

Received:
11 September 2018
Revised:
17 December 2018
Accepted:
21 January 2019

Cite as: Sarah Miragoli,
Elena Camisasca,
Paola Di Blasio. Investigating
linguistic coherence relations
in child sexual abuse: A
comparison of PTSD and non-
PTSD children.
Heliyon 5 (2019) e01163.
doi: [10.1016/j.heliyon.2019.e01163](https://doi.org/10.1016/j.heliyon.2019.e01163)



Investigating linguistic coherence relations in child sexual abuse: A comparison of PTSD and non-PTSD children

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Abstract

Background: Language is the most common way to communicate internal states and emotions into a narrative form. Studies on the use of language provide a useful understanding of how people process an event and interpret it.

Objective: The aim of this study was to investigate the effects of PTSD on the narrative coherence of children's reports of sexual abuse.

Participants and setting: Narrative coherence was analyzed within a group of 89 allegations of children ($M = 10$; range: 4–16), who were victims of sexual abuse. Thirty-seven children presented the symptoms for a diagnosis of PTSD.

Method: Linguistic Inquiry Word Count (LIWC) was employed and narrative coherence was analyzed through some linguistic markers (first-person singular pronouns, conjunctions, and cognitive words).

Results: Results illustrated the effects of PTSD on the narrative coherence, in terms of first-person singular pronouns, conjunctions, and cognitive processes. Indeed, compared with traumatic narratives of children without PTSD, traumatic narratives of children with PTSD contained a greater number of first-person singular pronouns ($M_{PTSD} = 1.45$ versus $M_{non-PTSD} = 1.12$) and a smaller number of conjunctions ($M_{PTSD} = .37$ versus $M_{non-PTSD} = .67$), cognitive ($M_{PTSD} = 2.93$ versus $M_{non-PTSD} = 3.76$) and insight words ($M_{PTSD} = 2.29$ versus $M_{non-PTSD} =$

3.09). Regression analyses were used to examine if age and PTSD were predictors of the narrative coherence, suggesting the effects of PTSD in predicting the use of the first-person singular pronouns and the conjunctions.

Conclusion: This study could underline the importance of considering the PTSD in legal testimony of children who have been sexually abused.

Keywords: Linguistics, Psychology

1. Introduction

The way people use words communicate psychological information about themselves (Pennebaker et al., 2003) and their mental state (e.g., Alvarez-Conrad et al., 2001; Amir et al., 1998; Miragoli et al., 2014; Schnurr et al., 1986). Studies on the use of language provide a useful understanding of how people process an event and interpret it, in order to make sense of the experiences (Simon et al., 2010; Tausczik and Pennebaker, 2010). In particular, literature underlines that, during stressful or traumatic events, people alter the ways they think and express themselves. Several studies on traumatic and non-traumatic experiences illustrate that many parts of speech change (e.g., Berliner et al., 2003; Byrne et al., 2001; Fivush et al., 2002). In particular, according to some authors (e.g., Koss et al., 1996; Terr, 2008; van der Kolk and Fisler, 1995), narrative incoherence and fragmentation represent a psychological effect of a traumatic experience.

In literature traumatic narratives are often described as incomplete, fragmented, and incoherent (e.g., Foa et al., 1995; Harvey and Bryant, 1999; Marshall and Shell, 2002; Tromp et al., 1995; van der Kolk and Fisler, 1995) and can be considered as a reflection of the memory difficulties in encoding, processing, and integrating the traumatic event into the autobiographical memory (Brewin, 2001; Brewin et al., 1996; Brewin and Holmes, 2003; Ehlers and Clark, 2000).

Much of the research on this topic examined the traumatic narratives associated with Post-Traumatic Stress Disorder (PTSD) in adults (e.g. Ardino et al., 2013; David et al., 2010; Zoellner and Bittinger, 2004). However, the structure of trauma narratives in PTSD patients is complex: In particular, literature focused on the link between PTSD and narrative coherence, with mixed results. Several studies illustrated that narrative disorganization may indicate on the existence of PTSD symptoms (e.g., Halligan et al., 2003; Jelinek et al., 2010) and that the traumatic narratives become more coherent and less fragmented as PTSD symptoms decrease throughout exposure to therapy (Foa et al., 1995; Moulds and Bryant, 2005). Conversely, other studies miss to find a relationship between narrative organization and PTSD symptoms (Berntsen et al., 2003; Gray and Lombardo, 2001; van Minnen et al., 2002; Peace et al., 2008).

Developmental research has clearly shown that age is a crucial factor in the narrative coherence and that preschool age children are less able to provide consistent and organized narrative accounts (e.g., [Allen et al., 1994](#); [Berman and Slobin, 1994](#); [Karmiloff-Smith, 1985](#); [Hudson and Shapiro, 1991](#)). Indeed, by the age of 6, children provide personal experiences' stories organized according to the main orientation information (who, what, when and where) and to the cognitive and emotive evaluations ([Stein, 1988](#)); by the age of 8, the narratives become linguistically more cohesive, temporally ordered and enriched by causal links and attributions of meaning ([Peterson and McCabe, 1991](#); [Shapiro and Hudson, 1991](#); [Stein and Glenn, 1982](#)). Age remains a determining factor even in children's traumatic narratives (e.g., [Cordon et al., 2004](#); [Di Blasio, Miragoli and Procaccia, 2012](#); [Miragoli et al., 2016](#); [Pipe et al., 2004](#); [Lamb et al., 2000](#)), in terms of coherence (level of orientation: place, time, people and actions), temporal order and evaluations of events ([Ghetti et al., 2002](#); [Miragoli et al., 2017](#); [O'Kearney et al., 2007](#)).

Nevertheless, the specific link between narrative coherence and PTSD has received less attention in children. [O'Kearney et al. \(2011\)](#) documented interesting connections between the integration of children's traumatic memories and the severity of post-traumatic stress symptoms. In particular, traumatic narratives that contained a smaller proportion of causal connectives were associated with higher levels of avoidant symptoms. Similarly, in a previous study, [O'Kearney et al. \(2007\)](#) identified a relationship between causally cohesive narrative and intrusive post-traumatic symptoms.

In developing an account of what makes a text coherent, an influential suggestion is to study psychological text-structuring mechanisms by the linguistic devices people use to signal relations in the narrative ([Knott and Sanders, 1998](#); [Pennebaker, 1997](#)). In particular, according to many theories of discourse connectedness ([Hobbs, 1979](#); [Mann and Thompson, 1986](#)), the cognitive approach to coherence, pursued by [Sanders et al. \(1992, 1993\)](#), suggests that coherence relations should be considered as cognitive mechanisms. As a matter of fact, when a speaker processes a discourse, he/she constructs and expresses a mental representation of the information, integrating the individual propositions into a larger and whole representation and drawing together separately perceived events and personal states ([Gernsbacher and Givon, 1995](#); [Noordman and Vonk, 1997](#)). Among the linguistic devices (connectives, conjunctions, and subordinators), which make coherence relations explicit, this study considered first-person singular pronouns, conjunctions and cognitive mechanisms, insight and causal words. In our study we primarily use coherence to refer to "linguistic coherence", in terms of jointed thoughts and how they are interrelated in a meaningful narrative, sequencing temporally or causally the events ([Cain, 2003](#); [Hudson and Shapiro, 1991](#); [Shapiro and Huston, 1991, 1997](#)).

Specifically, the use of personal pronouns provides to the narrative main information about the subject of attention and can be a useful linguistic device to identify focus, processing, and intentions of the speaker (Tausczik and Pennebaker, 2010). In clinical literature people who are experiencing physical or emotional pain tend to focus their attention on themselves and subsequently use more first-person singular pronouns (e.g., Rude et al., 2004; Stirman and Pennebaker, 2001). Some studies indicated that first-person singular pronouns tend to correlate positively with psychological distress and impairment of mental and social functioning (such as depression and suicide; Campbell and Pennebaker, 2003; Pennebaker et al., 2003; D'Andrea et al., 2012). Conversely, less use of pronouns could be in line with some memory theories of PTSD (e.g., Brewin, 2001; Brewin et al., 1996; Ehlers and Clark, 2000), where traumatic memories are more sensory/perceptual and less episodic.

Whilst personal pronouns provide information about the focus of attention, conjunctions (e.g., and, or, therefore, because, etc.) join multiple thoughts together and are significant for providing cohesion and coherence to narratives (Graesser et al., 2004). By analyzing the allegations of child sexual abuse, Miragoli et al. (2017) illustrated that children with PTSD symptoms, compared with children without PTSD symptoms, were less able to provide grammatically cohesive and consistent narratives. In particular, PTSD predicted the use of subordinating conjunctions among the clauses and the orientation level (who, what, when and where) to provide a general sense of the traumatic event.

Cognitive mechanisms (e.g., cause, know, ought) are indicative of more complex and cohesive language (Tausczik and Pennebaker, 2010). In particular, when describing a past event, causal (e.g., because, hence, therefore, effect, etc.) and insight words (e.g., think, believe, know, etc.), two specific linguistic subcategories of cognitive mechanisms, suggest the active process of appraising or making meaning of events (D'Andrea et al., 2012; Kross and Ayduk, 2008; Pennebaker et al., 1997). In clinical literature, studies on the treatment of trauma in adult patients considered the changes in the cognitive words' use (especially in causal and insight words) as an important marker of the mental wellbeing (Alvarez-Conrad et al., 2001; Amir et al., 1998; Foa et al., 1995; Pennebaker et al., 1997; van Minnen et al., 2002). In particular, in traumatized patients, when the active post-traumatic symptoms diminished, their traumatic narratives presented more cognitive evaluations and more details related to the internal states, as indexes of a greater reflective processing and of a more adaptive functioning (Boals and Klein, 2005; Pennebaker et al., 1997; Sales et al., 2005). Moreover, the cognitive approach is at the base of important theories on PTSD (Brewin, 2001; Brewin et al., 1996; Brewin and Holmes, 2003; Ehlers and Clark, 2000), that consider the degree of conceptual processing, during a traumatic event, to be crucial for the ability to intentionally retrieve memory information and to tell it in a coherent narrative form.

2. Hypothesis

Narrative coherence in child sexual abuse testimony has recently been the subject of an ongoing debate (e.g., Klettke et al., 2010; Miragoli et al., 2017; Westcott and Kynan, 2004). In particular, it is not completely clear how children testify under the effect of the post-traumatic symptoms and, above all, there is little knowledge of the differences in organization and structure of depositions given by sexual abuse victims with and without PTSD.

The present paper can be seen as a contribution to this debate. Based on prior work indicating that linguistic analyses provide significant information on the mental states and the internal representation of the personal events (e.g., Alvarez-Conrad et al., 2001; Amir et al., 1998; Pennebaker et al., 2003), the present study investigated the link between language and traumatic experiences in sexually abused children, with and without PTSD. Moreover, by beginning from a hypothesis about the psychological nature of coherence relations — namely as a set of conceptual relations used by speaker when processing a text (Knott and Sanders, 1998; Sanders and Noordman, 2010) - this study aimed to explore, in the allegations of the children, some linguistic markers of the narrative coherence (first-person singular pronouns, conjunctions, cognitive mechanisms, insight and causal words). Linguistic Inquiry Word Count (LIWC; Pennebaker et al., 2001), a standardized method used to analyze spoken and written language, was employed for this purpose.

In accordance with literature (Miragoli et al., 2014, 2017; O’Kearney et al., 2007, 2011), we assumed that PTSD could have a significant effect on the narrative coherence of children’s reports of sexual abuse. Specifically, we hypothesized that the use of some linguistic and semantic words (first-person singular pronouns, conjunctions, cognitive mechanisms, insight and causal words) would relate to distress of the traumatic experience (e.g., Fivush et al., 2002; Tausczik and Pennebaker, 2010). Specifically, compared with traumatic narratives of children without PTSD, traumatic narratives of children with PTSD may contain a smaller number of conjunctions and cognitive words (especially insight and causal words). Moreover we expected that PTSD, together with age (Cordon et al., 2004; Di Blasio et al., 2012; Pipe et al., 2004; Lamb et al., 2000), could take on predictive role in the narrative coherence.

3. Methodology

This study evaluated the traumatic narratives of 89 children (60 girls and 29 boys), who were victims and witnesses in criminal proceedings involving allegations of child sexual abuse. All criminal proceedings ended with the conviction of the accused at the Criminal Court of Milan (Italy). At the time of the testimony, their mean age was 10 years ($SD = 3.5$ years; range: 4–16 years). All the children

were Italian and properly Italian speaking. No child had received therapeutic treatment for the trauma.

As far as the characteristics of traumatic experiences, 43.8% ($n = 39$) of the cases concerned domestic sexual abuse and 56.2% ($n = 50$) occurred outside the family. In most cases (67.4%, $n = 60$), the sexual abuse was serial (with a minimum duration of one year).

As in previous studies (Di Blasio et al., 2012; Miragoli et al., 2014, 2017), a PTSD profile was defined as a specific pattern of mental effects due to a traumatic experience, which matches the formal criteria for PTSD in the DSM IV–TR (APA, 2000). In this study, 37 children (41.6%) presented the symptoms required for a PTSD profile (symptoms of re-experiencing the trauma, of avoidance/emotional numbing, and of increased arousal).

The information about the sexual abuse and about the PTSD profile was derived from the legal documentations of criminal proceedings. The legal dossiers ranged from 2008 to 2016.

Forensic interviews were conducted in the courtroom by skilled interviewers, trained in evaluating the child sexual abuse allegations. These semi-structured interviews consisted of four main phases (relationship building, free narrative, questioning, and closure; Faller, 2007; Melinder et al., 2010; Di Blasio et al., 2012), were audio-recorded and transcribed verbatim. Only the content referring to the traumatic event (e.g., details of sexual abuse, characteristics and duration, relationship to the perpetrator, thoughts and feelings about the event), expressed spontaneously or in response to questions, was analyzed.

Subsequently, in accordance with the requirements stated in the LIWC Manual (Pennebaker et al., 2001), the transcripts were processed in order to calculate the total word count and the percentage of words in linguistic and semantic categories (first-person singular pronouns, conjunctions, cognitive mechanisms, insight and causal words). Each category was computed as a ratio with respect to total word count.

The study was approved by the Ethics Committee of the Psychology Department of the Catholic University of Milan (Italy). Moreover informed consent and authorizations to consult the trial files were obtained from the President of the Criminal Court of Milan (Italy).

4. Materials

4.1. Post-traumatic stress disorder

In order to investigate PTSD profile and to verify children' diagnostic status, structured interviews were administered by clinical psychologists (experts in child sexual

abuse) in the legal report phase. These diagnostic interviews were reflective of the DSM IV–TR (APA, 2000) criteria for PTSD and assessed the post-traumatic symptoms' severity and frequency (in terms of hyper-arousal and intrusive symptoms, estrangement, numbing, and lack of interest).

4.2. Linguistic inquiry and word count

Linguistic Inquiry and Word Count (LIWC) program (Pennebaker et al., 2001) is a computerized approach to discover which features of speaking and writing language referring to emotional life experiences (Klein and Boals, 2001; Pennebaker et al., 1997; Rude et al., 2004) could predict the psychological measures and the subsequent health improvements (Pennebaker and King, 1999; Pennebaker et al., 2003). LIWC is able to reveal semantic patterns of speech by calculating the frequencies with which different categories of words are used in relation to the total number of words in a sentence (Pennebaker et al., 2001). In this study, LIWC was used to obtain the percentage use of words related to first-person singular pronouns, conjunctions, cognitive mechanisms, causal and insight words in allegations of child sexual abuse.

5. Analysis

We analyzed the data through a three-step strategy. Firstly, the correlations among age, PTSD and the linguistic measures of LIWC (first-person singular pronouns, conjunctions, cognitive mechanisms, insight and causal words) were calculated to explore initial bivariate associations and to determine possible covariates. Second, the Student's *t* test was conducted to explore PTSD differences (with *versus* without PTSD). Finally, hierarchical multiple regression analyses were performed to verify if age and PTSD were predictors of the linguistic measures of LIWC.

6. Results

Narratives ranged in length from 184 to 8,412 words ($M = 1,442$; $SD = 1,228$). The descriptive statistics of the linguistic measures of LIWC (first-person singular pronouns, conjunctions, cognitive mechanisms, insight and causal words) are presented in Table 1.

Linguistic measures of LIWC were not associated with the characteristics of traumatic event (severity and duration of the abuse, relationship with the perpetrator: intrafamilial *versus* extrafamilial abuse). Moreover, gender differences were not observed.

The correlation analysis (Table 2) illustrated the positive associations between age and conjunctions ($r = .26$, $p < .05$), cognitive mechanisms ($r = .23$, $p < .05$), insight ($r = .25$, $p < .05$) and causal ($r = .33$, $p < .01$) words. Namely, older children,

Table 1. Descriptive statistics of the linguistic measures of LIWC (N = 89).

	Mean	SD	Range
Narrative length (Word Count)	1,442	1,228	184–8,412
1 st Person singular	1.26	.70	.00–3.60
Conjunctions	.55	.45	.00–1.82
Cognitive mechanisms	3.43	1.71	.48–9.11
Insight	2.77	1.69	.00–8.96
Causation	1.86	.91	.00–4.28

Table 2. Age, PTSD and linguistic measures of LIWC (N = 89).

	1	2	3	4	5	6	7
1. Age	-						
2. PTSD	-.20	-					
3. 1 st Person singular	-.01	.22*	-				
4. Conjunctions	.26*	-.31**	-.08	-			
5. Cognitive mechanisms	.23*	-.22*	-.17	.60**	-		
6. Insight	.25*	-.23*	-.15	.61**	.85**	-	
7. Causation	.33**	-.06	-.02	.15	.23*	.18	-

Note. * $p < .05$, ** $p < .01$.

compared to younger children, produced more cohesive and cognitively elaborated narratives, with more insight and causal references.

Regarding PTSD, the correlation analysis indicated the positive associations between PTSD symptoms and first-person singular pronouns ($r = .22$, $p < .05$), and the negative associations between PTSD symptoms and use of conjunctions ($r = -.31$, $p < .01$), cognitive mechanisms ($r = -.22$, $p < .05$) and insight word ($r = -.23$, $p < .05$). Namely, children with PTSD symptoms used more first-person singular pronouns and were less able to provide cohesive and cognitively organized narratives, especially in terms of thought processes. These aspects were further confirmed by the findings of the Student's test (Table 3).

Hierarchical multiple regression analyses were performed to verify if age and PTSD were predictors of the linguistic measures of LIWC of: first-person singular pronouns, conjunctions, cognitive mechanisms, insight and causal words. Table 4 illustrates the unstandardized regression coefficients (B), standard error estimates (SEB), the standardized regression coefficients (β), and R^2 statistics. Only significant models are presented.

In general, our results showed that PTSD was significantly related to the linguistic features of the narrative coherence. In particular, PTSD was the single predictor

Table 3. PTSD differences (N = 89).

	Without PTSD (<i>n</i> = 52)		With PTSD (<i>n</i> = 37)		<i>t</i> ₍₈₇₎
	Mean	SD	Mean	SD	
1 st Person singular	1.12	.60	1.45	.86	-2.11*
Conjunctions	.67	.52	.37	.35	3.21**
Cognitive mechanisms	3.76	2.03	2.93	1.27	2.27*
Insight	3.09	1.97	2.29	1.18	2.33*
Causation	.09	.13	.08	.13	.54

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

Table 4. Predictors of linguistic measures of LIWC (N = 89).

	B	SEB	β
<i>Outcome: 1st person singular</i>			
R ² = .05			
F = 4.47*			
Age	.01	.02	.04
PTSD	.33	.16	.22*
<i>Outcome: Conjunctions</i>			
R ² = .14			
F = 6.80**			
Age	.03	.01	.21*
PTSD	-.27	.10	-.27**
<i>Outcome: cognitive mechanisms</i>			
R ² = .06			
F = 4.92*			
Age	.12	.05	.23*
PTSD	-.66	.38	-.18
<i>Outcome: insight</i>			
R ² = .10			
F = 4.57*			
Age	.11	.05	.22*
PTSD	-.64	.37	-.18

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

of first-person singular pronouns ($\beta = .22, p < .05$). Moreover, together with age ($\beta = .20, p < .05$), PTSD predicted the conjunctions ($\beta = -.27, p < .01$). Instead, regarding the cognitive mechanisms ($\beta = .23, p < .05$) and insight words ($\beta = .22, p < .05$), age was the single predictor.

7. Discussion & conclusion

Language is the most common and intelligible way to translate internal states and emotions into a narrative form. The present study was designed to examine differences in the psychological basis of coherence relations in sexually abused children, with and without PTSD symptoms. In particular, we focused on the analysis of linguistic markers of the narrative coherence, employing some original word categories computed with LIWC (Pennebaker et al., 2001; first-person singular pronouns, conjunctions, cognitive mechanisms, insight and causal words).

According to Pennebaker and King (1999), who claimed that the words people use to express themselves are stylistic behaviors and can provide important information regarding the mental representations of the self and the personal experiences, our results provided some information about the organization of traumatic narratives and about the effects of PTSD in the narrative processing of the traumatic event. First, in our study, children with PTSD used significantly more first-person singular pronouns and seemed to be more self-centered than children without PTSD, regardless of age. These findings were in line with literature and suggested that traumatic memories are closely associated with aspects of self-schemas and are encoded self-referentially within personal memory (e.g., Camisasca et al., 2014; Feiring et al., 2010; Procaccia et al., 2013). Specifically, in clinical literature Self-Focused Attention (SFA) often represents a maladaptive response and/or a cognitive bias, which has been strongly connected with the perception of negative affect and to many psychopathological conditions (e.g., anxiety and depression; Mor and Winquist, 2002; Salovey, 1992; Wood et al., 1990). In particular, Ingram (1990) coined the term “self-absorption” to describe the “dysfunctional quality of maladaptive SFA” (p. 169), as an excessive and inflexible attention to own internal states. Moreover, Carver and Scheier (1990, 1998) suggested that self-focus plays a significant role in a self-regulatory process, through which individuals assess the discrepancy between their current self and a salient standard and engage in discrepancy-reducing behaviors when a negative discrepancy is detected. This explanation is in line with the mood-as-information theory, which contended that individuals use mood cues as significant information guiding them in the expression of self (Schwartz and Clore, 1996). A context in which the negative discrepancy is particularly salient is the experience of negative life events, such as the child sexual abuse (Camisasca and Miragoli, 2014).

Second, in our study PTSD was negatively associated with the use of conjunctions among the clauses, thus preventing the orientation level to provide a general sense of who, what, when and where the events took place (Cain, 2003). In literature conjunctions are often used as a source of evidence about the underlying semantic relations (Knott and Sanders, 1998), allowing the meanings are communicated effectively (Shapiro and Hudson, 1991, 1997). Therefore, in line with literature

(Miragoli et al., 2017; O’Kearney et al., 2007), our findings revealed that children with PTSD symptoms, compared with children without PTSD symptoms, appeared less able to provide connected and consistent narratives. Namely, in children with post-traumatic symptomatology, the traumatic narratives of sexual abuse were fragmented and poorly organized, with disjointed and dissociated concepts and thoughts. Cohesive connectives may be crucial to the construction of a coherent integrated representation of an event (Gernsbacher, 1997) and may indicate how the children integrate information into memories (Brewin, 2001; Brewin and Holmes, 2003; Ehlers and Clark, 2000). In line with literature (Miragoli et al., 2017; O’Kearney et al., 2007), PTSD and age together were important factors in establishing a cohesive narrative.

Third, in our study the cognitive mechanisms (in particular, insight words) was lower in narratives of children with PTSD, compared to children without PTSD. These results were in line with the literature, that suggests that the proportion of cognitive words is often mentioned as agent of the mental change and as an index of the active processing of the traumatic experience (e.g., Alvarez-Conrad et al., 2001; Amir et al., 1998; Foa et al., 1995; Pennebaker et al., 1997; van Minnen et al., 2002). Namely, as more functional and adaptive strategies have developed to cope with the trauma (and even the active PTSD symptoms are reabsorbed), the traumatic narratives are enriched by references to the internal world, which are markers of a great reflective capacity (e.g., D’Andrea et al., 2012; Di Blasio et al., 2012; Kross and Ayduk, 2008). Moreover, the limited use of the insight words of children with PTSD could be the linguistic expression of the intrusive symptoms, that invade their traumatic narratives with threatening and unexpected negative emotions, weakening their cognitive resources and their emotional stability (Ehlers and Clark, 2000). In particular, as an effect of the intrusive symptoms, the content of the narratives could present an incoherent form, lack of cognitive and causal processing (Sales et al., 2005; Stallard, 2003).

In conclusion, we believe that these results contributed to the understanding of the role of PTSD in the narrative processing of the traumatic information. In particular, they showed the need to differentiate the narratives of child sexual abuse in the light of specific cognitive and emotional mechanisms, produced by the presence/absence of PTSD symptoms. Indeed, in children with PTSD profile, the marked attention of self and the scarcity of other linguistic devices (conjunctions, cognitive and insight words) contributed to give less coherence to their traumatic narratives. For these reasons, the quantitative linguistic analyses, such as that captured by a computerized text analysis program, could be a useful tool for a more impartial investigation of the narrative coherence and the psychological health in child sexual abuse too.

Moreover, in the literature regarding child sexual abuse, the importance of narrative coherence in clinical settings and in judgments of child credibility is evident (Ghetti et al., 2002; London et al., 2005). Indeed, in clinical settings, more self-focused, less

cohesive and reflective narratives may be significant predictors of post-traumatic symptoms' severity and useful indicators of prognosis for children too (O'Kearney and Perrott, 2006; Miragoli et al., 2014, 2017). On the other hand, in legal settings, jurors often view consistency in the depositions as a sign of the credibility of the witness (e.g., London et al., 2005; Myers et al., 1999). The coherence of a deposition is evaluated in relation to narrative contents and their organization, which essentially depend on a combination of cognitive and narrative competences. Competences which, as we know, mature with age (e.g., Cordon et al., 2004; Pipe et al., 2004; Lamb et al., 2000), but which can also be influenced by the emotional significance and by the traumatic effects of the experiences. Therefore, inconsistent and disorganized depositions could confirm that a traumatic event really happened and that the child is still so traumatized to not be able to tell the abusive facts in a coherent and cohesive narrative form (Miragoli et al., 2017). If children's depositions proves to be fragmented, incomplete and not very cohesive because of the psychological consequences of the trauma, even the criminal proceedings could be affected.

Additional suggestions for future studies are related to the methodological limitations of the present study. First, the sample size was rather small and the children were involved in different experiences of sexual abuse, which had occurred at varying periods in the past. Also, the length of the narratives was very variable.

Second, the use of a word approach to the language analysis is filled with problems. Virtually, all text analysis program relying on word counts are unable to consider context or multiple meanings of words (Pennebaker et al., 2003). However, the literature (e.g., Pennebaker, 2000; Rellini and Meston, 2007) highlighted how the use of computerized text analyses (a standardized method to analyze language) is a potentially useful method to acquire quantitative information (frequency count of words) that exceeds same limitations imposed by questionnaires and biases of a subjective rater. Moreover, although in literature LIWC program (Pennebaker et al., 2001) is often used to analyze spoken and written language, other methods (such as thematic analyses) could be used to assess narrative coherence. Third, children's memories for sexual abuse may also be influenced by other factors. Namely, the difference in narrative coherence may be affected by the questioning style of forensic interviews or the social factors (embarrassment; Saywitz et al., 1991), and by how parents assist children in making sense of their experiences (Park, 2010). Finally, in our study, we used dichotomous categories rather than continuous measures for the assessment of PTSD, while more objective markers of PTSD severity would be useful.

To address these questions and to study narrative coherence systematically, several steps should be taken in future research. For example, it may be important to consider larger and more homogenous samples (compared to the characteristics of the traumatic experiences), to assess different clusters of PTSD symptoms, and to

perform a formal examination of questioning style. Moreover, because no baseline measure of narrative fragmentation was obtained for a neutral event, it would be interesting to compare traumatic narratives of sexual abuse with ordinary memories and to analyze extended free narratives of child sexual abuse without the influence of questioning.

Despite these limitations, we believe that our findings could contribute to the understanding of childhood trauma and autobiographical memory functioning and underscore the importance of considering the role of PTSD in legal testimony of children who have been sexually abused. Moreover, it should be seen as a first step in the application of the cognitive conception of coherence relations (Knott and Sanders, 1998; Sanders and Noordman, 2010) to child traumatic narratives, identifying some significant linguistic parameters able to go beyond a subjective impression of narrative coherence.

Declarations

Author contribution statement

Sarah Miragoli: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Elena Camisasca, Paola Di Blasio: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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