt. I publikasjon av resultatene vil alt presenteres anonymt og det vil ikke være mulig å identifisere enkeltpersoner.
Opplysningene om deg vil bli anonymisert eller slettet senest fem år etter prosjektslutt.

Deling av data og overføringer til utlandet
Ved å delta i prosjektet, samtykker du også til at dine anonymiserte svar på testene kan overføres til utlandet som ledd i forskningssamarbeid og publisering. Det kan være aktuelt å publisere funn fra studien i tidsskrift i for eksempel USA eller Australia hvor innsyn i data kreves. Dette kan være land med lover som ikke tilfredsstiller europeisk personvernlovgivning. Prosjektleder vil sikre at dine opplysninger blir ivaretatt på en trygg måte. Koden som knytter deg til dine personidentifiserbare opplysninger vil ikke bli utlevert.

Forsikring
NTNU har forsikring for alle sine forskningsprosjekt.

Godkjenning
Regional komité for medisinsk og helsefaglig forskningsetikk har vurdert prosjektet, og har gitt forhåndsgodkjenning (2018/1827)
Etter ny personopplysningslov har prosjektleder Ingvild Saksvik-Lehouillier et selvstendig ansvar for å sikre at behandlingen av dine opplysninger har et lovlig grunnlag. Dette prosjektet har rettslig grunnlag i EUs personvernforordning artikkel 6a og artikkel 9 nr. 2 og ditt samtykke.
Du har rett til å klage på behandlingen av dine opplysninger til Datatilsynet.

Kontaktopplysninger
Dersom du har spørsmål til prosjektet kan du ta kontakt med Trine Iren Svendsen, (480 69 608), Lisa Nordhaug (993 57 609) eller prosjektansvarlig Ingvild Saksvik-Lehouillier ved Institutt for psykologi, NTNU, på e-post: ingvild.saksvik.lehouillier@ntnu.no eller telefon: 73 55 08 64.

Personvernombud ved institusjonen er: Thomas Helgesen, e-post: personvernombud@ntnu.no

Tusen takk for at du er villig til å delta!

Vennlig hilsen,

Trine Iren Svendsen
Psykologstudent, NTNU

Lisa Nordhaug
Psykologstudent, NTNU

Prosjektleder
Ingvild Saksvik-Lehouillier
Førsteamanuensis, veileder
Institutt for psykologi, NTNU

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Kort om deg og søvn

1. Kjønn
   - ○ Kvinne
   - ○ Mann
   - ○ Annen oppfatning av kjønn

2. Din alder:
   - ○ 18-25
   - ○ 26 eller eldre

3. Er du student?
   - ○ Ja
   - ○ Nei

4. Hvor ofte pleier du å huske noe av drømmene dine når du våkner?
   - ○ Aldri
   - ○ 1-3 ganger i måneden eller mindre
   - ○ 1-2 ganger i uken
   - ○ 3 ganger i uken eller mer

5. Hvor mange timer foretrekker du å sove hver natt for å føle deg uthvilt?
   - -- None --

6. Har du jobb?
   - ○ Ja, fulltid
   - ○ Ja, deltid
   - ○ Nei

7. Har du jobbet skiftarbeid med nattarbeid den siste måneden?
   - ○ Nei
   - ○ Én gang
   - ○ 2-4 ganger
   - ○ Én gang i uka eller oftere

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Nå følger noen spørsmål som handler om din døgnrytme.

8. Når ville du foretrukket å stå opp hvis du hadde en full dags jobb (8 timer) og kunne velge arbeidstiden selv.

- ○ Før 0630
- ○ 0630-0729
- ○ 0730-0829
- ○ 0830 eller senere

9. Når ville du foretrukket å *legge deg* hvis du hadde en full dags jobb (8 timer) og kunne velge arbeidstiden selv?

- ○ Før 2100
- ○ 2100-2159
- ○ 2200-2259
- ○ 2300 eller senere

10. Hvis du *alltid* måtte legge deg kl 24:00, hvordan ville det da være å sovne inn?

- ○ Veldig vanskelig, ville ligget våken lenge
- ○ Ganske vanskelig, ville ligget våken en stund
- ○ Ganske lett, ville sovnet etter en kort stun
- ○ Lett, ville sovnet praktisk talt med en gang

11. Hvis du *alltid* måtte stå opp kl 06:00, hvordan ville dette vært?

- ○ Veldig vanskelig og ubehagelig
- ○ Ganske vanskelig og ubehagelig
- ○ Litt ubehagelig, men ikke noe stort problem
- ○ Lett - ikke noe problem i det hele tatt

12. Når begynner du vanligvis først å merke at du er trøtt og har behov for søvn?

- ○ Før 2100
- ○ 2100-2159
- ○ 2200-2259
- ○ 2300 eller senere

13. Etter at du har stått opp om morgenen, hvor lang tid tar det før du fungerer helt bra?

- ○ 0-10 min
- ○ 11-20 min
- ○ 21-40 min
- ○ over 40 min

14. I hvilken grad er du en morgenaktiv eller kveldsaktiv person?

- ○ Veldig morgenaktiv (morgenaktiv og kveldstrøtt)
- ○ Til en viss grad morgenaktiv
- ○ Til en viss grad kveldsaktiv

- ○ Veldig kveldsaktiv (morgentrøtt og kveldsaktiv)

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Om deg som person

15. Kryss av for det alternativet for hver påstand som best beskriver deg slik du generelt er

	Veldig feil	Litt feil	Verken eller	Litt riktig	Veldig riktig
Er festens midtpunkt	○	○	○	○	○
Lever meg inn i andres følelser	○	○	○	○	○
Får oppgaver unnagjort med én gang	○	○	○	○	○
Har ofte humørsvingninger	○	○	○	○	○
Har en livlig fantasi	○	○	○	○	○
Snakker ikke mye	○	○	○	○	○
Er ikke interessert i andre menneskers problemer	○	○	○	○	○
Glemmer ofte å sette ting tilbake på rett plass	○	○	○	○	○
Er avslappet mesteparten av tiden	○	○	○	○	○
Er ikke interessert i abstrakte ideer	○	○	○	○	○
Snakker med mange forskjellige mennesker i selskap	○	○	○	○	○
Har medfølelser med andre	○	○	○	○	○
Liker orden og struktur	○	○	○	○	○
Blir lett opprørt	○	○	○	○	○
Har vansker med å forstå abstrakte ideer	○	○	○	○	○
Holder meg i bakgrunnen	○	○	○	○	○
Er egentlig ikke interessert i andre	○	○	○	○	○
Roter ting til	○	○	○	○	○
Føler meg sjelden nedfor	○	○	○	○	○
Har ikke god fantasi	○	○	○	○	○

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Tusen takk for at du vil delta!

16. For at du skal kunne delta i studien behøver vi din epostadresse. Vennligst fyll inn din epostadresse dersom du ønsker å delta. Dobbeltsjekk at adressen er riktig før du trykker "ferdig".

Appendix B – The morning questionnaire

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God morgen!

Dette skjemaet vil nå stille deg en del spørsmål om din søvn, drømmer, følelser og behov. Noen spørsmål kan være vanskelige å besvare helt nøyaktig, men det oppfordres til å gi et så godt anslag som du kan. Det er ikke påkrevd at du besvarer alle spørsmålene for å gå videre i skjemaet. Vennligst besvar alle spørsmålene i én økt. Bryter du av underveis, må du starte på nytt. Husk å trykke «Ferdig» på siste side!

Vennligst fyll ut skjemaet så tett opptil oppvåkningstid som mulig, da man ofte kan glemme detaljer relativt fort. Du kan fylle ut skjemaet uavhengig om du husker å ha drømt eller ikke.

Ved spørsmål knyttet til dette skjemaet, ta kontakt med student Trine Iren Svendsen (tlf: 48069608 e-post: trineire@stud.ntnu.no), Lisa Nordhaug (tlf: 993 57 609, e-post: lisano@ntnu.no) eller prosjektansvarlig førsteamanuensis og psykolog Ingvild Saksvik-Lehouillier (tlf: 73 55 08 64, e-post: ingvild.saksvik.lehouillier@ntnu.no).

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Søvnkvalitet

På denne sida får du en del spørsmål om tidspunkt. Her er noen eksempler på hvordan svare på disse spørsmålene:

- Klokka sju om morgenen = 0700.
- Halv åtte om morgenen = 0730.
- Kl. ti om kvelden = 2200.
- Kvart på tolv om kvelden = 2345.
- Midnatt = 2400.
- Halv ett om natta = 0030.

Vennligst ikke bruk kolon, punktum eller andre tegn når du skal skrive klokkeslett.

1. Når gikk du til sengs i går kveld?

2. Når skrudde du av lyset og la deg for å sove i går kveld?

3. Hvor mange ganger våknet du i løpet av natten?
   Natten er definert som hele søvnperioden fra du skrur av lyset og sovner til du våkner uten å få sove igjen.
   - ○ Ingen ganger
   - ○ Én gang
   - ○ To ganger
   - ○ Tre ganger
   - ○ Fire eller flere ganger

4. Hvor lenge var du våken til sammen i løpet av natten? Vennligst oppgi *antall minutter*.

5. Hvor *plagsomt* var det for deg at du våknet i løpet av natta?

Ikke i det hele tatt	Litt	Moderat	En del	I svært stor grad
○	○	○	○	○

6. Hva var klokka da du våknet i dag tidlig, uten å få sove igjen?

7. Våknet du av vekkerklokke?

- ○ Ja
- ○ Nei

8. Hvordan var siste natts søvn totalt sett?
   - ○ Veldig lett
   - ○ Lett
   - ○ Middels
   - ○ Dyp
   - ○ Veldig dyp

9. Når sto du opp i dag tidlig?

10. Hvordan vil du vurdere din søvnkvalitet?
    - ○ Veldig dårlig
    - ○ Dårlig
    - ○ God
    - ○ Veldig god

11. Kan du huske å ha drømt noe i natt?
    - ○ Ja
    - ○ Nei

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Drømmer

12. Hvis du ikke husker noe av drømmene du har hatt i natt kan du hoppe over denne siden.

Husker du konkret innhold eller sekvenser av drømmen(e)?

- ○ Ja
- ○ Nei

13. Hvor detaljert husker du drømmen(e)?

- ○ Husker mange detaljer
- ○ Husker litt detaljer
- ○ Husker ingen detaljer

14. Hvilke typer følelser hadde du i drømmen(e)?

- ○ For det meste positive
- ○ Både positive og negative
- ○ Nøytrale
- ○ For det meste negative
- ○ Husker ikke

15. Hvis du husker noe av innholdet i drømmen(e), vennligst beskriv det her:

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Følelser

16. Her er en del ord som beskriver følelser og tilstander.
Hvordan føler du deg *akkurat nå*?

	Ikke i det hele tatt	Litt	Moderat	En del	I svært stor grad
Interessert	○	○	○	○	○
Irritabel	○	○	○	○	○
Oppmerksom	○	○	○	○	○
Inspirert	○	○	○	○	○
Opprørt	○	○	○	○	○
Skremt	○	○	○	○	○
Aktiv	○	○	○	○	○
Nervøs	○	○	○	○	○
Begeistret	○	○	○	○	○
Fiendtlig	○	○	○	○	○
Stolt	○	○	○	○	○
Frustrert	○	○	○	○	○
Skamfull	○	○	○	○	○
Sterk	○	○	○	○	○
Redd	○	○	○	○	○
Entusiastisk	○	○	○	○	○
Stresset	○	○	○	○	○
Besluttsom	○	○	○	○	○
Årvåken	○	○	○	○	○
Dårlig samvittighet	○	○	○	○	○

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Søvnighet

18. Hvor søvnig føler du deg *akkurat nå*?

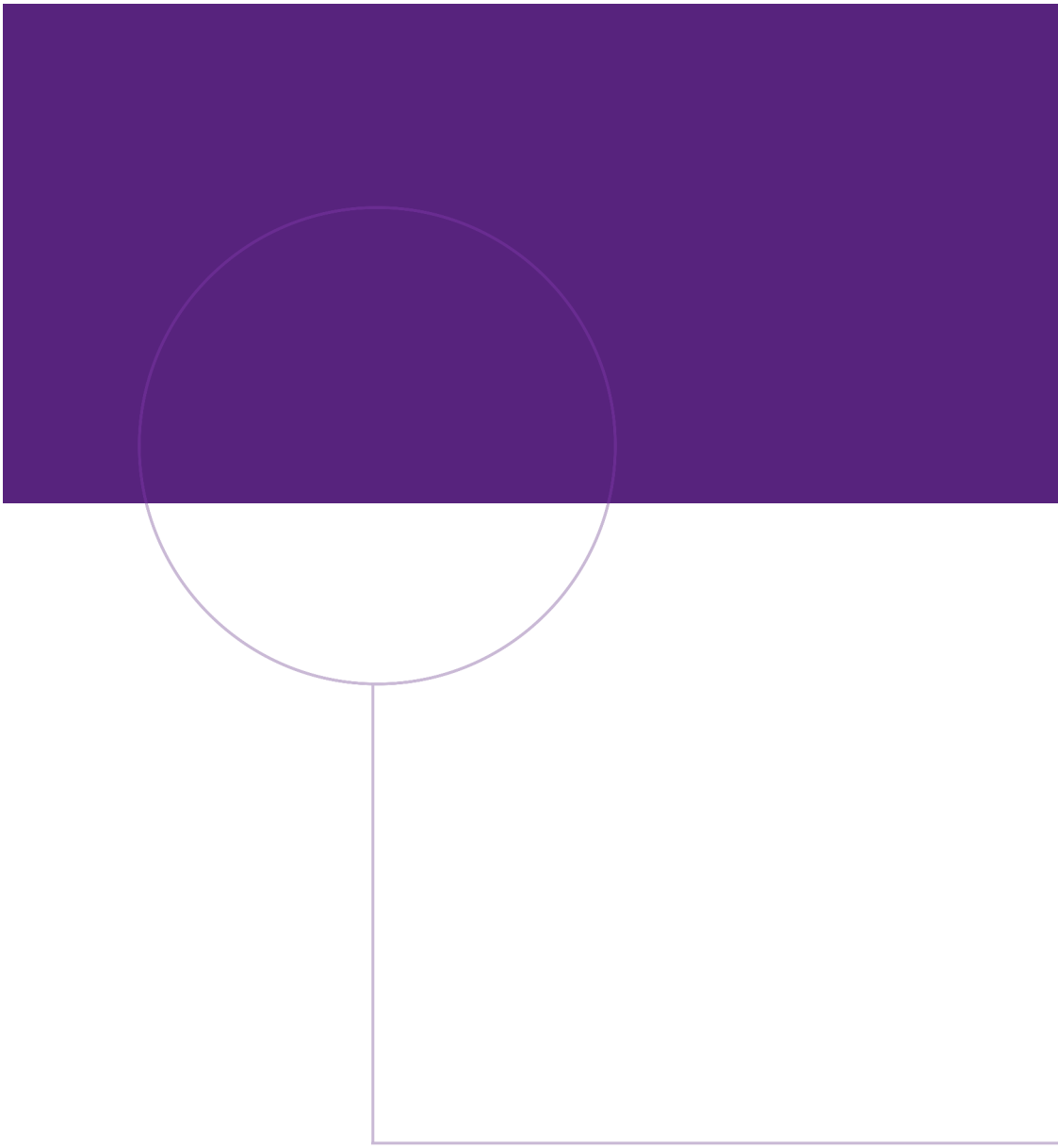
- ○ Veldig opplagt
- ○ Ganske opplagt
- ○ Opplagt
- ○ Litt opplagt
- ○ Verken opplagt eller søvnig
- ○ Litt søvnig
- ○ Søvnig, men ikke anstrengende å være våken
- ○ Ganske søvnig
- ○ Veldig søvnig, kamp mot søvnen, anstrengende å være våken

Appendix C – Log for the dream related changes before linguistic analysis with LIWC

Overview of the changes in the dreams that was done in order to get correct results from the Linguistic Inquiry and Word Count program.

1. In IBM SPSS (version 25): organized all responses from the participants who reported dreams and those who did not in a descriptive table, only keeping the connection between participants' IDs and dreams.
2. Dreams were corrected using Microsoft Word Office ProPlus 365.
3. Edited dreams to correct for Norwegian grammar, deleted superfluous words and signs, translated English and new Norwegian to Norwegian literary language, translated emojis, spaces, inserted commas and periods in sentences, deleted passages where participants wrote things like *"I'm not sure if I can write more in this box"* or that they could not recall more of the dream, corrected big and small letters, and the use of slang words to more proper language (without losing their original meaning):
    a. Translated words:
        i. Joine = bli med
        ii. Navn = venn/venninne
        iii. Instagram/snapchat = sosiale media, bildedelingsmedium
        iv. SMS = melding
        v. Skreenshotter = lagrer
        vi. Email = epost
        vii. Kkørrssten = kjæresten
        viii. St = at
        ix. "my life together" = orden på livet mitt
        x. "hylgrein" = strigråt
        xi. Fade = falme
        xii. Stratos = sjokolade
        xiii. Aom = som
        xiv. Svigers = svigerforeldrene
        xv. Drita = full
        xvi. Fantasyesque = fantasiaktig
        xvii. Etg = etasje
        xviii. Nanny = barnepike
        xix. Hj.tjenesten = hjemmetjenesten
        xx. Snapmap = sosiale media
        xxi. Fun fact = morsomme fakta
        xxii. Seduction = forførende
        xxiii. / = og, eller
        xxiv. Chilla = slappet av
        xxv. Awkward = merkelig
        xxvi. Outro = slutt
        xxvii. Vivid = virkelig
        xxviii. Error of continuation = følgefeil

4. Most of the changed words were substantives and prepositions.
5. Then all dreams were copied from Microsoft Word to Notepad and saved as separate .txt-files which the LIWC2015 program could analyse.
6. LIWC computed a table of categories, and the most interesting ones for this study (word count, positive affect words, negative affect words, and cognitive words) were used further. The words were given in the percentage of the total text word count (Goksøyr & Moxnes, 2019). The scores of these categories were copied over to the SPSS file as new variables and linked to their original IDs.
7. With all the new variables in place, one could run all the relevant statistics analyses in SPSS.



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