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State and trait predictors of negatively toned dreams in women:

A prospective investigation

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Résumé

Bien que les rêves dysphoriques, comme les mauvais rêves et les cauchemars, surviennent du moins occasionnellement chez la majorité des adultes, les facteurs impliqués dans l'occurrence de ces rêves, d'une nuit à l'autre, demeurent incertains. Par le biais d'un devis prospectif multiniveaux, nous avons étudié l'impact interactif des facteurs d'état et de trait sur l'occurrence de rêves dysphoriques d'une nuit à l'autre. Nous avons également exploré dans quelle mesure le contenu affectif et négatif des rêves de tous les jours était affecté par les mêmes facteurs. Des femmes adultes ont complété des mesures de trait de personnalité et de psychopathologie suivies de jusqu'à quatre semaines de journaux quotidiens de rêves et d'anxiété avant le coucher, ainsi que d'inventaires hebdomadaires de stress perçu. En contrôlant pour le rappel de rêve, une hausse hebdomadaire du stress perçu a significativement augmenté la probabilité d'avoir un rêve dysphorique une nuit donnée, alors que la psychopathologie a modéré positivement cette relation. Ces résultats suggèrent que les femmes adultes ayant un niveau plus élevé de psychopathologie seraient particulièrement sensibles au stress quotidien et donc plus susceptibles de faire des mauvais rêves ou cauchemars les nuits suivantes. Les analyses ont aussi révélé des effets positifs différentiels des variables d'état et de trait sur le contenu émotionnel et négatif des rêves de tous les jours. Ces résultats concordent avec le modèle neurocognitif des rêves dysphoriques proposé récemment et l'hypothèse de continuité des rêves. Les implications de cette étude et des recommandations futures sont émises.

Mots-clés: rêves dysphoriques, prospectif, modèle linéaire, anxiété d'état, stress perçu, psychopathologie, charge affective, détresse affective, contenu de rêve, hypothèse de continuité

Abstract

Although disturbing dreams, such as bad dreams and nightmares, are experienced at least occasionally by a majority of adults, the factors involved in the night-by-night occurrence of these dreams remain unclear. Using a prospective design and multilevel modeling, we investigated the interactive impact of state and trait factors on the nightly occurrence of disturbing dreams. We further explored the extent to which emotionally intense and negative everyday dream content was affected by the same variables. Adult women completed measures of personality and psychopathology followed by up to four weeks of daily dream logs, daily pre-sleep anxiety logs, and weekly perceived stress inventories. After controlling for dream recall, upsurges in weekly perceived stress significantly increased the likelihood of having a disturbing dream on a given night, whereas psychopathology positively moderated that relationship. These results suggest that adult women reporting higher levels of psychopathology are particularly sensitive to everyday stress and thus more likely to experience bad dreams or nightmares on subsequent nights. Analyses also revealed differential positive effects of state and trait variables on the emotional and negative content of everyday dreams. These findings are in line with a recently proposed neurocognitive model of disturbed dreaming and the continuity hypothesis of dreaming. The implications of this study and future recommendations are emitted.

Keywords: dysphoric dreams, prospective, linear model, state anxiety, perceived stress, psychopathology, affect load, affect distress, dream content, continuity hypothesis

Table of contents

4

List of tables

List of figures

List of appendixes

List of abbreviations

GEE   Generalized Estimating Equations

GSI   General Symptom Index of the SCL-90-R

HVC   Hall and Van de Castle (coding system)

OR   Odds ratio

PTSD   Posttraumatic stress disorder

SCL-90-R   Symptom-Checklist-90-Revised

WSI   Weekly Stress Inventory

To

Nightmares

&

Acceptance

Acknowledgements

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Foreword

This master's thesis contains a scientific article embedded as an independent section. Although this thesis was written with the intent to minimize repetitions between its sections and the scientific article, some repetitions were necessary as the article is meant to stand alone. Furthermore, please be advised that *Figure 1* of the article was named *Figure 2* in order to avoid any confusion with the first figure presented in this master's thesis.

Section 1 – Introduction

Dreaming is a rich and unique sleep-related experience considered to be psychologically meaningful by many contemporary dream theorists (Domhoff, 2003; Hartmann, 2010; Revonsuo, 2000; Wamsley, 2013). The nature of dream content has been widely studied within the framework of the continuity hypothesis of dreaming, a model that views dreams as a reflection—or an embodiment of—the dreamer's waking concerns, thoughts and activities. Despite several decades of dream research, the extent to which dreaming is continuous with various dimensions of waking life as well as the nature of this continuity remains to be elucidated and continues to be subject to debate.

One particularly vivid and emotionally intense category of dream experiences are disturbing dreams, which include bad dreams and nightmares, the latter of which can awaken the sleeper due to its intensely dysphoric nature. Contrary to the recurrent nightmares associated with traumatic events or full-blown post-traumatic-stress-disorder (PTSD; Pigeon, Mellman, & Pigeon, 2017), the vast majority of everyday disturbing dreams—though ubiquitous in the general population—are considered to be idiopathic, or without a known cause. That said, evidence indicates that the daytime experiences that evoke strong emotional responses in individuals are the most likely to find their way into dreams (Eichenlaub et al., 2018; Malinowski & Horton, 2014; Schredl, 2006), including disturbing dreams, and that dream content is reactive to the experience of naturalistic and experimental stressors (De Koninck & Koulack, 1975; Duke & Davidson, 2002).

In light of this literature, as well as within the context of a recently proposed neurocognitive model of disturbed dreaming (Levin & Nielsen, 2007), the goal of the present thesis is to investigate the impact of key state and trait factors associated with negative affectivity on the nightly occurrence of disturbing dreams. A diathesis-stress interaction in predicting the occurrence of such dreams will also be tested. Finally, this thesis further explores the extent to which emotional and negative everyday dream content is affected by similar state and trait variables.

The present thesis is divided into three main sections. The first section begins with an overview of dreams in general with a focus on the continuity hypothesis of dreaming and

disturbed dreaming. This next section details Levin and Nielsen's neurocognitive model of disturbed dreaming and reviews evidence supporting the role of state and trait factors of disturbed dreaming. Gender differences in the frequency of disturbed dreaming as well as general dream recall are also explored. This first section ends with a presentation of methodological considerations addressed by the present research as well as the project's objectives and hypotheses. The second section is comprised of a scientific article submitted for publication. The third and final section presents secondary and exploratory analyses for the main article along with a discussion of the project's findings, limitations, and suggestions for future research.

Dreaming

> Je dois rejoindre des amis pour célébrer l'anniversaire d'une amie. Le rendez-vous est dans le Vieux-Montréal. Il fait froid, il pleut, c'est la nuit. Je n'arrive pas à me souvenir de l'adresse exacte du lieu du *party*. Je marche seule dans les rues mouillées, je suis de plus en plus trempée. Je cherche tellement longtemps qu'à un moment donné, j'abandonne et je veux rentrer chez moi. Sur la route vers le métro, je vois un loup dans une rue. J'ai peur mais je me dis que peut-être, il ne m'a pas vu. Je continue. Erreur… il m'a vu et il me poursuit. Il se met à courir après moi. Je cours mais de façon lucide je me dis que si j'arrête et tente d'entrer en contact avec lui, il ne me fera aucun mal. Je m'arrête, me retourne vers lui. Moment d'attente et d'appréhension. Je me dis « Ça va marcher, il ne me fera pas de mal ». Je lui tends la main, la paume vers le sol, comme il est conseillé de faire avec les chiens. J'avance doucement la main. Il me regarde, doucement. Ma main arrive à son museau, je suis presque confiante. Arrivée à sa gueule, le loup me mord, doucement mais très fort. Il me mord tellement fort que ça me réveille. — 33 year-old woman

Dreaming is considered a state of consciousness that occurs during sleep and which involves various mental experiences including perceptions, thoughts and emotions (Stickgold, 2017). One aspect of dreams that renders their scientific study difficult is that their contents cannot be measured directly. Instead, they have to be recalled by the sleeper upon awaking and then communicated (e.g., verbally or in writing) to the experimenter. Thus, scientists never study dreams *per se*, but rather the reports of these dream experiences. The dream above, as relayed in written form by an adult woman, illustrates some common features of dreams, including bizarreness (e.g., wolf in the street) and emotionality (e.g., apprehension and fear). Indeed, bizarreness (content elements that are distorted or highly improbable in comparison to normal waking life) is one of the hallmark features of typical dreaming. Although it is difficult to quantify

and can be defined in a myriad of ways, dream bizarreness (including scene shifts and occurrence of highly unlikely or impossible events) has been found to occur in 75% of everyday dreams (see for a recent review, Zadra & Domhoff, 2017). Furthermore, depending on the studies, between 70% and 100% of dream reports are described as containing emotions (Fosse, Stickgold, & Hobson, 2001; Foulkes, Sullivan, Kerr, & Brown, 1988; Merritt, Stickgold, Pace-Schott, Williams, & Hobson, 1994; Nielsen, Deslauriers, & Baylor, 1991; Sikka, Valli, Virta, & Revonsuo, 2014). Sometimes, dream affect can be recalled with no other recollection of the dream's details (Schredl & Reinhard, 2009). Research on the emotional content and valence of everyday dreams gives rise to differing pictures depending whether dream affect is scored by external judges versus the dreamers themselves. Dreams are generally found to be more frequently negative when scored by external judges, while they are more likely to be described as containing positive emotions—or equally balanced emotions—when scored by the dreamer (see chapter on Methodological considerations for details).

Alongside the bizarre and emotional qualities of typical everyday dreaming, other elements frequently reported in adults' dreams include the presence of the dreamer along with other characters, especially known individuals, who are often interacting with the dreamer or engaged in various activities (Dale, Lortie-Lussier, Wong, & De Koninck, 2016; Domhoff, 1996; Zadra & Domhoff, 2017). Moreover, the overall content of dreams is similar across cultures (Dale et al., 2016; Domhoff, 1996) as well as relatively stable throughout adulthood (Lortie-Lussier, Côté, & Vachon, 2000; Schredl, 2013). Finally, although there exist great individual differences, dream recall is generally highest in children and has been found to gradually decrease from adolescence into advancing adulthood (Chivers & Blagrove, 1999; Nielsen, 2012; Schredl, 2008). On average, adults recall about one dream per week (from a representative German sample, Schredl, 2008), although some people may only remember a dream every few years while others report multiple dreams per night (see chapter on Methodological considerations for details).

Continuity hypothesis of dreaming

Nos occupations et nos préoccupations habituelles exercent une grande influence sur la nature de nos rêves, qui sont généralement comme un reflet de notre existence réelle. (d'Hervey de Saint-Denys, 1867, p. 28)

As shown by this quote by Léon d'Hervey de Saint-Denys, a professor of ethnography at the College of France with a keen interest in dreams, the idea of a continuity between our waking and dreaming lives is nothing new. However, over the past 50 years, this conceptualization of dreams has developed into one of the most widely studied frameworks for investigating and understanding the nature of dream content. The *continuity hypothesis* of dreaming, originally proposed by Bell and Hall, (1971) and further developed by Hall and Nordby (1972), proposes that the content of dreams reflects the dreamer's thoughts, concerns and salient experiences (Domhoff, 1996, 2003; Schredl, 2003). Although some common waking experiences remaining, such as reading, writing, and calculating, are rarely reported in dreams (e.g., Hartmann, 2000)—possibly due to cognitive and representational limitations in dreams—the continuity hypothesis has gathered much support from a variety of studies (e.g., DeCicco, Lyons, Pannier, Wright, & Clarke, 2010; Klůzová Kráčmarová & Plháková, 2015; Lortie-Lussier et al., 2000; Malinowski & Horton, 2014b; Pesant & Zadra, 2006; Schredl & Reinhard, 2009).

Two spheres of waking life that have been shown to be particularly continuous with dream content are social and emotional experiences. First, social interactions are overrepresented in dreams when compared to other content elements (Domhoff, 1996; Schredl & Hofmann, 2003). Not only are close social ties frequently incorporated into one's dreams (Domhoff, 1996; Zadra & Domhoff, 2017), but the nature of these relationships are also strongly mirrored in the dreamer's interactions with the analogous dream characters (Domhoff, 2003; Schredl, 2013). Furthermore, evidence suggests that this social continuity with dreaming might be more strongly associated with waking thoughts and preoccupations of a social nature rather than with actual waking social behaviors (Chen et al., 2015; DeCicco, Humphreys, & King, 2009; Schredl & Mathes, 2014). Second, positive and negative emotions experienced during wakefulness have been found to be reflected in subsequently experienced dream emotions (Gilchrist, Davidson, & Shakespeare-

Finch, 2007; Malinowski & Horton, 2014; Schredl, 2009a; Sikka, Pesonen, & Revonsuo, 2018). Moreover, emotions experienced during wakefulness are preferentially reflected in the emotional intensity of dreams as opposed to their valence (Cartwright, 1991; Schredl, 2006). Much of this research, however, has focused on negative and dysphoric emotions and associated dream content.

Disturbed dreaming

One type of dreaming that stands out by virtue of its vividness and presence of strong negative emotions is *dysphoric* or *disturbed dreaming* (Levin & Nielsen, 2007). Some researchers have highlighted the importance of differentiating between dysphoric dreams that cause an awakening (i.e., nightmares) and those that do not (i.e., bad dreams; (Halliday, 1987; Zadra & Donderi, 2000). For instance, bad dreams may be remembered in the morning following a natural awakening or from an alarm clock, or be recalled later in the day. While the use of the *awakening criterion* to differentiate nightmares from bad dreams have yielded highly informative results (e.g., Blagrove & Fisher, 2009; Blagrove & Haywood, 2006; Robert & Zadra, 2014; Zadra & Donderi, 2000), some researchers prefer the relative simplicity of grouping most forms of disturbed dreaming together.

The continuum of disturbed dreaming

One recent study (Robert & Zadra, 2014) of almost 10 000 home dream reports from 572 participants, compared the content of approximately 700 bad dreams and nightmares collected as part of the study. Of the 10 000 dreams, about 3% were nightmares and another 11% were bad dreams. Thus, about one out of every seven dreams recalled by people in their natural sleep environment contained strong negative emotions. In addition, the authors found that while nightmares were self-rated as being significantly more emotionally intense and bizarre than bad dreams, over 75% of both types of disturbing dreams included negative triggering events and that in over 60% of cases, these triggers occurred during the first third of the dream narrative. While fear was the most frequently reported emotion in these dream reports, about 35% of the nightmares and over half of the bad dreams contained other negative but equally intense emotions, including anger, sadness, confusion and disgust. Finally, nightmares were significantly

more likely than bad dreams to contain themes of physical aggression, being chased, evil forces and accidents, whereas themes of interpersonal conflicts were significantly more frequent in bad dreams. Based on this evidence, it appears that most disturbing dreams contain threats to survival, security, or self-esteem. Moreover, the findings also show that while nightmares and bad dreams share many characteristics, nightmares, with their more intense emotions, greater bizarreness, and tendency for more violent themes, represent a rarer and more severe expression of the same basic phenomenon.

Thus, disturbed dreaming has been conceptualized on a spectrum ranging from mild dysphoric dreams, to bad dreams, to idiopathic nightmares to recurrent traumatic or PTSD-related nightmares (Levin & Nielsen, 2007; Zadra & Donderi, 2000). Complementary evidence also supports this conceptualization of disturbed dreaming (Antunes-Alves & De Koninck, 2012; Levin, Fireman, Spendlove, & Pope, 2011; Schredl, 2003b). For instance, the more frequently one experiences nightmares, the more one's everyday dreams are likely to contain negative as well as intense emotions (Antunes-Alves & De Koninck, 2012; Schredl, 2003b).

Predicated on these conceptions of disturbed dreaming, the dream report of the 33 year-old woman featured at the start of this section can be viewed as a nightmare as it includes many of the nightmare features discussed in this chapter: a negative event as a trigger (the appearance of a wolf), strong negative emotions (fear and apprehension), a theme of being chased (by a wolf), physical aggression (the wolf biting the dreamer), and an awakening likely related to the intensity of the dream experience.

Prevalence of disturbed dreaming

For many reasons, the prevalence of disturbing dreams in the general population is difficult to estimate. First, as mentioned previously there is no consensus on research definitions of nightmares, let alone disturbing dreams. For instance, some researchers do not differentiate between nightmares that do not awaken the sleeper and those that do (e.g., Chivers & Blagrove, 1999) or consider bad dreams or highly unpleasant dreams that awaken the sleeper as nightmares (Blagrove & Fisher, 2009; Weinberg, Noble, & Hammond, 2015). Others assess nightmare occurrence while using the terms disturbing dreams and nightmares interchangeably (e.g.,

Klůzová Kráčmarová & Plháková, 2015). In addition, some researchers do not define nightmares for their participants (e.g., Rek, Sheaves, & Freeman, 2017) which can lead to interpretation and personal biases on the part of the participants. Second, the prevalence of disturbing dreams has been assessed in different ways, including with home dream logs as well as retrospective questionnaires which tend to underestimate disturbing dream frequencies (see Methodological considerations chapter for details). Third, the prevalence of disturbing dreams has also been reported in different ways: frequencies over a certain period (e.g., mean nightmares per month or year; Li, Zhang, Li, & Wing, 2010), percentage of participants reporting one or more nightmares over the study's duration (e.g., Fireman et al., 2014), percentage of participants reporting nightmares on an ordinal scale (e.g., frequently, occasionally, never; Sandman et al., 2015), percentage of disturbing dreams found in larger samples of everyday dreams (e.g., bad dream and nightmares; Robert & Zadra, 2014).

That being said, between 7% to 95% of adults have reported experiencing at least one nightmare per year (Blagrove, Farmer, & Williams, 2004; Schredl, 2003b; Wood & Bootzin, 1990). Approximately 2-5% of the general population report having one or more nightmares per week, which is considered a clinically significant level of occurrence (Pigeon et al., 2017). Furthermore, as previously discussed, one study of almost 10,000 home dream reports found that bad dreams and nightmares constitute about 13% of all home dream reports (Robert & Zadra, 2014) with bad dreams occurring about 3 to 4 times more often than nightmares (Fireman et al., 2014; Zadra & Donderi, 2000). Generally, disturbed dreaming is more frequent in younger adults (Nielsen, Stenstrom, & Levin, 2006; Nielsen & Paquette, 2007; Salvio, Wood, Schwartz, & Eichling, 1992) and occurs both more frequently and in a greater proportion of women than men (Blagrove et al., 2004; Fireman et al., 2014; Merritt et al., 1994; Nielsen et al., 2006; Sandman et al., 2015; Schredl, 2010; Schredl & Reinhard, 2011).

Theories and functions of dreaming

Over the past decades, numerous theories regarding a potential function of dreaming have been put forth (for an overview, see Domhoff, 2017). For instance, several theories propose that dreaming is a form of simulation of waking life (Domhoff, 2015; Domhoff & Schneider, 2018)

and that the functional role of dreaming is intimately tied to this simulation. Among the better known of such theories is the *threat simulation theory* of dreaming which argues that dreaming evolved to simulate threatening events from our environment in order to rehearse adaptive responses to such threats, thereby facilitating the successful avoidance of or dealing with such threats in waking life (Revonsuo, 2000), and the *social simulation theory* which posits that dreaming evolved to simulate people's waking social lives and concerns (Revonsuo, Tuominen, & Valli, 2015).

Other contemporary theories of dreams are centered around *memory consolidation processes* related to different sleep stages (e.g., Payne, 2010; Wamsley & Stickgold, 2011) and that dreaming reflects (while not playing a direct functional role) in those neurobiological processes. Since dreaming cannot be observed directly or independently from the underlying sleep stage out of which it arises, it is difficult to discriminate what can be attributed to a biological or adaptive function related to sleep versus dreaming *per se*.

In addition, although many contemporary dream theorists consider dreams to be psychologically meaningful products of the brain and agree that they show close relations to waking life elements in general and current concerns and emotionally salient experiences in particular (e.g., Domhoff, 2003; Hartmann, 2010; Revonsuo, 2000; Wamsley, 2013; Hobson & Schredl, 2011), many of these theorists nevertheless believe that dreams serve no biological function. Others have argued that dream content is essentially random, devoid of psychological significance and ultimately represent a by-product of brain activity during sleep and that that they serve no particular function (e.g., the protoconsciousness theory; Hobson, 2009).

The issue regarding a possible adaptive or biological function of dreaming as well as the nature of continuity versus discontinuity between the waking life elements and dream content lives remain hotly debated (e.g., see discussion in Hobson & Schredl, 2011 and subsequent commentaries; Blagrove, 2011; Domhoff, 2011; Hoss, 2011; Malinowski & Horton, 2011; Schredl, 2012). Overall, whether dreaming serves a definite adaptive function or many possible functions, whether these functions are dependent on the types of dreams experienced (e.g., everyday

dreams, emotionally charged dreams, affectedly neutral dreams, nightmares, lucid dreams etc) and/or on their underlying sleep-related processes remains to be determined.

Nevertheless, and consistent with the notion that dreaming is continuous with key facets of waking life (e.g., emotionally salient experiences and current thoughts and concerns), the emotional nature of dreaming has given rise to several theories suggesting that dreaming in general, and REM-sleep dreaming in particular, is involved in emotional regulation or processing (for a recent review, see Scarpelli, Bartolacci, D'Atri, Gorgoni, & De Gennaro, 2019). Examples of such theories include the emotion-processing model of dreaming (Hartmann, 1996), the emotion regulation function of dreaming (Cartwright, 2011; Kramer, 2013) and the emotion assimilation theory of sleep and dreaming (Malinowski & Horton, 2015). One of the better developed and often-cited theories in the field of dream research is the neurocognitive model of disturbed dreaming developed by Levin and Nielsen (2007, 2009) detailed below.

Neurocognitive model of disturbed dreaming

Levin and Nielsen's integrative and widely-cited neurocognitive model of disturbed dreaming (2007, 2009) takes into account cognitive-emotional as well as neurobiological aspects underlying the production of a wide range of disturbing dreams. This model is the theoretical anchor for the present master's thesis conceptualization of disturbed dreaming and underlies the experimental hypotheses put forth.

Assumptions underlying the model

Levin and Nielsen's neurocognitive model is couched within several key assumptions, including specific conceptions of disturbed dreaming. First, the authors assume a *cross-state continuity* between the waking and sleeping states which supposes that some of the same processes involved in the production of nightmares (e.g., increased emotional reactivity to negative events and general psychological distress) also play a role in the manifestation of pathological symptoms during the day (Levin & Nielsen, 2007, p. 495). Second, their *multilevel* model (p. 497) supposes that the processes underlying disturbed dreaming can be best understood by considering cognitive-emotional as well as neurobiological substrates likely involved in their production.

Third, consistent with the research mentioned above, the authors conceptualize disturbed dreaming on a continuum ranging from mildly unpleasant dreams, to idiopathic bad dreams, to severe recurrent nightmares associated with PTSD. This conception lead Levin and Nielsen (2007) to propose that all forms of disturbing dreams can be explained to varying degrees by similar underlying factors.

The cognitive-emotional branch of the model

In the cognitive-emotional branch of the model, termed *affect network dysfunction*, the authors introduce two categories of factors involved in the production of disturbing dreams, namely *affect load* and *affect distress*. The concept of *affect load*, defined as the "ongoing accumulation of stressful and emotional negative events" (Levin & Nielsen, 2009, p. 85), is conceptualized as a state variable with significant day-to-day fluctuations. By contrast, *affect distress*, defined as "a dispositional tendency to experience heightened distress in response to emotional stimuli" (p. 85), is viewed as a relatively stable trait factor. Thus, the higher one's level of affect load and affect distress, the greater the likelihood of experiencing disturbing dreams.
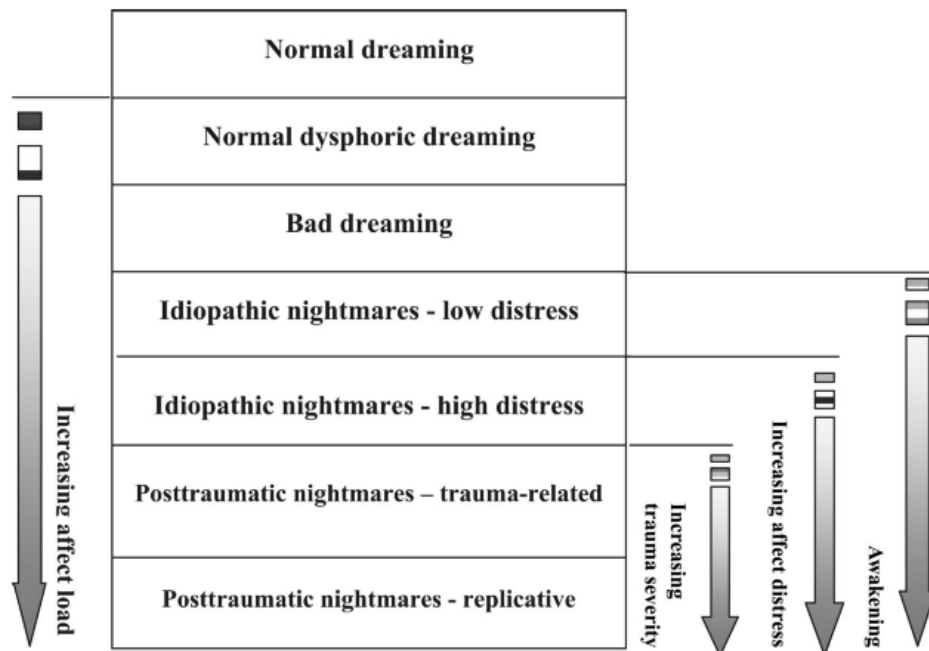
Figure 1. Typology of dreaming organized by increasing affect load, affect distress, and trauma severity (Levin & Nielsen, 2007, p. 486). Copyright 2007 by the American Psychological Association.

23

Levin and Nielsen (2007, 2009) further suggest that affect load increases the likelihood of experiencing all types of disturbing dreams (e.g., everyday dysphoric dreams, bad dreams, nightmares), whereas affect distress would play a preferential role in the experience of more severe types of disturbed dreaming, such as idiopathic nightmares and recurrent trauma-related nightmares (Figure 1). Finally, more severe types of disturbing dreams would, in turn, result in high levels of waking distress (i.e., waking emotional distress experienced following the experience of a disturbing dream), whereas less severe types (e.g., everyday dysphoric dreams and bad dreams) would result in little or no waking distress.

Diathesis-stress interaction

The notion of diathesis-stress modeling, developed in the context of psychopathological disorders, signifies that the development of such disorders results from an interaction between predispositional (or trait) factors and everyday stress (or state-related factors). Levin and Nielsen (2007) adhere to this interactive view by proposing that the frequency and intensity of dysphoric dreams is determined by an interaction between everyday fluctuations in emotional stress (affect load) and variations in people's disposition to respond to everyday stressors with strong negative emotions (affect distress). Thus, the authors propose that people with high levels of affect distress may be more reactive or sensitive to everyday stressors and thus more likely to experience disturbing dreams than people faced with similar stressors, but with naturally low levels of affect distress.

The neurobiological branch of the model

A few years after the Levin and Nielsen's initial model of nightmare production, the authors developed a complementary, neurobiological side to the model. Named the AMPHAC network, this added component describes the possible neural substrates involved in the production and recall of disturbing dreams (Levin & Nielsen, 2009). This neurobiological conceptualization owes its name to the brain regions believed to be involved in disturbed dreaming production, namely the amygdala (A), the medial prefrontal cortex (MP), the hippocampus (H), and the anterior cingulate cortex (AC; p. 85). Given that the aim of the present project is to test a prediction

derived from the affect network dysfunction part of the model, little focus is given to the added neurophysiological aspects of the model as part of this master's thesis.

State and trait factors of disturbed dreaming

Before examining the state and trait factors of negatively toned dreaming, it is important to highlight key differences between the concept of state versus trait factors. The concept of a personality *trait* is generally defined as a stable characteristic, whereas psychological *state* variables refer to various categories of experiences (such as everyday stressors) that can readily fluctuate over time due to different situations encountered in people's lives (see dissertation, Bieg, 2013). This distinction has led, for instance, to the development of two distinct measures of anxiety, both widely used in research: one measuring how anxious a person feels at a specific moment in time and the other measures how anxious people feel in general, regardless of changes in circumstances (State-Trait-Anxiety-Inventory; Spielberger, Corsuch, & Lushene, 1970). Levin and Nielsen's (2007) concept of affect load is viewed as a state factor, whereas affect distress is conceptualized as a trait factor.

Influence of affect load on disturbed dreaming

Studies on the impact of different stressors, perceived stress and state anxiety on dreams provide strong support for affect load as a state factor of disturbed dreaming. Generally, the investigation of the relation between stress and dreaming has been assessed either via the administration of pre-sleep experimental stressors, or through the study of the effects of exposure to naturalistic or real-life stressors. When compared, findings from these two research approaches have been contradictory and suggest that experimental and naturalistic stressors have differential effects on dreams. For instance, when investigated in relation to either acute or chronic real-life stressors (e.g., Armitage, 1992; Pagel, Vann, & Altomare, 1995), dream recall tends to increase in women while remaining constant or decreasing in men. By contrast, experimentally induced stressors are associated with lowered dream recall in women and little to no changes in men (Goodenough, Witkin, Lewis, Koulack, & Cohen, 1974; Segall, 1980).

Given these observations, and the fact that the proposed research involves naturalistic stressors, research on the relation between dream content and real-life stressors will be examined in greater detail. Research on the emotional sources of disturbed dreaming has mainly focused on nightmares following traumatic events, especially in relation to PTSD, with some work also being done on dreams in relation to major stressors, but with little attention given to minor and everyday stressors.

Traumatic and major stressors

Severe and recurrent nightmares that occur in the wake of a trauma and that often simulate aspects of the event vividly are one of the hallmark features of patients suffering from PTSD (see for a review, Pigeon, Mellman, & Pigeon, 2017). A wealth of clinical research points to traumatic and major stressful events as frequent predictors of nightmares and other forms of disturbed dreaming. Moreover, contemporary research is converging towards the notion of stress as a key factor influencing the occurrence of disturbing dreams. Consistent with PTSD research, the frequency of nightmares and other forms of disturbed dreaming (e.g., bad dreams) has been positively associated with the occurrence of traumatic events and major stressors such as combat exposure (Loveland Cook, Caplan, & Wolowitz, 1990), life-threatening injury (Mellman, Bustamante, Torres, & Fins, 2001), 9/11 (Nielsen et al., 2006), earthquakes (Wood, Bootzin, Rosenhan, Nolen-Hoeksema, & Jourden, 1992), sexual assault (Krakow, Tandberg, Barey, & Scriggins, 1995), childhood adversity (Csóka, Simor, Szabó, Koppa, & Bódizs, 2011; Duval, McDuff, & Zadra, 2010) as well as general measures of major life events (Picchioni et al., 2002; Zadra & Donderi, 2000). The majority of this research, however, did not assess if, how, or the extent to which the stressor affected each study participant, making it difficult to draw inferences on the mechanisms involved in the generation of such dysphoric dreams.

A study following a major earthquake in the San Francisco bay area illustrates in compelling fashion the importance of measuring one's emotional reaction to a stressor as opposed to simply assessing the exposure to it. Wood et al. (1992) compared nightmare frequency and anxiety at different points in time between undergraduate students from the San Francisco bay area and from Arizona (control condition). As predicted, students closer to the natural disaster had more nightmares following the event. More importantly, however, students'

levels of anxiety during the earthquake was significantly correlated with nightmare frequency, whereas their level of anxiety after the event as well as their self-rated level of perceived danger in relation to the earthquake was not. These results suggest that it is the distress experienced at the time of the stressor's occurrence—as opposed to mere exposer to such events—that is responsible for the observed increases in nightmare frequency.

Everyday perceived stress and anxiety

Researchers have increasingly turned their attention to everyday and stressor-related emotional distress (akin to affect load) as factors influencing everyday negatively toned dreaming. Although scarce, there is evidence of positive associations between the frequency of disturbing dreams (i.e., nightmares and recurrent dreams) and subjective measures of stress, including perceived stress (Kroth, Thompson, Jackson, Pascali, & Ferreira, 2002; Weinberg et al., 2015), psychological distress (Klůzová Kráčmarová & Plháková, 2015; Schredl, 2003b) acute stress (Blagrove et al., 2004) and minor stressors (Duke & Davidson, 2002; Schredl, 2003b). However, these findings have mainly relied on retrospective one-time assessments of both general perceived stress and estimates of disturbing dream frequency (e.g., for the past week or month preceding the study) which are subject to participant memory biases and inaccurate estimates, and which do not allow for day-by-day analyses (see Methodological considerations chapter for details). Frequent nightmares, however, have been associated with high levels of daily emotional distress (e.g., stress, anxiety and depression) experienced both during the daytime (Klůzová Kráčmarová & Plháková, 2015; Loveland Cook et al., 1990; Zadra & Donderi, 2000) and prior to bedtime (Antunes-Alves & De Koninck, 2012; Blagrove & Fisher, 2009; Cellucci & Lawrence, 1978), with some contradictory findings (Levin & Fireman, 2002).

Aside from the replicative trauma-related nightmares reported by people suffering from PTSD, research on the effects of non-traumatic real-life stressors on dream content reveals a near total absence of episodic memories of the events in dreams, including dysphoric dreams. Instead, these dreams may only feature distorted or metaphorical representations—if any—of such events (Delorme, Lortie-Lussier, & De Koninck, 2002; Hartmann & Brezler, 2008; Kron, Hareven, & Goldzweig, 2015). These findings are consistent with the observation that episodic memories of any kind occur in 0.5% to 2% of everyday dreams (Fosse, Hobson, & Stickgold, 2003; Malinowski

& Horton, 2014). Thus, thematic elements related to a major stressor, as opposed to its veridical repetition, have been shown to be more readily incorporated into dreams (Cartwright, 1991; Cartwright, Agargun, Kirkby, & Friedman, 2006; DeCicco et al., 2010; Propper, Stickgold, Keeley, & Christman, 2007).

In addition, there is some evidence showing that waking events incorporated into dreams may be more emotional and intense, but not necessarily more stressful or of a particular tone, than those that are not incorporated into dreams (Malinowski & Horton, 2014; Schredl, 2006). There is also support for a continuity between waking negative affect (e.g., stress and anxiety) and negative dream emotionality (Gilchrist et al., 2007; Kroth et al., 2002; Malinowski & Horton, 2014; Schredl, 2009a; Sikka et al., 2018), but with few exceptions (Delorme et al., 2002; Samson-Daoust, Julien, Beaulieu-Prévost, & Zadra, 2019).

In sum, while emotionally salient experiences are more likely to be incorporated in people's dreams, a vast majority of research in this area has been retrospective in nature, purely correlational, and did not make use of objective and validated instruments to quantify dream content (see Methodological considerations chapter for details).

Influence of affect distress on disturbed dreaming

While stress seems to be an important factor in disturbing dream production, not all people who experience stress experience disturbing dreams. This suggests that certain individuals might be more vulnerable or sensitive than others to the effects of stress on dream content. The predispositional component of Levin and Nielsen's neurocognitive model of disturbed dreaming (affect distress) can be operationalized with measures of psychopathology as well as the general distress generated by disturbing dreams.

Psychopathology

In addition to PTSD, nightmare frequency has been associated with an array of psychiatric disorders, including schizophrenia, bipolar disorder and anxiety disorders (see for a review, Skancke, Holsen, & Schredl, 2014). Consistent with clinical research, studies of students and healthy adults have consistently found higher levels of psychopathological symptoms to be

associated with increased frequency of disturbing dreams, including nightmares, bad dreams and recurrent dreams (Blagrove et al., 2004; Blagrove & Fisher, 2009; Brown & Donderi, 1986; Chivers & Blagrove, 1999; Lancee & Schrijnemaekers, 2013; Levin & Fireman, 2002; Levin et al., 2011; Zadra & Donderi, 2000; Zadra, O'Brien, & Donderi, 1998).

Psychopathology, however, encompasses many dimensions and several studies in the field of dream research have operationalized this construct by using the general psychopathological symptomatology scale (General Symptom Index, GSI, of the Symptom Checklist-90-Revised, SCL-90-R). This instrument has been validated in various countries and languages (including French; Derogatis, 1977; Fortin & Coutu-Wakulczyk, 1985; Fortin, Coutu-Wakulczyk, & Engelsmann, 1989; Holi, 2003). Scores on the GSI scale have been correlated with measures of dream content, including nightmare and bad dream frequency (e.g., Blagrove & Fisher, 2009; Brown & Donderi, 1986; Levin & Fireman, 2002; Levin et al., 2011; Pesant & Zadra, 2006; Schredl, 2003b) and will be used by the present project.

The broad association between psychopathological symptoms and disturbed dreaming has also been observed with specific dimensions such as depression (Duval et al., 2010; Levin & Fireman, 2002; Sandman et al., 2015), trait anxiety (Blagrove & Fisher, 2009; Duval et al., 2010; Zadra & Donderi, 2000) and neuroticism (Blagrove & Fisher, 2009; Li et al., 2010; Schredl, Landgraf, & Zeiler, 2003). Although Levin & Nielsen (2007) hypothesized that these associations would be stronger with more severe forms disturbing dreams (e.g., nightmares), research has shown both larger effects and no effects with nightmares as opposed to bad dreams (Blagrove et al., 2004; Blagrove & Fisher, 2009; Blagrove & Haywood, 2006; Zadra & Donderi, 2000). These inconsistencies, as well as the few studies not finding significant correlations between scores on measures of psychopathology and the frequency of disturbed dreaming (Belicki, 1992a; Chivers & Blagrove, 1999; Hartmann, Russ, van Der Kolk, Falke, & Oldfield, 1981), may be due to confounding factors involved in these relationships as well as to a vast range of methodological issues that characterize this field of research (see Methodological considerations chapter for details).

Finer indices of dream content

In a related vein, waking symptoms of psychopathology have also been shown to be continuous with specific dream content elements (see for a review, Skancke et al., 2014). For instance, the dreams of depressed patients are more likely to contain themes of depression and death than those of healthy controls (Schredl & Engelhardt, 2001). Similarly, one longitudinal study found that participants' negative dream content (e.g., failures, negative affect, aggressive social interactions) was moderately to strongly correlated to scores on measures of general psychopathology both at fixed points in time and over a six to ten-year period (Pesant & Zadra, 2006). Other studies also found general symptoms of psychopathology, depression, trait anxiety and neuroticism to be correlated with the frequency and intensity of negative emotions in everyday dreams (Blagrove et al., 2004; Brown & Donderi, 1986; Zadra & Donderi, 2000).

Nightmare Distress

Another concept akin to affect distress is nightmare-related distress which represents a measure of the waking distress generated by nightmares. For instance, this measure has been operationalized by the Nightmare Distress Questionnaire (Belicki, 1992b) which includes items such as "After you awaken from a nightmare, do you have difficulty falling back asleep?" and "Do nightmares affect your well-being?". Nightmare distress is more strongly correlated with disturbing dream frequency than with psychopathology (Belicki, 1992a; Duval et al., 2010; Klůzová Kráčmarová & Plháková, 2015; Martínez, Miró, & Arriaza, 2005) and has been shown in one study to mediate the relationship between nightmare frequency (but not bad dream frequency) and psychological well-being (i.e., scores on measures of anxiety, depression, neuroticism, and acute stress; Blagrove et al., 2004). This trait-like variable should not be confused with the state-like distress sometimes experienced immediately following an awakening from a nightmare.

The relative roles of state and trait factors

Despite the large body of evidence supporting the contributory role of state as well as trait factors in the occurrence of disturbing dreams, the relative contribution of these distinct factors (e.g., affect load and affect distress) as well as their possible interaction have rarely been investigated. Some studies find that affect load (i.e., stress, psychological distress, anxiety,

depression and somatization) better predicts nightmare occurrence than do personality traits (i.e., absorption and psychological boundaries; Klůzová Kráčmarová & Plháková, 2015; Schredl, 2003b). By contrast, others show that traits, such as worry, depersonalisation and dissociation, can play a significant and independent role in predicting nightmares and other sleep-related experiences (e.g., falling dreams, flying dreams and sleep paralysis) beyond the effects of affect load (i.e., negative affect, daily stress and PTSD symptoms; Rek et al., 2017; Soffer-Dudek & Shahar, 2011). However, most of these studies contrast affect load (e.g., stress and negative affect) measures with personality traits independent of the concept of affect distress (e.g., absorption, boundaries, dissociation).

One study used measures of affect load as well as affect distress to predict the frequency of disturbing dreams and their associated distress (i.e., waking distress experienced following a disturbing dream experience) as determined from three consecutive weeks of daily dream logs (Levin et al., 2011). The authors found that affect load (as measured retrospectively by the intensity of negative life events experienced in the past month) and affect distress (general psychopathology) independently and positively predicted bad dreams and nightmares as well as their related waking distress. However, after controlling for shared variance, only affect load predicted disturbed dreaming frequency, whereas only affect distress predicted disturbed dreaming-related distress. These findings reveal small (2% to 8%) but nonetheless significant differential effects of affect load and affect distress on the various aspects of disturbing dreams. Furthermore, these results suggest that while emotional distress may be responsible for the occurrence of disturbed dreaming, a predisposition to negative affectivity, or affect distress, may amplify people's emotional reaction to it. The retrospective nature of the study's measure of affect load (one-time estimate for the past month) did not allow for a night-by-night prediction of disturbed dreaming and the study was conducted on a large (*N* = 309) but solely undergraduate sample of students and for course credit (see Methodological considerations chapter for details).

Only two studies investigated the interactive impact of affect load and affect distress measures on dreaming using a daily prospective design. First, Blagrove and Fisher (2009) investigated the possible interaction between state and trait variables in relation to nightmare occurrence on a daily basis in 42 healthy adults reporting at least one nightmare a month.

Participants completed 14 consecutive days of dream logs as well as pre-sleep mood logs (anxiety and depression). A nightmare was considered to have occurred if the dream was rated as very unpleasant, on a Likert-type scale ranging from very unpleasant (1) to very pleasant (7), and if the content or emotions awoke the participants. Trait variables included measures of neuroticism, thick versus thin psychological boundaries, trait anxiety and psychopathology. The number of adverse life events experienced in the past year as well as childhood adversity were also assessed. The authors found small but positive within-subject correlations between nightmare frequency on two-week dream logs, and pre-sleep state anxiety (r = .10) and depression (r = .13). However, the authors did not find significant interactions when correlating trait measures with the within-subject associations between pre-sleep mood and nightmare occurrence.

Blagrove and Fisher (2009) then carried out post-hoc analyses using a subsample of participants exhibiting *thin psychological boundaries* (i.e., above the median for the group on the psychological boundaries measure; people with thin boundaries experience higher degrees of blending among a broad range of mental processes, such as between thoughts and feelings (Hartmann, 1991). Based on this subsample of participants, the authors found moderate to strong correlations between various trait measures (psychopathology, adverse life events, childhood adversity and thin boundaries) and the within-subject mood-nightmare associations (r = .43 to r = .52). Nevertheless, the study's small sample size did not allow for regression analyses predicting nightmare occurrence on a night-by-night basis. Since nightmare recall is even rarer than dream recall, which does not occur every night, the authors emphasized the necessity of assessing nightmares with dream logs of longer duration than two weeks.

The second study investigated state and trait predictors of general sleep-related experiences: a concept used to describe nocturnal phenomena such as nightmares, falling dreams, flying dreams and sleep paralysis (Soffer-Dudek & Shahar, 2011). Sixty undergraduate psychology students were asked to complete various questionnaires, including measures of dissociation (level of detachment from everyday experiences), depression, and the number stressful events in the past month. Then, they completed 14 consecutive days of logs assessing stress (mean stress for all daily stressors experienced on a given day) and general sleep-related experiences as well as sleep data. Multilevel linear modeling revealed that daily stress was

significantly predicting general sleep-related experiences but only in young adults scoring high on the trait measure of dissociation. Similarly, dissociation was a significant predictor of general sleep-related experiences only when participants experienced high levels of daily stress as opposed to low ones. Since this study did not investigate disturbing dreams *per se*, it is unclear if the relationships found are due to unpleasant nighttime experiences such as nightmares and bad dreams or other sleep-related experiences.

Taken as a whole, these studies provide support for a diathesis-stress interaction when determining the occurrence of disturbed dreaming.

Gender differences

Gender differences have been difficult to assess in dream research as women often participate more frequently in such studies (up to seven times more often than men) and are thus consistently overrepresented in dream research (e.g., Klůzová Kráčmarová & Plháková, 2015; Rek et al., 2017; Robert & Zadra, 2008). As mentioned previously, women have been found to experience more disturbing dreams than do men (see for a meta-analysis, Schredl & Reinhard, 2011) although there are a few findings showing no such gender difference (Blagrove & Haywood, 2006; Chivers & Blagrove, 1999; Levin et al., 2011). Women are also more likely than men to report that their dreams are associated with stressful events, loss and grieving, and that they can affect daytime mood (e.g., produce anxiety and stress (Pagel et al., 1995; Schredl, 2009b). Since women tend to have more disorders with negative affectivity (i.e., anxiety, depression and PTSD), as well as more frequent sleep disorders and more likely than men to be victims of physical and sexual abuse, it has been suggested that women are more at risk than men to develop frequent disturbing dreams (Levin & Nielsen, 2007). In the same vein, state and trait mechanisms implicated in disturbed dreaming may be different in women and men. Specifically, there is evidence that psychopathology is associated with nightmare frequency in women but not in men (Chivers & Blagrove, 1999), whereas the opposite holds true for specific stressors (i.e., 9/11; Nielsen et al., 2006).

In regard to dream content, there is evidence of women reporting higher frequencies of dreams containing emotions—especially negative ones—than do men (Dale et al., 2016;

Domhoff, 1996), although some studies find no gender differences in the distribution of various classes of emotions in people's dreams (Merritt et al., 1994). A recent study by Sikka and colleagues (2018) found no gender effects when trying to predict positive as well as negative dream affect (both self-reported and scored by external raters) using a range of predictor variables such as age, anxiety, depression, waking affect (positive and negative) and life-satisfaction.

State and trait factors of dream recall

When investigating which state and trait factors are involved in predicting disturbing dream occurrence, it is important to consider if these factors predict the recall of disturbed dreaming *per se* or simply dream recall in general. Measures of affect load, such as everyday perceived stress and negative affect, have been significantly and positively associated with general dream recall (Armitage, 1992; Duke & Davidson, 2002; Kroth et al., 2002; Loveland Cook et al., 1990; Pagel et al., 1995; Schredl & Reinhard, 2009), but this association may be considerably weaker with general dream recall than with the recall of disturbing dreams (Loveland Cook et al., 1990). In addition, there is evidence suggesting no significant association between measures of affect load (i.e., perceived stress, psychological distress, number of negative events) and dream recall (Brand et al., 2011; Schredl, 2003b).

Furthermore, the predispositional trait of affect distress, as operationalized by global psychopathology, has not been generally associated with dream recall frequencies (Blagrove & Pace-Schott, 2010; Schredl & Engelhardt, 2001; Schredl, 2003b). Nevertheless, while certain dimensions of psychopathology have been found to be positively associated with dream recall (e.g., anxiety), others show a negative association (e.g., depression; Armitage, Rochlen, Fitch, Trivedi, & Rush, 1995; Blagrove & Pace-Schott, 2010; Schredl & Engelhardt, 2001). In light of these findings, it is unclear if dream recall plays a mediating role in the state-trait and disturbing dream relationships although results from one study suggest that it does not (Schredl, 2003b).

Methodological considerations

Dream research comes with its own unique set of methodological and conceptual challenges, several of which have been briefly described in the previous chapters. These factors can complicate the interpretation of study findings, between-study comparisons, generalizations based on reported results as well as the replicability of studies. Below are some of the more frequently encountered limitations that were addressed in the present research. The manner in which this thesis addressed these limitations is detailed in the next chapter. This project's full methodology, however, is detailed in the formal research article presented in next section.

Student samples

A majority of studies on disturbing dreams involve undergraduate students (e.g., Blagrove et al., 2004; Fireman et al., 2014; Lee & Suh, 2016; Levin & Fireman, 2002; Levin et al., 2011; Martínez et al., 2005; Robert & Zadra, 2008; Wood et al., 1992). Moreover, in many of these studies, students are primarily recruited in psychology departments and receive course credit for their participation. Undergraduate psychology students, however, represent a very narrow portion of the general population and limit possible generalizations of the findings.

Retrospective and prospective measures

As mentioned previously, dreaming is a unique sleep-related experience that cannot be studied directly. The majority of dream research conducted on disturbed dream frequency has relied on participants' retrospective estimates to questionnaire-based items (e.g., "How many nightmares do you usually have per month? ...per year?"). When compared with daily home dream logs, retrospective questionnaires are subject to greater memory distortions (Beaulieu-Prévost & Zadra, 2015) and more likely to underestimate bad dream and nightmare recall frequencies (e.g., Robert & Zadra, 2008; Wood & Bootzin, 1990) as well as dream frequency in general (see for a review, Aspy, Delfabbro, & Proeve, 2015). Thus, the use of prospective daily dream logs is considered to be the gold standard for assessing dream recall and, by the same token, recall frequency of disturbing dreams (Levin & Nielsen, 2007).

However, in comparison with one-time retrospective questionnaires, dream logs require greater and longer time commitments on the part of the participants (e.g., providing dream narratives or other forms of log-based information over many days or weeks). This may explain the scarcity of research using prospective methods. Similarly, the majority of research in this field has focused on retrospective reports of perceived stress (e.g., stressors experienced over the past month; Levin et al., 2011) as opposed to prospective measures of perceived stress, anxiety or negative affect. The latter methodology allows for the investigation of the day-by-day effects of stressors on dreaming and its content. Moreover, this approach has been suggested by many researchers as one of the best ways to test the continuity hypothesis of dreaming (Brand et al., 2011; Robert & Zadra, 2014; Schredl, 2003b).

Statistical modeling

Since the 1970's and 80's, research using more complex statistical designs, such as general linear models and multilevel linear models, has been on the rise. This trend coincided with technological and computational advances allowing for the increasingly sophisticated analysis of large datasets. In particular, linear models allow for the simultaneous investigation of multiple within- and between-participant factors to predict a particular outcome (Tabachnick & Fidell, 2013). In the context of investigating the impact of waking factors on dreaming or vice and versa, very few studies have used such methods, especially on a prospective and day-by-day basis (Lancee & Schrijnemaekers, 2013; Samson-Daoust et al., 2019; Schredl & Reinhard, 2009; Sikka et al., 2018).

Dream recall as a covariate

When investigating potential predictors of disturbing dream occurrence, it is important to consider whether these factors are associated with the recall of disturbed dreaming *per se*, dream recall in general or both. As described earlier, stress and certain psychopathological traits (e.g., anxiety) have been associated with disturbed dreaming, but also associated with general dream recall (e.g., Blagrove & Pace-Schott, 2010; Loveland Cook et al., 1990). Considering this evidence, many studies fail to control for the overlapping general dream recall effect, especially when investigating the correlates of disturbing dreams. In a prospective study described earlier,

Blagrove and Fisher (2009) performed correlational analyses between daily negative mood scores and nightly occurrence of nightmares, including solely nights when a dream of any kind was recalled. One consequence of this strategy is that daily pre-sleep mood scores not associated with subsequent dream recall are not included in the analyses. To date, only one study (Samson-Daoust et al., 2019) has controlled for dream recall while using a prospective day-by-day design and hierarchical linear models to predict dream valence on a given day. As predicted, the authors found that dream recall was a significant contributor to their predictive model. Taken together, these studies emphasize the need for controlling for dream recall when predicting dream variables on night-by-night basis.

Dream content analysis

As mentioned previously, dreams rarely reflect episodic waking memories (e.g., Malinowski & Horton, 2014a). Although this fact adds to the need to better understand mechanisms underlying the continuity hypothesis of dreaming, many studies fail to use established or validated approaches for the objective scoring of dream content. This limitation is exemplified by the recent study of Kron et al. (2015) who investigated the dream content of individuals living in the Gaza strip while under constant rocket attacks. Dream content analysis was based on the authors' ratings of vaguely created dream content elements such as "Togetherness", "Symbolic" and "Stress-related situation". These examples of subjective and abstract dream content categories highlight the difficulties in drawing clear inferences on what specific dream content elements are associated with ongoing waking experiences or stressors. The best validated and established quantitative instrument for the objective scoring of dream content is the Hall and Van de Castle (HVC; 1966) coding system. Used in hundreds of studies in the field of dream research (e.g., Bulkeley & Kahan, 2008; Dale et al., 2016; DeCicco et al., 2010; Domhoff, 1996, 2015; McNamara, Mclaren, & Durso, 2007; Pesant & Zadra, 2006; Wong, Amini, & De Koninck, 2016), this instrument allows for the quantification of various dream content elements, such as settings, characters, social interactions as well as outcomes.

Although the HVC dream coding instrument yields consistently strong inter-rater agreements on its dream content scales (Domhoff, 1996), the assessments of dream affect from

external judges (as opposed to by the dreamers themselves) tend to give rise to an inaccurate portrayal of the emotions actually experienced by the dreamer. Specifically, the HVC coding system tends to overestimate the presence of negative emotions in dream reports and underestimate positive emotions (Dale et al., 2016; Domhoff, 1996; Sikka et al., 2014). Moreover, the unreliable ratings of dream affect by external raters sometimes results in the exclusion of this dream content category from the study's analyses (De Koninck & Koulack, 1975; Hartmann & Brezler, 2008). This discrepancy between external and self-rating of dream affect can be due to biases on the part of the raters, the fact that emotions—particularly positive ones—are not always explicitly detailed in dream reports as well as the fact that the HVC instrument contains only one category of positive emotions (happiness) compared with four categories of negative emotions (anger, apprehension, confusion, and sadness).

When dream affect is self-rated, the distribution of positive versus negative dream emotions tends to be more balanced (i.e., equal proportions of positive and negative emotions (Fosse et al., 2001; Foulkes et al., 1988; Samson-Daoust et al., 2019; Schredl & Reinhard, 2009) with a few studies reporting either a greater proportion of positive emotions (Sikka et al., 2014; St-Onge, Lortie-Lussier, Mercier, Grenier, & De Koninck, 2005) or of negative ones (Merritt et al., 1994; Sikka, Revonsuo, Sandman, Tuominen, & Valli, 2017). By contrast, when scored by outside raters using the HVC rating system, approximately 80% of all dream reports are scored as containing primarily negative emotions. Taken together, these findings indicate that a more accurate and representative portrayal of dream affect is achieved when this dimension of dream content is scored by the participants themselves.

Aim of the thesis

In light of the theories and findings reviewed above, the nature of the factors believed to influence the occurrence of dysphoric dreaming remains subject to debate and in need of elucidation. The present project aimed at investigating the interactive impact of everyday negatively-toned affective states (affect load) and predispositional traits (affect distress) on the nightly occurrence of idiopathic disturbed dreaming. A secondary goal of this thesis was to

explore the relative impact of state and trait variables on finer content elements of everyday dreams.

This thesis addresses several past studies' limitations. First, the present project is based on data collected from both student and general adult populations. Second, it relies on prospective measures of dream recall (i.e., daily dream logs) as well as affect load (i.e., daily pre-sleep anxiety scores). Third, the project's data was analyzed with generalized estimating equation (GEE) modeling (Hubbard et al., 2010), a branch of generalized linear modeling better suited to the non-normal distribution of the main variable of interest, namely disturbing dream frequency. In addition to disturbing dream frequency, the project also examines the occurrence of four finer dream content measures in relation to waking state and trait variables: intensity and negativity of dream emotions (scored by the dreamers themselves) as well as dream aggressive social interactions and misfortunes (i.e., any mishap, adversity, harm, danger, or threat which happens to characters as a result of circumstances over which they have no control), both scored with the objective and validated HVC coding system. Moreover, in order to obtain an adequate sample of dreams per participant, participants were required to complete 28 consecutive days of home dream logs. Finally, nightly dream recall was included as a covariate in all GEE models (except the dream recall model) to control for its effects when predicting the occurrence of disturbed dreaming and other dream content elements.

Objectives and hypotheses

The first objective of this master's thesis was to use a prospective experimental design to determine whether fluctuations in everyday affect load (as measured by daily scores of pre-sleep anxiety and weekly inventories of perceived stress) would subsequently predict nightly occurrence of disturbing dreams (i.e., bad dreams and nightmares). The second objective was to examine if this relationship was moderated by a predisposition to experience negative affectivity or affect distress (general psychopathology). The third objective was to determine if measures of affect load and affect distress would also predict negative and emotionally intense affect in everyday dreams. Finally, the fourth objective was to explore whether finer negative dream content elements (aggressive social interactions and misfortunes) would be similarly determined by measures of affect load and affect distress.

In light of these objectives and the empirical and theoretical evidence presented earlier, including Levin and Nielsen's neurocognitive model of disturbed dreaming, the following four predictions were tested:

1. High levels on affect load increase the likelihood of having bad dreams or nightmares on a given night.
2. High levels of affect distress increase the effect of affect load on the likelihood of experiencing disturbing dreams on a given night
3. High levels of affect load and affect distress increase the likelihood of reporting emotionally intense negative dreams on a given night.
4. High levels of affect load and affect distress increase the likelihood of reporting everyday dreams containing aggressions and misfortunes.

Section 2 – Article –
State and trait predictors of negatively toned dreams in women: A prospective investigation

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Abstract

Although disturbing dreams, such as bad dreams and nightmares, are experienced at least occasionally by a majority of adults, the factors involved in the night-by-night occurrence of these dreams remain unclear. Research suggests that one likely explanation for their occurrence resides in an interplay between waking state and trait variables. Using a prospective design, we investigated the interactive impact of state (nightly pre-sleep anxiety scores and weekly levels of perceived stress) and trait factors (personality, psychopathology) on the nightly occurrence of disturbing dreams. We further explored the extent to which emotionally intense and negative everyday dream content was affected by the same variables. 173 adult women completed personality measures followed by up to four weeks of daily dream logs, daily pre-sleep anxiety logs, and weekly perceived stress inventories. Multilevel models were used to test between- and within-participant effects when predicting night-by-night dream content outcomes. After controlling for dream recall, upsurges in weekly perceived stress significantly increased the likelihood of having a disturbing dream on a given night (OR = 1.134, p = 0.009), whereas psychopathology positively moderated that relationship (OR = 1.089, p = 0.005). These effects were greater in women with above group median scores of psychopathology, explaining 39% of the variance in nightly disturbing dream occurrence. These results suggest that adult women reporting higher levels of psychopathology are particularly sensitive to everyday stress and thus more likely to experience bad dreams or nightmares on subsequent nights. Our analyses also revealed differential positive effects of state and trait variables on the emotional content of everyday dreams. While the intensity of emotions in dreams was solely predicted by psychopathology, negatively toned dream content was predicted by both psychopathology and nightly levels of pre-sleep anxiety. These results are in line with a recently proposed neurocognitive model of disturbed dreaming. More work, however, is needed to refine our understanding of how specific state and trait factors interact and to what extent people's waking emotional experiences are continuous with the content of their dreams.

Introduction

Disturbing dreams, defined as vivid dreams containing strong negative emotions (Levin and Nielsen, 2007; Robert and Zadra, 2014), encompass a spectrum of dream experiences ranging from bad dreams (negatively-toned dreams that do not awaken the sleeper) to nightmares (highly disturbing dreams that awaken the sleeper) to replicative trauma-related nightmares (Zadra and Donderi, 2000; Levin and Nielsen, 2007). Most adults experience at least a few disturbing dreams per year and about 4% of the general population reports having one or more nightmares per week (Levin and Nielsen, 2007; Sandman et al., 2013). In addition, one study of almost 10 000 home dream reports from 572 men and women found that approximately 13% of all reported dreams were comprised of disturbing dreams (Robert and Zadra, 2014) and disturbed dreaming has been repeatedly shown to be more prevalent in women than in men (Fireman et al., 2014; Klůzová Kráčmarová and Plháková, 2015; Nielsen et al., 2006; Schredl and Reinhard, 2011).

One often-cited neurocognitive model of disturbed dreaming production (Levin and Nielsen, 2007, 2009) proposes that the occurrence of disturbing dreams as well as variations in the emotional intensity and negativity of everyday dreams are partially determined by day-to-day variations in emotional stress or what they term *affect load*. The model further stipulates that the relation between stress and dreaming is amplified by a predisposition to experience events with strong emotional distress, a factor known as *affect distress*. Numerous studies on the relation between disturbing dreams—including nightmares—and various real-life stressors lend strong support for affect load as a state predictor of disturbed dreaming (Duval et al., 2010; Krakow et al., 1995; Levin et al., 2011; Loveland Cook et al., 1990; Nielsen et al., 2006; Picchioni et al., 2002; Schredl, 2003; Soffer-Dudek and Shahar, 2011; Wood et al., 1992). The vast majority of these studies, however, did not include prospective measures of perceived stress nor assessed disturbing dream frequencies with daily dream logs, considered the gold standard in the field (Levin and Nielsen, 2007).

A variety of studies also supports the predispositional or trait component of Levin and Nielsen's (2007) neurocognitive model with general psychopathology almost always being positively associated with increased prevalence of bad dreams and nightmares (Blagrove et al.,

2004; Blagrove and Fisher, 2009; Chivers and Blagrove, 1999; Lancee and Schrijnemaekers, 2013; Levin and Fireman, 2002; Zadra and Donderi, 2000). However, much of this research has been conducted on undergraduate students, is based on one-time retrospective assessments of nightmare frequency, and did not examine interactions between perceived stress and trait factors such as personality or psychopathology.

Only two studies employed a prospective design to investigate the influence of state and trait factors on everyday dreams. The first study (Blagrove and Fisher, 2009) assessed pre-sleep state anxiety and depression in relation to trait measures believed to underlie nightmare occurrence. The authors observed positive within-subject correlations between nightmare frequency (assessed with two-week home logs) and pre-sleep state anxiety and depression (r = 0.10 and 0.13, respectively). They also found statistically significant interactions between their state and trait measures in association with nightmare frequency, but only in adults exhibiting thin psychological boundaries, a personality construct that describes the degree of separation or blending people experience among a broad range of mental processes (Hartmann, 1991). The study's relatively small sample size (N = 38), however, did not allow for the prediction of nightmare occurrence on a night-by-night basis.

The second study (Soffer-Dudek and Shahar, 2011) reported similar findings when investigating predictors of general sleep-related experiences—a concept encompassing various experiences such as nightmares, falling dreams, recurrent dreams, flying dreams and sleep paralysis. Specifically, daily stress significantly predicted general sleep-related experiences but only in undergraduate students scoring high on a trait measure of dissociation (level of psychological detachment from everyday experiences).

Much of the research on state and trait factors believed to underlie the occurrence of disturbing dreams has thus been limited by the often retrospective nature of the data, the use of single measurement points, a focus on nightmares or trauma-related dreams, and a lack of prospective assessment of state and trait interaction effects on the occurrence of negatively toned dreams. We therefore used a prospective day-by-day design to examine the interactive impact of daily indices of affect load with trait measures of affect distress on the nightly

occurrence of disturbing dreams. We further tested the relative impact of affect load and affect distress measures on the emotional intensity and negativity of everyday dreams. Based on the empirical and theoretical literature, including Levin and Nielsen's (2007) model of dysphoric dream production, we tested the following hypotheses:

I: Upsurges in affect load increase the likelihood of experiencing a disturbing dream on the subsequent night.

II: Trait measure of affect distress will increase the effect of state measures of affect load in the prediction of disturbed dream occurrence.

III: Higher levels in affect load and affect distress increase the likelihood of experiencing everyday emotionally intense and negatively toned dreams.

Methods

Participants

Participants were recruited as part of a larger program of research investigating the association between dream content and various personality factors. Recruitment was carried out via media announcements and was open to the general adult population. A total of 260 adults (207 women; 53 men) participated in this program of research. Of these, 211 (173 women; 38 men) completed all of the materials and over the minimal period of time required for the present study (see Procedure for details). Given the differences in nightmare and bad dream prevalence in men and women, that gender can impact the effect of stress and well-being on dream content (e.g., Chivers and Blagrove, 1999; Nielsen et al., 2006; Pagel et al., 1995), and that the number of male subjects in the present study was too small to explore sex-based effects within the planned statistical analyses, data from the 38 men were excluded from further analyses. The final sample thus consisted of 173 women between the ages of 18 and 55 ($M = 29.4 \pm 10.1$ years). The research was accepted by the university's Ethics Committee and signed consent was obtained from each participant.

Procedure

Questionnaires

Participants first completed a general *Sleep and Dream Questionnaire* (Zadra and Donderi, 2000) used to assess basic sleep, dream and demographic variables.

Affect distress

Affect distress was assessed using the General Symptom Index (GSI) scale of the validated French-Canadian version of the 90-item Symptom Checklist-90-Revised (SCL-90-R; Derogatis, 1977; Fortin and Coutu-Wakulczyk, 1985; Fortin et al., 1989). The GSI—the instrument's most widely used measurement of general psychopathology—assesses the overall severity of reported symptomatology and features excellent psychometric properties, with test-retest reliability coefficients ranging from 0.78 to 0.90 (Derogatis, 1977) and internal consistency coefficients for the French-Canadian version of 0.91 and 0.96 (Fortin et al., 1989; Fortin and Coutu-Wakulczyk, 1985). GSI scores were determined by the sum of all 90 items (possible range of 0 to 360).

Affect load

Affect load was assessed with two measures. The first measure required participants to rate their level of anxiety every night prior to bedtime using a Likert-type scale ranging from 1-very calm, to 5-very anxious. This scale was used instead of more detailed daily stress instruments such as the Daily Stress Inventory (Brantley et al., 1987) due to the multi-week nature of the study and our desire to limit volunteers' workload. The second measure, completed on a weekly basis, was the 87-item Weekly Stress Inventory (WSI; Brantley and Jones, 1989). This instrument generates two scores: the number of stressors experienced during the past week (WSI-Events) and the sum of perceived stress scores for these events (WSI-Impact) using a 7-point Likert scale ranging from 0 (did not occur) to 7 (very stressful). Test-retest reliability coefficients over one to three-hour intervals, and with rearranged item order are 0.83 and 0.80 for WSI-Event and WSI-Impact respectively, while the degree of internal consistency has been found to be consistently high with alphas ranging from 0.92 to 0.97 (Brantley et al., 1997). The WSI-Impact score was chosen as our state measure akin to affect load.

Dream content and frequency

Participants were required to provide upon awakening a complete written description for each remembered dream in a daily log for 28 consecutive days. In addition to each recalled dream's narrative, participants had to report the date, the general affect (neutral, positive, mixed or negative), the main emotions present (if any) and their respective intensities on a 5-point Likert scale. The participants further noted whether the dream was a lucid dream, night terror, nightmare, bad dream, erotic dream, recurrent dream or flying dream, for which they were provided written definitions. Nightmares were defined as very disturbing dreams in which the unpleasant visual imagery and/or emotions awaken the sleeper while bad dreams were defined as very disturbing dreams which do not awaken the sleeper (e.g., the dream is recalled only after awakening naturally or by external factors such as an alarm clock). The dream logs were used to measure dream, bad dream and nightmare recall frequencies. Bad dream and nightmare frequencies were combined to measure the frequency of disturbing dreams. Since less than 1% of all nights yielded more than one dream report, daily dream recall as well as disturbing dream recall were scored as dichotomous variables with recall being either present (1) or absent (0). This strategy has been used in studies modeling the day-to-day impact of disturbed dreaming on waking measures (Lancee and Schrijnemaekers, 2013) as well as the impact of waking measures on dream content (Sikka et al., 2018). The highest emotional intensity of all reported dream emotions on a given night (irrespective of valence) was used as the dream emotional intensity for that night.

Statistical analyses

Descriptive statistics and Pooled Pearson correlations (Kendall correlations for disturbed dreaming) were first calculated for our main variables. Generalized Estimating Equations (GEE) were then used to test our predictions and analyze our correlated and repeated data. This statistical method uses a population-averaged, or marginal approach, and allows for simultaneous between- and within-subject analyses, a more flexible distribution assumption, unbiased standard errors and a better handling of missing data (Hubbard et al., 2010). Models were computed using standardized predictors (daily pre-sleep anxiety, weekly perceived stress, psychopathology) and binary measures of dream and disturbing dream recall (absence, presence;

0, 1), as well as a continuous measure of dream emotional intensity and an ordinal measure of general dream affect (ascending from neutral, positive, mixed to negative; negative being the reference category). In addition, GEE analyses predicting disturbing dream occurrence, emotional intensity and negative affect included dream recall as a covariate (Hosmer et al., 2013). The final models were performed using autoregressive (AR1) working correlation structure as they yielded smaller Bayesian Information Criterions with the exception of the model predicting the ordinal outcome general dream affect. All GEE analyses were performed using the GENLINMIXED and GENLIN functions of the IBM SPSS Statistics for Windows software, Version 25 (IBM Corp., 2017).

Results

Descriptive statistics

Table 1 presents the means, standard deviations and ranges for the study's main variables including affect distress (psychopathology) as well as affect load (repeated measures of stress and pre-sleep anxiety) and general dream recall and disturbing dream recall both nightly and pooled monthly.

Of the 173 participants, 145 (84%) completed the daily home logs (dream as well as pre-sleep anxiety and/or weekly perceived stress) for the required period of 28 consecutive days. The duration for the remaining 16% of participants was between 7 and 21 days. Participants provided a total of 4460 days of data with 2376 of these (53%) yielding one or more dream reports for a total of 3128 dreams. As shown in Table 1, a little over 80% of all dream reports were described as containing emotions. Moreover, 75% of participants reported one or more disturbing dream during the study, with about 35% reporting an average of one or more disturbing dream per week. Overall, 17% of all dream reports were either nightmares ($n = 119$) or bad dreams ($n = 421$).

	Measures		M	SD	Min-Max	N
Trait	Psychopathology (SCL-90-R)	Once	66.92	43.98	2-226	173
State	Weekly perceived stress (WSI-I)	Weekly	64.30	46.02	1-284	628
		Total monthly	255.74	163.56	30-981	172
	Daily pre-sleep anxiety	Daily	2.58	1.11	1-5	4361
		Total monthly	72.04	15.98	36.30-128.59	171
Dream measures	Dream recall frequency	Nightly	0.70	0.84	0-7	4460
		Total monthly	19.03	12.63	1-66	173
	Disturbing dream recall frequency	Nightly	0.23	0.47	0-3	2376[†]
		Total monthly	3.30	4.14	0-27	173
	Dream emotional intensity	Nightly	3.73	1.06	0.6-5.0	1806[†]
	General dream affect	Proportions[†] (valid %)	Neutral	Positive	Mixed	Negative
			16.1%	18.9%	24.9%	40.1%
	Words	Per dream report	129.56	131.74	3-2018	2376[†]

Table 1. Descriptive statistics for trait and repeated state and dream content measures. SCL-90-R: General Symptom Index of the Symptom Checklist-90-R; WSI-I: Impact score of Weekly Stress Inventory; Daily pre-sleep anxiety: Five-point anxiety Likert scale. All reported dream outcomes are derived from dream logs and words were counted. Observations based on 173 participants. [†] Only nights with the recall of a dream or dream affect.

Affect load and affect distress

When averaged per participant, our sample of adult women had significantly lower levels of weekly perceived stress ($M = 63.9$, $SD = 40.9$, $t(689) = 6.18$, $p < 0.001$) than adult community norms ($M = 105.4$, $SD = 84.7$; Brantley et al., 1997). Similarly, our participants experienced significantly fewer stressful events ($M = 23.1$, $SD = 10.8$; $t(687) = 5.80$, $p < 0.001$) than in published norms ($M = 32.2$, $SD = 19.5$). By contrast, our participants' mean GSI score ($M = 66.9$; $SD = 43.98$) was significantly higher than the means of both the non-patient normative sample of women ($M = 32.4$; $SD = 31.50$; $t(651) = 11.05$, $p < 0.001$; Derogatis, 1977) and a comparable French-speaking Canadian sample of women ($M = 49.5$; $SD = 36.00$; $t(575) = 4.97$, $p < 0.001$; Fortin et al., 1989).

Finally, 68 participants (39%) reported GSI scores that were above the suggested clinical cut-off (T score of 63 or GSI score of 70; Derogatis, 1977).

Correlations between main measures

	Measures	1	2[a]	3[a]	4[a]	5[a,b]	6	7
Trait	1. Psychopathology (SCL-90-R)	-						
State	2. Weekly perceived stress (WSI-I)[a]	0.55***	-					
	3. Daily pre-sleep anxiety[a]	0.31***	0.49***	-				
Dream measures	4. Dream recall frequency[a]	0.14	0.16*	0.02	-			
	5. Disturbing dream recall frequency[a,b]	0.19**	0.20***	0.11	0.41***	-		
	6. Negative dream affect (ratio) (Negative/Total Affect Reports)	0.10	0.05	0.17*	- 0.09	0.20***	-	
	7. Dream emotional intensity (mean)	0.15	0.16*	0.05	0.23**	0.27***	- 0.04	-

Table 2. Pooled Pearson correlations between trait and state variables, dream recall frequencies and everyday emotional dream content (N = 173). 1: General Symptom Index of the Symptom Checklist-90-R; 2: Impact score of Weekly Stress Inventory; 3: Five-point Likert anxiety scale; 4-7: All reported dream outcomes are derived from dream logs. [a] Scores of these repeated variables were compiled and prorated per month. [b] Correlations presented with Kendall's tau coefficients. Based on 4529 observations of 173 participants. * $p \le 0.05$. ** $p < 0.01$. *** $p < 0.001$.

The Pooled Pearson correlation tests performed between state and trait factors and the main dream outcome variables are presented in Table 2. Measures of daily pre-sleep anxiety, weekly perceived stress, dream and disturbing dream recall frequencies were compiled and prorated on a per-month basis. Since the frequency distribution of disturbing dreams was positively skewed (Skewness = 2.70) and had a sharp distribution peak (Kurtosis = 10.10), Kendall's non-parametric correlation tests were used to assess all correlations with this variable (Field, 2009). Correlations with the two self-reported emotional dream outcomes were conducted using a computed frequency ratio of negative to all reported dream affect (negative/ neutral + positive + mixed + negative) and a mean of all emotional intensities across all nights. Measures of affect load (daily pre-sleep anxiety and weekly perceived stress) and affect distress (psychopathology) were, as expected, moderately to strongly correlated with each other. Of the affect load and

affect distress measures, psychopathology and weekly perceived stress were significantly correlated with disturbed dreaming frequency, whereas daily measures of pre-sleep anxiety were not. As expected, disturbing dream frequency was moderately associated with dream recall frequency as well as modestly associated with the negative dream affect ratio and mean dream emotional intensity.

GEE models for dream-related measures

Table 3 presents results from the GEE analyses predicting dream and disturbing dream occurrence (absence, presence; 0, 1), dream emotional intensity (continuous) and general dream affect (ordinal) using standardized measures of affect load (pre-sleep anxiety and weekly perceived stress) and affect distress (psychopathology).

Since dream recall occurrence was significantly and positively predicted by both psychopathology (OR = 1.112, p = 0.019) and weekly perceived stress (OR = 1.119, p = 0.014), models predicting disturbing dream occurrence, dream emotional intensity and dream negative affect included dream recall as a covariate to control for its effect. Beyond the effect of dream recall, only weekly perceived stress positively contributed to predicting disturbing dream occurrence on a given day (OR = 1.181, p < 0.001) although psychopathology yielded an alpha of .059. Specifically, the likelihood of reporting a disturbing dream increased by 18% for every increment in one standard score of weekly perceived stress (SD = 46.02; Table 1). Furthermore, when an interaction term between psychopathology and weekly perceived stress was included in the same model, psychopathology significantly and positively interacted with weekly perceived stress (OR = 1.089, p = 0.005; Figure 2) to predict the nightly occurrence of disturbing dreams. Together, the effects of weekly perceived stress and its interaction with psychopathology explained 22% of the variance in the occurrence of disturbing dreams on a given night.

To explore the extent of these relationships, we tested an additional model with a subsample of participants (n = 86) scoring above the group median on our measure of psychopathology (Mdn = 58). For this subgroup of participants, weekly perceived stress (OR = 1.239, p < 0.001) along with its interaction with psychopathology (OR = 1.148, p = 0.003) significantly explained 39% of the variance in disturbing dream occurrence on a given night.

Predictor	Dream occurrence (covariate)						Disturbing dream occurrence[‡]					
	b	SE	t	OR	95% CI	p	b	SE	t	OR	95% CI	p
Psychopathology (SCL-90-R)	0.106	0.045	2.355	1.112	[1.018, 1.214]	0.019*	0.084	0.045	1.887	1.088	[0.997, 1.187]	0.059
Weekly perceived stress (WSI-I)	0.113	0.046	2.453	1.119	[1.023, 1.225]	0.014*	0.166	0.046	3.638	1.181	[1.080, 1.291]	0.001***
Daily pre-sleep anxiety	-0.024	0.034	-0.692	0.977	[0.914, 1.044]	0.489	0.061	0.041	1.484	1.062	[0.981, 1.151]	0.138

Predictor	Dream emotional intensity[‡]						General dream affect[‡]					
	b	SE	t	OR	95% CI	p	b	SE	Wald χ^2	OR	95% CI	p
Psychopathology (SCL-90-R)	0.148	0.025	5.953	1.160	[1.104, 1.218]	0.001***	0.169	0.043	15.653	1.184	[1.089, 1.288]	0.001***
Weekly perceived stress (WSI-I)	0.004	0.026	0.145	1.004	[0.954, 1.055]	0.885	0.015	0.045	0.105	1.015	[0.929, 1.108]	0.745
Daily pre-sleep anxiety	0.020	0.021	0.945	1.020	[0.979, 1.062]	0.345	0.087	0.041	4.473	1.091	[1.006, 1.182]	0.034*

Table 3. Empirical models predicting nightly dream and disturbing dream occurrence, everyday dream emotional intensity and general dream affect. Models derived from Generalized Estimating Equations analyses using standardized predictors and binary outcomes (0, 1), except for dream emotional intensity (continuous) and general dream affect (ordinal; ascending from neutral, positive, mixed to negative; reference = negative). SCL-90-R: General Symptom Index of the Symptom Checklist-90-R; WSI-I: Impact score of Weekly Stress Inventory; Daily pre-sleep anxiety: Five-point Likert anxiety scale. Based on 4529 observations of 173 participants. All reported dream outcomes are derived from dream logs. *SE*, Standard error; *OR*, Odds ratio (Exp(*b*)); CI, confidence interval. [‡] Models included prospective dream recall as a covariate to control for its effect. * $p < 0.05$. *** $p < 0.001$.
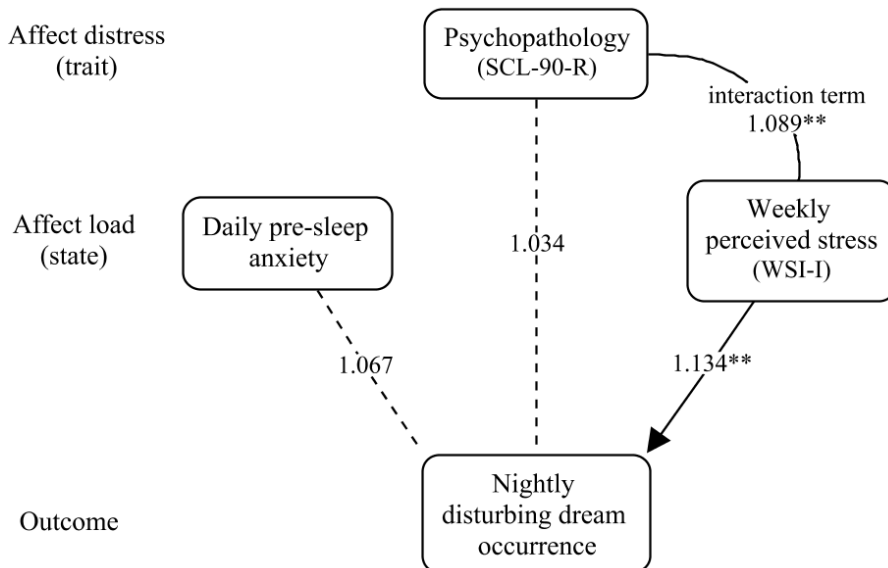
Figure 2. Empirical model predicting nightly disturbing dream occurrence. Model presents odds ratios derived from Generalized Estimating Equations analysis using standardized predictors and a binary outcome (presence, absence; 1, 0). SCL-90-R: General Symptom Index of the Symptom Checklist-90-R; WSI-I: Impact score of Weekly Stress Inventory; Daily pre-sleep anxiety: Five-point Likert anxiety scale. Disturbing dream occurrence derived from dream logs combining bad dream and nightmare occurrence. Model includes prospective dream recall as a covariate. Based on 4529 observations of 173 participants. Dotted lines represent nonsignificant independent contributions. ** $p < 0.01$.

The measures of affect load and affect distress also positively and significantly predicted the emotional aspects of everyday dreams, beyond the effect of dream recall (Table 3). Specifically, while the intensity of emotions in dreams was solely predicted by psychopathology, general dream affect was also predicted by daily levels of pre-sleep anxiety. Thus, for each point increase on the 5-point Likert pre-sleep anxiety scale ($SD = 1.11$; Table 1), the likelihood of reporting more negative dream affect the subsequent night increased by 9% (Table 3). This is the only contribution of pre-sleep anxiety to our models.

Discussion

This study was the first to use a daily prospective design to examine the interactive impact of state measures of affect load (daily pre-sleep anxiety and weekly perceived stress) and a trait measure of affect distress (psychopathology) on the nightly occurrence of disturbing dreams. Our findings revealed that after controlling for dream recall, level of weekly perceived stress was the sole significant predictor of disturbing dream occurrence while affect distress amplified this relationship, especially in participants with higher levels of psychopathology. These findings confirm our predictions that affect load increases the likelihood of experiencing disturbing dreams and that affect load interacts with affect distress when determining the everyday occurrence of disturbed dreaming. Contrary to our first hypothesis, however, daily measures of pre-sleep anxiety did not contribute significantly to any of the models tested, except in predicting general dream affect. Furthermore, psychopathology was the main predictor of both dream emotional intensity and general dream affect. The implications of these findings are discussed below.

Affect load as a predictor of disturbed dreaming

Although our participants' levels of weekly perceived stress were lower than published norms (Brantley et al., 1997), this marker of affect load still significantly increased the likelihood of experiencing disturbed dreaming (Table 3). This result is consistent with studies showing positive associations between the frequency of disturbing dreams and measures of affect load, including retrospective indices of perceived stress (Levin et al., 2011; Schredl, 2003; Weinberg et al., 2015), of self-reported psychological distress (Klůzová Kráčmarová and Plháková, 2015), and of minor daily hassles (Schredl, 2003).

The observation that daily pre-sleep anxiety did not contribute to disturbed dream occurrence beyond the effect of weekly perceived stress suggests that, when overall levels of emotional stress are low, an accumulation of perceived stress over multiple days is more likely to negatively impact disturbed dreaming than are daily fluctuations in anxiety. These findings are consistent with studies observing either no correlation between state anxiety and nightmare frequency (Levin and Fireman, 2002; Wood and Bootzin, 1990) or only weak to moderate positive

ones (*r* = 0.13 to 0.42; Blagrove and Fisher, 2009; Cellucci and Lawrence, 1978). Furthermore, since daily levels of pre-sleep anxiety and weekly scores of perceived stress explained only 24% of each other's variance (Table 2), the impact of pre-sleep anxiety may be modulated by its own distinct factors, such as degree of tiredness prior to bedtime or specific pre-sleep activities such as reading, watching television, use of cellphones, exposure to social media, or listening to music.

Finally, since the vast majority of the dreams in this study were reported upon awakening in the morning, they are more representative of late night dreams (Sikka et al., 2017) which, when compared to early-night dreams, are not associated with pre-sleep negative mood or stress (Cartwright et al., 1998; Roussy et al., 1996).

Affect distress as a predictor of disturbed dreaming

Affect distress (psychopathology) did not make a significant independent contribution to our predictive models of disturbing dreams beyond the contribution of affect load measures (daily-pre-sleep anxiety and weekly perceived stress; Table 3). Two other prospective studies similarly found no effect of measures of affect distress (i.e., psychopathology, neuroticism, trait anxiety) beyond those of affect load (i.e., intensity of negative events, state anxiety and depression) in predicting the frequency or occurrence of disturbing dreams (Blagrove and Fisher, 2009; Levin et al., 2011).

Psychopathology, however, interacted with weekly perceived stress by increasing its effect on disturbing dream occurrence (Figure 2), suggesting a moderating role in the relationship between perceived stress and disturbed dreaming. When we performed a post-hoc GEE analysis with participants scoring above the median on our measure of psychopathology, the impact of weekly perceived stress as well as its interaction with psychopathology increased the likelihood of experiencing a disturbing dream on a given night by 39%. In other words, as levels of psychopathology increase, so does its moderating effect on the relationship between stress and disturbing dream occurrence. This result suggests that women reporting above average levels of psychopathology are more affected by their everyday stress and thus the most vulnerable to subsequently experiencing bad dreams and nightmares—exactly what Levin and Nielsen's (2007) model of disturbed dreaming would predict.

Predicting emotional intensity and valence of everyday dreams

Our exploratory analyses revealed differential effects of affect load and affect distress on the emotional characteristics of everyday dreams. Psychopathology was the main positive predictor of the dreams' emotional intensity and negative dream affect. By contrast, pre-sleep anxiety did not independently predict dream emotional intensity but did predict negative dream affect on subsequent nights (a finding also observed in the correlational analyses). This is in line with results showing an impact of waking negative emotions on negative dream affect (Gilchrist et al., 2007; Malinowski and Horton, 2014; Schredl, 2009; Sikka et al., 2018), although not all studies have found such as relationship (Delorme et al., 2002; Samson-Daoust et al., 2019). Our findings also suggest that while affect distress increases the intensity of emotions in general, it has a stronger effect on negative emotions. Interestingly, studies have found that dreams preferentially incorporate waking experiences that are more emotional and intense, but not necessarily more stressful or with a particular tone (Malinowski and Horton, 2014; Schredl, 2006). The differential impact of affect load and affect distress on the valence and intensity of dream emotions thus remains to be clarified.

Taken as a whole, our findings reveal differential effects of affect load and affect distress on the night-by-night emotional and negative tone of everyday dreams. Specifically, while weekly perceived stress was more accurate in determining the likelihood of having disturbing dreams, general psychopathology was a better predictor of the emotional intensity and negative tone of all dreams. These findings support Levin and Nielsen's (2007) prediction that while fluctuations in everyday stress (affect load) increase the likelihood of experiencing various types of disturbing dreams, a predisposition to negative affectivity (affect distress) determines how intense and dysphoric dreams become. Furthermore, our results suggest that the emotional components of everyday dreaming are also determined by factors similar to the ones involved in predicting bad dreams and nightmares. This observation is consistent with the view of dysphoric dreaming as lying on a continuum (Fireman et al., 2014; Levin et al., 2011; Robert and Zadra, 2014).

General psychopathology and weekly perceived stress predicted night-to-night variations in dream recall, albeit not as strongly as for disturbing dreams. While there is evidence that everyday stressors are positively associated with dream recall, especially in women (Armitage,

1992; Duke and Davidson, 2002; Pagel et al., 1995), not all studies find such a relationship (Brand et al., 2011; Schredl, 2003). Furthermore, dream recall is not always positively associated with general psychopathology (Blagrove and Pace-Schott, 2010; Schredl and Engelhardt, 2001) and this relationship can vary according to which psychopathological dimensions are investigated since anxiety, but not depression, is often associated with dream recall (Armitage et al., 1995; Blagrove and Pace-Schott, 2010; Schredl and Engelhardt, 2001). Finally, the fact that dream recall frequency was significantly and positively correlated with mean dream emotional intensity suggests that emotional dreams (regardless of tone) are preferentially remembered upon awakening.

Study limitations

While our study's design aimed to address several limitations inherent to previous work in this field of research, we were unable to recruit a sufficiently large number of male participants to explore gender effects on our key variables. This question is of particular interest since women have been repeatedly shown to report more disturbing dreams than men do (Blagrove et al., 2004; Levin and Nielsen, 2007; Schredl and Reinhard, 2011) and are also more likely than men to believe that dream content is associated with stressful events (Pagel et al., 1995; Schredl, 2009). In addition, participants' dream logs were not collected on a daily basis but rather at the end of the study. The use of online or electronic tools for data collection that allow for daily timestamps for all submitted materials would be warranted, especially when investigating day-by-day fluctuations in perceived stress and subsequent dream content (see, for example, Samson-Daoust et al., 2019).

In sum, our findings support the affect load and affect distress components of Levin and Nielsen's (2007) neurocognitive model of disturbed dreaming. More work, however, is needed to refine our understanding of how specific state and trait factors interact and to what extent people's waking emotional experiences are continuous with the content of their dreams.

Author contributions

CB contributed to the study design, conducted the study, analyzed the results and wrote the manuscript draft. PM contributed to the statistical analyses and reviewed the manuscript. AZ obtained the research grants, designed and supervised the study, and reviewed the manuscript.

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Data availability statement

The raw data supporting the conclusions of this manuscript will be made available by the authors, without due reservation, to any qualified researcher.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Section 3 – Results and discussion of exploratory analyses

This present project was the first to use a prospective design to investigate the interactive impact of affect distress and daily and weekly measures of affect load on the nightly occurrence of disturbing dreams. The principal results from this work are contained in the scientific article presented in the previous section. In this section are detailed the results obtained from the exploratory investigation of whether other negative dream content elements, namely aggressions and misfortunes, are also influenced by the same state and trait factors investigated in relation to disturbed dreaming.

The 3128 dream reports collected from the 173 adult women that participated in the main study of the thesis (see preceding section) were scored for the presence of aggressive social interactions and misfortunes. These two content variables were chosen based on evidence suggesting that real-life stressors and affect distress (e.g., general psychopathology, depression, trait anxiety) may not only predict negative dream affect, but also other negative dream content elements, especially aggressive social interactions and misfortunes (Brown & Donderi, 1986; Bulkeley & Kahan, 2008; Pesant & Zadra, 2006). Thus, high levels in affect load (pre-sleep anxiety and weekly perceived stress) and affect distress (general psychopathology) were predicated to positively predict both the occurrence of dream aggressions and misfortunes in our participants' everyday dreams.

Dream reports were thus coded by two independent judges using the Hall and Van de Castle (HVC; 1966) system of quantitative content analysis. Both judges had previously received extensive training in the HVC coding system which provides explicit operational coding rules for 10 general nominal scales. Aggressive social interactions are defined in terms of a deliberate, purposeful act or covert expression of aggression while misfortunes are defined as any mishap, adversity, harm, danger, or threat which happens to a character as a result of circumstances over which he has no control. The two judges coded 10% of the total sample of dreams (about four dreams per participant) to obtain indices of interrater reliability. Disagreements between judges were resolved by discussion. The remaining dream reports were scored by either one of the two judges. Gwet's AC_1 (2008) scores yielded strong to very strong agreements for the scoring of

misfortunes (.78) as well as aggressions (.84).

Results

The coding revealed that 43% of the dream reports contained one or more aggressive social interactions while one or more misfortunes were present in 57% of all dream reports. The nightly frequency of these two content variables as well as their occurrence per 100 words are presented in Table 4.

Measures		M	SD	Min-Max	N
Aggressions	Nightly	0.96	1.63	0-21	2376[†]
	Per 100 words	0.68	0.44	0-2.70	173
Misfortunes	Nightly	1.15	1.52	0-14	2376[†]
	Per 100 words	0.81	0.45	0-2.68	173
Words	Per dream report	129.6	131.7	3-2018	2376[†]

Table 4. Descriptive statistics of dream aggressions and misfortunes and words for all reported dreams. *Note.* Dream aggressions and misfortunes were scored for all dream reports. [†] Nights with dream recall.

Table 5 presents the pooled Pearson correlation coefficients for dream aggressions and misfortunes with trait and state variables, overall dream and disturbing dream recall frequencies, and measures of dream affect for all reported dreams. As shown in Table 5, the frequency of dream aggressions and misfortunes per 100 words were not significantly correlated with either state (pre-sleep anxiety and weekly perceived) or trait (psychopathology) variables. The negative affect ratio in dreams was positively and moderately correlated with both dream aggressions and misfortunes per 100 words. Furthermore, dream aggression frequency was negatively associated with dream recall whereas the frequency of dream misfortunes was positively associated with disturbing dream frequency. None of the other correlations with dream aggression and misfortune frequencies were significant.

66

	Measures	Dream aggression frequency (per 100 words)	Dream misfortune frequency (per 100 words)
Trait	Psychopathology (SCL-90-R)	- 0.05	- 0.05
State	Weekly perceived stress (WSI-I)[a]	- 0.04	- 0.07
	Daily pre-sleep anxiety[a]	- 0.10	0.02
Dream measures	Dream recall frequency[a]	- 0.18*	- 0.06
	Disturbing dream recall frequency[a,b]	0.05	0.12*
	Dream negative affect (ratio) (Negative/Total Affect Reports)	0.35***	0.30***
	Dream emotional intensity (mean)	- 0.03	- 0.04
	Between aggressions and misfortunes	.02	

Table 5. Pooled Pearson correlation test coefficients for dream aggressions and misfortunes with trait and state variables, dream and disturbing dream recall frequencies, and dream affect. *Note.* SCL-90-R: General Symptom Index of the Symptom Checklist-90-R; WSI-I: Impact score of Weekly Stress Inventory; Daily pre-sleep anxiety: Five-point Likert anxiety scale. All reported dream outcomes are derived from dream logs. Dream aggressions and misfortunes were scored for all dream reports. Based on repeated data from 173 participants. [a] Scores of these repeated variables were compounded and adjusted monthly. [b] Correlations presented with Kendall's coefficients (tau). * $p \le .05$. *** $p < .001$.

GEE models were performed using nightly occurrence of dream aggressions and misfortunes as dichotomous outcomes (absence, presence; 0, 1). Pre-sleep anxiety, weekly perceived stress and psychopathology were standardized and included as the predictors with dream recall as the covariate. Results indicated that participants were 9% more likely to report aggressions in their dream narratives on a given night for every one standard deviation increase in levels of weekly perceived stress ($SD = 46.0$; Tables 1 and 6). By contrast, for every standard deviation above the mean on the measure of psychopathological symptomology ($SD = 43.98$; Table 1), participants were 8% more likely to report everyday dreams containing misfortunes.

	Dream aggressions					
Predictor	b	SE	t	OR	95% CI	p
Psychopathology (SCL-90-R)	0.048	0.036	1.331	1.050	[0.977, 1.127]	0.183
Weekly perceived stress (WSI-I)	0.088	0.038	2.323	1.092	[1.014, 1.176]	0.020*
Daily pre-sleep anxiety	0.025	0.033	0.768	1.026	[0.961, 1.095]	0.442
	Dream misfortunes					
Predictor	b	SE	t	OR	95% CI	p
Psychopathology (SCL-90-R)	0.077	0.037	2.077	1.080	[1.004, 1.162]	0.038*
Weekly perceived stress (WSI-I)	- 0.010	0.039	- 0.271	0.990	[0.918, 1.067]	0.786
Daily pre-sleep anxiety	- 0.046	0.033	- 1.377	0.955	[0.895, 1.020]	0.169

Table 6. Empirical models predicting the occurrence of dream aggressions and misfortunes on a given night. *Note.* Models derived from Generalized Estimating Equations analyses using standardized predictors and binary outcomes (0, 1) with dream recall as a covariate to control for its effect. Based on 4529 observations of 173 participant. SCL-90-R: General Symptom Index of the Symptom Checklist-90-R; WSI-I: Impact score of Weekly Stress Inventory; Daily pre-sleep anxiety: Five-point Likert anxiety scale. Dream aggressions and misfortunes were scored for all dream reports. SE, Standard error; OR, Odds ratio (Exp(b)); CI, confidence interval. * $p < .05$.

Discussion

These post-hoc analyses yielded differential positive effects for measures of affect load and affect distress on the prediction of aggressions and misfortunes in everyday dreams. These findings partially confirm our prediction and are consistent with the limited research in the field.

Weekly perceived stress was the sole and positive predictor of nightly occurrence of dream aggressions (Table 6). This may be explained by a continuity between the experience of waking social stressors or negative social interactions and dreamed social interactions. This idea is supported by findings showing that social stressors (i.e., interpersonal tensions and arguments) make up half of people's daily stressors (Almeida, Wethington, & Kessler, 2002) and that they constitute a similar proportion of the 86 minor stressors assessed by the measure of weekly perceived stress used in the present study. Considering that dream social interactions are often

overrepresented in dreams as compared to other dream content categories (Dale et al., 2016; Schredl & Hofmann, 2003) and that a recently proposed *social simulation theory* of dreams posits that dreams evolved to simulate people's waking social lives (Revonsuo, Tuominen, & Valli, 2015), experiencing waking stressful social situations may be mirrored in dreams, including through aggressive social interactions. Further work on the impact of interpersonal stressors on dream content is needed to clarify whether stressful social events in people's lives show greater continuity with dream content than other classes of stressful events and in what way.

We also found that psychopathology was the sole predictor of the occurrence of misfortunes in everyday dreams (Table 6). This finding may be accounted for by characteristics common to both measures. Specifically, since misfortunes imply that the dreamer experiences an unpleasant situation or threat outside of his or her realm of control, this may be congruent with some characteristics of impoverished well-being, such as feelings of helplessness, impressions of emotional vulnerability as well as bodily discomforts—all of which comprise examples of dream misfortunes.

Section 4 – General discussion

Results synthesis

The main findings presented in this master's thesis are as follows:

- Psychopathology and weekly perceived stress significantly and positively predicted the occurrence of general dream recall on a given night, whereas daily pre-sleep anxiety did not.
- Once controlling for dream recall, only weekly perceived stress positively predicted disturbing dream occurrence on a given night beyond the effects of daily pre-sleep anxiety and psychopathology.
    - Psychopathology interacted positively with weekly perceived stress to increase the latter's effect on disturbing dream occurrence on a given night.
    - Both the effect of weekly perceived stress on disturbing dream occurrence and the moderating effect of psychopathology were higher in the subsample of women with above group median scores on psychopathology.
- Once controlling for dream recall, psychopathology was the only significant and positive predictor of everyday dream emotional intensity, whereas everyday dream affect was positively predicted by both the psychopathology and daily pre-sleep anxiety measures.
- Weekly perceived stress was the only significant and positive predictor of the occurrence of aggressions in everyday dreams, whereas psychopathology was the only predictor of the occurrence of misfortunes in everyday dreams.

Taken as a whole, these results are in line with our four predictions. The findings, however, reveal differential effects of state and trait measures on the various dream content variables. The findings and their implications are discussed below.

The continuum of disturbed dreaming

The findings of the present thesis support the conceptualization of disturbed dreaming as existing on a continuum as proposed, among others, by Levin & Nielsen (2007, 2009). First, descriptive analyses revealed that while 25% of participants reported no disturbing dreams during the course of the study, a majority of participants who reported disturbing dreams either reported having bad dreams but no nightmares (33%) or both bad dreams and nightmares (35%). By contrast, only 7% of participants reported experiencing solely nightmare. These proportions are consistent with those from previous studies (Zadra, Pilon, & Donderi, 2006). These results reveal the tendency of people who have disturbing dreams to cluster into two distinct groups: individuals who report both nightmares and bad dreams, and a second group of people who report only bad dreams, thereby supporting the idea that nightmares represent a more severe expression of the same basic phenomenon.

Second, as expected, the frequency of disturbing dreams was significantly associated with a greater ratio of negative dream affect *and* higher mean emotional dream intensity for everyday dreams (Table 2). However, while the frequencies of dreamed aggressions and misfortunes per 100 words were also positively and moderately correlated with ratios of negative dream affect (r = .35 and .30 respectively; Table 5), they were not significantly correlated with mean dream emotional intensity. This observation suggests that the presence of aggressions and misfortunes in everyday dreams may render these dreams more negatively-toned, but not necessarily more intense.

This observation may be due to the fact that these two measures of dream content encompass events with varying levels of severity. For example, aggressive social interactions can range from covert feelings of hostility to physical assault. Thus, everyday dreams may contain more mild forms of aggressions and/or misfortunes while more severe manifestations are more likely to be found in more emotionally intense dreams, such as bad dreams and nightmares. Consistent with this idea, we found that the impact of affect load and affect distress on the occurrence of disturbing dreams (such as bad dreams and nightmares) was about twice as strong as their impact on the occurrence of aggressions and misfortune in everyday dreams (cf., Tables 3 and 6). Thus, day-to-day fluctuations in affect load and levels of affect distress better predict

emotionally intense dream experiences, such as bad dreams and nightmares, than they do less salient negative aspects of everyday dream content.

Differential effects of affect load and affect distress

As described earlier, the present findings revealed differential effects of affect load (pre-sleep anxiety and weekly perceived stress) and affect distress (general psychopathology) on various aspects of disturbed and everyday dreaming in our adult women sample.

When assessed as a whole, both of our affect load measures had a significant and independent impact on different content features of everyday dreams. First, weekly increases in perceived stress augmented the likelihood of reporting disturbing dreams, general dream recall, as well as the night-to-night occurrence of aggressive social interactions in everyday dreams (Tables 3 and 6). This is consistent with findings showing a strong correlation between everyday levels of stress and the frequency of disturbing dreams, as well as weaker associations with dream recall and dream aggressions (e.g., Bulkeley & Kahan, 2008; Kroth, Thompson, Jackson, Pascali, & Ferreira, 2002; Levin, Fireman, Spendlove, & Pope, 2011; Loveland Cook, Caplan, & Wolowitz, 1990).

As detailed in the main article of the thesis, a measure of accumulated emotional distress over a week may be better suited than a daily measure of emotional distress (e.g., the pre-sleep anxiety measured in the present study) to predict variations in the occurrence of disturbing dreams (Table 3) and, to a lesser extent, to predict everyday dream recall and the presence of aggressive social interactions in dreams (Tables 3 and 6). It is important to note that our measure of dream recall comprised all dreams recalled, including disturbing dreams. Thus, the smaller effects of our state and trait measures on dream recall may have overlapped with the ones observed in the occurrence of disturbing dreams. On the other hand, surges in pre-sleep anxiety independently increased the likelihood of subsequently reporting more negatively toned dreams. This small but nonetheless significant effect adds to the pool of contradictory findings—often based on differing methodologies—on the effects of negative pre-sleep experiences on disturbing

dream occurrence (Antunes-Alves & De Koninck, 2012; Blagrove & Fisher, 2009; Delorme et al., 2002; Samson-Daoust et al., 2019).

As predicted, and in line with Levin and Nielsen's (2007) model of disturbed dreaming, general psychopathology (affect distress) was a positive predispositional moderator of the relationship between weekly perceived stress (affect load) and the night-by-night occurrence of disturbing dreams (Figure 2). Thus, when faced with stressful situations that elicit an emotional response, women who exhibit higher levels of psychopathology are more likely to experience intense and unpleasant dreams such as bad dreams and nightmares. The moderation effect observed in this study increased even more with the severity of psychopathological symptoms as shown in a subsample of women scoring above the group median on our measure of psychopathology. These findings are consistent with the few studies finding state-trait interactions in relation to dream-related experiences (Blagrove & Fisher, 2009; Soffer-Dudek & Shahar, 2011) and provide empirical support for using diathesis-stress modeling when investigating state and trait effects on the occurrence of disturbed dreaming. Furthermore, while weekly perceived stress was a better predictor of likelihood of having disturbing dreams than was general psychopathology, the latter was a better predictor of emotionally intense and negatively toned dreams.

Taken as a whole, these results support Levin and Nielsen's (2007) hypothesis that fluctuations in everyday stress (affect load) increase the likelihood of experiencing a range of disturbing dreams whereas a predisposition to negative affectivity (affect distress) determines how intense these dysphoric dreams become (Figure 1).

Implications for emotional regulation in dreams

The present thesis demonstrated that even relatively small surges in daytime emotional distress were sufficient to negatively influence everyday dream content. Based on the previously reviewed literature, it is reasonable to assume that considerably larger effects would be observed with chronic or acute stressors as shown repeatedly, for example, in studies of dream-related disorders in trauma victims, including those suffering from PTSD (Duval & Zadra, 2010; Pigeon, Mellman, & Pigeon, 2017).

While the present thesis did not aim to test the possible emotional processing or emotional regulatory function of disturbed dreaming (see review; Nielsen & Carr, 2017) or of dreaming more generally (see review; Scarpelli, Bartolacci, D'Atri, Gorgoni, & De Gennaro, 2019), the findings obtained provide evidence for an emotional continuity between waking and dreaming experiences. As suggested by Levin and Nielsen (2007), the experience of recurrent nightmares would be indicative of emotional dysregulation while less severe forms of disturbed dreaming (e.g. bad dreams) may reflect successful emotional processing.

In addition, there is evidence that changes in dream content may be indicative of successful coping mechanisms. For instance, in a series of longitudinal studies of dream reports from depressed and non-depressed adults undergoing divorce, Cartwright and her collaborators (Cartwright, 1991; Cartwright, Luten, Young, Mercer, & Bears, 1998; Cartwright, Newell, & Mercer, 2001) found that dream content variables centered around affect and the representation of the ex-spouse was associated with how well their study participants adapted to their situation over time. Similarly, one longitudinal study (Pesant & Zadra, 2006) of healthy adults found that the content of participants' home dream reports was moderately to strongly correlated to their scores on measures of psychological well-being both at fixed points in time and over a 6- to 10-year period, with content variables of dream affect and social interactions showing the strongest relations.

How one copes with everyday stressors may also play a role in the experience of nightmares and their associated waking distress (Levin & Fireman, 2002; Nielsen & Zadra, 2011; Picchioni et al., 2002). For instance, engaging in problem-solving, fantasy and relaxing activities (e.g., reading, listening to music) following periods of stress may act as an emotional buffer as such activities may lower pre-sleep cortisol levels and can even be reflected in positive changes in dream content, including in nightmare and bad dream frequency (Delorme et al., 2002; Khalfa, Bella, Roy, Peretz, & Lupien, 2003; Malinowski & Horton, 2015; Simor, Csóka, & Bódizs, 2010).

Study limitations

Although this thesis aimed to address many of the shortcomings of previous studies in the field, it nevertheless faces its own limitations. These include the fact that the sample was limited to female participants, that the prospective dream logs were only collected at the end of the study and not on a daily or weekly basis, and that weekly perceived stress was assessed retrospectively. In addition, only one measure of affect distress (general psychopathology) and two measures of affect load (daily pre-sleep anxiety and weekly perceived stress) were used as predictors of dream content variables. It would have been interesting to have used complimentary measures of affect distress, such as nightmare-related distress (Belicki, 1992b) which has been found to be a better predictor of disturbing dream frequency than measures of psychopathology (e.g., Duval, McDuff, & Zadra, 2010; Martínez, Miró, & Arriaza, 2005). Furthermore, the inclusion of objective measures of general emotional reactivity, such as heart rate when faced with cognitive stress (Klůzová Kráčmarová, 2017) or a marker of blunted morning cortisol response (Nagy et al., 2015) would also have been of interest.

Likewise, although using single response Likert-Type scales to measure pre-sleep anxiety is a simple and time effective way to assess affect load on a daily basis and have been used by others (e.g., Blagrove & Fisher, 2009; Samson-Daoust et al., 2019), a more complex or multidimensional operationalization of the affect load construct may have been preferable. The Daily Stress Inventory (from which the WSI used in the present study was derived; Brantley, Waggoner, Jones, & Rappaport, 1987) is one such instrument, but the time required for its completion (participants must rate their perceived stress on 58 items) during several consecutive weeks may have led to significant number of dropouts given the already demanding nature of the study's protocol. Another way to assess daily affect load in a more comprehensive manner without adding excessive time demands on participants would be to compute a general score for a variety of emotions experienced during the day. Thus, a short inventory of negative and positive emotions with a Likert-type scale for each emotion's intensity (e.g., the PANAS scale; Watson, Clark, & Tellegen, 1988) would allow for the summation of general affect load as well as of negative and positive emotional loads.

On a more phenomenological level, whether one actually *experiences* either a waking event or a dream with strong negative emotions, or simply *remembers* it as such is difficult to distinguish given the intertwined and subjective nature of such processes. This is especially true when dealing with experiences which are detailed after their occurrence, as is the case with dream reports as well as retrospective inventories of stressors experienced over the past week or month. For instance, when assessed retrospectively, stressors from the past week may be remembered and reported by participants with high dispositional affect distress (psychopathology) as being more stressful than if assessed prospectively. This possibility of an overlap between affect load and affect distress is highlighted by the positive interaction between weekly perceived stress and psychopathology in predicting disturbing dream occurrence (Figure 2). Furthermore, although our measures of weekly perceived stress and psychopathology were viewed as discrete entities, of all the correlations computed on this dataset (Tables 2 and 4), the strongest was between these two variables (r = .55). This suggests that our measures of psychopathology and perceived stress may, at least in part, have been tapping into similar facets of people's lives.

Finally, the present thesis did not assess participants' possible history of past trauma nor did it take into account other factors potentially associated with disturbed dreaming, including the presence of sleep disorders, general sleep quality, and the use of alcohol and other drugs and medications.

Future research directions

Although the distinction between state and trait factors may appear straightforward, the operationalization of these constructs can be challenging as the same score on the same instrument can sometimes be conceptualized as a state or a trait variable. For instance, although several studies of disturbing dreams, including the present study, used the GSI scale of the SCL-90-R to assess the *trait* of general psychopathology (e.g., Blagrove & Fisher, 2009; Levin et al., 2011), one study (Schredl, 2003b) considered the very same GSI score as a *state* measure of psychological distress merely by changing the retrospective interval covered by the instrument

from the past month to the past week. Such issues become particularly problematic when state and trait effects on dreaming are contrasted, as done by Schredl (2003).

Similarly, Levin et al. (2011) used the Life Event Scale (intensity of negative events experienced in the past year) as a *state* measure of affect load by assessing the emotional load of these negative events only over the past month. To what extent lengthening or shortening an instrument's original and validated time interval justifies changes in its conceptualization as a trait or a state variable remains unclear, as are the potential impacts of such changes on study conclusions. These methodological issues, however, may explain some of the divergent findings reported in the literature.

Another important consideration is how disturbed dreaming is assessed. Although much of research in the field uses discrete measures of different types of dreams (e.g., unpleasant dreams, bad dreams, nightmares, recurrent dreams; Duke & Davidson, 2002; Schredl & Göritz, 2015; Zadra & Donderi, 2000), some studies have used continuous discrete measures to assess relevant aspects of the dreaming experience, such as degree of pleasantness (Blagrove & Fisher, 2009) as well as emotional valence and intensity (Malinowski & Horton, 2014; Schredl & Reinhard, 2009). In a related vein, since the occurrence of recurrent dreams has also been associated with periods of stress and impoverished psychological well-being (e.g., Brown & Donderi, 1986; Duke & Davidson, 2002) and can overlap with disturbing dreams, a measure of dream recurrence (e.g., ranging from the repetition of locations and characters to entire thematic contents) could be considered. Finally, distinguishing and/or controlling for dream-related parasomnias (e.g., sleep paralysis, sleep terrors) and providing clear definitions for the dream experiences being investigated (e.g., nightmares) is also of prime importance.

One of the main goals in investigating the etiology of idiopathic disturbed dreaming is to better understand why some people experience disturbing dreams while others do not. Thus, it is not only crucial to include participants who seldom have such dream experiences in the ensuing analyses, but also to be aware of how their inclusion (or exclusion) may impact the results. For instance, when investigating additional changes in our observed effects of state and trait measures on disturbing dreams, a post-hoc GEE analysis was performed using only the subsample of participants that reported one or more disturbing dreams during the course of the study (i.e.,

by removing the 43 participants with no reports of disturbing dreams in their logs). We found that the effect of perceived stress on disturbing dream occurrence was not only smaller, but no longer significant (OR = 1.091, p = 0.080), a finding that may be attributable to decreased variability within this subsample of participants.

Some nightmare researchers have tried to take such considerations into account by actively recruiting people reporting few if any disturbing dreams (e.g., Levin & Fireman, 2002; Wood, Bootzin, Rosenhan, Nolen-Hoeksema, & Jourden, 1992). Nevertheless, researchers sometimes specifically exclude, for a range of reason, participants reporting no disturbing dreams. One study, for instance, excluded such participants from analyses involving a measure of nightmare-related distress which required the experience of at least one disturbing dream during the study (Levin et al., 2011). A similar exclusion occurred in another study due to the researchers' inability to compute within-participant correlations when nightmare occurrence was 0 (absence of nightmare occurrence) on all log days (Blagrove & Fisher, 2009). This latter example underscores the need for more advanced and robust statistical methods when using a daily prospective design. In fact, as dream research moves toward online methods of data collection—which can allow for larger sampling as well as timestamped entries—more comprehensive statistical tests such as multilevel and generalized linear models may well be required.

Finally, while much research had focused on the correlates of disturbed dreaming, very little is known about factors underlying positively-toned dreams. For example, what are the predictors of euphoric dreams—as opposed to dysphoric ones—causing an awakening due to the intensity of the dream experience? Some researchers have begun turning their attention to positive dimensions of everyday dream content and recent evidence reveals associations between the occurrence of positively toned dreams and the experience of positive emotions as well as peace of mind during wakefulness (e.g., Gilchrist, Davidson, & Shakespeare-Finch, 2007; Sikka, Pesonen, & Revonsuo, 2018). Thus, while disturbing and recurrent dreams might be red flags reflecting poor psychological well-being or chronic stress, the opposite might be true for positive dreams (Schredl & Reinhard, 2009; Soffer-Dudek, 2017).

In conclusion, the findings presented in this master's thesis provide support for the affect load and affect distress components of Levin and Nielsen's (2007, 2009) neurocognitive model of

disturbed dreaming and, more generally, for the continuity hypothesis of dreaming. Future research in this field should evince a greater reliance on prospective methodologies, favor the conceptualization of dreaming experiences on a continuum, and investigate the determinants of positive dream experiences as well as negative ones. These considerations should permit a better understanding of the nature of dreams and their complex interrelations with a variety of waking life experiences.

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Appendix 1 – Consent form

FORMULAIRE DE CONSENTEMENT

Titre de la recherche : Corrélats psychologiques du contenu onirique et des cauchemars.

Chercheur : Antonio Zadra, Ph.D., professeur agrégé, Département de psychologie, Université de Montréal

A) RENSEIGNEMENTS AUX PARTICIPANTS

1. Objectifs de la recherche

Ce projet de recherche vise à mieux comprendre la relation entre certaines facettes de votre personnalité (p. ex. niveaux de bien-être psychologique, de stress quotidien) et différents aspects de vos rêves. Les procédures utilisées dans cette étude ne portent, à notre connaissance, aucun risque pour votre santé ou votre sécurité.

2. Participation à la recherche

Votre participation à cette recherche consiste à :

1. Répondre à des questionnaires concernant vos rêves et votre sommeil, votre niveau de bien-être psychologique ainsi que certaines dimensions de votre personnalité. Environ 20 minutes devraient vous suffirent à répondre à ces questionnaires.

2. Écrire le récit de vos rêves (donc émotions, thèmes, éléments visuels, etc) à la maison dans un livret préparé à cette fin. Vous devrez vous prêter à cet exercice pour une durée de 30 jours consécutifs. Selon votre rappel, entre 1 et 10 minutes chaque matin devraient vous suffirent à remplir le livret.

Cette étude ne comporte aucune rémunération.

3. Confidentialité

Les renseignements que vous nous donnerez demeureront confidentiels. Chaque participant à la recherche se verra attribuer un code alphanumérique et seul le chercheur principal et/ou la personne mandatée à cet effet auront la liste des participants et des numéros qui leur auront été attribués. De plus, les renseignements seront conservés dans un classeur sous clé situé dans un bureau fermé. Aucune information permettant de vous identifier d'une façon ou d'une autre ne sera publiée. Ces renseignements personnels seront détruits 7 ans après la fin du projet. Seules les données ne permettant pas de vous identifier seront conservées après cette date.

4. Avantages et inconvénients

En participant à cette recherche, vous pourrez contribuer à l'avancement des connaissances dans le domaine des rêves, incluant sur le sens psychologique de plusieurs types de rêves et de leur relation à la personnalité et au bien-être. Votre participation à la recherche pourra également vous donner l'occasion de mieux vous connaître.

Par contre, il est possible que le fait de rapporter des rêves perturbants (cauchemars ou mauvais rêves) vous amène à ressentir des émotions désagréables. Si cela se produit, n'hésitez pas à en parler avec l'agent de recherche. S'il y a lieu, l'agent de recherche pourra vous référer à une personne-ressource.

5. Droit de retrait

Votre participation est entièrement volontaire. Vous êtes libre de vous retirer en tout temps par avis verbal, sans préjudice et sans devoir justifier votre décision. Si vous décidez de vous retirer de la recherche, vous pouvez communiquer avec le chercheur, au numéro de téléphone indiqué à la dernière page de ce document. Si vous vous retirez de la recherche, les renseignements qui auront été recueillis au moment de votre retrait seront détruits.

B) CONSENTEMENT

Je déclare avoir pris connaissance des informations ci-dessus, avoir obtenu les réponses à mes questions sur ma participation à la recherche et comprendre le but, la nature, les avantages, les risques et les inconvénients de cette recherche.

Après réflexion, je consens librement à prendre part à cette recherche. Je sais que je peux me retirer en tout temps sans préjudice et sans devoir justifier ma décision.

Je consens à ce que les données recueillies dans le cadre de cette étude soient utilisées pour des projets de recherche subséquents de même nature, conditionnellement à leur approbation par un comité d'éthique de la recherche et dans le respect des mêmes principes de confidentialité et de protection des informations.

Je consens à ce que les données recueillies dans le cadre de cette   étude   Oui   Non
soient utilisées pour des projets de recherche subséquents de même nature,
conditionnellement à leur approbation par un comité d'éthique de la recherche
et dans le respect des mêmes principes de confidentialité et de protection des
informations.

Signature : _____   Date : _____

Nom : _____   Prénom : _____

Je déclare avoir expliqué le but, la nature, les avantages, les risques et les inconvénients de l'étude et avoir répondu au meilleur de ma connaissance aux questions posées.

Signature du chercheur_____   Date : _____
(ou de son représentant)

Nom : _____   Prénom : _____

Pour toute question relative à la recherche, ou pour vous retirer de la recherche, vous pouvez communiquer avec Antonio Zadra, professeur agrégé, au numéro de téléphone suivant : (514) 343-6626 ou à l'adresse courriel suivante : antonio.zadra@umontreal.ca.

Toute plainte relative à votre participation à cette recherche peut être adressée à l'ombudsman de l'Université de Montréal, au numéro de téléphone (514) 343-2100 ou à l'adresse courriel ombudsman@umontreal.ca. **(L'ombudsman accepte les appels à frais virés).**

Appendix 2 – Daily dream log

RAPPORT DE RÊVES

DATE :   HEURE :

RÊVE :

S.V.P., décrivez les aspects suivants de ce rêve :

Est-ce que ce rêve était :
    ☐ négatif   ☐ positif   ☐ les deux   ☐ neutre

Quelle est la clarté de votre rappel de ce rêve? (1 à 9) : _____

Emotions principale ressentie dans le rêve :

_____

Intensité de cette émotion (1 à 9) : _____

Type de rêve (si pertinent) :

         ☐ Cauchemar   ☐ Mauvais rêve   ☐ Rêve récurrent   ☐ Lucide
         ☐ Voler   ☐ Érotique   ☐ Terreur nocturne

Appendix 3 – Daily pre-sleep anxiety scale

Indicateur d'humeur

Code de participant : _____   **Semaine 1**

A chaque soir, veuillez évaluer votre niveau de stress/anxiété avant de vous coucher à l'aide de l'échelle suivante :

très calme...........................calme.................peu anxieux...........moyennement anxieux.........très anxieux
    1   2   3   4   5

Date	Niveau d'anxiété
Jeudi soir le 2 février 2006	1 2 3 4 5
Vendredi soir le 3 février 2006	1 2 3 4 5
Samedi soir le 4 février 2006	1 2 3 4 5
Dimanche soir le 5 février 2006	1 2 3 4 5
Lundi soir le 6 février 2006	1 2 3 4 5
Mardi soir le 7 février 2006	1 2 3 4 5
Mercredi soir le 8 février 2006	1 2 3 4 5