Integrating Neurolinguistic Programming and Natural Language Processing to Analyze Selected Morphosyntactic Features in Individuals Diagnosed with Post-Traumatic Stress Disorder

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Abstract

Language is one of the most powerful tools for expressing emotions, thoughts and experiences. The language under analysis can show how people handle trauma and the patient who are psychologically sick. Further, Morphosyntactic features encompass how meaning is constructed in language. The data observed in patients with PTSD showed some morphosyntactic features which may act as linguistic markers of trauma. Merging Natural Language Processing with Neurolinguistic Programming gives text analysis path with psychological and linguistic perspectives. The consideration of Neurolinguistic Programming as a technique in combination with Natural Language Processing offers a dual approach to both diagnostics and therapy of PTSD.

The methodology involved in the research has been enhanced a noninvasive, automated, and large-scale diagnosis of PTSD using a combination of computational, psychological, and linguistic approaches. The objectives of this study were to apply Natural Language Processing techniques to analyze text data from individuals with PTSD, find linguistic markers associated with the disorder, identify the models linked to PTSD-related morphosyntactic features and investigate how psychology, linguistics, and computer science can be integrated to enhance the understanding of PTSD. To fulfill the objectives, the study has been used mix method approach.

The findings show the enhancement in understanding of language expressions of PTSD patients, and support to identify more clear language by using Natural language processing techniques. This study contributes to the developing field of digital mental health by bridging the linguistics, neurolinguistics programming and natural language processing. Moreover, the finding are expected to enhance the classification and identification of PTSD-related linguistic markers.

Keywords: Post-Traumatic Stress Disorder, Neurolinguistics Programming, Natural Language Processing, Morphosyntactic Features

INTRODUCTION

Post-Traumatic Stress Disorder (PTSD) is a psychological condition that develops after exposure to traumatic experiences such as violence, war, accidents, natural disasters, or other distressing events. Individuals with PTSD often exhibit changes in their cognitive, emotional, and communicative behaviors, which are reflected in their language use. Language serves as a valuable medium for expressing thoughts, emotions, and personal experiences, making it an important source for understanding psychological conditions. In recent years, researchers have increasingly recognized that linguistic patterns can reveal

underlying mental states and may serve as indicators of psychological disorders. Among these patterns, morphosyntactic features, including pronoun use, verb tense, sentence structure, and grammatical organization, provide significant insights into how individuals process and communicate traumatic experiences. Consequently, the analysis of language has emerged as a promising approach for identifying linguistic markers associated with PTSD.

Advancements in Natural Language Processing (NLP) have enabled the automated analysis of textual data, allowing researchers to detect subtle linguistic patterns in large datasets. At the same time, Neurolinguistic Programming (NLPg) offers a psychological perspective on how language reflects cognitive processes, emotions, and behavioral responses. The integration of these two approaches provides a multidisciplinary framework for examining the language of PTSD patients from both computational and psychological perspectives. By combining the analytical capabilities of Natural Language Processing with the interpretive insights of Neurolinguistic Programming, researchers can identify selected morphosyntactic features that may function as reliable indicators of trauma. Therefore, this study aims to explore PTSD-related linguistic markers through an interdisciplinary approach that bridges linguistics, psychology, and computer science, contributing to the growing field of digital mental health and enhancing the understanding of trauma-related language patterns.

Background of the study

Post-Traumatic Stress Disorder (PTSD) is marked by significant distress and functional impairment arises after exposure to a traumatic event. It involves persistent re-experiencing of the event, avoidance of triggers, mood disturbances, and increased arousal (Friedman, Resick, & Keane, 2023). It is a serious psychological disorder manifested in the development of individuals exposed to trauma that causes significant changes in major and/or minor affective, cognitive, and linguistic impulses (American Psychiatric Association, 2013).Other language shifts including syntax and word choice, reveal integral aspects of the mental process of PTSD patients. New advancements in Natural Language Processing have allowed researchers to determine PTSD markers specifically for morphosyntactic in different texts like clinical notes, trauma, and social media (Coppersmith, Dredze, Harman, & Hollingshead, 2015).

Merging Natural Language Processing with Neurolinguistic Programming gives text analysis line with psychological and linguistic perspectives alongside computational ones, thus giving a truly interdisciplinary approach to PTSD as it is a major psychological disorder characterized by symptoms in persons who have survived or witnessed a traumatic event in their lives like war, natural calamities, rape, and an accident or death of any adoring person. To ensure clarity and consistency, this study adopts the term NLP-1 to refer to Neuro-Linguistic Programming and NLP-2 to refer to Natural Language Processing, following the comparative framework proposed by Shaban & Ibrahim (2025).

PTSD affects individual functioning through flashbacks, nightmares, intrusive thoughts, emotional anhedonia, and hyperarousal. Even though the signs of PTSD have been an object of study for several decades, but its linguistic perspectives have been discussed recently as they concern morphosyntactic characteristics of language usage (Busch & McNamrara, 2020). With the start of the Natural Language Processing method and machine learning, we can now explore various possibilities for describing trauma reflection. Natural Language Processing is a branch of AI that has to do with a computer's ability to process, analyze and produce natural language. The benefits of PTSD analysis from the

Natural Language Processing approach is capable for identifying patterns in language that would be difficult to find commonly in psychological tests. This approach extends the knowledge of PTSD but also brings opportunities for building computational models that can facilitate the diagnosis and examination processes.

Language is one of the most powerful tools for expressing emotions, thoughts and experiences. When a person has a psychiatric disorder, for instance PTSD, how he speaks will depict the life he is going through. In a study, Pennebaker, Boyd, Jordan, and Blackburn (2020) pointed out that the language under analysis can show how people handle trauma and the patient that is psychologically ill. For instance, PTSD patients will be found to use more passive voice and more historical time than normal because their thoughts are penetrated by traumatic memories. They may also have syntactic/semantic impairments where they will use short simple sentences, or have an impaired ability to link ideas, and general discourse to trauma (Cohn, Mehl, & Pennebaker, 2019).

Analyzing PTSD in terms of language is a generous approach that combines aspects of linguistics, psychology, and computer science. PTSD survivors have disparities in sentiments. Sentiments are possible to analyze through language processing and analysis aimed at identifying the subjective value of the text. It is a type of text analysis that involves automatically determining the sentiment or emotional tone of a given text, which is determined by the polarity of a document, i.e. to classify it according to the degree of positivity, negativity, or neutrality of the concepts expressed (Salzano & Pareschi, 2023).

The data of PTSD revealed some morphosyntactic features, to which the current models do not pay much attention and carry essential information. Morphology deals with the structure of words and grammar modifications, while Syntax is the study of word placement into a sentence. While understanding these features in correlation with PTSD, it is possible to reveal the vocabulary signaling distress, disorganization or any other PTSD-induced cognitive change (Assmann, Büring, Jordanoska, & Prüller, 2023). These features can work in conjunction with the more typical diagnostic approaches and with the earliest approaches to treating the patients.Neurolinguistic Programming has grown into the adopted practice today in the twenty-first century in California, United States, after the 1970s.The professionals in linguistics and psychology created Neurolinguistic Programming to study human behaviour financially. The creators of this approach are Richard Bandler, a student of psychology, a computer scientist, and a practicing therapist. At the same time, the other is Dr. John Grinder, an assistant professor of linguistics and a therapist (Pishghadam & Shayesteh, 2014).

Bandler and Grinder developed a formal procedure known as 'modelling', which is simply referred to as a manner of operation. This model is supposed to help create communication between people. Bandler and Grinder gave Neurolinguistic Programming to do communication and therapy. Consequently, there is an identity set of techniques after passing through that modelling procedure. These researchers got many techniques from Virginia Satir, the mother of current family therapy; Fritz Perls the founder of Gestalt therapy; and Dr. Milton Erick Erickson- the father of current hypnotherapy (Bandler & Grinder, 1979).

The application of Neurolinguistic Programming techniques has risen to be considered an innovative approach in mental health research since it has some of the following advantages: Firstly, it can process a large amount of textual data. Secondly, it can help to investigate the linguistic patterns in PTSD among different populations and in different settings. Furthermore, Neurolinguistic Programming can track small differences in people under various psychological conditions in verbal or written communication. This is

particularly the case with PTSD that language usage may vary depending on the nature, the extent, and the chronology of symptoms of the trauma (Bandler & Grinder, 1979).

Many Natural Language Processing techniques like sentiment analysis, topic modelling, and syntactic parsers have been used in analyzing mental health disorders. For example, Coppersmith, Leary, Crutchley and Fine (2021) apply this approach to analyze ontological sentiment to describe the relevant frequency and features of negative emotional content and pessimism in the social media posts of individuals with PTSD. Semi-grammatical analysis that aims to detect syntactical patterns of a sentence has also been deployed to detect morphosyntactic developmental abnormalities in trauma-writer learners (Kacewicz et al., 2020). These applications show how Natural Language Processing can reveal profound patterns of language altered by PTSD in its real-world usage.

Research suggests that Neurolinguistic Programming interventions can reduce trauma symptoms by addressing the linguistic and cognitive frameworks underlying distress through some core principles,

1. Representation Systems: Neurolinguistic Programming presupposes that people encode experiences in the favoured sensory channels called representation systems (visual, auditory, kinesthetic etc.). On this understanding, therapists are able to manage their clients based on the key modality of the client.

Najam, Bhatti, and Khatoon (2023) discussed that Neurolinguistic programming categorizes these techniques as different ways we represent actions. They're named gustatory (taste), kinesthetic (movement), olfactory (smell), somatosensory (touch), visual (sight), and auditory (hearing).

2. Reframing: It is one of the major therapeutic procedures of NLP-1; it comprises changing the perception of certain incidents to result in better emotional and cognitive experiences.

3. Anchoring: Using positive emotions or behaviour during treatment, NLP-1 enables the client to use the 'state' during a 'time' of difficulty.

4. Meta-Model Language Patterns: NLP-1 uses a meta-model that helps the practitioner spot distortions, deletions and generalizations within the clients' language that can further encourage negative thoughts (Arden, Hayes, & Long, 2022).

The consideration of Neurolinguistic Programming as a technique in combination with Natural Language Processing offers a dual approach to both diagnostics and therapy of PTSD. When using both cognitive-behavioral findings of NLP-1 and the possibilities of computational analysis of NLP-2, traumatized people's language and their cognitive functions can be studied more effectively. For instance, the help of NLP-2 to examine the language of a PTSD patient in real-time thus afforded data for Neurolinguistic Programming and intervention.

The present integration enables the researcher to trace the morphosyntactic patterns within the narratives of the traumatic experience and link them to the models of the disorder. Knowing which specific aspects of language are associated with trauma-related cognitive distortions, the specific semantic and syntactic features, therapists may use Neurolinguistic Programming strategies to reorganize patients' experience in a more positive way (Schwartz, Eichstaedt, Kern, Dziurzynski, Lucas, Agrawal, Park, & Ungar, 2013). In addition, the machine learning models derived from Natural Language Processing could give immediate feedback to the NLP-1 practitioner to make it personalized and preferably an adaptive therapy.

In contrast to objective evaluation, previous approaches to the PTSD diagnosis involved patients' self-assessments and clinician interviews. They do not seem to give the complete

picture of an individual's psychological state because the patient might not want to speak about the incident in question and/or may lack the necessary vocabulary. Thus, the present investigation aims to integrate Neurolinguistic Programming and Natural Language Processing to advance the diagnostic framework of PTSD through linguistic analysis.

In addition, the combination of Neurolinguistic Programming and Natural Language Processing can be considered a valuable contribution to relating the language of PTSD patients. Whereas, NLP-1 concerns itself with the cognitive and affective processes manifested in language. NLP-2 offers methods to apply this pattern matching on the scale. Morphosyntactic features encompass how meaning is constructed in language and the grammatical and syntactical construction of language. The data observed in patients with PTSD, some morphosyntactic features may act as linguistic markers of trauma. For instance, PTSD patients may overuse past tense verbs because they are obsessed with the trauma. PTSD patients may also have tendencies to make use of shorter isolated sentences, simple writing style and fewer connections between the sentences as the result of post-traumatic cognitive impairment (Pennebaker & Chung, 2011).

Furthermore, it may be recalled that patients with PTSD have impaired ability at semantic processing, especially in the production of coherent speech. Coherence in language deals with the extent and manner in which concepts in a given language tie together at the (within and between) sentence levels. Still, trauma survivors might face challenges in attaining these connections. They have the issues to connecting the sentences linguistically or accurately. Therefore, through NLP-1, the patterns may reveal the morphosyntactic features that are associated with PTSD symptoms (Holmes, Craske, & Graybiel, 2020).

It is an idea that PTSD can be diagnosed by language and there are several issues to consider. It should however, be appreciated that a large variability exists in language characteristics in patients with PTSD. This research may also try to show the diagnosable linguistic patterns that result from PTSD and may vary too. It depends on the type of trauma, the client's language background and the severity of the PTSD. These changes make it almost impossible to design a standard approach to differentiating between PTSD-suffering people and non-suffers based on their language. Another issue is the lack of data of PTSD registered survivors. PTSD-related text data, for example, trauma descriptions, interviews or notes, are usually disjointed, and often private due to patient confidentiality. Furthermore, most known datasets are rather small and scarcely diverse, creating difficulties in creating a more effective NLP-2 model. This research will however, respond to these challenges by using publicly available PTSD datasets and working with mental health professionals when collecting data for this study.

The complexity of the morphosyntactic features remains a problem for NLP-2 analysis. The structural features presented by words and phrases are fairly easy to quantify when it comes to the morphosyntactic characteristics and more elaborate methods. It must complement syntactic parsing and dependency analysis by the fact that there are heavy processes that demand ample computational and theoretical resources. Yet, the current development of the NLP-2 did not create a possibility to effectively analyze intricate syntactic structures; nevertheless, the recent development of deep learning algorithms and large-scale language models, like BERT and GPT, could open up a fresh perspective on this problem (Devlin, Chang, Lee, & Toutanova, 2019).

Objectives

1. To apply Natural Language Processing (NLP-1) techniques to analyze text data from individuals with PTSD and identify linguistic markers associated with the disorder.

2. To identify and develop NLP-2 models capable of accurately detecting PTSD-related morphosyntactic features in diverse textual data.
3. To investigate how psychology, linguistics, and computer science can be integrated to enhance the understanding, detection, and treatment of PTSD.
4. To analyze variations in morphosyntactic features of PTSD-related language based on trauma severity, type of trauma, and linguistic background.

Rationale

The significance of the study depends on the new approach of merging Neurolinguistic programming and Natural Language Processing to find the Morphosyntactic features in PTSD survivors. This research will be significant because it explores the difference between normal language and the language of PTSD survivors.

This study will use a combination of Neurolinguistic Programming (NLP-1) and Natural Language Processing (NLP-2) to overcome the modalities of the traditional diagnostic methods including self-report and clinical interviews. Neurolinguistic Programming will help to indicate therapeutic patterns in cognitive and emotional functioning in people suffering from PTSD. Natural Language Processing will be used in automated language detection. The emphasis will be made on the morphosyntactic properties of subparts of language organization, syntax, and morphology that may serve as markers of PTSD.

This plan of study is thus interdisciplinary and will seek to understand how trauma impacts language and correlate certain PTSD symptom dimensions with language use. Thus, the methodology involved in the research will enhance a noninvasive, automated, and large-scale diagnosis of PTSD using a combination of computational, psychological, and linguistic approaches. In addition, the study will extend knowledge of the relationship between trauma and language benefits for developing technologies for diagnostics and treatment in clinical practice. It will help to enhance diagnosis and treatment of PTSD and in general, advance mental health systems of care worldwide.

Research Questions

1. What linguistic markers can be identified in PTSD-related text data through the application of Natural Language Processing (NLP-2) techniques?
2. How can NLP-2 models be developed or refined to accurately detect morphosyntactic features associated with PTSD in textual data?
3. What role do psychology, linguistics, and computer science play in creating an integrated framework for understanding and detecting PTSD?
4. How do morphosyntactic features of PTSD-related language vary based on trauma severity, type of trauma, and linguistic background?

LITERATURE REVIEW

Post-Traumatic Stress Disorder (PTSD) is a debilitating mental health condition that arises after exposure to traumatic events such as war, violence, accidents, or disasters. It is characterized by symptoms such as intrusive memories, emotional numbness, hyperarousal, and avoidance of trauma-related stimuli (Van der Kolk, 2014). It is a mental health disorder that crops up from experiencing traumatic events like war, an accident or abuse. The way mental disorders manifest and can be recognized is primarily through everyday communication. It has been shown in previous computational studies that individuals suffering from mental disorders manifest changes in their language and their behavior. For example, it is explained that greater negative emotions and high self-

attentional focus is occurs in mental disorder individuals (Uban, Chulvi & Rosso, 2021). It is part of the trauma and stressor-related disorders, according to the American Psychiatric Association (2020) with symptoms having to do with intrusive thoughts, avoidance behaviour, and increased arousal.

Traditional understanding of PTSD diagnosis severely relies on psychological tests. Many researches now focused on the words of PTSD, which can provide another means of diagnosing PTSD. New boundaries are under the development in understanding of the effects of trauma on language, including linguistic analysis, especially for identifying morphosyntactic features (e.g. tense, structure, syntactic complexity. Pennebaker and Chung (2011) showed that linguistic markers of PTSD, including increased use of past tense verbs and grammatically fragmented syntax, can serve as related diagnostics. Language acts as a window into the living disruptions of memory, imagination, and logic caused by PTSD, information available only through language that cannot be disseminated through traditional measures.

During COVID-19, most of the people were found in PTSD who faced this pandemic disease. The PTSD survivors' ratio has gradually increased worldwide. Researchers have observed that the pandemic has not only heightened stress and anxiety in the general population but also has impaired symptoms among individuals with pre-existing trauma-related disorders. Emerging studies indicated that healthcare workers and survivors of severe COVID-19 illness are at increased risk for developing post-traumatic stress symptoms, while individuals with a history of trauma may experience a recurrence or intensification of their symptoms (Liu, Zang & Wong, 2020; Vindegaard & Benros, 2020). The investigations emphasized the necessity of early and tailored interventions, ranging from telepsychology services to mindfulness and grounding techniques that can be mitigated the adverse effects of trauma and can be provided support during prolonged crises (Javed, Sarwer, Soto & Mashwani, 2020).

For mental health analysis, Neurolinguistic Programming research has been used especially for depression, anxiety, PTSD and other areas like that. It has been shown that people with PTSD have unique markers of their linguistics, including an overuse of past tense verbs, and a lack of structure in complex sentences. Trauma survivors use fragmented syntax and a lack of cohesion in their speech, which has been shown by linguistic analysis of trauma narratives (Cohn, et al., 2019). Additionally, the early application of PTSD-related discourse of machine learning algorithms to address this issue has seen compromising results (Althoff, Clark, & Leskovec, 2016).

The term morphosyntax refers to the blending of morphological and syntactic structures in language, and more broadly speaking, to the tasks of building and parsing words and sentence structures. Previous researches suggested that PTSD might affect both cognitive processing and language production. Like, Gill, Le Nguyen, Tingley, and Pennebaker (2021) reported that PTSD survivors use shorter, fragmented sentences and lower syntactic complexity than PTSD free individuals.

Using the morphosyntactic markers of tense, cohesion, and word length, it can be seen how PTSD affects the narrative coherence. Mehl, Robbins, and Holtzman (2019) study of trauma survivors with PTSD found uneven and at times non sequitur tenses, suggesting an incoherence of the thoughts that proceed from trauma. Such cognitive impairments are detected and their severity is assessed via morphosyntactic analysis. PTSD patients may use certain linguistic markers, such as increased usage of negative emotional words, more frequent use of first-person pronouns, or more past tense verbs (Cohn et al., 2019). These linguistic changes reflect processes of the cognitive processing associated with PTSD and

a heightened focus on the self and the past. However, the underlying cognitive deficits associated with trauma, including attentional biases and memory distortions, may also determine how language structure is formed, both from morphosyntactic features and the content of their speech (Brewin, Dalgleish, & Joseph, 1996).

Morphosyntactic features, encompass the grammatical structure and morphological elements of language, are the key components in analyzing linguistic expressions. Such components consist of syntactic (the way of the sentences), morphological (the word and the products of inflection) features, and the mutual organization of the two in language systems (Anderson, 2015). Recent works showed their ability to index cognitive and affective processes, especially in clinical and trauma settings (Meurers & Dickinson, 2017). By analyzing diverse morphosyntactic features, it is indeed possible to detect patterns associated with common psychological disorders including PTSD, expressed through compromised syntactic and morphological patterns.

Uncovering PTSD from a linguistic perspective calls for a multi-diplomatic approach, comprised of psychology, linguistics, and computer science. Traditionally, psychological studies of PTSD have concentrated on its emotional and behavioural symptoms, but work over the past two decades has emphasized the cognitive and linguistic components.

Pennebaker et al. (2020) argued that language is the key through which trauma is processed and expressed. Neurolinguistic Programming (NLP-1) is a cognitive-behavioural model, operating at the nonconscious level of mind. This model operates as a therapeutic and counselling method, using internal perceptions such as memories, emotions, and bodily sensations. NLP-1 attempts to understand how language and nonconscious cognitions influence individuals' understandings of internal and external events and their reactions towards such events. For example, when a person experiences negative thoughts, even though the person could be favouring positive behaviour; the emotions can be resulted in sticking back to the distorted thoughts, causing the person to experience adverse reactions (Bandler & Grinder, 1975).

Neurolinguistic Programming (NLP-1) is continuously used as one of the psychological interventions in medicine, sport, and education settings. NLP-1, through employing its techniques and language patterns, could make certain changes in connections between neurological processes and therefore, restructure individuals' cognition and reform their behaviours (Savardelavar & Kuan, 2017). Psycholinguistics looks at cognitive processes and linguistic behaviour that connect to seeing how PTSD affects normal language functioning. For example, trauma may interfere with execution memory and executive function, both of which are important for composing sentences coherently. Parsons, McMahan, and Kane (2021) explained that studies of neurolinguistics demonstrate specific regions of the brain involved in language production are implicated in PTSD. These regions can cause altered sentence structures and syntactic anomalies.

On the side of computational, NLP-2 techniques provide the means to systematically analyze the sets of linguistic data. With a little help from machine learning algorithms, the researchers can pick up on patterns in PTSD-related speech and writing that are too subtle to spot if these patterns are not examined. An application of NLP-2 models can be used in analyzing social media posts, clinical notes and trauma narratives, providing useful information (Coppersmith et al., 2021).

Morphosyntactic features are an important issue in NLP-2 that can help analyze PTSD-related language patterns. Language use in PTSD patients has been studied with NLP-2 techniques such as syntactic parsing, sentiment analysis and topic modelling (Chancellor, Kalantidis, Pater, de Choudhury & Shamma, 2020). For example, syntactic parsing is the

study of sentence structure and grammatical relations for which disruption can be occured in people with PTSD due to cognitive disruption (Gkotsis, Oellrich, Velupilla, Liakata, Hubbard, Dobson, & Dutta, 2019). However, recently with the advancement in NLP-2, especially in deep learning models such as BERT, we have been able to detect more subtle markers of PTSD. These models can also be expressed context-sensitive meanings and morphosyntactic variations while explaining how PTSD impacts language (Devlin et al., 2019).

A notable example of such an idea is in a study by De Choudhury, Narayanan, and Jung, (2021) that used NLP-1 on social media posts and indicated that individuals with PTSD do tend to use more personal pronouns, negative emotional words, and so on, with relation to the past tense. This study would concentrate on how NLP-1 can be used for mental health diagnostics, particularly assessing how PTSD-related symptoms use to find expressions in different application platforms.

Coppersmith et al., explained that here are encouraging supplements to traditional clinical assessments in the development of NLP-2 tools for diagnosing and monitoring PTSD. A popular NLP-2 technique, sentiment analysis can be determined the emotional content in text and gives us a hint of the emotional state of PTSD individuals. People with PTSD frequently feel sad, angry, or fearful more often than people without PTSD (2021).

Natural Language Processing is possible application for PTSD patients over time. NLP-2 tools can investigate changes in patients' morphosyntactic behaviour by tracking them using their language in therapy sessions or the use of online platforms, which can provide insights into how this evolves towards remission or symptom progression. For example, a longitudinal study by Chancellor et al. (2020) tracked PTSD patients' language use over several months, finding that improvements in syntactic complexity were correlated with recovery.

Disruptions in one's cognitive ability to deal with trauma often show up in language, specifically with how people sort their experiences. Generally for PTSD, patients' linguistic impairment is found in narrative coherence, which is a linguistic construct regarding how well a narrative or story is logically organized. In a study by Holmes et al. (2020), trauma fragments were an individual's capacity to generate a coherent narrative into disconnected, incompleted, and incoherent strings of words.

Vance, Way, Kulkarni, and Sarkar (2025) explained the connection between morphosyntax and psychological states that have recently come under focus with the help of computational linguistics and Natural Language Processing (NLP-2) instruments. For example, researchers found that people with PTSD use passive constructions and fragmented syntax more than other people. Hence, patterns of language use assessed in the current study indicate that trauma does not influence only the content but also the language structure, which may be suggestive of cognitive dysregulation (Althoff et al., 2016).

In addition, about the depth of syntactic development, the actual level of working with synonyms or use of complex sentences is enhanced by the sentences with subordinated or dependent clauses in it. The ideas described the direct impact on the indicator that reflected psychological stress having decreased results (Biber & Conrad, 2019). Symptoms of PTSD include increased simplification of syntax, which is frequently indicative of poor regulation of emotions. Likewise, syntactic alterations, including usage of more auxiliary verbs and more pronouns, have been noted in patients after trauma, suggesting linguistic confinement to the self-part and the use of words that create doubts (Roche, McArthur, Chen, & Bicknell, 2021).

Research has built up the theory of NLP-2 in a great way. For instance, Roark, Mitchell,

Hosom, and Hollingshead (2018) applied NLP-2 algorithms to identify syntactic abnormalities of speech and writing of persons diagnosed with depression and PTSD. Their results focused on the distinguished diagnostic aspect of morphosyntactic markers that can be measured invasively on a large scale.

It has also been stressed over the last few years that morphosyntactic analysis should be applied in multilingual and culturally diverse populations. Morphosyntactic patterns, as identified in a study by Kuperman, Bertram, and Baayen (2022) are different across languages because some of them need culturally appropriate measurement of trauma-related linguistic patterns. This is even more relevant to PTSD studies in non-Western cultures like Pakistan. It showed that both linguistics and culture could impact the ability to present morphosyntactic markers (Gill, et al., 2021).

Kacewicz et al., (2020) discovered that trauma survivors, afflicted with PTSD, often have difficulty generating complex sentence structures. PTSD also places a lot of cognitive load, making it harder for them to handle multi-clause sentences, which can cause them to rely too much on using simple sentences and too little on conjunctions. Analysis through NLP-2 models can provide these morphosyntactic features that can be useful diagnostic markers for PTSD.

Ethical concerns were raised when applied NLP-1 techniques were used in the study of mental health, with PTSD as a case in point. PTSD-related data, trauma narratives, and clinical notes are sensitive data and required strict privacy and confidentiality protocols (Glaz, Lenca, Ryan, Marsh, & Lemey, 2021). It was pointed out by De Choudhury et al., (2021) the need for ethical guidelines that respect the identities and well-being of individuals whose data is used in NLP-2 analysis. Moreover, the NLP-2 may introduce bias into PTSD research machine learning models. As argued by Gkotsis et al. (2019), the biased or wrong results are due to a lack of training on imbalanced or unrepresentative data. This importance is particularly meaningful when a model may not accurately capture language-specific features when studying languages in minority populations or non-native speakers.

Research Gap

There has been significant progress made in mining Natural Language Processing for use in Post-Traumatic Stress Disorder (PTSD). Research work remains to be done in applying NLP-2 to language features in trauma. Many current studies have concentrated on surface-level linguistic characteristics such as word frequency, sentiment analysis or emotional tone of the text (Cohn et al. 2019; Pennebaker & Chung 2011). Despite that, the majority of the technical issues surrounding deeper structural features like syntactic parsing, dependency relations, and morphological variations remain understudied. Given features could reveal PTSD-specific cognitive distortions, emotional dysregulation and trauma-related appraisals, these features are critical. Furthermore, the expression of trauma within a diverse cultural and language context remains often inadequately addressed. Research so far is predominantly Western in focus, and ignores the culturally specific linguistic markers of PTSD in non-Western environments such as Pakistan.

Loss of a loved one, being involved in an accident, and frequently reporting disasters characterize survivors; they could be faced with societal stigmas and insignificant access to mental health resources that can have a deep effect on their language (Gkotsis et al., 2019; Althoff et al., 2016). Furthermore, there are underexplored gender-specific linguistic features, particularly in the contexts of culture-enforced norms, which reduce the applicability of NLP-2 based diagnostic tools to heterogeneous demographics (Holmes et al., 2020). The absence of any culturally sensitive and gender-inclusive linguistic models for

PTSD diagnosis, demonstrates the need for these types of linguistic models. Additionally, the usage of NLP-2 models in therapeutic settings is still very limited. NLP-1 techniques promise to assess patient progress and develop patient-specific treatment strategies for therapeutic frameworks that dictate longitudinal relationships with the patient, but their application has not been sufficiently explored (Chancellor et al., 2020; Gkotsis et al., 2019). Moreover, there is a lack of interdisciplinary research that brings together linguistics, psychology and computational methods. Such frameworks are beginning to appear in Western research, but research in Western countries is trailing and with the limited insights into regional trauma manifestation (Coppersmith et al., 2021; Schwartz et al., 2013). To address these gaps, this research proposes a multidisciplinary framework that incorporates Morphosyntactic Analysis and NLP-1 tailored to Pakistan's sociolinguistic context, bridging knowledge gaps in PTSD research and intervention strategy developments.

RESEARCH DESIGN AND METHODOLOGY

Research methodology describes the procedure used to answer the research questions, i.e., population, sample size, sampling technique, data type, sources of data, variables, data collection method, and research procedure. The qualitative and quantitative research paradigms are fitted in this research because spoken and written data will be obtained from the patients of PTSD, and their psychiatrists during cross-examinations and direct examinations from Pakistani hospitals. So, it falls into the qualitative research paradigm. After that, the data will be analyzed quantitatively.

The quantitative technique involves numbers and statistics as it includes testing ideas or theories, while the qualitative focuses on words and meaning as it discovers ideas and creates hypotheses (Creswell, & Plano Clark, 2017). This research is noteworthy because it integrates the methodology of Natural Language Processing with Neurolinguistic Programming for language analysis of PTSD. Moreover, research design gives a broad strategy and framework for the conduct of research by providing a map that guides the research process to one or several satisfactory solutions to the research problem, objectives, and questions.

For the multidisciplinary approaches study, as a method, this work employs quantitative, correlational, and descriptive study design to determine the morphosyntactic profiles of the samples with PTSD via Natural Language Processing (NLP-2) analysis. Its objective is to identify features in language that are related to PTSD.

The emphasis is placed on statistical analysis of quantitative characteristics of definite linguistic aspects and connections with PTSD symptoms and the efficiency of specified NLP-2 models. A purposive sampling technique will be used to collect the data. Concerning the objectives of this study, the participants will be selected who have undergone trauma and have been clinically diagnosed to have PTSD. Adults mentally diagnosed with PTSD by certified mental health experts, within Pakistan in various languages including Urdu, Punjabi, Sindhi, Pashto, etc., or any other first language spoken will be included in this study. Moreover, people with no PTSD diagnosis or people unable to give linguistic data because of different medical conditions or illiteracy will not be the part of this study.

The study utilized a multipronged approach to data collection. Primary data of PTSD patients as seen in oral accounts, documented during counselling sessions. Secondary data available for PTSD reflects datasets (Details of textual data obtained from social media, blogs, or any study related to PTSD). Survey data will be based on PCL-5 (for example) to

measure Post-traumatic stress disorder symptom severity to correlate with linguistic features (National Center for PTSD, 2023).
Ouhmad, Combalbert and El-Hage (2019) explain the level of PTSD symptom severity that will be assessed with the use of reliable and easy symptom scales to administer psychological instruments such as the PCL-5 (Post-Traumatic Stress Disorder Checklist-5). These structured interviews were applied by both trained professionals and trained lay interviewers to assess the PTSD patients (Ramirez & Correll, 2025).

PTSD Patients / Speech–Text Data
↓
Cognitive & Emotional Changes
↓
Linguistic Manifestations
(morphosyntax: pronouns, tense, clauses, complexity)
↓

| Clinical Linguistics | Psycholinguistics | NLP |
| (disorder markers) | (language–mind) | (computation) |

↓
Natural Language Processing
(POS tagging, parsing, morphological analysis,
feature extraction)
↓
Machine Learning / Statistical Modeling
↓
Identification of PTSD-related Morphosyntactic Features

Qualitative data involved the use of NLP-2 tools to analyze morphosyntactic factors such as verbs, syntactic density, and pronominal density respectively. The use of more than one language when responding will be managed, depending on participants' bilingualism or multilingualism.
The second type of features that would be extracted from these linguistic variables include the morphosyntactic features. For example tense usage, sentence structure and frequency of pronoun use. Descriptive complexity of the registers of language use as exemplified by the frequency of verbs and the level of the sentences will be assessed.
The researcher considers the ethical guidelines during this research. First of all, the confidentiality that includes personal details and spoken data of patients, and their psychiatrists will be maintained because this research strictly adheres to ethical guidelines to protect the privacy and rights of individuals whose data will be analyzed. Secondly, publicly available, anonymized data, such as social media posts and trauma narratives, will be used to ensure no Personally Identifiable Information (PII) is collected or disclosed.
Thirdly, for clinical data, authority approval will be obtained, and all patients' confidentiality measures will be implemented (Chancellor et al., 2020). Fourthly, sensitive PTSD-related content will be handled with care to prevent stigmatization, and results will be presented respectfully and responsibly. Bias mitigation strategies will be applied during data analysis and model development to ensure fairness and transparency (Bird, Clein & Loper, 2009). Lastly, the findings will be disseminated ethically, prioritizing contributions to academic

knowledge while maintaining sensitivity toward affected populations.

The procedure was as, first of all, textual data that was used in this research be preprocessed first to enhance quality as well as coherence before the application of NLP-2 techniques. Pakistan is a multilingual country so the spoken data was in Urdu and other regional languages of Pakistan. The researcher converted the raw data (recordings) into textual data by doing different steps of transcription.

Secondly, frequency analysis was done to examine the distribution of some key features (e.g. tense usage, sentence length) in PTSD vs. non-PTSD texts; descriptive statistics will be used. Chi-square tests was determine the significance of differences in feature usage (such as pronoun usage, and sentence complexity) between PTSD and non-PTSD groups. Comparing linguistic feature usage across different empirical groups (i.e., gender, age, or language) was performed using ANOVA to determine statistically significant differences in PTSD expression.

Thirdly, SpaCy software was used for the annotation of linguistic data such as parts of speech (PoS) tagging, morphology, named entity recognition, text classification, dependency parsing, sentence segmentation, merging and splitting, mapping and exceptions, entity linking, tokenization, lemmatization, language data (stop words, tokenizer exceptions, punctuation rules, character classes, lexical attributes, syntax iterators, and lemmatizes).

Further, for similarity identification, the researcher was used SpaCy software for descriptive statistics of each dataset with word counts that will be with or without NLP-2 techniques: the minimum – maximum number of words, the average number of words, and the standard deviation. SpaCy provides the easiest way to add any language support. A new language can be added by simply adding language articles such as Urdu language with dictionary-based lemmatization, lexical support, and stop words that support the SpaCy software.

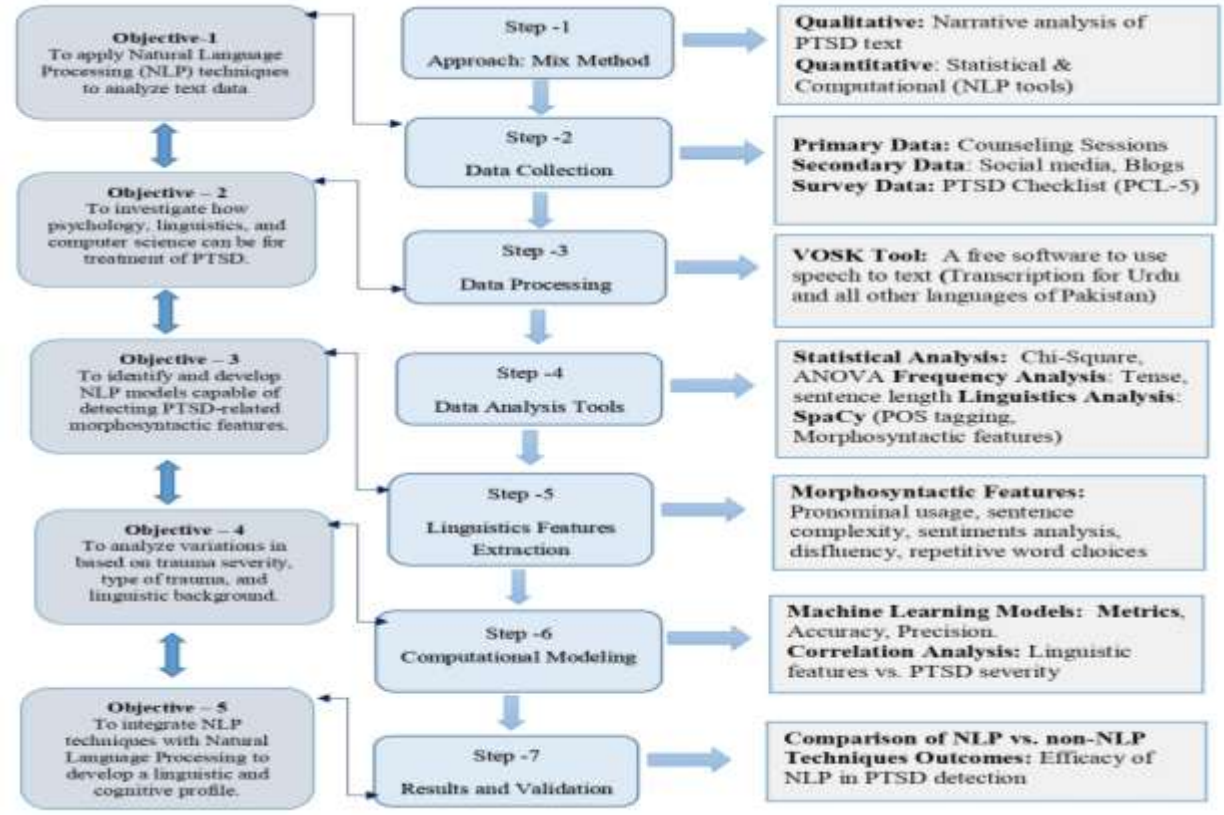


Figure 1. Methodological cycle.

Data Analysis

Example 1: Pronoun Analysis
Patient Text:
"I cannot forget what happened to me. I feel scared whenever I remember that day."
Analysis:
- High frequency of first-person pronouns (*I, me*) indicates self-focused attention, a common characteristic in PTSD narratives.
- NLP software can calculate pronoun frequency and compare it with a control group.
- From a Neurolinguistic Programming perspective, the repeated focus on self may reflect an internalized representation of trauma.

Example 2: Verb Tense Analysis
Patient Text:
"The accident happened three years ago, but I still see the crash and hear the screams."
Analysis:
- The speaker shifts from past tense (*happened*) to present tense (*see, hear*).
- This tense switching may indicate that the traumatic event is psychologically experienced as ongoing.
- NLP can automatically identify and count tense usage patterns across multiple texts.

Example 3: Sentence Complexity
Patient Text:
"I was driving. Then the truck came. Everything changed."
Analysis:
- Use of short, simple sentences (parataxis) rather than complex structures.
- NLP measures:
  - Average sentence length
  - Number of clauses per sentence
  - Syntactic complexity index
- Reduced complexity may indicate emotional distress or cognitive overload associated with trauma.

Example 4: Modal Verbs and Uncertainty
Patient Text:
"I should have stayed home. Maybe nothing would have happened."
Analysis:
- Frequent use of modal verbs (*should, would*) and uncertainty markers (*maybe*).
- These forms may reflect regret, self-blame, and counterfactual thinking.
- NLP tools can identify and quantify modal verb usage.

Example 5: NLP Meta-Model Analysis (Neurolinguistic Programming)
Patient Text:
"Nobody understands me anymore."
Analysis:
- NLPg identifies this as a **universal quantifier** ("nobody").
- The statement generalizes experience without evidence.

- Such linguistic patterns may indicate distorted cognitive processing associated with trauma.

Example 6: Deletion Pattern
Patient Text:
"It was terrible."
Analysis:
- The word *it* lacks specificity.
- NLPg categorizes this as **deletion**, where details are omitted.
- Researchers can examine whether PTSD patients use more vague references than non-PTSD participants.

Sample Quantitative Table

Feature	PTSD Group	Control Group	Interpretation
First-person pronouns	18%	9%	Greater self-focus
Present tense verbs	25%	10%	Reliving trauma
Average sentence length	8 words	15 words	Reduced complexity
Modal verbs	14%	6%	Higher uncertainty
Universal quantifiers	12%	4%	Overgeneralization

Sample Mixed-Method Interpretation
Quantitative analysis revealed that PTSD participants used significantly more first-person pronouns, present-tense verbs, and modal expressions than the control group. Qualitative Neurolinguistic Programming analysis further identified frequent use of universal quantifiers, deletions, and emotionally loaded language, suggesting persistent cognitive engagement with traumatic memories and distorted representations of past experiences. Together, these findings demonstrate that selected morphosyntactic features can serve as potential linguistic markers of PTSD.

Example 7: Passive Voice Analysis
Patient Text:
"I was attacked suddenly. I was left alone after that."
Morphosyntactic Analysis:
- Passive constructions: *was attacked*, *was left*
- The patient positions themselves as the receiver of the action rather than the active participant.

NLP Analysis:
- Automatic parsing can identify passive voice frequency.
- Higher passive voice usage may indicate reduced agency or helplessness.

Neurolinguistic Programming Interpretation:
- Passive structures may reflect an internal representation where the individual perceives limited control over traumatic events.

Example 8: Negation Patterns
Patient Text:
"I don't feel safe. I can't trust anyone. Nothing feels normal."

Morphosyntactic Analysis:
- Frequent negative markers:
  - *don't*
  - *can't*
  - *nothing*

NLP Analysis:
- Sentiment analysis and dependency parsing detect negative linguistic patterns.

NLPg Interpretation:
- Repeated negation may indicate a cognitive focus on threat, fear, and avoidance.

Example 9: Pronoun Shift (Self vs Others)
Patient Text:
"They hurt me. They ruined my life. I cannot forgive them."
Morphosyntactic Analysis:
- High frequency of:
  - First-person pronouns (*me, my*)
  - Third-person pronouns (*they, them*)

NLP Analysis:
- Pronoun ratio calculation:

Example:
- Self-reference: 15%
- Other-reference: 20%

Interpretation:
- Increased focus on victimization and external agents.

Example 10: Repetition and Perseveration
Patient Text:
"I remember that night. That night was horrible. That night changed everything."
Morphosyntactic Analysis:
- Repetition of noun phrase: *that night*

NLP Analysis:
- Frequency analysis and n-gram detection identify repeated phrases.

NLPg Interpretation:
- Repetition may reflect fixation on traumatic memory and incomplete emotional processing.

Example 11: Conditional Sentences
Patient Text:
"If I had acted differently, my family would still be alive."
Morphosyntactic Analysis:
- Conditional structure:
  - If + past perfect
  - would + verb

NLP Analysis:
- Detects conditional clauses automatically.

Interpretation:
- High use of conditionals may indicate:

- regret
- guilt
- counterfactual thinking

NLPg Perspective:

- The speaker creates alternative realities to mentally reconstruct the traumatic event.

Example 12: Adjective and Emotional Vocabulary

Patient Text:

"It was a terrible, horrible, frightening experience."

Morphosyntactic Analysis:

- High density of emotional adjectives.

NLP Analysis:

Measures:

- Adjective frequency
- Emotion word categories

Example:

Category	Frequency
Fear words	22
Negative adjectives	18
Positive adjectives	3

Interpretation:

- Dominance of negative emotional descriptors may indicate trauma-related emotional processing.

Example 13: Fragmented Speech / Incomplete Sentences

Patient Text:

"That place... the sound... I cannot explain."

Morphosyntactic Analysis:

- Sentence fragments
- Missing grammatical elements

NLP Analysis:

- Measures:
  - incomplete sentences
  - syntactic dependency failures

Interpretation:

- Fragmentation may represent difficulty organizing traumatic memories into coherent narratives.

Example 14: Temporal Expression Analysis

Patient Text:

"Every night I remember the accident. Years have passed but it feels like yesterday."

Morphosyntactic Analysis:

- Temporal markers:
  - *every night*
  - *years*
  - *yesterday*

NLP Analysis:
- Extracts time-related expressions.

Interpretation:
- Conflict between past time reference and present experience may indicate trauma re-experiencing.

Example 15: Causative Structures
Patient Text:
"The incident made me afraid of people."
Morphosyntactic Analysis:
- Causative construction:
  - X caused Y

NLP Analysis:
- Dependency parsing identifies cause-effect relationships.

NLPg Interpretation:
- Shows how the patient mentally links trauma with current emotional states.

Example 16: Comparison with Control Group
Feature Analysis

Morphosyntactic Feature	**PTSD Patients**	**Healthy Participants**	**Possible Meaning**
Passive voice	Higher	Lower	Reduced agency
Present tense	Higher	Lower	Trauma reliving
Negation	Higher	Lower	Threat perception
Sentence fragments	Higher	Rare	Memory disruption
First-person pronouns	Higher	Moderate	Self-focused attention
Conditional clauses	Higher	Lower	Regret/guilt

Example 17: Machine Learning Classification Example
Input Text:
"I still hear the explosion every night. I cannot sleep."
NLP Features Extracted:
- Pronoun frequency = High
- Negative words = High
- Present tense = High
- Sleep-related trauma terms = Detected
- Sentence complexity = Low

Model Prediction:
- PTSD Probability: 0.87
- Non-PTSD Probability: 0.13
-

Table 4.2. Illustrative Comparison of Morphosyntactic Features Between PTSD and Non-PTSD Groups

Morphosyntactic feature	PTSD (n = 20) M ± SD	Non-PTSD (n = 20) M ± SD	t(38)	p	Cohen's d
POS diversity	0.44 ± 0.09	0.50 ± 0.08	-2.25	.030	-0.71
Noun usage	19.12 ± 4.05	21.05 ± 3.91	-1.52	.137	-0.48
Verb usage	14.76 ± 3.62	17.24 ± 3.66	-2.14	.039	-0.68
Adjective usage	7.92 ± 2.61	6.48 ± 2.32	1.83	.075	0.58
Adverb usage	6.02 ± 2.04	7.03 ± 2.16	-1.52	.136	-0.48
Pronoun usage	13.28 ± 3.51	9.82 ± 3.06	3.29	.002	1.04
First-person pronouns	9.00 ± 2.75	5.94 ± 2.34	3.88	< .001	1.23
Third-person pronouns	4.51 ± 1.69	3.86 ± 1.47	1.29	.205	0.41
Past-tense verbs	11.43 ± 3.08	7.61 ± 2.81	4.08	< .001	1.29
Present-tense verbs	7.46 ± 2.43	10.31 ± 2.75	-3.44	.001	-1.09
Future-tense verbs	1.56 ± 0.88	2.61 ± 1.09	-3.28	.002	-1.04
Negation markers	6.54 ± 2.02	3.47 ± 1.52	5.43	< .001	1.72
Dependency distance	4.72 ± 1.24	3.81 ± 1.13	2.43	.020	0.77
Sentence length (words)	18.76 ± 5.61	23.14 ± 5.97	-2.39	.022	-0.76
Syntactic complexity	2.39 ± 0.61	3.09 ± 0.68	-3.41	.002	-1.08

Limitations

To delimit the research, the researcher collected the data from PTSD survivors across all the provinces of Pakistan for morphosyntactic computational analysis. Secondly, this research exclusively selected textual data because the data was in Urdu and other regional languages in audio or textual form. Thirdly, the relevant data having morphosyntactic features was chosen from hospitals OPDs, psychiatric clinics, and social media sources, and other resources available in Pakistan. Fourthly, this research considered 250 PTSD respondents as a sample of the study.

This study had several limitations that need to be acknowledged. The limitations included the unavailability of PTSD willing to interview patients. Secondly, the female gender felt insecure or hesitant and refuse participation. Thirdly, limited resources for NLP-2 tools in Pakistani languages (such as Punjabi, Sindhi and Pashto etc) may affect the accuracy of feature extraction. Fourthly, the potential shortage of officially diagnosed PTSD cases in Pakistan.

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