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Identification of the marks of psychic trauma in spoken language: Definition of the "SPLIT-10" diagnostic scale

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Abstract :

Problematic.- The search for understanding psychological trauma has grown considerably over the past fifteen years, leading to a real conceptual revolution at the crossroads of psychiatric, psychological, neurobiological, sociological, anthropological fields etc. However, despite all these enrichments of semiological descriptions, the under-diagnosis and late diagnoses of post-traumatic disorders, at the stage of intense suffering, remain numerous. Either because the traumatic origins of the disorders remain unclear, due to their very clinical characteristics, that is to say the "unspeakable experience" constituting dissociation in language, or because the healthcare system and the networks of practitioners come up against impassable conceptions which undoubtedly reflect the psychotraumatic process spreading even in theoretical discourse, to the point of rendering them ineffective. Now is the time to build a new model. Based on a linguistic methodology, the standardized computerized and manual study of the speech of psychically injured patients recently enabled us to define the notion of traumatic psycholinguistic syndrome (SPLIT).

Objectives.- Our new perspective aims to overcome the diagnostic and therapeutic obstacles with which too many people with mental health injuries still face. More objective than semiological and psychometric approaches, linguistic markers pave the way for the digital phenotyping of post-traumatic stress disorder and make it possible to better assess the recommended care. After discussing the pioneering work in the literature, we build a psycholinguistic tool allowing the identification of psychically injured subjects.

Methods.- The exploratory analysis material includes two corpuses of traumatic event narratives called "Bataclan" (n = 20 collected among survivors of the Paris attacks in 2015) and "Afghanistan War" (n = 15 collected among French soldiers deployed), which are matched to a control group. The narratives were transcribed and segmented into clauses and the following linguistic characteristics were analyzed: disfluencies (silent pauses, hesitation pauses, vocalic lengthenings, incomplete words, incomplete utterances, contiguous word repetitions), narrative coherence, certain lexical fields (concerning death, emotions, etc.), spatio-temporal reference, references to the person (personal and generic pronouns in particular), and non-literal language were also taken into account.

In order to confirm the validity of the SPLIT-10 scale, we tested it on two additional corpora of traumatic narratives: the "Nice" corpus (n = 20) collected in the days following the attack perpetrated in Nice (14 July 2016) and the "sexual assault" corpus (n = 20) composed of testimonies from people who were victims of a single sexual assault that occurred during adulthood.

Results.- Linguistic characteristics which proved irrelevant either because they were insignificant, or because they were too frequent and / or in practice difficult to discriminate were eliminated: lexicon of emotions, verbal tenses, non-generic pronouns, narrative coherence. Conversely, the criteria appearing to be the most relevant in order to differentiate between traumatic and non-traumatic narratives were the following ones: lexicon concerning death, body parts and unreality; verbs of perception, movement or position of the body; spatial context including the appreciation of distances; generic pronouns; mention of the time and duration of the event; incomplete utterances; repetitions; and non-literal language. These criteria constitute a 10-item scale that we exemplify criterion by criterion, then as a global test. The results show that the SPLIT-10 scale significantly discriminates between traumatic and non-traumatic narratives.

Discussion.- The SPLIT-10 items correspond to 5 psycholinguistic sub-syndromes: reference to death (item no.1), derealization (item no.2 to 4), depersonalization (item no.5 to 7), flashbacks (item no. 8 and 9) and unspeakable (item n ° 10). While these items turn out to be compatible with the criteria for PTSD retained by the DSM-5 (like those concerning acute stress disorder), the linguistic markers that we have identified appear to be much more detailed and specific to the psychological trauma than the usually described psychiatric symptoms. Because it accurately accounts for dissociation, SPLIT-10 is syndromically more consistent than the definition of PTSD in the nosography.

It would be useful to replicate our study by considering larger multicenter corpora by controlling comorbidities, by varying the types of unique and complex traumatic events, and by focusing specifically on traumas occurring in childhood where language is still being constructed. In addition, the cut-off of SPLIT-10 retained at 5 could be revised upwards, or even be adapted according to the length of the verbal production. Moreover, a feasibility

analysis should be carried out in current clinical practice measuring the effectiveness of practitioners trained in the use of this new tool.

Beyond the 10 items that we have retained, it would be finally interesting to develop a more complex scale by integrating many other linguistic characteristics that can be used for fundamental research purposes.

Conclusion.- As much as it infiltrates the theoretical discourse trying to grasp it, traumatic dissociation has until now remained a notion difficult to model. As a new clinical approach to dissociation, the traumatic psycholinguistic syndrome reflects the “injury of language” constituting the trauma. The definition of the SPLIT-10 scale appears more objective than the usual clinical analysis or the scales and questionnaires based on the nosography, which calls for the subjective assessment of symptoms by the patient and / or the practitioner. Nevertheless, far from denying all subjectivity, complementing lexical and syntactic linguistic approaches, the semantic analysis of discourse also offers to better characterize the specificity of what caused the trauma in a singular subject. Finally, allowing to get out of traumatic dissociation, the pragmatic analysis of the dialogical interaction between the patient and the clinician will prove to be fundamental in order to understand the effective therapeutic mechanisms.

Keywords: post-traumatic stress disorder, psycholinguistics, textual analysis, traumatic psycholinguistic syndrome, diagnostic scale, linguistic marker.

Introduction

The understanding of psychological trauma has grown considerably over the past fifteen years, leading to a real conceptual revolution at the crossroad of psychiatric, psychological, neurobiological, sociological, anthropological fields [90]. Based on a linguistic methodology, the standardized computerized and manual study of the speech of mentally injured patients recently enabled us to define the notion of traumatic psycholinguistic syndrome (SPLIT) [9,23,85]. This new perspective has the ambition to overcome the diagnostic and therapeutic dead ends with which too many people with mental health injuries still face. In order to better explain the challenges of this approach, we review the origins and evolution of the semiological and nosographic characterization of post-traumatic stress disorder and we highlight the limits of current conceptions. Then, we present previous work related to language and psychic trauma in order to determine possible markers of interest. These linguistic markers are then tested on an exploratory basis on two corpora of trauma narratives (war and terrorist attack). The scoring scale is tested on two additional corpora (terrorist attack and sexual violence). We finally discuss the consistency of our results before opening up the reflection further.

1) From the origins of psychic trauma to its future overcoming

1.1) The unfinished construction of the characterization of post-traumatic symptoms towards the DSM-5 (2013)

Psychic disturbances that occur as a result of traumatization have been described since Antiquity. Since then, symptoms caused by psychic injuries have been successively discovered, forgotten then discovered again. From the second half of the twentieth century on, as the question of the reliability of the psychiatric diagnosis was becoming important, the American classification introduced in its first edition of 1952, in the chapter of transient personality disorders, the “psychic symptoms secondary to a factor of stress”, although intrusion symptoms were not part of the criteria (American Psychiatric Association, Diagnostic and Statistical Manual of mental disorders, DSM) [2]. The following version of the DSM, published in 1968, suppressed this entity by refusing any place for psychotraumatic consequences in the official nosography [3]. Is it for reasons of fear of a “contagion” of post-traumatic disorders among the troops engaged in Vietnam (1955-1975), a war massively dividing public opinion? Once the fighting was over, the “new” entity of “post-Vietnam syndrome” which appeared in the media may be interpreted as a first attempt for American society to seek appeasement. In addition, insurance companies required

criteria to compensate Guys suffering from epidemics of alcoholism and suicides. The existence of psychic trauma then resurfaced under the name of Post-traumatic stress disorder in 1980 in the publication of the DSM-III [4]. Associated to anxiety disorders, this entity was then considered as a reaction to a stressful event which would cause psychological distress in most individuals. However, contrary to current conceptions, dissociative symptoms are described as rare. In 2013, the DSM-5 included a new category called "Trauma- and Stressor-Related Disorders" which presents a more detailed description of acute stress disorder (ASD) and post-traumatic stress disorder (PTSD) [5].

However, the separation between acute and chronic post-traumatic disorders based upon a strict temporal criterion is debatable, since both disorders belong to the same symptomatic continuity whose temporality and expression vary significantly from one injured individual to another. Another issue concerns the new notions of "trauma at a distance" (via modern means of communication), "indirect trauma" (leading to massive psychological effects in a loved one of a psychotraumatized person) and repeated "micro- trauma" more related to stress than to trauma. At the same time, the manual tries to cut short the risk of "traumatic inflation" by limiting to professionals (investigators, rescuers, administrative agents working on the subject of the tragedy, remote pilots of armed drones, etc.) the possibility of trauma through electronic media. However, this dichotomy has no epidemiological or clinical justification. In fact, these nosographic changes derive from the societal consequences of the 9/11 attacks in the United States (incessant exposure to television images sometimes taken during the tragedy by victims thanks to their smartphones, mainly near the World Trade Center) and the subsequent wars events in Iraq and Afghanistan (massive engagement of fighter pilots and drones, analysis of photographs and video by intelligence agents, etc.). Beyond a natural evolution of ideas, these semiological inaccuracies illustrate the difficulty of differentiating, for the clinical and research approach, traumatic intrusion symptoms from depressive and / or anxious ruminations, or even from flashbulbs¹. Finally, the definition of post-traumatic stress disorder in the DSM-5 is relatively sketchy and does not encompass a precise description of what constitutes a traumatic event, nor of the diversity of post-traumatic psychological disorders².

1.2) The very recent densification of the clinical description of post-traumatic mental disorders

Definitory of trauma since Pierre Janet, the notion of "dissociation" has recently re-emerged in contemporary literature as the cardinal origin of the traumatic process, and as a dimension to explore in therapy [57,58 , 91.92.94.95]. In this sense "dissociation" does not refer to ideoaffective dissociation or discordance in reference to schizophrenic disorders³. Instead, traumatic dissociation accounts for the alteration and / or disjunction of normally integrated consciousness functions: memories, emotions, affects, feelings, internal and environmental perceptions, behavioral actions and cognitions. The dissociative symptoms are manifested by a modification of temporospatial perceptions (slowing down of time, perception of a great silence in the middle of a deafening noise, etc.), a derealization (impression that the environment is becoming unreal, alteration of sensorialities, etc. .), depersonalization (seeing the scene from the outside, fragmentation of the body, etc.), automatic motor behavior (adapted to control danger or on the contrary exposing to danger), and partial or extensive amnesia of the facts. However, because of its own intrinsic characteristics, this notion of traumatic dissociation seems difficult to grasp and appears in different criteria of PTSD in the DSM-5 (criteria B3 and D1) as well as in an "additional" criterion characterizing a subtyping of PTSD called "with dissociative symptoms". In practice, intrusion symptoms, which are manifestations of dissociation are the pathognomonic sign of trauma, where the subject re-experiences the horrifying scene with its load of unbearable distress as if

¹ A memory flash well referenced in time and space recalling the source memory of a major societal event such as the death of J.F. Kennedy or the explosion of the space shuttle Challenger, to cite the most studied [63,69].

² The International Classification of Diseases, in its tenth edition of 1993, is even more concise [98].

³ However, there are possible common features between these two meanings of the term "dissociation" [8].

he were still there. These traumatic repetitions include several forms that are sometimes associated with each other: nightmares, ecmnesias (or flashbacks), stereotypical mental concerns, illusions of re-experiencing the event when the subject believes he recognizes elements of the traumatic scene in his environment, elementary motor phenomena reiterating the behavioral reaction that occurred during the event, behaviors of repetition (running away, crying, self- or hetero-aggressive acting out, etc.), impulses to tell or write the event on the model of recitation [17]. It should be noted that intrusion symptoms, associated with the other cardinal symptoms of PTSD (neurovegetative hyperactivation and cognitive-behavioral avoidance strategies intended to prevent the occurrence of a new traumatic confrontation in reality or imagination) can have different manifestations which are not simple "comorbidities" or "complications", but which constitute authentic post-traumatic clinical forms. Indeed, these symptoms are closely associated with the trauma and / or its consequences: anxiety disorders (separation anxiety, obsessive-compulsive washing disorders in the aftermath of a sexual assault, etc.), misuse of psychoactive substances, grief complicated by the revival of a loved one who died, post-traumatic psychosis with integration of traumatic elements within the paralogical or hallucinatory system, specific modifications of the personality (emotional lability inducing new traumatic exposures, dissociative identity disorder, etc.), somatoform and / or psychosomatic physical suffering in particular when the physical and psychic integrities have been concomitantly impacted (conversions and post-traumatic pain in particular), neuropsychological damage (in particular of working memory), and social maladjustment (at home, or in the professional domain) [17]. These multiple expressions of trauma do not always co-exist but can fluctuate over time: the repetition syndrome can fade, or even disappear, while others signs of dissociation can appear or increase.

However, despite all these enrichments of semiological descriptions in contemporary English and French speaking worlds, the under-diagnosis and late diagnoses of post-traumatic disorders, sometimes at the stage of intense suffering, remain numerous. Either because the traumatic origins of the disorders remain unclear, due to their very clinical characteristics, that is to say the "unspeakable experience" constituting dissociation in language [9,13]. Or again because the care system and the networks of practitioners come up against impassable conceptions which undoubtedly testify, without knowing it, to the psychotraumatic process spreading even in theoretical discourse, to the point of rendering them inoperative [13,14]. Now is the time to build a new model.

1.3) Towards an epistemological renewal of the characterization of psychological trauma and its clinical consequences

Today, some epidemiological studies lead to the paradox that more psychotraumatic syndromes are diagnosed in subjects confronted with ordinary life events rather than terrifying events. Could there be "post-traumatic syndrome without psychological trauma"? Such abstruse results only prove to be evidence of a low reliability in carrying out structured interviews, diagnostic and / or psychometric scales, instruments based on the limited nosographic criteria of the DSM [19]. How to disentangle intrusion memories from re-experiencing, morbid rehashes, anxious ruminations or even normal cognitions? Even if they aim to be objective, the clinicians or the researchers interpreting the symptoms are inevitably captive of their subjectivities. Societal subjectivities also, as much as diagnostic criteria, clinical and scientific methods and tools appear to stem from their times [20]. In addition, individual subjectivities are both sensory determined by the sensitivity of perceptual biological sensors leading to early clinical intuition, but also integrated neurocognitive arising from the hypothetico-deductive reflexive experience [20]. More objective criteria could be revealed by functional brain imaging and certain biomarkers, but such promising advances only remain for the time being studied in a laboratory context, and not (yet) applicable to medical practice. [12]. In parallel, many effective psychotherapeutic protocols have emerged in order to help people with psychic injuries (behavioral and cognitive techniques, hypnotic practices, psychodynamic therapies, EMDR, narrative therapies, etc.), but they do

not provide any integrative model, nor the understanding of the efficient mechanisms allowing the appeasement of the symptoms [16].

In order to better characterize psychic trauma and its clinical consequences, and in order to better model and evaluate operative psychotherapeutic care, it is urgent to build a new epistemological conception of trauma. The evolution of ideas is reaching a turning point where it turns out to be possible to bring together clinicians and researchers from various disciplines in order to propose a new model based on linguistics and psycholinguistics, which are, overall, little known to psychologists and psychiatrists, although language is central to the psychotherapeutic practice. After discussing the pioneering work identifiable in the literature on trauma and language, we propose a psycholinguistic tool allowing the identification of psychically injured subjects, based on an original linguistic study carried out on several corpora of psychotraumatized patients (war, terrorist attack and sexual assault). We argue that linguistic markers are more objective than semiological and psychometric approaches and that they pave the way for digital phenotyping of PTSD and allow better evaluation of recommended care.

2) First steps of the psycholinguistic approach to psychic trauma in the literature

A search in the titles and / or summaries of the Boolean keywords and operators “post traumatic stress disorder [AND] linguistic” using the Medline database only found about ten references as of January 1, 2021. The addition of the keywords "narrative [AND] autobiographic memory [AND] autobiographical memory [AND] language" offers more than a hundred titles which generally tackle psycholinguistic issues from a very distant point of view. After two recent reviews of the literature, O'Kearney et al. (19 studies published between 1995 and 2004) [73], then Crespo et al. (22 studies published between 2004-2015) [39], we have reviewed the bibliography, focusing on work specifically concerning psychic trauma and psycholinguistic concepts [10].

Dating back to the 1980s, the preliminary studies referenced on Medline were lexical analyzes focusing on emotions, feelings and coping strategies. For instance the themes of anger, isolation, self-accusation, guilt, shame are found in the speech of women and men victims of sexual abuse in childhood, [64,87]. The speech of resilient victims is marked by a better verbalization of emotions and a better language organization compared to subjects still suffering from PTSD [51,74,75]. From the mid-1990s on, studies essentially referred to two paradigms of linguistic analysis: the 13-item scoring by Foa et al. [46], and the speech analysis software developed by Pennebaker et al. (Linguistic Inquiry & Word Count - LIWC) [76]. Very recently, using automated language processing before manual confirmation focusing on the variables of interest⁴, Gayraud and Auxéméry modeled the traumatic psycholinguistic syndrome (SPLIT) [9] [Box 1]. However, the literature deserves to be more finely discussed according to its four prevalent axes: (i) emotional and perceptual dimensions, (ii) temporal context, (iii) references to the self, (vi) narrative “disorganization”.

2.1) Emotional and sensory dimensions

A large number of lexical studies find an increased use of terms related to death, emotions (negative and positive) and sensory perceptions [27,34,48,53,61]. The proportion of words related to death are positively correlated with the severity of post-traumatic symptoms [1], and there is an opposite relationship between the expression of positive emotions and avoidance strategies [65]. As the lexical aspects of language are the easiest to process via software analysis, the majority of the above-mentioned studies used the LIWC [77].

⁴ Using the software Alceste [83,84].

However, the analysis of isolated words as well as the conception of a univocal link between linguistic forms and meanings proves to be highly problematic since a linguistic form can have several functions or meanings, and conversely, a function or a meaning can be expressed by different linguistic forms. Based on their knowledge of the world and of the sentential or situational context, natural speakers easily resolve such ambiguities, but it proves highly challenging for software analysis. Similarly, computerized text analysis such as LIWC are not able to process linguistic phenomena such as sarcasm, comparisons or metaphor, which nevertheless appear frequently in trauma narratives [9,43]. Idioms are especially challenging because of their arbitrariness, their frequency (half of a speaker's lexicon according to [55]), their non-compositional meaning (the meaning of the idiom does not correspond to the sum of the meaning of its words as shown by the following examples: "kick the bucket, pushing up daisies, pop one's clogs, six feet under, to bite the dust") [81].

2.2.) Temporal context

The majority of studies suggest that the use of verbal tenses is influenced by disturbances of temporal events and an increased use of the present tense in order to relate past events (historical present) [48, 60, 65,86]. The permutations between past and present tenses in the accounts of traumatic events produced by people suffering from PTSD are unintentional and reflect the re-experiencing of events with a lack of temporal perspective [32,48,53,60,79]. However, other studies show contradictory findings. For instance, Beaudreau described a greater frequency of the present tense in narratives with emotionally "neutral" content than in positive or traumatic narratives [27]. Furthermore, Fernandez-Lansac & Crespo do not find any significant difference in the use of the present tense between traumatic or emotionally positive narratives [45]. For still other authors, past tense accounts have been associated with more distress among individuals who experienced traumatic events, as if these people were "stuck" in their ruminations [54]. Following this interpretation, Mundorf & Paivio find that the accounts of horrific events produced after a therapy display present and future tenses [70]. These contradictory results can be accounted for by the fact the methodology in the above-mentioned studies eludes two fundamental linguistic notions: the difference between verbal tense and real time, on the one hand, and the difference between form and use of verbal tenses, on the one hand.

First of all, it is important to clarify the term "temps", which is polysemous in French: the tenses of verbs (tense in English) do not correspond to objective or calendar time. The use of a specific "verbal tense" does not indicate anything about the "temporal context" in which the story is taking place (or was taking place, will take place). For example, the present verbal tense can refer to actions or states taking place during the utterance ("I am thirsty"), it can also be used to relate past events ("yesterday, I arrive at the cafeteria and I see Paul with Virginie !"), Or future ones ("tomorrow, I promise, I stop drinking"). Hence, it is important to distinguish between the verbal temporal form and its use. For example, the present tense can hold an enunciative value referring to an event in the process of occurring: "I am tired" (ie now, while I'm speaking); a panchronic or universal truth value: "the water boils at 100 degrees Celsius" (i.e. whatever the moment); or even a historical present value: "last week I arrive at my gym class and I find the door locked!" (I.e. a moment in the past)⁵. Unfortunately, computerized text analysis does not allow the distinction between linguistic forms and their values as only superficial word form counts are computed. An additional issue to be kept in mind is that the use of the historical present as well as the alternation of past and present tenses is a frequent phenomenon to relate past events in every day conversations, and that it is not a pathological phenomenon [25,82].

2.3.) Self-reference through the use of pronouns

⁵ Note that in English, there are two present tenses : simple and progressive

Jaeger et al. found a greater use of pronouns (all persons included) in accounts of women who have suffered assault, and that this overuse was associated with severe dissociation symptoms as well as intense guilt [56]. Concerning more precisely the first person pronouns, Rubin (2011) observed a preponderant use of the pronoun "I" in subjects suffering from PTSD evoking both their trauma and a positive life event [88]. Mergenthaler & Bucci found that an increased use of the pronoun "I" is associated with more ruminations of the traumatic event, while a higher use of the pronoun "we" (which is understood as a better ability to seek help from others) seems to predict a favorable clinical outcome [68]. In the majority of research, the use of the first person ("I") is interpreted as a sign of withdrawal into oneself and is an early linguistic marker of PTSD [62], which predicts the duration of symptoms [40]. Other studies find conflicting results, again probably due to methodologies that do not take into consideration precise linguistic knowledge [42,66].

First, considering that "I" constitutes the only form available to the speaker to refer to himself appears very reductive: in reality, the speaker has a variety of forms to refer more or less explicitly to himself, within the speech he produces. For example in French, "on" (one) can be used as an equivalent of "je" (I): to the question "how are you?" ", one can answer "one is fine" (i.e. "I am fine"). In addition, the first person singular is also found to be included in "we" (i.e. we = I + others), and also by generic uses of pronouns such as "on" (one) (ie people in general, including me) as in the sentence "one is paralyzed at that moment". Finally, let us indicate that the increased use of person singular pronouns is not typical of PTSD but instead has been correlated with various psychic contexts such as depression [93], relational dissatisfaction [89], romantic break-up [31], etc., suggesting the lack of specificity of this linguistic marker.

2.4.) "Disorganization" or narrative "fragmentation"

The use of "disorganized" or "fragmented" to characterize the discourse of PTSD sufferers is pervasive in the literature. However, these terms are not clearly defined by linguistic characteristics, if not defined at all, and thus "measured" in a very variable way. Foa et al. (1995) evoke "fragmentation" (via incomplete statements, speech fillers, repetition of ideas) and "disorganized" thoughts (via "confusion" and "disjunction", terms that are not better explained) [46,50,52,96]. For other authors, the notions of "fragmentation" and "disorganization", not defined either, are evaluated by the degree of readability or comprehensibility of verbatims [6,47,49,100]. Halligan et al. (2003), like Jelinek et al. (2010) attempt to assess the "coherence" of the accounts by external judges, or even by the patients themselves, using scales, but again, without precisely explaining their conceptions [50,60]. Only Rubin (2011) briefly defined 'disorganization' through the use of a metric scale based on: (i) contextual (to what extent does the narrator provide enough information to locate the spatial and temporal event); (ii) chronological (to what extent is sufficient information provided to historically order the facts); (iii) thematic (to what extent does the narrator use causal links, interpretations ... until bringing a resolution to his narration) [24,88]. Overall, the blurry definitions and the great divergences of appreciation towards what nevertheless appears to constitute the same phenomenon, make the results of previous studies difficult to interpret and to compare, which explains very contradictory findings in the literature [6,29,33,34,47,50,52,59,86,88,96,99].

The cardinal problem with this research concerns the very object to which the character "fragmented" or "disorganized" is attributed: it is not clear whether it is speech, memory or thought that is "fragmented" or "disorganized". For example, some works consider unfinished utterances as "thoughts in suspense", which seems wrong to us because one can have a completed thought without wanting, or without being able, to express it completely. Other clinicians have been able to consider filled pauses (eg: "uh ...") as narrative breaks even though they are linguistically known to normally have a lexical retrieval function for the speaker as well as they provide time to the interlocutor to integrate the

previously transmitted information [38]. Thought, speech and memory are naturally linked but they are not synonymous [22,28,34,46,60,96].

Since the 1970s, several linguists have sought to specify the rules necessary for the proper formation of a discourse and for textual coherence [41,78]. Certain sequences of sentences are more acceptable texts than others, as shown by the following examples borrowed from Charolles [36]:

(1) Max is sick. He has a fever.

(2) Max is ill. The earth rotates.

(3) Widows receive only half of their late husband's pension. Married women receive a pension equal to half of the one received by their deceased husband. They only get fifty percent of the benefits their husbands received when he was alive.

(4) Paul does not have a car. He sells his car to buy a new one.

(5) Marie is sick. She suffers from terrible migraines.

(6) Marie bought a Louis XV cabinet. She suffers from terrible migraines.

For a sequence of sentences in everyday language⁶ to be coherent (i.e. to constitute a text) it should meet four meta-rules: continuity, progression, non-contradiction and congruency Charolles [35]:

- **Continuity** refers to the fact that the presence of constant elements is necessary in order to give unity to the text. Continuity can be achieved via pronouns as in (1) where “he” refers to “Max”. In (2) however, the continuity requirement is violated as “the earth” has nothing to do with “Max”.
- **Progression** is related to the renewal of semantic information: new information must be provided in addition to the repeated concepts that are mentioned. In (3) this requirement is not fulfilled as each sentence repeats the same idea.
- **Non-contradiction** refers to consistency, the speaker cannot make a statement and contradict it in the same discourse, as in (4).
- **Congruency** refers to the way facts and concepts presented in the text link together and what role they play in relation to each other. The relationship between “sick” and “migraines” is obvious in (5), while the link between “Louis XV cabinet” and migraines in (6) is nonexistent.

2.5.) Necessity to study other linguistic markers

Previous studies (in spite of their linguistically imprecise methodologies) have pointed out several linguistic markers that are potentially associated and relevant to trauma narratives; the lexicon (mostly the lexicon of emotions, sensations and death), the temporal context, pronouns (in particular first person singular), and discursive organization. In addition to these linguistic markers, we propose to explore other categories such as dysfluencies and metaphors.

3.) Psycholinguistic study

The exploratory analysis material includes two corpora of traumatic event narratives named respectively "Bataclan" and "Afghanistan" as well as a control corpus. The first corpus "Bataclan" corresponds to 20 testimonies collected from survivors during the three days following the terrorist attacks perpetrated in Paris on November 13, 2015. The "Afghanistan War" corpus contains 15 psychiatric interviews of military patients treated for post-traumatic stress disorder following a mission in Afghanistan. These subjects have a mean Post Traumatic Checklist Scale (PCLS) score of 52.8 [97]. In order to constitute a control group, we collected 20 personal accounts of non-psychotraumatic events that occurred during a concert or a stay abroad (not life-threatening incidents, such as loss of luggage, bank card, car breakdown or an incident caused by a drunken person, always without gravity). The characteristics of these three corpora are presented in Table 1.

⁶ Poetic language is not considered here

The narratives were transcribed and segmented into propositions (each proposition comprising a verb and its arguments⁷). All calculations are based on percentages as a function of the total number of propositions in the narrative in order to neutralize possible differences in the length of the corpora. The dysfluencies were transcribed as follows (i) silent pauses [SP] lasting more than 200 ms; (ii) filled pauses (e.g.: "I [UH] grabbed my bag") lasting more than 200 ms; (iii) vowel lengthening (e.g.: "Heeee [ALL] took his gun"); (iv) false starts where the beginning of the word is pronounced but the end is aborted (e.g.: "They sh_ they shot"); (v) incomplete utterance where the beginning of the sentence is pronounced but the end is aborted (e.g., "it was / we were all scared"); (vi) contiguous word repetitions (e.g., "we saw the the the lasers of the the guns pointing at us").

The following language features were analyzed from 6 dimensions of analysis:

- > **Narrative coherence** by computing the number of transgressions to the rules of continuity, progression, non-contradiction and congruency;
- > **Lexicology** focusing on words designating: death, emotions (positive and negative with automatic identification thanks to the Emotaix software [80], sensations or perceptions (external and internal), parts of the body, unreality (of the self and the environment);
- > **Spatio-temporal orientation** including the mention of:
 - the precise time of the event and/or its duration,
 - the spatial context in reference to precise objects and elements of the traumatic scene and/or the distances of the objects (between them and/or in relation to the self), and the configuration of the place,
 - the three values of the present verbal tense (enunciation, historical, panchronic), as well as the past tense, imperfect tense, pluperfect tense, future tense and conditional tense,
 - verbs encoding body position and/or movement;
- > **References to person** based on occurrences of the first person singular and plural pronouns, as well as different uses of the pronoun "on" distinguishing between personal (e.g., on = we) and generic (e.g., on = people in general). The pronouns "tu" and "vous" were also included when used generically;
- > **Identification of dysfluencies** by objectifying silent or filled pauses, false starts, incomplete utterances, and word (or short phrase) repetitions;
- > **Identification of comparisons and metaphors.**

For each dependent variable, a percentage related to the number of propositions in the narrative was calculated. For statistical analysis, whenever the distribution was normal (Shapiro-Wilk test) and homoscedasticity (Levene test), a one-factor analysis of variance ANOVA or t-test was applied with a threshold $\alpha < 0.05$ (Bonferroni adjustment at $p < 0.01$ for post hoc comparisons). Otherwise, Kruskal-Wallis and Mann-Whitney tests were used.

For the exploratory analysis phase, we present the results corresponding to each of the 6 dimensions of interest in order to retain the most relevant items for the development of a diagnostic rating scale. This psycholinguistic tool, named "SPLIT-10", will be exemplified criterion by criterion, then in a global test, before being verified on two other corpora of trauma narratives, one concerning the Nice attack, the other concerning victims of sexual assault.

3.2) Results of the exploratory analysis

3.2.1) Differences across groups

Table 2 presents the main results.

Regarding coherence, none of the results is significant: the rules of continuity, non-contradiction and congruity are not violated by either the "trauma" nor the control groups; the rule of progression appears to be violated in both the trauma and the control narratives.

⁷ That is the subject and complements of the verb (direct and indirect objects in particular)

Lexically, the trauma stories contain significantly more verbs of perception, references to death and to body parts. In addition, there are more references to unreality in the Bataclan narratives compared to those from Afghanistan ($p = 0.002$) and to those produced by the controls ($p = 0.001$). On the other hand, the lexicon of emotions is not significantly different across the three corpora.

With regard to the temporal context, the analysis of the verbal tenses did not reveal any significant difference between the groups, with the exception of the pluperfect tense, which was more frequent in the control's accounts. On the other hand, the traumatic accounts contained significantly more details about the time or duration of the event. Moreover, control subjects verbalized less often references to body movements or position. Following the same trend, the analysis of the spatial aspects reveals that the traumatic accounts present significantly more verbs concerning body positions or movements, and more references to the spatial context.

With regard to self-reference, significant differences were observed in the use of the first person singular "I", which was much more important in the Afghan war narratives, which, conversely, contained fewer first person plural pronouns ("we" or "us"). Generic pronouns appear significantly more important in trauma narratives compared to controls.

Considering dysfluencies, silent or filled pauses are found to be of high frequency in all corpora without significant difference. On the other hand, contiguous word repetitions and incomplete utterances were found to be significantly less produced by control subjects, while false starts were found to be more frequent in the Bataclan corpus.

Finally, the trauma narratives contain significantly more comparisons and metaphors compared to the control subjects' narratives.

3.2.2) Discriminatory nature of language items

A second step of the exploratory analysis consisted in calculating the percentage of people in each group who used each language feature at least once. For some markers that are relatively frequent in the common language, the percentage of use of at least 2 times and at least 3 times was calculated (table n°3).

The notion of coherence does not prove to be discriminating: the rule of progression appears to be transgressed at least once with a high percentage in the three groups (between 70 and 90%); the other rules are not violated in any of the narratives.

On the lexical level, the expression of emotions remains frequent in all the groups. With regard to the mention of death, body parts and the unreality, we observe that few people in the control group mention them at least once, whereas the psychologically injured people make much more reference to them. Moreover, while the percentage of subjects in the control group using a verb of perception at least once remains quite high (75%), if we consider the percentage of people mentioning these verbs at least twice, it drops down in the control group while it remains at its peak in the trauma narrative groups.

Turning to the temporal context, the percentage of people mentioning it at least once in their narrative is lower in the control group than in the other ones, while the different verbal tenses are used frequently by all groups (the controls, however, show a clear propensity for the pluperfect). Between 85 and 90 % of the psychologically injured people mention spatial information vs. 35% in the control subjects (movement or position of the body, precise elements of the environment, distances).

Concerning the reference to oneself, the percentage of people pronouncing "I" at least once is irrelevant since 100% of the subjects use it repeatedly. The first person plural is also used by 100% of the speakers. The analysis of the generic pronouns, on the other hand, is more discriminating, as the percentage of control subjects using them at least once remains low (10%).

Concerning dysfluencies, silent and filled pauses are present in 100% of the subjects whatever their group. On the other hand, the percentage of subjects verbalizing an incomplete utterance at least once is between 90% and 100% in the traumatic narratives, whereas it drops to 45% in the control subjects. With regard to word repetitions, the percentage of people producing them at least once is very high, including in the control group (80%), but if we consider the percentage of people producing them twice or three times, it decreases to 70% and 45% respectively in the control group, while it remains

particularly high (around 90%) in the traumatic groups. As for false starts, they seem to characterize mainly the Bataclan corpus.

Finally, the percentage of speakers producing a comparison or a metaphor at least once correctly discriminates between traumatic and non-traumatic narratives (15% for the controls compared to 80 to 95% for the other groups).

3.3.3) Elimination of irrelevant characteristics

In order to differentiate between traumatic and non-traumatic narratives, the previous analyses made it possible to eliminate irrelevant characteristics, either because they were not significant, or because they were too frequent and/or difficult to identify in clinical practice: lexicon of emotions, verbal tenses, non-generic pronouns, coherence. Conversely, the most relevant criteria appear to be the following: lexicon concerning death, body parts and unreality; verbs of perception, movement or body position; spatial context including the appreciation of distances; generic pronouns; mention of the time and duration of the event; incomplete utterances; contiguous repetitions; comparisons and metaphors. We finally retained a 10-item scale, the ordering of which will be specified in the discussion.

3.2) Presentation of the "SPLIT-10" rating scale

3.2.1) The SPLIT-10 scale

1	Death		
2	Spatio-temporal context		
3	Unreality		
4	Metaphors & comparisons		
5	Body parts		
6	Verb of body movement or body position		
7	Generic pronoun		
8	Perceptions – Sensations (x2)	1. <input type="checkbox"/>	2. <input type="checkbox"/>
9	Repetitions (x3)	1. <input type="checkbox"/>	2. <input type="checkbox"/> 3. <input type="checkbox"/>
10	False start or incomplete utterance		
	TOTAL / 10		

Validity Context: Calculations were obtained on the basis of samples with an average size of 450 words, corresponding to an average duration of 3 minutes. For scoring purposes, it is important that the scale be applied to productions of comparable size.

3.2.2) Explanation of each criterion of the SPLIT-10

Before testing the "SPLIT-10" on two additional corpora of trauma narratives (victims of attacks and sexual assaults), we exemplify the feasibility of scoring each item of this scale on the basis of extracts from the corpora quoted in italics, where the relevant words for the rating are indicated in bold.

Reference to death (item n°1)

The speaker mentions the lexical field of death:

- *We think of very silly things like would I rather **die** on the spot or be injured and fake **death**?*
- *And then one one one one one bathe in **death** I mean physically we are surrounded by [SP] **dead bodies**.*
- *So j_ I know that danger is behind [SP] I know that **death** is behind me.*
- *I was looking at that door and I was thinking [UH] [SP] **death** is going to come in.*
- *I saw the vehicle as a **coffin***

Spatiotemporal context (item n°2)

The speaker provides precise details on the spatiotemporal context by giving, for example, the exact time at which the events took place, the duration of the events or the difficulty in evaluating this duration:

- *I looked at the time on my cell phone it was **12:53 am** [SP] so **9:49 pm** was when I was sending the text message that's when I heard the detonations and **12:53 am** when my son called me there I told him I was alive that I was out.*

- *It lasted **one hour and a quarter** because I had the clock above my eyes and I also had his watch near my eyes and so **one hour and a quarter**.*

- *It lasted **forever** but I think it was **two three minutes** but **two three minutes** that lasted **an indefinite time**.*

- *To say exactly how long it lasted I am unable to say between ten and fifteen minutes?*

The speaker also gives precise indications on the configuration of the places where the events occurred, the objects that were part of the traumatic scene, the appreciation of the distances:

- *And we look at the **wrought iron barred window** we were completely stuck in a **very small shower**.*

- ***The stool was overturned** [SP] someone came in and put a newspaper against [UH] **the light bulb** [SP] and then he threatened me [SP] I tried to call.*

- *He took me into a **cellar** where there was already a **bed** prepared a **box spring** and a **mattress** there were **holes on the wall**.*

- *Because he really was knocked down a **few millimeters** from me.*

- *He went to the end of the alley that is about **300 meters** with plane trees.*

Unreal character of the scene (item n°3)

The speaker uses the lexicon of strangeness to express the strange, unreal, even unbelievable character of the events he was confronted with:

- *It's so atrocious that it's **as if we weren't in reality**, well, that's how I experienced it.*

- *It seems **completely unreal** to think that we had a bullet in the middle of Paris, it's **a bit surreal**.*

- *In fact, I see it **as if I were watching a movie** and I don't have the impression that it's real.*

- *What I'm going to say is that it's **seriously surreal** and you might not believe me but I barely had time to realize it.*

- *My brain went into off mode and I felt like I was **actually leaving my body** and it was like I was **watching the scene from above** and I could see it was happening and I couldn't react.*

- *I found myself undressed **there was a black hole** I did not know any more what it was about.*

Metaphors and comparisons (item n°4)

The speaker uses comparisons (using the conjunction "like") or metaphors (comparison without a conjunction) to try to explain the traumatic scene:

- *People were really falling **like dominoes**.*

- *It destroys us **like a puzzle** where we pick up the pieces or we are picked up in pieces.*

- *And he was running into people **as if we were at the bowling**.*

- *They fell on us but they were **like flies**.*

- *Everything that happened was **a kind of parenthesis**.*

- *And then we saw UH well a **human tide** of dead people.*

- *I found myself in the middle of **a bloody battlefield**.*

- *I saw a **firework of human beings**, they were in the air, they were falling down.*

Mention of body parts (item n°5)

The speaker mentions the parts of the body (his own or someone else's) in the literal sense via the anatomical lexicon and/or translating physical injuries:

- *Finally there were lots of **bodies** lying all over the place and there were shaking **feet**.*

- *I was partly lying on top of a man who had a **bloody leg**, I also felt **blood on my right hand**.*

- So I told him to come quick actually so that he would hold the **artery** because there was **blood** there was too much **blood**; so I pressed here then I took the **arm** off.
- I caught a lady who had been shot twice in the **buttocks** and in the **left thigh**.

Body movement and position (item n°6)

The speaker uses verbs of body movement and position which do not involve a change of location (e.g., "get up", "fall", "move", "crouch", "run", "walk", "lie down", "sit", etc.):

- *I **get up** at last I **stumble** I **slip** in the blood / I **crawl** / I **get** to the stairs towards the emergency exit in fact / well there it's the rush / I hear the shooting behind / I **fall down** the stairs again / I **crawl out**.*
- *He starts the car and I immediately **fall down** on the back seat.*
- *So I was **on all fours** trying to figure out what was going on.*
- *I was completely **paralyzed** on the ground.*

Generic pronouns (item n°7)

The speaker mentions the pronouns "on" (one), "tu" (you) and "vous" (you) in a generic value, referring to a vague and indeterminate group of humans equivalent to "people in general" or "anyone" :

- ***one** is more or less an animal at this point it's the survival instinct.*
- *One minute it's fine, the next minute it's not, the next minute it's fine, the next minute it's not always fine, and then **you** think it's fine, **you** think it's fine, and then **you** fall back.*
- *When everyone throws themselves at **you** and **you** throw yourself at others and **you** have to get down on the ground because it's shooting in all directions and **you** don't know where it's shooting.*

Perceptions and sensations (item n°8)

The speaker uses at least twice verbs of perception ("to feel", "to see", "to hear", etc.) or words referring to sensations ("smells", "colors", etc.):

- *I **feel** that someone is stuck to me I am in the position of the fetus in fact on the side / he too is stuck against me and I I **feel** his heart and his breath finally here / it lasts a certain time very very long / I **have the sensation to feel** or to **hear** the casings which fall really on me or next to me / my ear **whistles** I I / there is the **odor of powder** once again which / which really invades my nose entirely.*
- *I don't know how long I stayed locked up in the bathroom / **hearing** the terrorists walking around, **seeing** their feet / because I could **see** under the bathroom door the soles of the shoes, the shadows / **hearing** the tape, **hearing** the pliers, **hearing** the things they were moving / **sounds** that I didn't know / that were in fact just all the elements to build the bomb that was going to destroy the whole Bataclan.*

Contiguous repetitions (item n°9)

The speaker repeats the same word or phrase one or more times in succession (mainly determiners, pronouns and prepositions)⁸:

- *And then we saw **the the** lasers of **the the** guns of **the the** officers of the raid in fact pointing at us.*
- *I saw [EUH] **some some some** wounded children.*
- *We secured the area [UH] of **the the** vehicle **that was** [UH] **that was** [UH] **that was** [UH] broken down.*

Incomplete word or utterance (item n°10)

The speaker pronounces incomplete utterances (marked in transcription by the sign [/], or pronounces the beginning of a word without finishing it (false start):

- *And just when we take refuge **it was** / we heard maybe twenty thirty blows **I /***

⁸ Words repeated with an emphasis function should not be scored as in the example: "We were very very scared!". These cases do not constitute dysfluencies and are therefore excluded from the count because these repetitions are produced voluntarily.

- *I mean, in this kind of moment, there are all the people who get on your nerves, so it's **inevitable that you** /*
- *There was really uh / yeah **it was** / there was blood everywhere **it was** / the **river it was** / and uh / it was a lot of blood.*
- ***The river was** / and, uh, **as a result of** / we tried to intercept them in the middle of the night.*
- *We had a fatality during an exercise, **he was** / we didn't see where the shot came from.*
- ***And I** / look right in front of you*
- ***There were d** / three grenades that exploded at my feet*
- *We **st**/ we had to stay*
- *I realized that it was a **v**/ an attack*

3.2.3) Exemplification of the global scoring of the SPLIT-10 scale

We exemplify here the global scoring of the scale by analyzing three narratives from the Bataclan, Afghanistan and Control corpora.

3.2.3.1) Barbara, Bataclan survivor, speaking 3 days after the attack:

leur seul message c'était un [PS] un message [EUH] [PS] de vengeance en fait <i>their only message was a [SP] message [UH] [SP] of revenge in fact</i>	Repetition (1)
de dire <i>to say</i>	
que [ALL] voilà la France [EUH] s'attaquait [EUH] [PS] s'attaquait à leurs frères à leurs sœurs en Syrie PS <i>that [ALL] France [UH] was attacking [UH] was attacking their brothers and sisters in Syria [SP]</i>	Repetition (x2)
il se sont / <i>they are /</i>	Incomplete utterance
je les ai clairement entendus <i>I clearly heard them</i>	Perception (1)
dire <i>say</i>	
qu'ils étaient l'état islamique [PS] <i>that they were the Islamic state [SP]</i>	
alors c'est c'est grâce en fait grâce à l'assaut du raid <i>so it's thanks to the raid</i>	Repetition (x3)
qu'on qu'on a pu sortir [PS] en fait <i>that we were able to get out [SP] in fact</i>	Repetition (x4)
on [EUH] à un moment on a entendu [EUH] [PS] les terroristes <i>we [UH] at one point we heard [UH] [SP] the terrorists</i>	Perception (x2)
hurler encore [PS] encore plus fort <i>screaming again [SP] louder and louder</i>	
reculez reculez <i>back off back off</i>	Movement verb
n'approchez pas <i>don't come any closer</i>	Movement verb
on a entendu les otages aussi <i>we heard the hostages too</i>	Perception (x3)
hurler [PS] <i>screaming [SP]</i>	
et on a aussi entendu [EUH]	Perception (x4)

<i>and we also heard [UH]</i>	
les hommes [EUH] voilà les hommes du raid approcher <i>the men [UH] here come the men of the raid</i>	Movement verb
i i i ils hurlaient aussi <i>they they they they were screaming too</i>	Repetition (x5)
il y avait au bout d'un [ALL] d'une petite minute <i>there was after a [ALL] of a little minute</i>	Duration
il y a la personne qui était la plus près de la porte <i>there's the person who was closest to the door</i>	location
qui qui a entrouvert [PS] de quelques centimètres [PS] <i>who opened [SP] a few centimeters [SP]</i>	Repetition (x6) + location
et là on a vu les les lasers des des pistolets des des officiers du du raid en fait [EUH] <i>and then we saw the lasers of the guns of the officers of the raid in fact [UH].</i>	Perception (x5) + Repetition (x6)
se pointer vers nous [PS] [EUH] <i>pointing at us [SP] [UH]</i>	
et là on a tous hurlé <i>and then we all screamed</i>	
qu'on était des des otages et <i>that we were hostages and</i>	Repetition (x7)
de de surtout pas tirer PS <i>not to shoot [SP]</i>	Repetition (x8)
et [EUH] et voilà donc ils nous fait sortir un par un les mains en l'air [PS] <i>and [UH] so they made us come out one by one with our hands up [SP] and [UH] and that's it</i>	Body part
et [EUH] et voilà ils nous ont fouillés [EUH] <i>and [UH] and then they searched us [UH].</i>	
ils nous ont fouillés tout tous les / <i>they searched us all /</i>	Incomplete utterance
il y avait une toute une colonne en fait de d'officiers du raid euh tout tout le long jusqu'à la sortie <i>there was a whole column of raid officers all the way to the exit</i>	
ils nous fouillaient en permanence <i>they searched us all the time</i>	
pour être sûrs <i>to make sure</i>	
qu'on ait rien PS <i>that we didn't have anything [SP]</i>	
et donc voilà on a couru couru dans le bataclan <i>and so there we were running running into the Bataclan</i>	Movement verb
pour sortir [EUH] [PS] <i>to get out [UH] [SP].</i>	
et là on [ALL] [PS] on a vu [EUH] [PS] ben s_ une marée humaine de de gens morts quoi [PS] de sang <i>and there we [ALL] [SP] saw [UH] [SP] well s_ a human tide of dead people [SP] of blood</i>	Metaphor + Body part + death
c'était c'était affreux affreux <i>it was it was awful awful</i>	Repetition (x9)

N.B.: in this excerpt, all the uses of "on" are synonyms of "us" and are therefore not generic (and therefore not rated).

1	Death		1
2	Spatio-temporal context		1
3	Unreality		0
4	Metaphors & comparisons		1
5	Body parts		1
6	Verb of body movement or body position		1
7	Generic pronoun		0
8	Perceptions – Sensations (x2)	1. <input checked="" type="checkbox"/> 2. <input checked="" type="checkbox"/>	1
9	Repetitions (x3)	1. <input checked="" type="checkbox"/> 2. <input checked="" type="checkbox"/> 3. <input checked="" type="checkbox"/>	1
10	False start or incomplete utterance		1
	TOTAL / 10		8

3.2.3.2) Alexandre, engaged in Afghanistan, confiding 3 years after his mission:

Ben c'était un tout hein [PS] <i>Well, it was a whole thing [SP].</i>	
c'était [EUH] ben en fait [EUH] du / <i>it was [UH] well in fact [UH] from /</i>	Incomplete utterance
je pense avec les mois accumulés là-bas [EUH] <i>I think with the months accumulated there [UH],</i>	Duration
les tirs reçus [EUH] sur [EUH] sur sur nous [EUH] enfin sur notre position [PS] [EUH] <i>the shots that were fired [UH] on [UH] on us [UH] and on our position [SP] [UH]</i>	Repetition (1)
ben tous les morts que qu' il y avait à à ce moment-là [PS] <i>All the dead people that there were at that moment [SP].</i>	Repetition (x2) + death
mais c'est pas forcément [EUH] les militaires français hein <i>but it's not necessarily [UH] the French military</i>	
je parlais des [PS] militaires afghans les afghans [PS] <i>I was talking about the [SP] Afghan military, the Afghans [SP].</i>	
beaucoup de de ben de gens qui étaient déchiquetés <i>a lot of people who were torn to pieces</i>	Repetition (x3) + body part
qui arrivaient [EUH] ben chez nous [EUH] [PS] <i>who came [UH] well to us [UH] [SP]</i>	
pour pour qu'on les soigne quoi [PS] <i>to be treated [SP]</i>	Repetition (x4)
qui passaient par le poste de filtrage [PS] <i>who went through the screening station [SP]</i>	
passait par nous [PS] <i>went through us [SP]</i>	
les attaques de mortier sur la fin ben [PS] il y en a pas eu tellement que ça <i>the mortar attacks at the end well [SP] there weren't that many</i>	
mais [ALL] la première fois que ça vous arrive [PS] / <i>but [ALL] the first time it happens to you [PS] /</i>	Generic pronoun
les tirs [EUH] ben de roquettes aussi [PS] sur la fin [PS] <i>[UH] the shootings [UH] well the rocket attacks [UH] well, also at the end [SP]</i>	
après on était aussi ben quarante-cinq minutes [EUH] sous le feu [PS] sous le feu [EUH] ben ennemi [PS]	Repetition (x5) + duration + metaphor

<i>afterwards we were also well forty-five minutes [UH] under fire [SP] under enemy fire [UH] well [SP]</i>	
on était sur une position [EUH] [PS] sur un [PS] un poste de police [PS] afghan [PS] <i>we were on a position [UH] [SP] on a [SP] on a afghan police station</i>	Repetition (x6)
puis là on s'est fait prendre à partie pendant plus de quarante minutes [PS] <i>then there we were attacked for more than forty minutes [SP]</i>	Duration

1	Death		1
2	Spatio-temporal context		1
3	Unreality		0
4	Metaphors & comparisons		1
5	Body parts		1
6	Verb of body movement or body position		0
7	Generic pronoun		1
8	Perceptions – Sensations (x2)	1. <input type="checkbox"/> 2. <input type="checkbox"/>	0
9	Repetitions (x3)	1. <input checked="" type="checkbox"/> 2. <input checked="" type="checkbox"/> 3. <input checked="" type="checkbox"/>	1
10	False start or incomplete utterance		1
	TOTAL / 10		7

3.2.3.3) Michel, control subject responding to the standardized instruction⁹: "Can you tell us something unexpected that happened at a party or concert you attended?":

Je devais avoir une vingtaine d'années [PS] <i>I was about 20 years old [SP]</i>	
et j'essayais <i>and I was trying</i>	
d'aller le plus souvent possible à des concerts [PS] <i>to go to concerts as often as possible [SP]</i>	
et Bob Dylan devait passer en concert [PS] à Lyon <i>and Bob Dylan was going to play a concert [SP] in Lyon</i>	
qui était à 200 kilomètres de chez moi [PS] <i>which was 200 kilometers from my house [SP]</i>	Location
et donc j'avais réussi <i>and so I had managed</i>	
à avoir des places [PS] <i>to get tickets [SP]</i>	
et j'étais ravi <i>and I was delighted</i>	
parce que c'était un vrai événement [PS] pour moi [PS] <i>because it was a real event [SP] for me [SP]</i>	
de pouvoir voir [PS] ce [PS] chanteur en concert [PS] <i>to be able to see [SP] this [SP] singer in concert [SP]</i>	Perception (1)
je j' avais évidemment pas de voiture [PS] <i>I obviously didn't have a car [SP]</i>	Repetition (1)

⁹ In order to minimize possible bias influenced by the instruction

donc il avait fallu <i>so I had</i>	
que je trouve un moyen <i>to find a way</i>	
pour me [PS] rendre à ce concert [PS] <i>to get to this concert [SP]</i>	
ça avait pas été facile [PS] <i>it was not easy [SP]</i>	
mais finalement j'avais réussi <i>but finally I had managed</i>	
à y aller <i>to go there</i>	
si je me rappelle bien <i>if I remember correctly</i>	
j'avais dû à la fois faire du stop <i>I had to hitchhike</i>	
prendre un train [EUH] <i>and take a train [UH]</i>	
finir à pied etcetera [PS] <i>end up walking etcetera [SP]</i>	Body part
mais ravi d'aller assister à ce fameux concert de Bob Dylan [PS] <i>but I was happy to go to this famous Bob Dylan concert [SP]</i>	
sauf que [PS] juste avant d'arriver [PS] <i>except that [SP]] just before arriving [SP]</i>	
j'ai appris [PS] <i>I learned [SP]</i>	
que le concert avait eu lieu la veille [PS] <i>that the concert had taken place the day before [SP]</i>	

1	Death		0
2	Spatio-temporal context		1
3	Unreality		0
4	Metaphors & comparisons		0
5	Body parts		1
6	Verb of body movement or body position		0
7	Generic pronoun		0
8	Perceptions – Sensations (x2)	1. <input type="checkbox"/> 2. <input type="checkbox"/>	0
9	Repetitions (x3)	1. <input checked="" type="checkbox"/> 2. <input type="checkbox"/> 3. <input type="checkbox"/>	0
10	False start or incomplete utterance		0
	TOTAL / 10		2

3.3) Testing the SPLIT-10 scale on two additional corpora of psychologically injured patients: validation and determination of the cut-off

In order to confirm the validity of the SPLIT-10 scale, we tested it on two additional corpora of trauma narratives: the "Nice" corpus collected in the days following the attack in Nice (July 14, 2016), and the "sexual assault" corpus composed of testimonies of people who were victims of a single sexual assault that occurred during adulthood (only one man present). The characteristics of these new corpora are presented in Table 4.

Graph 1 shows the scores obtained on the SPLIT-10 scale for the five corpora (70 psychologically injured patients versus 40 controls).

A group effect is observed ($F(4,102) = 37.97$ $p < 0.001$), with each of the trauma groups obtaining a significantly higher score than the control group ($p < 0.001$), whereas they do not differ from one another. The SPLIT-10 scale perfectly discriminates between traumatic and non-traumatic accounts.

Table 5 shows the minimum and maximum scores obtained.

A cut-off of 5 is worth keeping (noting that the minimum scores found in the psychologically injured correspond to narrative sizes slightly below 450 words).

4) Discussion of the SPLIT-10 psycholinguistic scale: accuracy and clinical consistency

From two corpora of psychologically injured patients and a control corpus, we have highlighted linguistic elements in order to study their most discriminating characteristics in order to identify traumatic narratives. Contrary to what had been widely reported in the literature up to then, we found, thanks to a rigorous linguistic methodology, that the emotional lexicon does not appear to be discriminating, whatever its valences, neither are the use of the present tense or of silent and filled pauses¹⁰. Once we had discarded the other dimensions that were not very applicable to clinical practice in the field, we confirmed the interest of the SPLIT-10 scale thanks to two other corpora of psychotraumatized people. The ordering of relevant markers was presented from the outset according to a psychiatric logic that we will now explain by exemplifying it with the help of verbatim reports from the corpora.

4.1) Improving the clinic of psychological trauma with linguistic markers

The SPLIT-10 items correspond to 5 psycholinguistic sub-syndromes: reference to death (item n°1), derealization (item n°2 to 4), depersonalization (item n°5 to 7), re-experiencing (item n°8 and 9) and unspeakability (item n°10).

The first item, **the lexicon of death**, refers to the classic definition of a **potentially psychotraumatic event** (the "equivalents of death" not rated in our study are very often associated: serious injuries, confrontation with horrifying and cataclysmic scenes, etc.), while remaining insufficient to retain the traumatic event in the sense of the American nosography, which requires, in addition, the concomitance of an intense negative emotion named "peri-traumatic distress" (fear, disgust, shame, guilt, etc.). From an etiopathogenic and clinical point of view, this notion of traumatic distress¹¹ now seems insufficient to characterize a trauma that is better understood by the concept of **traumatic dissociation**, to which items 2 to 7 correspond directly and which can be subdivided according to the two axioms of derealization and depersonalization.

Derealization corresponds to items 2 to 4. The speaker provides precise details concerning the **spatial context** by focusing on elements of the environment to the detriment of an overall vision, according to a microspic apprehension of the traumatic scene. Unusual or horror-filled objects and details ("*a mattress and holes in the wall*") stand out from the background, which takes on a blurred appearance. Also in the same item (item n°2), the information concerning the **temporal context** oscillates between hyperprecision or incapacity to define time and its flow "two or three minutes which last an indefinite time". Also, the **unreality** of the traumatic experience, its strangeness, is reported via the eponymous lexicon evoking the "*surreal*" aspect, the impression of a "*black hole*" (item n°3). Trying to grasp these atypical, improbable feelings, the psychologically injured people regularly use **comparisons and metaphors** referring to "*a film*", "*a kind of parenthesis*" or "*a puzzle*" (item n°4).

The **depersonalization** (item n°5 to 7) is essentially manifested via the relationship to the body, through the mention of the parts of the body (item n°5), which is fragmented "*artery*", "*foot*", "*thigh*", and a

¹⁰ The issue of false starts, which are significantly over-represented only in psychologically injured war victims, remains unresolved.

¹¹ Indeed, instead of the prefix "peri-", purists will speak of per-traumatic distress because this neuropsychic state contemporary with the trauma is immediate and post-immediate.

preeminence for "*blood*"¹². The individual in danger for his life is attached to his physical integrity, on which he sometimes crouches or flees in a panic while his thoughts remain inhibited, translating the reflex reactions of freeze (e.g. "tetanized", "collapsed", etc.) or of flight (or even fight; e.g. "to run", "to crawl", etc.) which is captured through item n°6 referring to the verbs of movement and positioning of the body¹³. The last mark of depersonalization rated by item n°7 constitutes the use of **generic pronouns** occurring in place of the pronoun "I" as if the speaker were eclipsed from the traumatic scene, reified by an aggressor or imprisoning circumstances. The narrative of the psychically wounded subject also presents the tendency to depersonalize others, as if to try to take them towards a shared fascination of the revival, to make them captive of the horror, to justify the banality of the evil: "*we are more or less animals at that moment*".

The **re-experiencing** of the scene is manifested by the use of **perception verbs** related to the five senses (sight, hearing, smell, etc.). Integrated within item n°8, these verbs must have been used twice in order to obtain a good discriminating threshold, which brings them closer to the mechanism of **linguistic repetitions** rated in item n°9 where the psychologically injured subject reiterates contiguously the same word several times in a row, essentially via function words translating lexical access difficulties, which are finally overcome in a majority of cases. **Incomplete utterances** (item n°10) reflect this same mechanism where the discourse is suspended, interrupted by fractures, voids, in a word: the **unspeakability** of the psychological trauma, the counterpart of its inconceivability, its indecipherability.

If the items of the SPLIT-10 scale prove to be compatible with the criteria of PTSD in the DSM-5 (just like those concerning acute stress disorder), the linguistic markers that we have identified appear to be clearly more detailed and specific of psychological trauma than the psychiatric symptoms usually described. Thus, in the sense that they precisely account for dissociation, the SPLIT-10 items are syndromically more consistent than the PTSD definition.

4.2) Lexical prominence of the linguistic markers considered

Except for the field of emotions, all the markers considered are lexical (items n°1, 2, 3, 5, 6, 8), in association with two syntactic markers (items n°9 and 10; without retaining either the present tense or the notion of "disorganization") and the two pragmatic markers studied (items n°4 and 7). The SPLIT-10 items thus remain essentially based on lexical-semantic markers, which are easier to rate. At the same time, lexical retrieval difficulties appear to be the cause of syntactic disturbances: lexical retrieval, which is normally automated in the speech production process, becomes subject to failures - most often transient - in the production of a word which could evoke the traumatic scene. While modifiers such as epithet adjectives and noun complements remain rare, psychologically injured subjects attempt to produce words or phrases by successive approximations leading more or less quickly, or not, to the target word. The dysfluencies are then expressed by vowel lengthening, repetitions of function words before a noun, pronouns before a verb and adverbs before an adjective. In the most severe cases, the speaker produces snatches of words or syntagms, or even stalls on grammatical words. Attempting to overcome these difficulties by approaching the targeted lexical item, the patient produces circumlocutionary and periphrastic formulas sometimes accompanied by synonymic approximations. The words that cannot be retrieved are replaced by metaphors of the catachresis type or "filler" terms. Moving away from a subjective point of view, the discourse is confined to generalities to the point of using "ready-made" phrases and fixed expressions intended to replace those that the patient does not elaborate himself: "*that's life*". It should be noted that if the speaker has to select words from his mental lexicon, he must at the same time choose the syntactic structure that best corresponds to the message he intends to convey. Syntagmatic and phrastic analysis also reveals impairments reflecting dissociation: even if incomplete utterances persist, certain false starts can be completed or repaired, but overall, the

¹² The severity of the traumas studied, both physical and psychological, constitutes an exponential factor of severity with regard to their mutual morbidity.

¹³ These reactions to a stressor are called the "3Fs" for Fight, Flight, and Freeze.

fluency of speech remains troubled by snatches and iterative accidents. However, the traumatic anomia is not always irreducible: the psychically injured subject can describe verbally, at least a little, his traumatic experience or his revivals but, via a verbal description which is stuck to the sensations felt at the time of the event, without being able to detach himself from them, the speech becoming a literal repetition of the horror. In other words, what emerges in the language is nothing other than the recitation of the traumatic scene where the sensory expression is much more developed than the verbalization of the cognitions.

Thus, reflecting the different cardinal symptoms of trauma associating dissociation (items n°2 to 7 including lexical, semantic and pragmatic characteristics), re-experiencing (items n°8 and 9 respectively lexical and syntactic characteristics) and unspeakability (item n°10 syntactic characteristic), all the components of language (lexical, syntactic and pragmatic) are disturbed in the traumatic discourse.

4.3) The internal consistency of the SPLIT-10 expresses the dissociative structure of the trauma

In linguistic terms, the SPLIT-10 corresponds to the characteristic symptoms of psychological trauma, divided into the following sub-scores: dissociation (derealization and depersonalization), re-experiencing and unspeakability. It should be kept in mind that the references in the literature to the "disorganization" and "fragmentation" of the discourse were not considered as discriminating characteristics, since the discourse appears to be well organized, reflecting what we have described as the specific structure of traumatic discourse¹⁴. If we consider re-experiencing as a repetition of dissociation, as well as discursive fractures, 9 out of 10 items on the SPLIT-10 result from a dissociative manifestation, the first item constituting a fundamentally defining element of psychological trauma, namely the confrontation with death. In SPLIT-10, depersonalization appears to be the counterpart of derealization at the level of the self, with the fragmented body parts referring to the spatial criterion of the external environment and the body movements corresponding to the notion of duration¹⁵. Federated by dissociation, the SPLIT-10 has a good internal coherence, as shown by certain utterances corresponding to several items, phenomenon which could be even more discriminating. In particular, the notion of unreality appears to be strongly correlated with that of metaphorization: "*I see it as a film as if I were watching a film and I don't feel that it is real*". This last example also associates the item "perception" and still possesses the replicative dimension through the words "like" and "film", even though these repetitions are not strictly contiguous. There are many other non-contiguous repetitions in the trauma narratives that we have not retained because of the relative difficulty of identifying them manually in real time, except when they are close together: "**hear** the tape **hear** the pliers **hear** the elements that were moving" (for this example, only the "perception" item will be rated in strict reference to the SPLIT-10) Also, depersonalization is strongly associated with metaphorical and/or comparative devices: "*I felt like I was leaving my body and it was as if I was looking at the scene from above*"; "*I am in the position of the fetus*". It should also be noted that pronominal marks can be the object of linguistic repetitions: "*because I I could see the soles of the shoes under the door of the toilet*". Finally, The consistency of the SPLIT-10 items is illustrated by the relative unspeakability of death and, more generally, of the traumatic scene, leading to incomplete statements or repetitive linguistic stumbling blocks, and to lexical field referring to death(item no. 1) and to metaphors (item no. 4).

Moreover, items 2 to 7 are directly compatible with criterion B of the DSM-5 corresponding to re-experiencing and dissociation, the latter dimension also being present in cardinal criteria D1 (dissociative amnesia), D6 (detachment from others), and above all, by the additional criteria S1 and S2

¹⁴ This is coherent with the psycholinguistic literature which, contrary to appearances, has never been able to identify syntactic incoherence in the speech of patients suffering from mental disorders or psychiatric diseases. In particular, rather than a departure from certain rules that are difficult to characterize, the architecture of the language of the schizophrenic subject obeys a particular organization, coherent, and even perhaps co-coherent (by the association of two coherences giving the apparent aspect of disorganization) [26,71,72].

¹⁵ The severity of the traumas studied, both physical and psychological, constitutes an exponential factor of medical and psychological morbidity.

evoking depersonalization and derealization respectively, but in a tenuous way¹⁶. The SPLIT-10 is more specific to trauma and gives more details than the DSM-5 about dissociation and re-experiencing¹⁷. Nevertheless, the criteria corresponding to the post-traumatic depressive dimension are absent from the SPLIT-10 (Criterion D of the DSM-5), as are those referring to avoidance and neurovegetative hyperactivity (criteria C and E), but these symptoms, if they can be considered as specifically psychotraumatic because of their particular characteristics are not presented as such in the DSM-5 [17,21].

5) Further analyses: increasing the density of psycholinguistic analyses

5.1) Necessary replication studies to confirm the specificity of the SPLIT-10 and to specify its cut-off

If the SPLIT-10 appears to be specific to the trauma clinic, would it be advisable to replicate it in larger multicentric corpora by controlling for comorbidities (especially depression and addiction), by varying the types of unique traumatic events (serious accidents, assaults, especially sexual assaults, war, natural disasters, individual or collective nature of the trauma experience, etc.), by focusing on type 2 traumas, also known as "complex" traumas, which constitute repeated traumatic exposures in a similar context (political violence, professional environment, intra-family aggression, etc.), by focusing specifically on traumas occurring in childhood when language is still being constructed, and by developing research into old age, where neurocognitive disturbances can lead to a specific clinic and discourse [18]. Also, the SPLIT-10 cut-off score of 5 could be revised upwards, or even adapted according to the length of the verbal production (remember that this score of 5 was rated in the shortest stories). Finally, a feasibility analysis should be conducted in routine clinical practice to measure the effectiveness of practitioners trained in the use of this new tool.

5.2) Towards a better understanding of the neurocognitive mechanisms of trauma: what role do emotions play?

For the DSM-5, a persistent negative emotional state and an inability to feel positive emotions are symptoms of post-traumatic stress disorder¹⁸. However, we have observed that the use of the lexicon of emotions does not constitute a discriminating element in the discourse of psychologically injured people. Concerning the basic instinctive emotions, generally brief, emotions called non-cognitive or primary and depending rather on the amygdala (fear, anger, disgust, surprise, joy), the works referred to lexicology and syntax are very rare and not very comparable, in particular because of the relative absence of consensual definition of what constitutes an "emotion" and also, because of the diversity of the studied languages. For example, on the syntactic level, it would appear that the unpleasant emotions of subjects suffering from depression are expressed by means of more complex sentences associating more subordinate clauses, adverbial modifications and auxiliaries, negations, circumstantial complements, modified nouns, modal verbs... that is to say, globally the opposite of what we authenticated in SPLIT-10 [37]. However it is difficult, in the current state of science, to differentiate between emotions, even simply according to their positive or negative valences, perhaps because our emotions often associate or even switch between them. These difficulties of characterization are also found in the trauma clinic where the so-called "negative" emotional valences (confusion, anger, fear, disgust, guilt, hatred, etc.)

¹⁶ S1) Depersonalization: persistent or recurrent experiences of a feeling of detachment, and of being an outside observer of one's mental or bodily processes;

S2) Derealization: persistent or recurrent experiences of unreality of the environment.

¹⁷ This is even more so in comparison with the Post Traumatic Checklist Scale (PCLS-5), a self-administered scale most commonly used in France and modelled on the DSM-5 criteria but without the S criterion detailing traumatic dissociation [7,97], whereas confusion with anxiety and depressive disorders due to a lack of specificity has been regularly observed [30].

¹⁸ Mood changes, sometimes constituting post-traumatic depression, are secondary to the trauma, whereas the negative emotion is above all contemporary with it (even if it persists afterwards) [21].

contemporary with the trauma may be added to or even replaced, under the effect of dissociation, by positive emotional expressions such as laughter or singing, which appears to be a point of clinical continuity with the ideo-affective dissociation observed in schizophrenia. Whether positive or negative, emotions could lead to an equivalent of cognitive double-tasking, resulting in a simplification, a slowing down or even a disruption of the language production process [44,67]. Thus, the language performance failures detailed in the SPLIT-10 may result in part from disruption of working memory, which is closely related to executive functions (inhibition, strategy development, planning, spatiotemporal management, recall of details, certain attentional abilities, etc.). Many more studies are needed to understand precisely the links between changes in language use and structure and related neurocognitive functions.

5.3) Clarifying the pragmatics of dialogic interaction for psychotherapeutic purposes

Beyond the 10 items that we have retained, it would be interesting to elaborate a more complex scale by integrating numerous other linguistic characteristics that could be used for fundamental research purposes (other verbal tenses than the present tense, other figures of speech such as synecdoche or personification, non-contiguous repetitions, passive and infinitive forms, use of interrogative pronouns, identification of non-verbal language markers such as gestures, mimics, etc.). But above all, the pragmatic markers deserve to be further analyzed by taking into account the interaction. A term derived from semiology¹⁹, pragmatics considers the study of signs in concrete situations: language is analyzed from the point of view of its use in a given context. Considered sometimes different from linguistics, a current made up of multiple sensibilities, pragmatics gathers the study of the characteristics of the use of monological and dialogical language: objects of discourse, psychological motivations of the interlocutors, conversational analysis, etc. When he wants to convey a message, the speaker must not only produce words ordered according to the structures of the grammar of his language, but also construct a discourse that takes into account the situation of communication by adapting to his addressee, his presumed knowledge, his social status, etc. For example, in the corpora we have studied, the use of indefinite pronouns by psychologically injured subjects makes it possible either to describe the event from the outside, distanced from the individual experience, de-subjectivized, or to include, to involve the interlocutor in the traumatic horror as if to make him captive of it, a witness or even an obliged participant in the verbal scene. We have also associated metaphors with pragmatic analysis, as they allow the speaker to convey the unspeakable aspects of his traumatic experience, since some of these figures of speech are popular expressions.

Conclusion

The understanding of psychic injuries has benefited from a major revival of interest in contemporary psychiatry and psychology. The improvement of the description of post-traumatic stress disorder in the DSM-5 could still be completed by the various specific clinical forms constituting post-traumatic psychic disorders. However, for reasons inherent to the psychic injury, the suffering of psychotraumatized people remains marked by an indescribable quality: it is a post-traumatic symptom in itself, limiting diagnostic sensitivity by reference to the semiology. Thus, as much as it permeates the theoretical discourse attempting to grasp it [14], traumatic dissociation remained, until recently, a notion that was difficult to model. A new concept of dissociation, the traumatic psycholinguistic syndrome reflects the "language wound" that is a constituent of trauma. The SPLIT-10 scale appears to be more objective than clinical analysis or scales and questionnaires based on nosography (which always require subjective assessment of symptoms by the patient and/or the practitioner). But far from denying all subjectivity, and complementing the lexical and syntactic linguistic approaches, the semantic analysis of discourse could also offer a better characterization of the specificity of what has caused trauma in a singular subject [15]. Finally, in order to get out of the traumatic dissociation, the pragmatic analysis of

¹⁹ Science studying the systems of signs, not to be confused with medical semiology, which is concerned exclusively with clinical signs.

the dialogical interaction between the patient and the clinician will prove to be fundamental in order to understand the effective therapeutic mechanisms.

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