

An examination of the relationship between language use in post-trauma nightmares and psychological sequelae in a treatment seeking population

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Summary. Nightmares are thought to exist on a continuum of dream experiences, reflecting a more dysphoric process relative to dreams (Levin & Nielsen, 2009). Although there exists an established relationship between nightmares and increased symptomatology, the meaning of this relationship is still unclear (Davis et al., 2008). This study utilized the nightmare transcriptions from a treatment seeking sample of chronic and frequent nightmare sufferers to explore the relationship between language usage in nightmare narratives and indices of distress including posttraumatic stress disorder [PTSD] symptom severity and individual PTSD symptom cluster severity, nightmare frequency, nightmare distress, and nighttime panic symptoms. It was hypothesized that there would be significant relationships between language use and the aforementioned indices of distress. Specifically, that there would be a positive relationship between symptomatology and words related to negative emotions and perceptual processing, and a negative relationship between symptomatology and the use of words related to cognitive processes and positive emotions. Results indicate that language use, specifically words related to perceptual and cognitive processes, in post-trauma nightmares is associated with increased PTSD symptoms severity, nightmare distress, nightmare frequency, and nighttime panic symptoms. These results suggest that language use in nightmares may reveal important information about underlying cognitive and emotional processes that may help to better understand the etiology and maintenance of PTSD symptoms.

Keywords: Posttraumatic stress disorder, post-trauma nightmares, sleep, language use, LIWC

1. Introduction

Nightmares differ from dreams in that they involve intensely negatively valenced emotions, most often fear, and result in the disruption of sleep (American Academy of Sleep Medicine, 2014). It is a relatively ubiquitous phenomenon to experience a nightmare or nightmares in one's lifetime (Sandman et al., 2013). However, the experience of frequent and distressing nightmares is much rarer and usually associated with psychopathology (Schredl & Goeritz, 2019). The prevalence of nightmares is much higher in individuals who have experienced trauma compared to those who have not (Lemyre et al., 2019). In a trauma-exposed population, the presence of nightmares is associated with increased distress and symptomatology relative to those who do not have nightmares (Hasler & Germain, 2009). Furthermore, the content of the post-trauma nightmare (PTNM) is also predictive of increased risk for more severe symptoms such that the more similar the nightmare content is to the traumatic experience, the more severe the associated symptoms (Levin & Nielsen, 2007). The nature of these relationships remains unclear, however. To better understand how nightmares are related to psychological functioning, it may be necessary to examine the content of the nightmare via language use. It

is likely that nightmare content reflects underlying schema that the dreamer possesses. Due to the strong relationship between language use and underlying cognitive and emotional processes, the nightmare report may provide insight into important aspects of psychological functioning, and thus help to better understand how nightmares become associated with worse psychological outcomes (Bulkeley & Graves, 2018).

Post-trauma nightmares (PTNM), or nightmares that have an onset associated with a traumatic event, tend to be repetitive, replicative of the trauma to various extents, and lead to a fear of sleep (Campbell & Germain, 2016). PTNM commonly occur in response to a trauma, and their presence is a risk factor for the development of PTSD (Duval et al., 2013; Mellman et al., 2007; Wood et al., 1992). Due to the link between nightmares and associated dysfunction, and the high prevalence observed in this population, nightmares, a type of rapid eye movement (REM) sleep disturbance, have been conceptualized as the hallmark symptom of PTSD (Germain, 2013; Ross et al., 1989). Additionally, there is a positive relationship between the severity of the traumatic experience and nightmares, such that the more severe the trauma, the higher the risk for developing nightmares and experiencing increased nightmare distress (Duval et al., 2013). Conversely, the treatment of PTNMs has been shown to improve trauma-associated nighttime and daytime symptoms (Davis et al., 2007; Ellis, 2016). Additionally, research has shown that treatment for PTSD may cause PTNMs to become less trauma focused and decrease in frequency. However, it should be noted that without treatment that focuses on nightmares specifically, PTNM often do not abate (Davis, 2008).

There are important differences between PTNM and id-

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idiopathic nightmares (Hasler & Germain, 2009). PTNMs, related to idiopathic nightmares, are associated with increased nightmare frequency and distress, and increased psychopathology (Davis et al., 2011). In a trauma-exposed population, Germain and Nielsen found that people who have PTNM suffer from more awakenings and delayed sleep onset compared to people with idiopathic nightmares (Germain & Nielsen, 2003). These types of sleep disturbances are associated with impoverished sleep quality as well as daytime problems such as irritability, interpersonal difficulties, work impairment, and decreased energy.

Dreams of those who have PTSD typically involve the reliving of the traumatic experience to some degree in regards to the content and the emotion experienced during the traumatic event. Research has found that PTNM are typically negative, lack bizarreness, and are similar to the traumatic experiences (Levin & Nielsen, 2007). There are various types of PTNM, including those that consist of trauma-replicative content [i.e., the storyline is very similar to the event], those that are trauma-similar [i.e., there are some aspects similar to the event, but people, places, and the specific things that happen will differ], and those that are trauma-dissimilar [i.e., no clear connection in content with the event]. In general, the more similar in content the nightmare is to the trauma, the more distressing the nightmare is, in addition to being associated with increased rates of psychopathology (Davis, 2011). Similarly to the failure of adaptive cognitive processing in PTSD, the content of nightmares of those with PTSD also become stuck and repetitive (Hartmann, 2010). As the content of PTNM are often replicative of a previously experienced traumatic experience, the content of these nightmares is thought to represent the survivor's interpretation of the event and to be reflective of the beliefs that the survivor has regarding the event (Brewin et al., 2011, Ehlers & Clark, 2000).

The occurrence of PTNMs have been puzzling to dream researchers as they have been conceptualized as a failure in the proposed adaptive function of dreams. It is likely that this function of sleep and dreaming as a regulatory role between pre-sleep mood and post-sleep mood can fail either through the inability to sustain sleep or failure to adaptively process information (Cartwright et al., 2006). As chronic PTNMs represent a failure in recovery from the traumatic experience and sleep plays an adaptive role in the recovery process, there exists a vicious cycle that prevents the sufferer from rehabilitating after a traumatic experience (Germain, 2013). Levin and Nielsen (2007) propose that that the presence of psychopathology leads to the etiology of nightmares, and that the content and consequences of nightmares stem from psychological symptoms.

The information gleaned from a dream report can offer information regarding cognitive and emotional states experienced by the dreamer. Text analysis refers to the reduction of a body of text into quantitatively derived constructs that can be utilized to determine the presence and intensity of characteristics within the text (Chung & Pennebaker, 2018; Shapiro & Markoff, 1997). Linguistic Inquiry and Word Count (LIWC) is a computer program developed by Pennebaker and his team as a method of quantitative text analysis. Based on the knowledge that human language conveys information about underlying affective and cognitive processes, the use of LIWC allows researchers to effectively study these processes within written and verbal speech. LIWC works through identifying words within bodies of

text that theoretically belong to defined categories such as emotional tone, cognitive states, perceptual processes, grammar, and computes a percentage of the word use that belongs to a certain construct from the total word count of the sample (Pennebaker et al., 2015). LIWC was developed based on the observation that the way in which people wrote about personal distressing events were functionally related to health outcomes (Pennebaker, 2018; Pennebaker & Beall, 1986). Since its development, the use of LIWC has been studied in numerous clinical samples and with various types of text samples (for review, Tausczik & Pennebaker, 2010). Recently, trauma researchers have begun measuring language use within trauma narratives, and investigating the relationship between language use and treatment outcomes.

One of the mechanisms that is thought to contribute to the onset and maintenance of PTSD is the cognitive organization of the traumatic memory (Jelinek et al., 2010). As language use represents underlying cognitive behavior, examining language use is a potential resource for examining the organization of a memory. Trauma narratives consistently contain more negative emotion words and fewer positive emotion words, compared to narratives involving non-distressing disclosure (Booker et al., 2018, Hemenover, 2003). The use of words related to cognitive processing have also been found to be implicated in populations of people with a history of trauma, such that decreased use of words related to cognitive processing is associated with increased risk of more severe PTSD symptoms (Kleim et al., 2018). The use of words indicative of insight and causality suggest that there is an active cognitive processing, and use of tentative words is suggestive of a lack of processing (Tausczik & Pennebaker, 2010). Additionally, studies have shown that people who are experiencing distress will use more words that reflect anger, negativity, and anxiety (Lyons et al., 2018). In a study by Guastella and Dadds (2006), participants instructed to write about their trauma in the most detail included more negative emotion words and perceptual words compared to those who were instructed to write about their thoughts and feelings about the trauma, but given no further instruction.

Although LIWC was not created specifically with dreams and nightmares in mind, it has been utilized in previous studies to examine the language content in dreams, bad dreams, nightmares, and PTNMs (Bulkeley & Graves, 2018; Hawkins & Boyd, 2017; McNamara, 2008; Paquet et al., 2020). LIWC has been shown to reliably distinguish these types of dreaming experiences based on language use in meaningful ways, such that nightmares contain more negative emotions and anxiety than other types of dreams (Fireman et al., 2014; McNamara et al., 2015). Relative to dreams, PTNMs demonstrate increased use of words related to perceptual processes, affective processes, negative emotions, anxiety, anger, and sadness (Paquet et al., in press). In this same study, PTNMs did not differentiate significantly from dreams with use of words related to cognitive processes or positive emotions. These studies utilizing previous and current versions of LIWC have supported the hypothesis that LIWC can be used reliably to analyze word counts of dreams and nightmares. Due to the high prevalence of nightmares in those who have experienced trauma, and the documented relationship between language use, nightmares, and underlying processing, it seems that the next logical step is to examine the language use of nightmares in those who have experienced trauma.

Current Study

Due to the previously established relationship between nightmare content and associated psychological sequelae, the current study utilizes LIWC to understand how content measured by LIWC can yield insight into a person's psychological state. Within this study, several hypotheses are posed regarding the relationship between LIWC measurements and specific symptomatology. Specifically, we hypothesize that 1) There will be a positive correlation between words related to overall perceptual processes, and hearing, seeing, and feeling processes, and dependent variables of total PTSD severity and individual symptom cluster severity, nightmare frequency, nightmare distress, and nighttime panic symptoms, 2) there will be a significant positive correlation between words related to negative emotions, and dependent variables of total PTSD severity and symptom cluster severity, nightmare frequency, nightmare distress, and nighttime panic symptoms and there will be a negative correlation between words related to positive emotion and the same dependent variables, and 3) there will be a negative correlation between words related to cognitive processes, insight, causation, and dependent variables of total PTSD severity and symptom cluster severity, nightmare frequency, nightmare distress, and nighttime panic symptoms and there will be a positive correlation between words related to tentativeness and the same dependent variables.

2. Method

2.1. Participants and Procedure

Participants in this study were recruited from the community in a Midwestern city as part of an ongoing investigation of the effectiveness of a brief cognitive-behavioral intervention for PTNM, Exposure, Relaxation, and Rescripting Therapy (ERRT; Davis, 2008). Participants in these clinical trials were adults aged 18 and over who had experienced a traumatic event in their lifetime and reported at least one nightmare occurrence per week. Exclusionary criteria for all of these trials included active psychosis, active suicidal and homicidal intent, untreated bipolar I or II disorder, and/or reported substance or alcohol abuse within the past six months. For the purpose of this study, only those who completed an ERRT session that required writing and verbally reading out loud the account of the most distressing nightmare that could be remembered were included. Additionally, this session must have been recorded, or a copy made of the nightmare report, in order to complete the transcription, which resulted in a total of 53 nightmares from 53 individuals. This study included data from five different trials of ERRT. For the current analysis, veteran nightmare reports were also excluded from this study. Demographic information about the participants are presented in Table 1.

2.2. Measures

2.2.1 Demographics

Participant demographics, including age, gender identity, race/ethnicity, and sexual orientation was collected and can be found in Table 1.

2.2.2 PTSD and nightmares

Two different self-report measures of PTSD symptoms were administered to participants over the entire course of the several different trials that are included in this study. A survey measure of nightmare experiences created with the lab are then used to measure nightmare symptoms.

The Posttraumatic Stress Diagnostic Scale and PTSD Checklist.

The Posttraumatic Stress Diagnostic Scale was utilized in trials up until 2013 (PDS; Foa et al., 1997). The PTSD checklist for the DSM-V was utilized after 2013 (PCL-5; Weathers et al., 2013b). The PDS and PCL-5 were both developed to measure the presence and severity of symptomatic criteria for PTSD. The PDS corresponds to the DSM-IV, and is designed to measure current severity of PTSD symptoms. The experience of seventeen symptoms over the past month are assessed along a 4-point Likert scale in reference to an index traumatic event that the participant identifies as the most distressing. In addition to total symptom severity, the severity of each of the previously established three symptom clusters, reexperiencing (cluster B), avoidance (cluster C), and arousal (cluster D), can be assessed as well. This measure can also be used as a diagnostic tool. The PCL-5 is similar to the PDS as it can be used to measure total symptom severity, symptom cluster severity, and determine PTSD diagnosis, but instead follows the DSM-5 criteria, therefore there are four cluster symptoms that are measured on this scale. The PCL-5 was reduced to a 3-factor structure that reflects the structure of the PDS so that they could be used together. In order to maximize power, the total and cluster scores on these measures were converted to z-scores so that they could be standardized and compared. The internal reliability estimate for the present study was $\alpha = 0.94$ for the PDS and $\alpha = 0.93$ for the PCL-5.

Clinician Administered PTSD Scale. Two versions of the Clinician Administered PTSD Scale were used due to the fact that the diagnostic criteria of PTSD has changed since the start of the ERRT clinical trials. In the earlier trials, the Clinician Administered PTSD Scale for the DSM-IV (CAPS-IV; Blake et al., 1995) was used. In later trials, the Clinician Administered PTSD Scale for the DSM-V (CAPS-5; Weathers et al., 2013a) was used. The CAPS-IV utilizes a

Table 1. Participant demographics by group

Item	M	SD	n (%)
Age	42.6	13.93	--
Female	--	--	39 (73.6)
Male	--	--	12 (22.6)
Transgender	--	--	2 (3.8)
Caucasian	--	--	47 (88.7)
African American	--	--	2 (3.8)
American Indian	--	--	1 (1.9)
Other	--	--	3 (5.7)
Heterosexual	--	--	46 (88.7)
Gay/Lesbian	--	--	2 (3.8)
Bisexual	--	--	3 (5.7)
Questioning	--	--	1 (1.9)
Pansexual	--	--	1 (1.9)

Table 2. Psychological diagnosis and nightmare qualities experienced by sample

	n (%)
Meet for PTSD	35 (66)
PTNM	41 (77.4)
Idiopathic nightmares	12 (22.6)
Replicative nightmares	18 (34)
Similar Nightmares	22 (42)
Unrelated Nightmares	13 (24)

Note. PTSD = Posttraumatic stress disorder; PTNM = Post-trauma nightmares.

5-point Likert scale for both frequency and intensity ratings separately, while the CAPS-5 also utilizes a 5-point Likert scale that incorporates both severity and frequency. Both the CAPS-IV and the CAPS-5 can be used to assess total symptom severity, symptom cluster severity, and confer diagnosis. In order to utilize both of these scales concurrently in this sample, the same process was used that was reported for the self-report PTSD measures so that scores on these measures could be combined. The internal reliability estimate for both versions of the CAPS in the present study was $\alpha = 0.92$.

Trauma-Related Nightmare Survey (TRNS). The TRNS (Cranston et al., 2016) is a 15-item self-report measure that assesses the frequency and severity of post-trauma nightmares as well as the nightmare characteristics (e.g., how similar the nightmare is to the experienced trauma, and duration and onset of nightmares). The TRNS also assesses cognitions, emotions, and behaviors that are associated with the nightmares (Davis et al., 2001). The TRNS has adequate test-retest reliability and convergent validity in a study conducted by Davis and Wright (2007) and demonstrated good test-retest reliability and moderate to strong convergent validity in a more recent study conducted by Cranston and colleagues (2016). For the current study, there were several items of interest: the severity and frequency of nightmares as well as the number of nighttime panic symptoms endorsed in response to having a nightmare.

2.3. LIWC

LIWC2015 processes texts through the categorization of each analyzed word according to various empirically derived “dictionaries” (Pennebaker et al., 2015b). A total of 93 output variables are measured for each text that is analyzed, and includes: word count, 4 summary language variables, 3 general descriptor categories, 21 standard linguistic dimensions, 41 word categories tapping psychological constructs, 6 personal concern categories, 5 informal language markers, and 12 punctuation categories. All output variables, except total word count, words per sentence, and the summary language variables, are measured as a percentage of the words belonging to the specific dictionary that exist in the entirety of the text. The entire dictionary that makes up LIWC2015 comprises of 6400 words. The dictionary for LIWC2015 was largely developed based on the 2007 program version. To develop the dictionaries, many sources are utilized such as Roget’s Thesaurus, standard English dictionaries, and expertly generated lists related to each category that were internally and externally determined to

be valid and reliable. As part of its development, LIWC has been applied to several different types of texts (e.g., novels, editorials, internet vestiges), encompassing over 80,000 authors and over 230 million words to establish differential language patterns for differing types of texts.

2.4. Procedure

Recruitment processes for this study included the use of fliers, newspaper and radio advertisements, and referrals from local clinicians, and has been ongoing since 2009. Screening processes since 2009 have proceeded through completing a brief phone screen to determine eligibility. If the individual was found to be eligible, he/she was invited to complete an in-person initial assessment that included structured clinical diagnostic interviews and self-report measures. Following an assessment, if the individual was still eligible, depending on the clinical trial, s/he was randomly assigned to either a treatment condition as part of a randomized control trial, or would be assigned to a specific ERRT protocol designed for a specific clinical group. As part of the ERRT protocol, certain sessions were dedicated to the discussion of the individual’s most distressing nightmare. Within these sessions, the individual is instructed to write the account of the nightmare to include as much detail as possible, in first-person, and as if the nightmare is hap-

Table 3. Psychological symptoms of sample

Item	N	M	SD
PTSD Symptoms			
CAPS-5	30	32.57	15.50
CAPS-5 Intrusion Symptoms		8.20	5.13
CAPS-5 Neg. Cog. & Emot.		4.07	2.23
CAPS-5 Avoidance Symptoms		11.43	6.96
CAPS-5 Arousal Symptoms		8.87	4.13
CAPS-IV	20	55.65	23.30
CAPS-IV Intrusion		27.24	10.23
CAPS-IV Avoidance Symptoms		28.82	14.67
CAPS-IV Arousal Symptoms		25.94	8.66
PCL-5	30	44.86	18.48
PCL Intrusion Symptoms		11.37	5.88
PCL Neg. Cog. & Emot.		5.33	2.41
PCL Avoidance Symptoms		15.18	8.17
PCL Arousal Symptoms		11.79	4.72
PDS	21	22.65	13.77
PDS Intrusion		6.73	5.02
PDS Avoidance		6.83	5.13
PDS Arousal		12.55	5.06
Sleep and Nightmare Qualities			
Nightmare Frequency	53	3.65	2.14
Nightmare Distress	53	3.51	.85
Nighttime Panic Symptoms	53	5.89	3.00

Note. PTSD = posttraumatic stress disorder; CAPS-5 = Clinician Administered PTSD Scale for the DSM-5; CAPS-IV = Clinician Administered PTSD Scale for the DSM-IV; PCL-5 = PTSD checklist for the DSM-5; PDS = Posttraumatic Diagnostic Scale.

Table 4. Correlations between perception words and outcome variables

Variable	PTSD Total	Cluster B	Cluster C	Cluster D	Nightmare frequency	Nightmare distress	Panic symptoms
Perceptual processes	0.24	0.27	0.29*	0.12	-0.06	0.07	0.21
See	0.23	0.10	0.28*	0.05	-0.04	-0.12	0.11
Hear	0.32*	0.38**	0.31*	0.22	-0.01	0.29*	0.44**
Feel	-0.11	0.12	-0.10	-0.09	-0.07	-0.11	0.03

Note. PTSD = posttraumatic stress disorder, * $p < .05$ ** $p < .01$

pening in the present. The individual is then asked to read the nightmare aloud. There were two primary methods of transcribing participants' nightmares: either through utilizing Microsoft Word to transcribe photocopies of the nightmare, or utilizing Open Office on a separate secure computer to transcribe nightmares from audio recordings. The same person transcribed all nightmares, and in order to ensure accuracy of the transcription, all recordings were listened to at least two times to ensure accuracy of content, and subsequently all transcriptions were checked at three different time points for typographical errors. All transcriptions were then analyzed utilizing LIWC. All procedures were approved by the university's Institutional Review Board.

2.5. Data Analysis Plan

Database creation. The database for this study was built from each of the clinical trial databases to include all participants with completed nightmare transcriptions. Each participant in the database included the LIWC output for the LIWC-analyzed nightmare transcription as well as all of the responses to all of the measures of interest for this study.

Analyses. Analyses were conducted using the IBM Statistical Package for Social Sciences, Version 24 (SPSS Inc., 2014). Descriptive analyses were conducted for demographic information such as gender, age, race, and ethnicity. Additional descriptive analyses were conducted to identify the presence of psychological symptom variables (a more thorough description can be found in Tables 2 and 3). Descriptive analyses were also conducted to compute the mean values and standard deviations of the study sample on each of the LIWC variables. Some of the LIWC variables of interest were significantly skewed. Square root transformations were applied to significantly positively skewed variables.

To test the hypothesis, correlation analyses were completed between the LIWC and outcome variables. A correlation analysis was selected over regression analyses due to the fact that this sample size was not large enough complete regression analyses with moderate power. Therefore, at this stage of data analysis, it is not possible to control adequately for confounding variables. The impact of not being able to control for other variables on the interpretation of the results will be discussed later.

3. Results

Hypothesis 1 stated that there would be an overall positive correlation between LIWC variables related to perception and dependent variables. To test this hypothesis, Pearson's correlations were utilized. Words related to overall perceptual processes and visual processing was significantly positive correlated with the avoidance symptom cluster of PTSD ($p < 0.05$), but was not significantly correlated with any of the other PTSD symptoms or nightmare symptoms. Use of words related to hearing were significantly positively correlated with total PTSD symptom severity, the re-experiencing and avoidance symptom cluster of PTSD, nightmare distress, and number of nighttime panic symptoms ($p < 0.05$). Words related to tactile touch were not significantly correlated with any of the dependent variables. Thus, this hypothesis was partially supported. The results of hypothesis 1 are presented in Table 4.

The second hypothesis stated that there would be a positive correlation between use of words related to negative emotions and dependent variables, and a negative correlation between positive emotion words and dependent variables. To test this hypothesis, Pearson's correlations were utilized. This hypothesis was not supported. The use of words related to positive emotions and negative emotions were not significantly correlated with any of the dependent variables. The results of hypothesis 2 are presented in Table 5.

The third hypothesis stated that there would be a negative correlation between use of words related to cognitive processes, and specifically insight and causation words and dependent variables, and a negative correlation between words indicative of tentativeness and dependent variables. To test this hypothesis, Pearson's correlations were utilized. This hypothesis was partially supported. Words related to cognitive processes were negatively correlated with total PTSD symptom severity, each of the symptom clusters' severity, nightmare frequency and distress, and number of nighttime panic symptoms ($p < 0.05$). Words related to causality and tentativeness were not significantly correlated with any of the dependent variables. Words related to insight were significantly negatively correlated with arousal PTSD symptoms, nightmare frequency and number

Table 5. Correlations between emotion words and outcome variables

Variable	PTSD Total	Cluster B	Cluster C	Cluster D	Nightmare frequency	Nightmare distress	Panic symptoms
Positive emotions	0.06	0.06	0.07	0.23	-0.17	-0.02	-0.05
Negative emotions	-0.15	0.06	-0.07	-0.11	-0.06	0.09	0.14

Note. PTSD = posttraumatic stress disorder, * $p < .05$ ** $p < .01$

Table 6. Correlations between cognitive words and outcome variables

Variable	PTSD Total	Cluster B	Cluster C	Cluster D	Nightmare frequency	Nightmare distress	Panic symptoms
Cognitive processing	-0.37**	-0.31*	-0.29*	-0.47**	-0.33*	-0.29*	-0.27*
Cause	-0.14	-0.06	-0.25	0.05	0.04	-0.18	-0.10
Insight	-0.25	-0.24	-0.21	-0.28*	-0.32*	-0.06	-0.31*
Tentative	-0.11	-0.12	-0.09	-0.16	-0.05	-0.25	-0.09

Note. PTSD = posttraumatic stress disorder, *p<.05 **p<.01

of nighttime panic symptoms ($p < 0.05$). The results of hypothesis 3 are presented in Table 6.

4. Discussion

Dream researchers have suggested that future directions in the content analysis of dreams should focus on determining psychopathological indicators in dream content (Bulkeley & Graves, 2018). This study aimed to preliminarily examine the relationship between specific nightmare content and psychological symptoms of PTSD and nightmares. The present study built upon existing literature utilizing LIWC that demonstrated the presence of negative emotion words in nightmares and the differences in cognitive and perceptual word use related to trauma exposure. The results of this study have supported the hypothesis that language use in nightmares reveals important information about underlying cognitive and emotional functioning.

In the current study, the use of words related to hearing was significantly positively correlated with total PTSD symptom severity, as well as cluster B (reexperiencing) and cluster C (avoidance) symptom severity, nightmare distress, and nighttime panic symptoms. Word use related to seeing and overall perceptual processing was significantly positively correlated with cluster C symptom severity, as well. The observation that these PTNM narratives have increased use of perceptual words may provide insight to the nature of avoidance that trauma survivors often demonstrate. As PTNMs are typically recurrent, replicative, and frequent, trauma survivors are continuously and vividly reminded of their trauma often, and therefore maintain the distress associated with avoidance of trauma reminders. This relationship can also be understood by the heightened distress and night-

time panic symptoms the current sample reported related to their nightmare experiences. In accordance with Mowrer's two-factor theory of PTSD, the avoidance of trauma cues maintains distress and dysfunction (Foa et al., 1989; Zoellner et al., 2020).

In this study, the use of emotion words was not significantly correlated with PTSD and nightmare symptomatology. This could be explained by the fact that the majority of this sample reported a high level of negative emotion words in their nightmares. Therefore, there was not a wide variance of differential emotional experiences within these nightmare reports.

The results of this study did show a significant correlation between decreased general cognitive processing and increased PTSD and nightmare symptom severity, as well as a significant negative correlation between use of insight words and cluster D (arousal) symptom severity, nightmare frequency and nighttime panic symptoms. Pennebaker, Mayne, and Francis (1997) suggested that the use of cognitive processing and emotion words predict processing of events. The use of cognitive mechanism words, especially about past events, are indicative of active processing and reappraisal. Other studies utilizing LIWC in trauma-exposed populations found that when people write about their trauma, those with a diagnosis of PTSD utilize language that incorporates less cognitive processing words than those without PTSD (Jelinek et al., 2010). The results of this study support previous findings such that in this study, those who have decreased cognitive processing demonstrated in their nightmares have increased severity of PTSD and nightmare symptoms. Therefore, these PTNM narratives may be predictive of psychological functioning and current process-

Table 7. Intercorrelations amongst independent variables

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Perceptual processes	1	--	--	--	--	--	--	--	--	--
2. See	0.53**	1	--	--	--	--	--	--	--	--
3. Hear	0.53**	0.13	1	--	--	--	--	--	--	--
4. Feel	0.37**	-0.19	-0.11	1	--	--	--	--	--	--
5. Positive emotions	-0.02	0.06	-0.22	0.06	1	--	--	--	--	--
6. Negative emotions	-0.04	-0.26	-0.12	0.44**	-0.08	1	--	--	--	--
7. Cognitive processing	-0.05	-0.15	-0.23	0.20	-0.06	0.20	1	--	--	--
8. Cause	-0.16	-0.38**	-0.12	0.14	0.34*	0.08	0.11	1	--	--
9. Insight	-0.08	-0.24	-0.28*	0.20	-0.06	0.04	0.64**	-0.07	1	--
10. Tentative	-0.16	0.11	-0.06	-0.16	-0.09	-0.05	0.39**	0.01	-0.01	1

Note. *p<.05 **p<.01

Table 8. Intercorrelations amongst outcome variables

Variable	1.	2.	3.	4.	5.	6.	7.
1. PTSD Total	1	--	--	--	--	--	--
2. Cluster B	0.92**	1	--	--	--	--	--
3. Cluster C	0.93**	0.77**	1	--	--	--	--
4. Cluster D	0.89**	0.80**	0.74**	1	--	--	--
5. Nightmare frequency	0.27	0.21	0.22	0.37**	1	--	--
6. Nightmare distress	0.20	0.23	0.14	0.26	0.18	1	--
7. Panic symptoms	0.56**	0.55**	0.51**	0.54**	0.25	.46**	1

Note. PTSD = posttraumatic stress disorder, * $p < .05$ ** $p < .01$

ing of the trauma. Furthermore, these results may help to explain the relationship between nightmares and increased symptoms, such that as evidence for cognitive processing decreases, nightmare frequency increases, as well as, arousal symptoms (which includes poor sleep).

The results of this study may have important treatment considerations. Several studies have found that language use changes over the course of treatment. Other studies have also found that baseline measurements of language use can predict treatment outcomes. A study conducted at the University of Pennsylvania asked survivors who were participating in exposure therapy to transcribe their trauma narratives and found that those narratives that included greater use of cognitive words when writing about the trauma was related to improved post-treatment anxiety outcomes (Alvarez-Conrad et al., 2001). Treatment studies have found that language use, measured by LIWC, changes from pre-treatment to post-treatment in people with PTSD. When a group of people who were instructed to write about a traumatic experience, but additionally instructed to make cognitive reappraisals of the event or to find benefit from enduring the event, they demonstrated increased use of insight and causation words (Guastella & Dadds, 2006). Another study instructed survivors of breast cancer who participated in therapy to write about their experience, and found that their narratives included increased cognitive processing words and emotion words (both positive and negative) between pre- and post-treatment (Martino et al., 2015).

5. Limitations

There are several limitations to be mindful of when interpreting the results of this study. One limitation is the small sample size, which influenced the types of statistical analyses we could utilize. A sample size of around 50 leads to underpowered results of regression analyses (Cohen, 1988). The small sample size prevented the use of statistical analyses such as regression that would have allowed the control of other variables when examining the relationship between word use measured by LIWC and symptom severity. In Tables 7 and 8, the intercorrelations amongst independent variables and dependent variables are reported separately. There were significant correlations amongst dependent variables, therefore, it is possible that there are important confounding variables that may explain the relationship between LIWC results and symptom severity. Participants will continue to be added to this database so that these data can be utilized in more powerful ways. Due to the small sample size, this study should be viewed as a preliminary or pilot study

that is meant to generate hypotheses in the future. Another limitation of the study is the potential generalizability of the results. This sample was also a treatment seeking sample that was predominately middle-aged Caucasian females, therefore the results of this study may not generalize to other populations that do not have significant negative health outcomes or of more diverse demographics.

Furthermore, the data from this study involves data from clinical trials that have been ongoing since 2009 and diagnostic criteria for PTSD has changed throughout the course of these studies. In the previous version of the DSM, PTSD was defined as having three symptom clusters: re-experiencing, avoidance, and arousal. Currently, however, PTSD is now considered to have four symptom clusters with the addition of negative alterations in cognition and mood to the previously asserted three clusters. In order to maximize the amount of data that could be included in this study, only symptoms from the previously established three clusters were utilized since a large portion of this sample's symptoms of negative alterations in cognitions and mood were not assessed.

6. Future directions

In general, more information is needed about the content and language use of PTNM. This is the first study using LIWC to establish psychological correlates of language use in PTNM and therefore hopes to provide rationale for continuing to investigate PTNM with this program. This study only focused on a set of LIWC variables and the use of clinical assessments of symptomatology. There are many more LIWC variables to be studied that may be relevant to the content of nightmares as well as much more data that is collected within these clinical trials that may explain the relationship between nightmare content and associated problems.

As previously discussed as part of the limitations, this is a correlational study. As more data is collected and more specific types of relationships are considered, it will be important to utilize more sophisticated data analysis procedures to better characterize the relationship between language use and psychological functioning. Due to the intercorrelation amongst dependent variables, in the future it will be important to control for specific variables so that the relationship between language content and psychological functioning can be further understood.

The results of this study suggest that there are important and strong relationships between language use and psychological functioning. Therefore, the next steps from this

study should involve the investigation of the relationship between language use in nightmares and treatment outcomes. Additionally, as more data can be collected according to the current model of PTSD delineated in the DSM 5, it will be important to update the analyses of this study so that the relationship between language use and the current cluster D symptoms of PTSD can be examined.

Lastly, during ERRT, participants are also guided through writing rescriptions of their nightmares. During rescription of the nightmare, the therapy and client collaboratively target salient problematic themes in the nightmare report, that are then subsequently altered in adaptive ways. Future research should investigate the changes that occur between the nightmare report and the nightmare rescription with LIWC, and additionally see if these changes correspond to changes in symptomatology and treatment outcomes.

7. Conclusion

It is important to specifically consider the language use of PTNMs within the totality of dream experiences. PTNM are a unique dream experience to those who have experienced a trauma. It is also important to understand the etiology and maintenance of PTNM due to the fact that dreams theoretically represent a form of cognition, in combination with the fact that a major symptom of PTSD is the negative impact that trauma has on the survivor's cognitions. The repetitive and realistic nature of a PTNM is conceptualized as a failed dream, as it is thought to serve no function. This is juxtaposed to the proposed functionality of the much more common transient experience of a nightmare during times of stress. Understanding nightmares in the context of PTSD could help to elucidate the etiology and maintenance of cognitive and emotional problems people commonly experience in response to a trauma. Overall, these results suggest that language use within PTNM is associated with psychological functioning. Therefore, these results will help to better understand the unique problematic relationship between nightmares and decreased psychological functioning and impairment.

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