J. Behav. Ther. & Exp. Psychiat. 57 (2017) 135–142

Contents lists available at ScienceDirect

Journal of Behavior Therapy and Experimental Psychiatry

journal homepage: www.elsevier.com/locate/jbtep

# The relationship between processing style, trauma memory processes, and the development of posttraumatic stress symptoms in children and adolescents☆

Anna McKinnon, PhD [a, *], Neil Brewer, PhD [b], Kate Cameron [b], Reginald D.V. Nixon, PhD [b]

[a] Macquarie University, Australia
[b] Flinders University, Australia

ARTICLE INFO

*Article history:*
Received 4 October 2016
Accepted 17 April 2017
Available online 21 April 2017

*Keywords:*
Post-traumatic stress
Data-driven processing
Autobiographical memory
Meta-memory
Children

ABSTRACT

*Background and objectives:* Data-driven processing, peri-event fear, and trauma memory characteristics are hypothesised to play a core role in the development of Posttraumatic Stress Disorder. We assessed the relationships between these characteristics and Posttraumatic Stress (PTS) symptoms in a sample of youth.
*Methods:* Study 1 (N = 36, 7–16 years), involved a sample of children who had undergone a stressful orthopaedic procedure. One week later they answered a series of probed recall questions about the trauma (assessed for accuracy by comparison to a video) and reported on their PTS symptoms. They also rated confidence in their probed recall answers to assess meta-cognitive monitoring of their memory for the trauma. In Study 2, a sample of injured children (N = 57, 7–16 years) were assessed within 1-month of a visit to an Emergency Department, and then at 3-month follow-up. They answered probed recall questions, made confidence ratings, and completed measures of data-driven processing, peri-event fear, PTS and associated psychopathology. Memories were verified using witness accounts.
*Results:* Studies 1 and 2 did not find an association between PTS symptoms and trauma memory accuracy or confidence. In Studies 1 and 2 data-driven processing predicted PTS symptoms.
*Limitations:* The studies had modest samples sizes and there were ceiling effects for some accuracy and confidence items.
*Conclusions:* Data-driven processing at the time of a trauma was associated with PTS symptoms after accounting for fear at the time of the trauma. Accuracy of recall for trauma memories was not significantly related to PTS symptoms. No decisive conclusion could be drawn regarding the relation between confidence in trauma memories and PTS symptoms.



## 1. Introduction

Children suffering from Posttraumatic Stress Disorder (PTSD) re-experience memories of their traumas in a number of harmful ways, including intrusive thoughts, images and flashbacks (Brewin, 2011). Cognitive models (Brewin, 2001; Ehlers & Clark, 2000) have been prominent in attempts to explain the factors that drive and maintain PTSD and have attracted support in studies with adult, child and adolescent samples. Across the present two studies, we assessed one pathway proposed in these models. The relationships of encoding processes, trauma memory accuracy and confidence in memories to the presence of Posttraumatic Stress (PTS symptoms) were investigated in samples of children and adolescents.

Ehlers and Clark (2000) explain that higher levels of fear, dissociative reactions and reliance on data-driven processing to encode traumatic events increase the likelihood of an individual developing PTSD (Geddes, Ehlers, & Freeman, 2016; Halligan, Clark, & Ehlers, 2002; Halligan, Michael, Clark, & Ehlers, 2003; Michael & Ehlers, 2007). Data-driven processing is defined as the encoding of sights, sounds and smells associated with an experience, as opposed to reliance on conceptual processing, which is associated with processing the meanings, inferences and implications of an

☆ Address of work completion: Flinders University, Sturt Road, Bedford Park, SA, 5042.

* Corresponding author.Centre for Emotional Health, Department of Psychology, Macquarie University, NSW 2109, Australia.
*E-mail address:* anna.mckinnon@mq.edu.au (A. McKinnon).

http://dx.doi.org/10.1016/j.jbtep.2017.04.004
0005-7916/

event (Halligan et al., 2003; Murray, Ehlers, & Mayou, 2002). This construct has a degree of overlap with dissociation, a complex cluster of cognitive disruptions which may include or can affect levels of consciousness, memory, identity or perception of the environment (DSM-5, 2013). It is argued that reliance on data-driven processing to encode traumatic events renders a trauma memory less accessible for voluntary retrieval, but that there is an increase in accessibility via involuntary trauma memory recall (Brewin, 2011).

The primary focus of these studies was to evaluate the role of data-driven processing to predict trauma memory characteristics and adjustment in children in the aftermath of a trauma. This relationship has been tested and shown to be important in several clinical studies of injured adults adopting self-report methodology to index processing style and trauma memory (Halligan et al., 2003; Murray et al., 2002). Self-report memory quality ratings are commonly conceptualised as indices of meta-memory (for review see Bedard-Gilligan & Zoellner, 2012). The reliance on uncorroborated self-reports to measure memory and a failure to distinguish between meta-memory and objective indices is problematic. This is likely to have contributed to varying views as to whether memory following trauma is 'fragmented' or 'enhanced' (see for discussion Brewin, Gregory, Lipton, & Burgess, 2010; Rubin, Bernsten, & Klindt Bohni, 2008).

Several analog trauma film studies carried out with adult samples have also investigated the role of data-driven processing alongside accuracy of trauma memory recall in determining vulnerability to intrusive remembering (Holmes & Bourne, 2008; Holmes, Brewin, & Hennessy, 2004; Krans, Naring, & Becker, 2009; Nixon, Cain, Nehmy, & Seymour, 2009; Nixon, Nehmy, & Seymour, 2007). At the outset, it is important to point out that cognitive theory (Ehlers & Clark, 2000) does not make explicit predictions regarding the relation of the accuracy of trauma memories to overall adjustment. Findings using an analog approach converge with clinical studies suggesting that faulty encoding processes are linked to the development of intrusive trauma memories. Whilst clinical studies suggest a deficit in meta-memory exists, analog studies indicate accuracy of recall of traumatic experiences does not play a causal role in the disorder's development (Holmes & Bourne, 2008; Holmes et al., 2004; Krans et al., 2009; Nixon et al., 2007, 2009).

These issues have received less attention in children and adolescents. It has consistently been found that self-reported fear at the time of a trauma is linked to symptoms of posttraumatic stress in children (Kassam-Adams & Winston, 2004; Meiser-Stedman, Dalgleish, Smith, Yule, & Glucksman, 2007a). Several studies of children attending emergency departments have found that perceptions of trauma memory quality are related to PTSD symptoms (Mayou, Ehlers, & Bryant, 2002; Meiser-Stedman et al., 2007a; Meiser-Stedman, Smith, Yule, & Dalgleish, 2007b). In a clinical sample of injured children it was shown that the relationship of data-driven processing to PTSD was mediated by perceptions of trauma memory quality (McKinnon, Nixon, & Brewer, 2008). In those data there was a strong correlation between data-driven processing and dissociation ($r = 0.61$). One interpretation is that the data-driven processing measure is related to but not simply measuring the same thing as the dissociation measure. Whilst this emerging evidence is supportive of cognitive models, the role of trauma memory recall accuracy is currently unknown. As children differ vastly from adults with respect to their memory capabilities (Salmon & Bryant, 2002), a downward extension of the findings of adult analog studies cannot be assumed.

Given the acknowledgement that cognitive theories of PTSD in adults also apply in children (Meiser-Stedman, 2002), and the emerging evidence in adults and youth that encoding and perceptions of trauma memory are important to adjustment, an important next step is to determine whether memory accuracy is related to children's PTS response. In developmental research it has been observed that under high levels of arousal individuals recall the central aversive aspects (information directly related to the cause of the stress) of traumatic experiences with higher degrees of vividness and accuracy and this often comes at the expense of recall of peripheral aspects (less consequential background details, actions, people, or objects) (Christianson & Safer, 1996; Christianson, 1992). Studies indicate that children who go on to develop PTSD are characterised by higher levels of fear and that they engage in sub-optimal data-driven processing to encode events (Kassam-Adams & Winston, 2004; Meiser-Stedman et al., 2007a). If this is a result of high levels of emotional arousal, we would expect that, when asked to recall their experiences in the weeks and months following an event, the child would recall this event less accurately.

Accordingly, we undertook two studies to examine this proposition. We employed two approaches to assess the relationships of data-driven processing and trauma memory accuracy to overall adjustment. These methods were based on procedures described in the forensic literature which involved studying children's recall in naturalistic contexts (e.g., recalling medical procedures such as voiding cystorethogram and lumbar puncture) (Salmon & Pereira, 2002; Salmon, 2002), where some kind of verification of recall accuracy was possible via videotape records or third party reports (Peterson & Bell, 1996; Peterson, 2011). In Study 1, we recruited a group of children undergoing a routine medical procedure involving the removal of percutaneous Kirschner wires conceptualising these events as an analog to the traumatic events that can precipitate PTSD. It is recognised that stressful events produce symptoms on a continuum (Broman-Fulks et al., 2009) and, for children, stressful medical procedures can be experienced as traumatic and may elicit PTSD-like reactions (Wintgens, Boileau, & Robaey, 1997). Surgeons partially insert *k*-wires into the skin to hold destabilised fractures in place. We chose this procedure because other medical procedures previously studied in the forensic field (e.g., voiding cystorethogram) are carried out too infrequently in children over the age of 7 years. Furthermore, young people typically have Kirschner wires removed only once (i.e., not repeated, for example, like burns dressings) and, in Australia, these are removed in an orthopaedic clinic without analgesic medication. At Time 1 (T1), immediately after their procedure, children rated their processing style on the data-driven processing questionnaire. One week later at Time 2 (T2), children completed a memory interview (corroborated by video) followed by measures of PTSD. Important covariates and associated psychopathology were also measured, including fear, pain, intelligence and mood. In Study 2, interviews were carried out with families within a month of a trauma (T1) and then a similar interview was carried out three months (T2) later. At both interviews, children completed a memory interview and measures of PTSD and associated psychopathology. Witnesses corroborated children's recall of recent stressful events using the technique of verifying the injured child's memory with witnesses to the event (in most cases parents) to provide an index of memory accuracy (Peterson & Bell, 1996; Peterson, 2011).

We also investigated some exploratory hypotheses. It is possible that the accuracy of trauma memories is unrelated to PTSD, but that children's *monitoring* of their memories is associated with the disorder. Consistent with this, a number of research studies show that self-ratings indicating that the trauma memory is poor and fragmented are related to the development of PTSD (Meiser-Stedman et al., 2007a, 2007b). An assessment of meta-cognitive monitoring can be made by asking the child to give a confidence rating immediately after answering each probed recall question. These studies indicate that when conditions are not 'optimal'