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# Tell Us Your Story: Investigating the Linguistic Features of Trauma Narrative

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## Abstract

Linguistic features can predict several aspects of human behavior. Little is known, however, about whether syntactic, semantic and structural language features can also predict psychological disorders such as posttraumatic stress disorder (PTSD). The current study investigated whether the linguistic properties in trauma narratives written by survivors of a Motor Vehicle Accident (MVA), change as function of the intensity of PTSD symptoms. A short form diagnostic tool known as the Posttraumatic Stress Disorder Checklist (PCL) was used to determine the severity of participant PTSD symptomatology. Using a text capture paradigm participants were then asked to write a neutral narrative or a narrative that described their traumatic event. PCL scores were compared to linguistic variables from eight different computational linguistic algorithms. Results from this study suggested that the relative intensity of PTSD symptomatology affects syntactic, semantic, and structural aspects of the narrative.

**Keywords:** Posttraumatic Stress Disorder; PTSD; Trauma Narrative; Linguistic Features.

## Introduction

Language patterns can be good predictors of relations in the world. For instance, language statistics can predict the modality of a word (Louwerse & Connell, 2011), the iconic relationship of words (Louwerse, 2008), social networks (Hutchinson, Datla, & Louwerse, 2011), and even geographical locations of cities (Louwerse & Benesh, 2012; Louwerse & Zwaan, 2009). Language patterns have also shown to be predictors of aspects of human behavior. For instance, linguistic features predict fraudulent events (Louwerse, Lin, & Semin, 2010), predict an individual's personality type (Gill, Nowson, & Oberlander, 2009), whether they are lying (Hancock, 2004), and even to what extent they visit their doctor's office (Campbell & Pennebaker, 2003).

Despite the predictive utility of language, there is very little computational linguistic research that investigates whether language features predict psychological symptoms such as those associated with Posttraumatic Stress Disorder

(PTSD). Considering the ability of linguistic patterns to demonstrate mental processes and behaviors, and the concise delineations of PTSD symptomatology, the question can be raised whether linguistic patterns in written narratives from trauma survivors can be related to the severity of the trauma. More specifically, can language use reflect PTSD symptoms and their relative intensity? This research question was investigated in the current study.

PTSD is an anxiety disorder diagnosed to persons having "experienced, witnessed, or having been confronted with events that involve potential death, serious injury, or a threat to the physical integrity of oneself or others" (DSM-IV, 2000, p. 467). PTSD patients will persistently re-experience the event, while simultaneously avoiding thoughts, and/or environmental reminders of the event, with some or all of these symptoms lasting for longer than one month. Specific symptoms include re-experiencing the traumatic event, avoiding thoughts of the event, mental/emotional numbing, as well as hyper-arousal. These symptoms are further delineated to include flashbacks, nightmares, sleep difficulties, and irritability. These symptoms are clustered into three overarching categories, "Re-experiencing Symptoms", "Avoidance Symptoms", and "Hyperarousal Symptoms (DSM-IV, 2000), even though not all symptoms are necessary for a PTSD diagnosis.

In recent years the prevalence of PTSD has increased. Studies indicate that 20% of women and 9% of men will develop PTSD, while 6.8% of those diagnosed will live with the disorder indefinitely (Kessler et al., 1995). This increase is due not only to an awareness of the disorder in the clinical community, but also to the development of diagnostic tools such as the PTSD Checklist (PCL). The PCL is a 17-item self-report measure that monitors trauma symptomatology much like the 30-item structured interview, Clinician Administered PTSD Scale (CAPS). Despite the CAPS being the longstanding method to PTSD diagnosis, current research validates that the PCL correlates highly with the CAPS measure as well as with its diagnostic efficiency (Blanchard, Jones-Alexander, Buckley, & Fomeris, 1996).

For instance, one study demonstrated the reliability of the PCL even within highly specific civilian populations (e.g. college students, Motor Vehicle Accident survivors) (Elhai, Gray, Docherty, Kashdan, & Kose, 2007). These direct questions administered in both the CAPS and PCL have proven to be a valid way of determining PTSD (Blanchard et al., 1996). However, it would be desirable to have an alternative, perhaps less direct, measure that reveals PTSD symptoms identified by the CAPS and PCL. This would allow for patients to be prescreened. Given the evidence from computational linguistic measures predicting human behavior, it might be the case that the language used by PTSD patients predicts the severity of the disorder.

There are indications that language use in PTSD patients might be indicative of the disorder. For instance, one main issue impeding recovery from the disorder is that sufferers have difficulty mentally integrating the event into their current cognitive schemas (Dalglish, 2004). Traumatic experience is mentally represented by two constructs, situationally accessible memories (SAMs), and verbally accessible memories (VAMs), but only VAMs can be deliberately retrieved; SAMs are activated by situation dependent reminders of the event (Brewin et al., 1996). Ironically, even though VAMs are memory representations that are readily accessible, PTSD patients will still report confusion of the details, as well as difficulty in forming coherent accounts of the traumatic event (Ehlers, Ehling, & Kleim, 2012). The language of a PTSD patient might reflect this confusion, or reflect their lack of clarity in recalling the details of the traumatic event.

Language use of trauma survivors has been studied before (i.e. therapeutic measures and interventions) (Sloan et al., 2012). One such example comes from work conducted by Tausczik and Pennebaker (2010). In their study writing samples collected in temporal units (e.g. over an extended time period). Some of these samples were related to a participant's traumatic experience, while others were non-emotional in nature. Tausczik and Pennebaker not only demonstrated the health benefits of narrative production by noticing a decrease in doctor visits for those writing about the traumatic experiences, but they were also able to identify word categories related to depression (e.g. pronouns), seeing similar patterns in health improvements as a function of increases or decreases in the usage of these categories.

Similarly, Smyth, Stone, Hurewitz, and Kaell (1999) investigated the effectiveness of PTSD treatment as a result of narrative production rather than fragmented discourse (i.e., discourse without narrative structure) In their study narrative production showed to alter a trauma survivor's tendency to avoid thoughts, as well as aid their recovery. The implication here is that the mental integration of traumatic events can be facilitated by means of narrative production. Smyth et al. (1999) also showed that writing leads to a reduction in symptoms of patients with chronic illness. The Smyth et al. (1999; 2001) findings support those of Tausczik and Pennebaker (2010) by isolating the type of

writing task that produces the greatest benefit; specifically, narrative production vs. fragmented and/or controlled discourse.

Often, the analyses of trauma language include global characteristics. For instance, Mansfield et al. (2010) described the foci of their analysis with terms such as complexity, personal growth, and resolution, which indicate positive change in thinking when reflecting on a difficult event, the ability to see different perspectives and outcomes, or the reconciliation with difficult life experiences. Similarly, Tuval-Mashiach et al. (2004) used terms such as coherence, self-evaluation, and meaning. Clearly, these concepts are not problematic in themselves – interrater reliability avoids that the abstract terms might lead to ambiguity – yet a computational operationalization of such concepts is difficult.

Rather than focusing on the global characteristics of trauma language, our analyses of trauma narratives utilized word-level linguistic models that not only offer a large spectrum of linguistic dimensions, but also provide theoretical grounding in the organization of their categories. Based on the theoretical frameworks these models provide, it is possible to isolate constructs similar to those of the aforementioned studies, while simultaneously revealing constructs previously unconsidered?

Because little computational linguistic work has been done on the analysis of trauma narratives, computational linguistic algorithms to analyze the data covered a wide range of dimensions, including syntactic and semantic algorithms. These algorithms can generally be classified into general structural (e.g., word count), syntactic (e.g., connectives) and semantic (e.g., word choice) dimensions of language, whereby some used a bag-of-words approach (e.g. LIWC), whereas others used a probability approach (MRC), whereas yet others relied on the computation of different factors (e.g., type-token ratio). Eight different algorithms were used, categorized in Figure 1.

Within the syntactic dimension, two algorithms were used, one focusing on general linguistic features, the other on interclausal relationships. For general linguistic features, we used 67 features from the Biber model (1988). These features primarily operate at the word level (e.g., parts-of-speech) and can be categorized as tense and aspect markers, place and time adverbials, pronouns and pro-verbs, questions, nominal forms, passives, stative forms, subordination features, prepositional phrases, adjectives and adverbs, lexical specificity, lexical classes, modals, specialized verb classes, reduced forms, dispreferred structures, and co-ordinations and negations.

Specific interclausal relationships were captured using Louwse's (2002) parameterization, including positive additive, (e.g. *also*, *moreover*), negative additive (e.g. *however*, *but*), positive temporal (e.g. *after*, *before*), negative temporal (e.g. *until*), and causal (e.g. *because*, *so*) connectives.

The semantic dimension can be broken down in three subdivisions: psycholinguistic ratings, conceptual

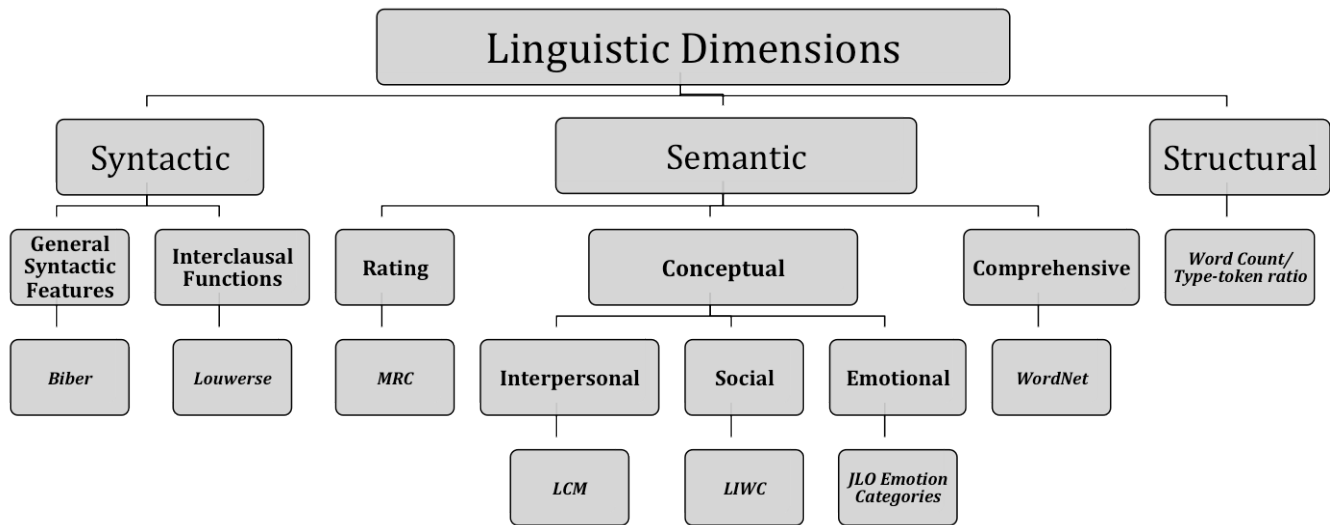


Figure 1. Linguistic Category Distinctions

relations, and comprehensive classifications. Psycholinguistic ratings are computed using the MRC Psycholinguistic Database (Coltheart, 1981), to get ratings on the familiarity, concreteness, imaginability and meaningfulness of words.

The conceptual dimension covers three categories: interpersonal, social and emotional language. Interpersonal language use is captured by the linguistic category model (LCM) (Semin & Fiedler, 1991). The model consists of a classification of interpersonal (transitive) verbs that are used to describe actions or psychological states and adjectives that are employed to characterize persons. This classification gives insight into the meanings of verbs and adjectives that people use when they communicate about actors and their social events. The model makes a distinction between five different categories of interpersonal terms

Social language features were captured by Pennebaker et al.'s (2007) Linguistic Inquiry and Word Count (LIWC). LIWC consists of 63 syntactic (e.g., pronouns) and semantic word categories (e.g., death, family) that focus on semantic aspects of discourse, namely aspects of discourse related to social phenomenon.

Emotional words are captured by the classification proposed by Johnson-Laird and Oatley (1989). These words are classified into two classes, broadly basic emotions (anger, fear, disgust, happiness etc.) and complex emotions (guilt, pity, tenderness etc.). The basic emotions indicate no cognitive load hence they are also called raw emotions, whereas the complex emotions indicate cognitive load.

For the comprehensive category WordNet (Miller & Fellbaum, 1998) was used, consisting of 150,000 words in 44 base types, including 25 primitive groups for nouns (e.g. time, location, person, etc.), 15 for verbs (e.g. communication, cognition, etc.), 3 groups of adjectives, and 1 group of adverbs. For the structural dimension, discourse features such as type/token ratio and word count were used.

The current study aims to utilize these linguistic categories to analyze written narratives produced by participants who experienced an MVA. The intent is to complement the aforementioned studies on the basis of trauma narrative language, but to include measures that have yet to be utilized in these studies; namely the categories featured here, but also participant scores on the PCL. The PCL scores obtained in our sample population will act as a dependent variable from which the associated linguistic features will be compared. Due to PCL scores resting on a continuum, it is possible that the usage of certain linguistic categories will increase and/or decrease as a function of these scores.

Following the analyses of texts captured in this study, the linguistic patterns found will be used as predictor variables to analyze texts collected in studies conducted by Shipherd and Beck (1999, 2005). Two data sets from their studies will be analyzed; texts collected from MVA survivors, as well as texts collected from survivors of sexual trauma. In both data sets, there are samples from trauma survivors suffering from PTSD, as well as individuals exposed to trauma though not suffering from PTSD. All of the subjects included in their studies were evaluated using the CAPS or PCL criteria. This allows for a parallel analysis of all of their texts as well as those collected here. The intent is to not only support the reliability of the predictor variables, but also to confirm or deny the possibility that these variables will dependently fluctuate within the range of PCL scores obtained, as we have demonstrated here.

## Experiment

The current pilot study utilized linguistic category frequencies to analyze written narratives produced by participants who experienced an MVA. These frequencies were then compared with different levels of participant PTSD symptomatology as measured by the PCL.

Table 1: Six featured linguistic categories.

Category	Examples
Determiners (Biber Model)	these, those, few, many, every, any, much, a, an, the, some, all
Death (LIWC Model)	died, dead, dying, fatal, alive, grief, mortal, demise, decease(d)
Function (LIWC Model)	definitely, ahead, might, nearly, across, enough, among, been
Causal Negation (Connectives Model)	although, nevertheless, unless, provided that
Punctuation (Biber Model)	. ‘ , “ / ? ! ( ) –
Word Count	(count of words per document)

## Methods

### Participants

Forty-three undergraduate students from the University of Memphis (31 females) participated in the study for course credit. Participants were prescreened to assess PCL scores and to determine whether they had experienced an MVA. All participants in this study had at some time experienced an MVA, though not all participants suffered from PTSD.

### Procedure

A 2x2 design was employed, both counterbalanced and randomized, where half of the participants first wrote about their MVA, while the others completed the neutral text first. Each condition included both tasks. Both text capture tasks were ten minutes in length. Each task, regardless of order, was partitioned by a ten minute cognitive distractor task to minimize carryover effects. The cognitive distractor task utilized in this experiment was a number-based Sudoku puzzle.

## Results and Discussion

PCL scores ranged from 17-65 ( $M = 25.07$ ,  $SD = 9.38$ ). Five participants from the study (10% of the sample population) had PCL scores high enough to suggest a PTSD diagnosis (composite score of 35 or higher), falling within the range of earlier reported estimates of PTSD prevalence (Kessler et al., 1995).

Mixed effects regression analyses were conducted on the normalized frequencies of the linguistic variables with PCL scores and text type (trauma or neutral) as fixed factors, and condition (neutral and trauma narrative) as a random factor (Baayen, Davidson, & Bates, 2008). The model was fitted using the restricted maximum likelihood estimation (REML) for the continuous variable (PCL scores). F-test denominator degrees of freedom were estimated using the Kenward-Roger's degrees of freedom adjustment to reduce the chances of Type I error (Littell, Stroup, & Freund, 2002).

Results suggested a significant relationship between PCL scores and six linguistic variables, four categories from the syntactic dimension, and one from both the semantic and structural dimensions. (See Table 1).

PCL scores were related to the use of punctuation,  $F(1, 81.09) = 13.474$ ,  $p < .001$ , such that when PCL scores increased the more punctuations were found. Word Count and PCL score were related,  $F(1, 81.029) = 4.467$ ,  $p < .05$ , with high PCL scores yielding longer texts. The relevance of these categories might be explained by the fact that the patient is unable to lock in the event's specifics, instead using more words in an attempt to accurately describe the event. The presence of these linguistic units could be a byproduct of suppression, in that they are avoiding the acknowledgement of the traumatic event's specifics.

Another variable related to PCL scores were the frequency of determiners (Biber),  $F(1, 82.004) = 8.597$ ,  $p < .01$ , with higher PCL scores yielding fewer determiners. Determiners, in written and spoken discourse, are used to add discrete specification to the information being conveyed (Argamon et al., 2003; Biber et al 1998; Mulac & Lundell 1994). It makes sense that determiners in texts written by a PTSD sufferer would find less use, as the disorder affects an individual's ability to concretize specifics from the event.

Negative causal connectives (e.g., *although*, *nevertheless*) showed a positive relation with PCL scores,  $F(1, 81.136) = 4.74$ ,  $p < .05$ . The increase of negative causal connectives as a function of higher PCL scores might be explained both by suppression and avoidance. Negative causal connectives imply a causal relation that is negated, perhaps to create a distance to the events described, or reflecting an uncertainty in the claims made in the preceding clause.

In addition, the LIWC semantic category "death" was related to PCL scores,  $F(1, 81.127) = 7.113$ ,  $p < .01$ , likely explained by the inherent nature of traumatic events regardless of whether the trauma experienced was psychological or physical in nature. Also from LIWC, the category "function" yielded a positive relation with PCL scores,  $F(1, 82) = 6.911$ ,  $p = .01$  (e.g. as PCL scores increased, the use of "function" words increased).

Interestingly, emotions categories from the LIWC and Johnson-Laird and Oatley Emotions models did not reach significance in relationship to PCL scores. However, "Negative Emotions" from the LIWC model reached significance in comparison of text types,  $F(1, 81.151) = 4.955$ ,  $p < .05$ , as well as "Basic Emotions" from the Johnson-Laird and Oatley Emotion model,  $F(1, 81) = 9.742$ ,  $p = .002$ . The findings here imply an emotional foundation

in texts written about the PTSD sufferer's recall of the traumatic event.

## General Discussion

Previous research has shown that linguistic features can predict a multitude of aspects of human behavior. Whether linguistic features might also be indicative of psychological disorders is however less clear. We investigated whether the linguistic properties in trauma narratives written by survivors of a Motor Vehicle Accident (MVA), change as a function of the intensity of posttraumatic stress disorder (PTSD) symptoms. The severity of participant PTSD symptomatology was compared to linguistic variables from eight different computational algorithms.

It may not be surprising from the quantity of variables used in our analysis that some would demonstrate the hypothesized relationship between PCL scores and language use. However, the results featured here can be grounded in theoretical constructs that are in line with what would be expected from the clinical psychological literature. Just as well, since not all of the associated PTSD symptoms are required for a PTSD diagnosis, it is possible that not all of the symptom clusters would emerge in the texts collected. Of the three main PTSD symptom clusters, the variables revealed in our analyses align most with that of the "Avoidance" distinction. The Avoidance cluster of the PTSD symptom inventory identifies a PTSD sufferer's propensity to avoid thoughts and reminders of the event. This cluster includes the thought suppression behavioral phenomenon often associated with PTSD as well (DSM-IV, 2000).

For example, Chung and Pennebaker (2007) have highlighted the ability of function words to reveal psychological states. Function words are subjectively personal, and have a multifaceted utility in the personalization of discourse. Due to the personal nature of traumatic experience it is notable that function word usage would fluctuate as a result of the severity of the traumatic event. The difficulty in mentally integrating the traumatic experience could be one reason why higher PCL scores would reflect a decreased usage of this category. The PTSD patient is unable to work the experience into their current cognitive schemas. The lack of personalization in the narrative reflects the individual's inability to map the experience into long-term memory.

The deficiency of the determiners category can be explained through "Avoidance" symptoms. Determiners, in written and spoken discourse, are used to add discrete specification to the information being conveyed (Argamon et al., 2003, Mulac & Lundell 1994; Biber et al 1998). It makes sense that determiners in texts written by a PTSD sufferer would find less use, as the disorder affects an individual's ability to concretize specifics from the event.

An increase in negative causal connectives aligns with the "Avoidance" distinction as well, as though an individual suffering from PTSD second-guesses their statements, demonstrating uncertainty as a product of cognitive

distancing. The word count and punctuation could be explained here as well, as the participant is unable to lock in the specifics, and instead uses more words in an attempt to accurately describe the event. The presence of these linguistic units could be a byproduct of suppression, in that they are avoiding the acknowledgement of the traumatic event's specifics. Or just as well, as suggested earlier, PTSD survivors are unable to recall these specifics. From these relationships there is evidence that a person suffering from PTSD trauma can cognitively distance themselves from the details of the event. And while it does not map well in the "Avoidance" cluster, the revealed presence of words from the semantic category "Death" can be explained by the inherent nature of traumatic events regardless of whether the trauma experienced was psychological or physical in nature.

The emotion categories that were shown to differ across text types can be reasoned to explain a PTSD patient's propensity for emotional numbing. Despite the existence of emotional numbing, emotions are still attached to the experience. In writing about the traumatic experience these emotions are faced and thus resurface. This might explain the relative intensity of emotion word usage when describing the traumatic event and the lack of presence in narratives irrelevant to this experience.

Even though the computational linguistic variables show a relationship with PTSD measures, it is clearly not the case that a direct relationship can be assumed, nor should the findings here be seen as an attempt to replace existing clinical psychology measures of diagnosis. At the same time, the current study is encouraging enough to pursue further analysis that might provide a first filter to identify those at risk of PTSD. The categories revealed here are promising, as they align with crucial aspects of the fragmented nature of a PTSD sufferer's recall of their traumatic experience. As well, from the categories discovered here, it is reasonable to presume these same categories and patterns will appear in the analysis of texts collected during the Shipherd and Beck (1999, 2005) studies.

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