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The Manifestation of Post-Traumatic Stress in Children and Young Persons aged 7-14 years and Implications for PTSD Diagnosis

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Abstract

Each year, millions of children are exposed to potentially traumatic events world-wide. Posttraumatic stress disorder (PTSD) is one of the most common disorders to be diagnosed in children following exposure to trauma (DiMauro, Carter, Folk, & Kashdan, 2014; Norris et al., 2002). PTSD causes substantial distress and has the potential to adversely impact children's long-term social, emotional, and physical development and well-being (Fairbank & Fairbank, 2009; Pynoos et al., 2009; Seng, Graham-Bermann, Clark, McCarthy, & Ronis, 2005). Our knowledge regarding PTSD symptom expression in children aged 7-14 years is limited. Researchers and clinicians have raised doubts about the diagnostic validity of the Diagnostic and Statistical Manual of Mental Disorders (DSM) PTSD criteria for children and adolescents (Blom & Oberink, 2012; Carrion, Weems, Ray, & Reiss, 2002). Even though the DSM-5 introduced substantial changes to the PTSD diagnostic criteria which apply to children 7 years and older, the majority of these changes were not tested with children prior to their inclusion (Friedman, 2013; Kilpatrick et al., 2013; Miller et al., 2013). Consequently, it is not known whether these changes improve the validity of the diagnosis in children. This remains a key gap in knowledge which has the potential to hinder our ability to effectively identify and provide timely clinical intervention to trauma-exposed children aged 7-14 years in need of attention and care.

The overall aim of this thesis was to:

1) Advance empirical knowledge of PTSD expression in children and young persons aged 7-14 years and,

2) Explore age-related differences in PTSD symptom expression.

Research questions were examined by completing a series of secondary analyses on the PTSD after Acute Child Trauma (PACT) Data Archive. PACT is an international archive of de-identified data sets from prospective research studies of children exposed to an acute, potentially traumatic event. The final sample included 757 children drawn from nine different studies conducted in four countries (Australia, Switzerland, United Kingdom, and the United States). Chapter One provides a general overview of the literature and a rationale for the thesis. Chapter Two presents a systematic scoping review that discusses the most recent research examining PTSD symptom presentation in children aged 7-14 years. Chapter Three presents the findings from the first study which examined differences in the manifestation of PTSD symptoms between pre-adolescent (7-11 years) and adolescent (12-14 years) children. This study used univariate statistics to examine age-related differences in the frequency of individual symptoms. This study also used binary logistic

regression and receiver operator characteristics (ROC) curve analyses to examine age-related differences in the association between PTSD symptoms and functional impairment. The findings from this study highlighted age-related differences in PTSD symptom presentation, the clinical importance of particular PTSD symptoms, and the importance of assessing functional impairment. Chapter Four presents findings from a study which used latent class analysis to explore differences in PTSD symptom profiles in three different age-groups: Young Group (7-9 years), Latency Group (10-11 years), and Adolescent Group (12-14 years). Findings from this study highlighted that PTSD symptom profiles vary according to developmental stage, and the profiles most associated with functional impairment do not appear to correspond to the DSM-5 PTSD algorithm. Chapter Five examined the developmental sensitivity of the new DSM-5 requirement to endorse one symptom of effortful avoidance to obtain a PTSD diagnosis, and the clinical significance of effortful avoidance symptoms in three age-groups of children. This study found that the new effortful avoidance requirement did not reduce the developmental sensitivity of the DSM-5 PTSD diagnosis for the majority of children. However, it also highlighted that the developmental sensitivity of this diagnosis was reduced for a small but clinically significant minority of children. The dissertation concludes in Chapter Six with a discussion of the overall findings, their diagnostic and clinical implications, and directions for future research. Two key contributions of knowledge which have emerged from this thesis are: 1) The importance of functional impairment in the assessment of trauma-exposed children, and 2) The need to consider alternative diagnostic models to better account for age-related differences in PTSD symptom presentation.

Declaration by Author

This thesis is composed of my original work, and contains no material previously published or written by another person except where due reference has been made in the text. I have clearly stated the contribution by others to jointly-authored works that I have included in my thesis.

I have clearly stated the contribution of others to my thesis as a whole, including statistical assistance, survey design, data analysis, significant technical procedures, professional editorial advice, financial support and any other original research work used or reported in my thesis. The content of my thesis is the result of work I have carried out since the commencement of my higher degree by research candidature and does not include a substantial part of work that has been submitted to qualify for the award of any other degree or diploma in any university or other tertiary institution. I have clearly stated which parts of my thesis, if any, have been submitted to qualify for another award.

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Publications during candidature

No publications

Publications included in this thesis

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Contributions by others to the thesis

This thesis is based on data collected from five different research groups spanning four countries, over the course of more than a decade. Consequently it would not have been possible without the contributions of a number of researchers and the children and families who originally participated in the research.

Important statistical tutoring and advice on latent class analysis was provided by Peter Rankin, PhD researcher at the Institute for Social Science Research, University of Queensland. Timely advice on SPSS data management was provided by Jacelle Warren, biostatistician at Recover Injury Research Centre.

Statement of parts of the thesis submitted to qualify for the award of another degree

None

Research involving animal or human subjects

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This research project underwent ethical review by the UQ School of Medicine Low Risk Ethical Review Committee. The full UQ application was approved by Associate Professor Diann Eley on 10 April 2016.

A copy of the ethics approval letter is included in the thesis appendix.

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Keywords

PTSD, posttraumatic stress disorder, trauma, trauma-exposure, children, adolescent, impairment, avoidance, DSM-5

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FoR code: 1701, Psychology, 50%

For Mum

Whose love set this all in motion

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List of Abbreviations and Symbols Used in the Thesis

<	Less than
<=	Less than or equal to
>	Greater than
>=	Greater than or equal to
ADIS-P	Anxiety Disorders Interview Schedule – Parent Version
AIC	Akaiki Information Criterion
AUC	Area under the curve
B	Beta, standardised regression coefficient
BIC	Bayesian Information Criterion
BLRT	Parametric Bootstrap Likelihood Ratio Test
BVR	Bivariate residuals
CAPS-CA	The Clinician Administered PTSD Scale for Children and Adolescents
CI	Confidence interval
df	Degrees of freedom
DSM-5	Diagnostic and Statistical Manual for Mental Disorders - Fifth Edition
DSM-5 MA	Diagnostic and Statistical Manual for Mental Disorders - Fifth Edition, Modified Algorithm
DSM-IIIR	Diagnostic and Statistical Manual for Mental Disorders - Third Edition, Revised
DSM-IV	Diagnostic and Statistical Manual for Mental Disorders - Fourth Edition
ICD-11	International Classification of Diseases 11th edition
IDA	Integrative Data Analysis
LCA	Latent class analysis
MLR	Maximum Likelihood with Robust Standard Errors
MVA	Motor vehicle accident
N	Total number of cases
n	Number of cases in sub-sample
OR	Odds ratio
p	significance level
PTSD	Posttraumatic stress disorder
PTSD-AA	Alternative Algorithm for Posttraumatic stress disorder
ROC	Receiver Operator Characteristics
SABIC	Sample Size Adjusted Bayesian Information Criterion
SD	Standard deviation
SE	Standard error
SPSS	Statistical Package for Social Sciences
VIF	Variance inflation factor
χ^2	Chi square

Chapter 1. Introduction

1.1. General Introduction

1.1.1. Background to Study

I first became familiar with the PTSD diagnosis when I worked as a mental health clinician treating children who had experienced a variety of traumas such as child abuse, community violence, and natural disasters. During the course of my practice, I noticed that many of my child clients, despite exhibiting substantial functional impairment and symptoms that seemed to be a consequence of trauma-exposure, did not meet full criteria for the DSM-IV PTSD diagnosis. This posed an immediate ethical challenge. Although the children referred to me were in need of treatment, they would not qualify for mental health services in the California mental health system without a diagnosis. This early career experience demonstrated to me the critical importance of ensuring that the DSM-5 PTSD diagnosis was developmentally sensitive and it has provided the impetus for my research in this area.

1.1.2. PTSD: A Substantial Public Health Problem in Children

Each year, millions of children are exposed to potentially traumatic events worldwide. Reported rates of lifetime exposure in childhood have varied from 15% (Cuffe et al., 1998) to more than 68% (Copeland, Keeler, Angold, & Costello, 2007). Posttraumatic stress disorder (PTSD) is one of the most common disorders to be diagnosed following exposure to trauma (DiMauro et al., 2014; Norris et al., 2002). PTSD causes substantial distress and has the potential to adversely impact children's long-term social, emotional, and physical development and well-being (Fairbank & Fairbank, 2009; Pynoos et al., 2009; Seng et al., 2005). In a recent meta-analysis, Alisic et al. (2014) estimated the PTSD incidence rate after exposure to trauma for children and adolescents to be 16%. The researchers acknowledged that this rate may, in fact, under-estimate the incidence of PTSD as significant groups of trauma-exposed children who were more vulnerable to developing PTSD (i.e. children from war/conflict, children with pre-existing mental health problems) were excluded from the analysis.

1.1.3. History of the PTSD Diagnosis in the DSM

Since its existence, all editions of the DSM have included a category for mental health reactions that emerge after exposure to trauma, although initially this stress reaction was primarily considered to apply to soldiers and civilians exposed to war (i.e. Nazi holocaust survivors) (Andreasen, 2010; Wilson, 1995). PTSD first appeared as a diagnosis in 1980 in the DSM-III (American Psychiatric Association, 1980). The incorporation of PTSD in the DSM-III was influenced by U.S. Vietnam veterans advocating for a diagnosis that recognised combat-related stress and which could be used to facilitate access to disability benefits and treatment services (Andreasen, 2011).

Although the DSM-III PTSD diagnosis also applied to civilians exposed to a broad range of traumas (e.g., domestic violence, rape, and child abuse), the diagnostic criteria were developed primarily based on research conducted with combat soldiers (DiMauro et al., 2014). Although the diagnostic criteria have gone through several iterations since their introduction in 1980, none of the field trials conducted have included children younger than 15 years (Kilpatrick et al., 1998; Kilpatrick et al., 2013; Miller et al., 2013). In addition, both the DSM-IV and the DSM-5 required a high threshold of evidence before any changes could be made to the diagnostic criteria (Clark, Cuthbert, Lewis-Fernández, Narrow, & Reed, 2017; Friedman, 2013). As a result, a number of PTSD symptoms (i.e. flashbacks) currently contained within the DSM-5 PTSD diagnosis apply to children 7 years and older, but were initially based on research conducted with male soldiers (DiMauro et al., 2014).

It is noteworthy that in recognition of the unique ways that PTSD symptoms may manifest in children, the DSM-III-R and DSM-IV added modifications to the PTSD criteria to improve diagnostic sensitivity for children (American Psychiatric Association, 1987, 1994). The majority of these modifications were continued in the DSM-5 PTSD diagnosis. Although these modifications were an important step that moved the field further in improving diagnostic sensitivity for children, it is noteworthy that the modifications were not initially based on empirical evidence but on clinical experience and expert opinion (J. A. Cohen & American Academy of Child & Adolescent Psychiatry Work Group on Quality Issues, 1998). Taken together, these facts demonstrate that the DSM-5 PTSD diagnosis is based on limited empirical evidence for children aged 7-14 years (Blom & Oberink, 2012).

1.1.4. Paediatric PTSD in Children 6 Years and Younger

Since the introduction of the DSM-IV in 1994, a substantial amount of research has been conducted on PTSD in preschool children (children aged 6 years and younger). Specifically, several studies demonstrated that the DSM-IV PTSD diagnostic threshold was too high and excluded a large number of preschool children who were experiencing post-traumatic stress symptoms and substantial impairments to their functioning (De Young, Kenardy, & Cobham, 2011a; Levendosky, Huth-Bocks, Semel, & Shapiro, 2002; Ohmi et al., 2002; Scheeringa, 2008; Scheeringa, Zeanah, & Cohen, 2011; Scheeringa, Zeanah, Myers, & Putnam, 2003). Furthermore, researchers also argued that several DSM-IV PTSD symptoms were based on highly internalised phenomena that preschoolers were unable to articulate or that were developmentally inappropriate (i.e., detachment and estrangement from others, a sense of a foreshortened future) (Scheeringa & Zeanah, 1995; Scheeringa, Zeanah, Drell, & Larrieu, 1995).

Following this, child trauma researchers developed an alternative set of PTSD criteria for preschoolers identified as the PTSD Alternative Algorithm (PTSD-AA) (Scheeringa et al., 2003; Scheeringa, Zeanah, Myers, & Putnam, 2005). In addition to lowering symptom threshold counts, PTSD-AA incorporated symptoms which were anchored in observable behaviours and that were consistent with child development. Numerous research studies demonstrated the superior validity of this alternative criteria to diagnose preschoolers over that of the DSM-IV PTSD (Scheeringa, Myers, Putnam, & Zeanah, 2012; Scheeringa, Peebles, Cook, & Zeanah, 2001) (De Young et al., 2011a; Scheeringa et al., 1995). Based on this new body of empirical research, the DSM-5 introduced a PTSD subtype for children 6 years and younger based on the PTSD-AA (American Psychiatric Association, 2013a; Friedman, 2013).

1.1.5. Diagnostic Sensitivity in Children 7 Years and Older

The research on the diagnostic validity of PTSD in children aged 7-14 years was more limited than the research conducted with younger children (Carrion et al., 2002; Copeland et al., 2007; Iselin, Le Brocque, Kenardy, Anderson, & McKinlay, 2010; Meiser-Stedman, Smith, Glucksman, Yule, & Dalgleish, 2008; Schäfer, Barkmann, Riedesser, & Schulte-Markwort, 2006). Since the DSM-5 adopted a conservative approach requiring a high threshold of evidence to support any changes from the DSM-IV PTSD criteria, the emerging research on children 7 years and older was not considered compelling enough to warrant modifications (Friedman, 2013). Consequently, the criteria for diagnosing PTSD for children 7 years and older has remained the same as that of diagnosing adults with PTSD (American Psychiatric Association, 2013a).

Child trauma researchers and practitioners have raised questions regarding the developmental sensitivity of PTSD criteria and the consequent ability to accurately identify school age children who are experiencing PTSD (Danzi & La Greca, 2017; Scheeringa et al., 2011; Van der Kolk, 2005). Since the DSM-5 has retained the majority of the PTSD symptom criteria from the DSM-IV, doubts that were raised regarding the diagnostic validity of the DSM-IV criteria remain similar for the DSM-5 PTSD criteria.

Studies published since the DSM-5 PTSD diagnosis was introduced have yielded mixed findings regarding developmental sensitivity for children aged 7-14 years. In a recent study which compared diagnostic sensitivity between DSM-IV and DSM-5 in children aged 7-12 years, Mikolajewski, Scheeringa, and Weems (2017) concluded that the DSM-5 PTSD diagnosis was more developmentally sensitive for 7-12 year olds than the DSM-IV PTSD diagnosis. They found that that the DSM-5 PTSD diagnosis identified 17% more children with substantial PTSD symptoms and functional impairment than the DSM-IV diagnosis. The authors concluded that their study provided preliminary evidence to support the changes made to the DSM-5 PTSD diagnosis

for children aged 7-12 years. In contrast to the findings of Mikolajewski et al. (2017), Danzi and La Greca (2016) found lower diagnostic prevalence rates using DSM-5 PTSD criteria as compared to the DSM-IV PTSD criteria in children aged 7-11 years who were exposed to a natural disaster. Furthermore, when Danzi and La Greca (2016) examined the suitability of three different diagnostic systems [DSM-IV, DSM-5, and the proposed International Classification of Diseases 11 (ICD-11) criteria] (World Health Organization, 2015) they found that each system diagnosed different children with PTSD, resulting in poor overlap between the systems. Even more remarkable was that almost no new cases of PTSD were identified using the DSM-5 compared to the DSM-IV. Consequently, and in sharp contrast to Mikolajewski et al. (2017), Danzi and La Greca (2016) recommended caution in the use of the DSM-5 PTSD diagnosis with pre-adolescent children.

1.1.6. Sub-Threshold Diagnoses or a Lack of Diagnostic Sensitivity?

High rates of sub-threshold PTSD have been documented in adults, but have not usually been regarded as an indicator of a lack of diagnostic sensitivity (Marshall et al., 2001). However, given the scarcity of research conducted with children aged 7-14 years, and the lack of diagnostic sensitivity already demonstrated with children 6 years and younger, high rates of sub-threshold diagnoses may be a marker of under-diagnosis in children 7 years and older.

A number of studies have demonstrated high rates of sub-threshold PTSD in children and young persons using either the DSM-IV or DSM-5 PTSD criteria. One group of studies which showed high rates of sub-threshold PTSD failed to assess functional impairment (Aaron, Zaglul, & Emery, 1999; Blanc, Bui, Mouchenik, Derivois, & Birmes, 2015; Hafstad, Dyb, Jensen, Steinberg, & Pynoos, 2014; Thabet, El-Buhaisi, & Vostanis, 2014). As a result, it was unclear if the children with sub-threshold PTSD were also experiencing significant impairment in functioning and warranted clinical intervention (and therefore would call into question the developmental sensitivity of the PTSD diagnosis). Equally plausible, however, was the possibility that the diagnostic criteria appropriately eliminated children that had some PTSD symptoms as is common after trauma exposure, and that these symptoms did not reach the threshold of a mental health condition requiring clinical intervention.

A second group of studies assessed diagnostic sensitivity directly by examining sub-threshold PTSD and functional impairment using both liberal and stringent diagnostic algorithms (Carrion et al., 2002; Copeland et al., 2007; Danzi & La Greca, 2017; Iselin et al., 2010; Meiser-Stedman et al., 2008; Mikolajewski et al., 2017; Schäfer et al., 2006). These studies have provided stronger evidence that diagnostic threshold counts may be too high resulting in the under-diagnosis of PTSD in children aged 7-14 years. In a landmark study, Carrion et al. (2002) examined the differences in functional impairment and distress between children aged 7-14 years who met full

DSM-IV PTSD criteria and children with sub-threshold PTSD. The researchers found that children with sub-threshold PTSD (defined as meeting two out of the three symptom clusters) did not differ in their level of functional impairment, distress, or rates of co-morbidity from children who met full PTSD criteria.

Meiser-Stedman et al. (2008) conducted a study that compared diagnostic rates between the PTSD-AA and the DSM-IV PTSD criteria in children aged 2-10 years. The researchers found that the prevalence rate for PTSD increased from 2.1% (using the DSM-IV criteria) to 18.8% (using the PTSD-AA criteria) in children aged 7-10 years. Of particular importance was the finding that there were no significant differences in the number of symptoms (mean = 11.6 symptoms) that were present between the children who met the criteria for DSM-IV PTSD and those that met the PTSD-AA criteria (even though it required a lower number of PTSD symptoms), substantiating the argument that the DSM-IV PTSD criteria was not sensitive enough to identify children experiencing significant post-traumatic stress symptoms.

Most recently, Danzi and La Greca (2017) found that extending the more liberal DSM-5 PTSD for Children 6 Years and Younger criteria to pre-adolescent children, diagnosed almost twice as many children with PTSD than the DSM-5 criteria, even when functional impairment was required for diagnosis. Similarly, Mikolajewski et al. (2017) found DSM-5 PTSD for Children 6 Years and Younger diagnosed significantly more pre-adolescent children (53%) as compared with the DSM-IV criteria (37%) although this was not the case with the adolescent children in their sample. It is notable that even when children were diagnosed with this more liberal algorithm requiring a lower symptom threshold, both studies (Danzi & La Greca, 2017; Mikolajewski et al., 2017) found that these children were still significantly more functionally impaired than undiagnosed children. These results support the premise that the more stringent DSM-5 PTSD criteria may under-diagnose pre-adolescent children. Adding further complexity to this discussion, however, was the finding in both studies that children diagnosed according to the more stringent PTSD algorithm (DSM-IV or DSM-5), had greater severity in functional impairment than children diagnosed according to DSM-5 PTSD for Children 6 Years and Younger. Therefore, although the two most recent studies provided evidence that a large number of children with significant PTSD symptoms and functional impairment were only identified if more liberal diagnostic criteria were used, they also provided evidence that those children were less severely impaired than those captured by more stringent criteria (Danzi & La Greca, 2017; Mikolajewski et al., 2017).

Taken together, these studies have demonstrated that serious questions continue to exist regarding the developmental sensitivity of the DSM-5 PTSD criteria for children aged 7-14 years. Additional research examining PTSD symptom expression in this age-range is needed to determine

whether lowered symptom threshold counts and alternative diagnostic criteria should be applied to this age-group.

In addition to concerns regarding diagnostic sensitivity, there also exists the possibility that PTSD may not be a single construct and therefore does not present in a homogenous way for those who experience it (Shevlin & Elklit, 2012). This suggestion is not isolated to paediatric PTSD but parallels a growing debate found in adult PTSD research (DiMauro et al., 2014; Galatzer-Levy, 2014; Galatzer-Levy & Bryant, 2013). Although the DSM PTSD diagnosis was initially based on the assumption that PTSD followed a common pathway which comprised the same symptom clusters for all who experienced the disorder (Andreasen, 2011), a number of researchers have challenged this assumption in adults (DiMauro et al., 2014; Galatzer-Levy, 2014; Shevlin & Elklit, 2012). In fact, the compelling body of research which now exists demonstrating substantial heterogeneity in adult PTSD symptom presentations led Galatzer-Levy and Bryant (2013) to argue that the current DSM-5 PTSD diagnosis produces false negatives, misses those in need of clinical intervention, and therefore poses "untenable limitations" for those researching enduring psychological responses after exposure to traumatic events (Galatzer-Levy & Bryant, 2013, page 658). The current debate has spurred the use of latent mixture modelling in research studies to identify sub-groups of trauma-exposed people experiencing PTSD symptoms which may not strictly accord with the DSM-5 diagnosis (Djelantik, Smid, Kleber, & Boelen, 2017; Galatzer-Levy & Bryant, 2013; Steenkamp et al., 2012; Wolf et al., 2012).

Although more limited than adult research, paediatric research has also highlighted heterogeneity in PTSD symptom presentations (Armour, Layne, et al., 2011; Ayer et al., 2011; Contractor et al., 2013). Similar to adult research, the reasons for this heterogeneity remain unclear. Given the rapid and transformative changes in physical, cognitive, social, and emotional development in children aged 7-14 years, exploring PTSD symptom heterogeneity across developmental stages and whether a common pathway model of PTSD is applicable to this age-group is an important area for further investigation.

1.2. Thesis Aim and Research Questions

The overall aim of this thesis was to:

1) Advance empirical knowledge of PTSD expression in children and young persons aged 7-14 years and,
2) Explore age-related differences in PTSD symptom presentations.

1.3. Overview of Thesis Structure

The University of Queensland supports PhD candidates to include publications in their thesis. This thesis is comprised of six chapters which are outlined below. Four of these chapters (systematic scoping review and each of the three empirical studies) have been written as journal articles and have been submitted for publication. As a result of this, some repetition is present in the literature review, methods, and limitations sections of each empirical study.

1.3.1.1. Chapter 1: Introduction

This chapter provided a general review of the literature and outline of the PhD thesis.

1.3.1.2. Chapter 2: PTSD in children aged 7-14 years and implications for diagnosis: A systematic scoping review.

This paper summarised the most recent research on PTSD symptom expression in children aged 7-14 years that has been published since the last literature review (Scheeringa et al., 2011). It has mapped the consistencies and variations in PTSD symptom expression and identified gaps in knowledge which merit further research.

1.3.1.3. Chapter 3: Age-related differences in PTSD symptom expression in children aged 7-14 years (Study 1)

This paper examined differences in PTSD symptom expression between pre-adolescent and adolescent children. The study explored differences in the frequency with which symptoms were endorsed, the number of symptoms endorsed, and the saliency of individual symptoms and their relationship with functional impairment.

1.3.1.4. Chapter 4: Latent class structure of PTSD symptoms in children aged 7-14 years (Study 2)

This paper examined PTSD symptom profiles in three different age-groups of children: Young Group (7-9 years), Latency Group (10-11 years), and Adolescent Group (12-14 years). The study also investigated which symptom profiles were most likely to be associated with diagnosis and functional impairment.

1.3.1.5. Chapter 5: Symptoms of effortful avoidance in trauma-exposed children aged 7-14 years and implications for diagnostic sensitivity (Study 3)

This paper explored the significance of effortful avoidance symptoms in three different age-groups of children: Young Group (7-9 years), Latency Group (10-11 years), and Adolescent Group (12-14 years). It also examined the DSM-5 requirement to endorse at least one symptom of effortful avoidance and its impact upon diagnostic sensitivity.

1.3.1.6. Chapter 6: Discussion

This is the final chapter in the thesis. It summarises and discusses the major findings and limitations of the three empirical studies included in this thesis. It concludes with diagnostic and clinical implications of the findings, and recommended directions for future research

Chapter 2. PTSD in Children aged 7-14 years and Implications for Diagnosis: A Systematic Scoping Review

2.1. Abstract

Children aged 7-14 years are diagnosed with the same criteria for posttraumatic stress disorder (PTSD) as adults. However, the developmental sensitivity of the Diagnostic and Statistical Manual 5 (DSM-5) PTSD diagnosis in this age group is currently unknown. A systematic scoping review was conducted to describe the most recent PTSD research in children aged 7-14 years, discuss implications for the DSM-5 PTSD diagnosis and to identify research gaps which merit further study. The scoping review was conducted in five stages: 1) Identifying the research question; 2) Development of a search strategy; 3) Study selection; 4) Data extraction; and 5) Summarising the findings. Few studies examined symptom presentation in children aged under 10 years. The majority of children in the included studies were 10 years and older limiting our understanding of PTSD symptom expression in children 7-10 years. The scoping review identified that intrusion symptoms were a characteristic component of PTSD expression in this age group. The review also identified that the symptom "inability to recall an important aspect of the trauma" may not be valid in children exposed to medical trauma as it may not distinguish between medical symptoms and psychogenic amnesia. The two new cognitive symptoms (distorted cognitions and negative beliefs/expectations) appeared to be an important part of PTSD symptoms in children 11 years and older. There was insufficient evidence to establish validity of the new symptom, negative emotional state. In conclusion, the developmental sensitivity of the DSM-5 PTSD diagnosis for children aged 7-14 years remains uncertain. Research comparing symptom presentation across developmental periods is necessary to unmask potential age-related differences. Research on PTSD symptom expression in children aged 7-10 years is particularly needed.

Each year, millions of children are exposed to potentially traumatic events worldwide. PTSD is one of the most common disorders to be diagnosed following exposure to trauma (DiMauro et al., 2014; Norris et al., 2002). PTSD causes substantial distress and has the potential to adversely impact the long-term social, emotional, and physical development and well-being of children (Fairbank & Fairbank, 2009; Pynoos et al., 2009; Seng et al., 2005). A substantial body of research now exists which has demonstrated that the DSM-IV PTSD diagnosis lacked sensitivity in diagnosing children 6 years and younger (De Young et al., 2011a; Levendosky et al., 2002; Meiser-Stedman et al., 2008; Ohmi et al., 2002; Scheeringa, 2003; Scheeringa & Zeanah, 2008). As a result, the PTSD diagnosis in the DSM-5 for children aged 6 years and younger was changed (American Psychiatric Association, 2013b). However, because the research on the diagnostic validity of PTSD in children aged 7-14 years was mixed and more limited than the research conducted with younger children (Carrion et al., 2002; Copeland et al., 2007; Iselin et al., 2010; Meiser-Stedman et al., 2008; Schäfer et al., 2006), it was considered less compelling to warrant modifications in the DSM-5 (Friedman, 2013). Consequently, the criteria for diagnosing PTSD for children 7 years and older remains the same as that of diagnosing adults (American Psychiatric Association, 2013b).

Given that the DSM PTSD diagnosis was originally based on research conducted primarily with adults and adolescents 15 years and older, and that the most recent changes have not been tested with children (Kilpatrick et al., 2013; Miller et al., 2013), the sensitivity of the DSM-5 PTSD diagnosis for children aged 7-14 years is uncertain. As the socio-emotional world of children is undergoing a series of transformations during this age period, PTSD could manifest in unique ways which are different from adults or children 6 years and younger. For example, we now know that intrusive recollections can manifest through repetitive play in children (American Psychiatric Association, 2013b), a different symptom presentation to that of adults.

Scheeringa et al. (2011) completed the last literature review on paediatric PTSD to provide preliminary recommendations to DSM-5 work groups. In their review, they specifically addressed diagnostic sensitivity and symptomatic expression in children aged 7-14 years and the need for more research on this age group. The 7 years since that review has marked an important time of transition in the field of PTSD from the use of the DSM-IV to the DSM-5. The DSM-5 reconceptualised PTSD from an anxiety-based disorder driven by fear-circuitry to a disorder that encompassed a broader range of negative alterations to

emotions and behaviour (American Psychiatric Association, 2013b; Friedman, 2013). The DSM-5 also introduced an alternative algorithm to diagnose PTSD in children 6 years and younger which has the potential to influence our understanding of PTSD in older children.

We believe that an important way to consolidate understanding on PTSD symptom expression in children aged 7-14 years is to systematically map the literature published since the last review. The scoping review is a systematic approach used to identify the breadth of research and the research gaps in a topic area. It includes a systematic search as well as a structured method for charting and summarising the data. It differs from a systematic review in that the focus of the search is broader and it does not include a quality appraisal of studies. We followed the steps described by Arksey and O'Malley (2005) for this review: 1) Determine the research question; 2) Identify studies; 3) Select studies; 4) Chart data; and 5) Collate, summarise and report the results.

2.1.1. Aims of the Study

The aims of this study were:

1) To summarise the most recent research on PTSD symptom expression and the developmental sensitivity of PTSD symptoms in children aged 7-14 years,
2) To identify gaps in the research that merit further study, and
3) To discuss implications of this review.

2.2. Method

Relevant studies were identified through systematic searches in two major electronic databases: Published Literature on International Traumatic Stress (PILOTS) and PsycInfo. Searches were restricted to articles published in peer-reviewed journals between 2010 and 22/12/2017.

2.2.1. Search Strategy

Keywords included were variants of "post-traumatic stress", "post-traumatic symptom", or "PTSD", and variants of "child" or "adolescent". English and French articles were retrieved because the primary author also spoke French. We hand-searched reference lists of literature reviews and key articles for additional studies. A citation search was also conducted to identify additional studies relevant to this review using the most recent literature review and key articles.

2.2.1.1. *Inclusion Criteria*

1) Study participants were exposed to trauma as defined by the A1 criteria for PTSD in the DSM-IV. The A1 criteria requires that an individual "experienced witnessed, or was confronted with an event or events that involved actual or threatened death or serious injury, or a threat to the physical integrity of self or others" (American Psychiatric Association, 1994, p. 427).
2) A mean participant age was between 7-13.9 years or the researchers reported results separately for children between the aged of 7-14 years.
3) Studies used validated instruments to assess PTSD.
4) Studies reported on specific PTSD symptoms or clusters (as opposed to solely reporting PTSD prevalence).

2.2.1.2. *Exclusion Criteria*

1) Single case studies.
2) One study was excluded due to inadequate information regarding methodology.

2.2.2. Charting, Summarising and Reporting Data

Study information regarding participants, setting, exposure type, measures, study design, comorbidity, and findings were extracted into a standardised form. After extraction, study results were charted thematically and summarised according to DSM clusters and rates of symptom endorsement (See Table A1 in Appendix A for included studies).

2.3. Results

2.3.1. Search Results

The literature search identified 3592 articles. The majority of articles were excluded because they did not provide information about symptom presentation, or the studies were focused on children over the age of 14 years. After a full-text review of 971 articles, we determined 62 articles met the inclusion criteria. See

Figure 2-1 for the PRISMA flowchart.

2.3.2. Study Characteristics

An overview of the samples and their characteristics are in Table A1. As only 12 studies with independent samples used participants exclusively between the ages of 7-14 years, we included all studies that had a mean age that fell between 7-13.9 years. Data on the number of children in each age category was not available for the majority of studies. Based on the mean, standard deviation and width of the age range, we determined that the majority

of study participants were over 10 years of age. Females comprised 41% of the study participants.

The studies originated from a wide range of countries with the greatest number of studies from the USA (30%), Australia (11%), China (8%), and the Netherlands (8%). More than two thirds of the studies originated from developed countries. Study samples were exposed to different traumas including natural disaster (32%), medical trauma (13%), child abuse (11%), war (11%), and varied exposures (27%). We purposely brought together research across the whole range of trauma exposures given that the DSM-5 applies the same criteria across cultures and trauma types to diagnose PTSD. In the next section, we summarise our findings regarding symptom expression for each PTSD symptom cluster.

2.3.3. Intrusion Criteria

Multiple studies have reported that intrusion symptoms were endorsed by the majority of trauma-exposed children in their samples (Adams et al., 2014; Dogan, 2011; Hashemi, 2017; Kaplan, Kaal, Bradley, & Alderfer, 2013; Nixon et al., 2013; Sprung & Harris, 2010). A large Turkish study which examined PTSD symptom frequencies in adolescents aged 12-17 years more than 1 year after the Marmara earthquake found the most frequently endorsed symptoms were "upset with thoughts of the earthquake" (89%) and "upset at reminders" (90%). Similarly, Kaplan et al. (2013) found 90% of the sample (siblings of cancer patients) reported at least one re-experiencing symptom. In this study, the most frequently endorsed symptom was "feeling upset when you think about or hear about the cancer". Adding further validity to the importance of this symptom, Boelen and Spuij (2013) found that this symptom discriminated best between PTSD caseness and non-caseness in a study examining bereavement related PTSD. Additional substantiation of the commonality of intrusion symptoms was found in a Zambian study where trauma-exposed orphans and vulnerable children most frequently endorsed symptoms from the DSM-IV PTSD re-experiencing and arousal clusters (Familiar et al., 2014).

Mixed findings have been reported regarding age-related differences in intrusion symptoms. In a large study (n = 2000) following a tornado (Adams et al., 2014), it was found that younger adolescents (aged 12-13) were less likely to endorse the intrusion cluster than older adolescents (aged 14-17 years). In a study of Norwegian children (aged 6-18 years) exposed to the South Asian tsunami (Dyb, Jensen, & Nygaard, 2011), researchers also found that higher age was associated with higher levels of re-experiencing symptoms. In contrast,

Nixon et al. (2013) found that younger children (aged 6-11 years) exposed to a road traffic accident were more likely to endorse higher levels of re-experiencing symptoms than older children (aged 12-14 years). Unfortunately, none of these studies compared the level of post-traumatic symptoms and functional impairment between these groups, so it is not known whether the differences in endorsement rates signalled issues with diagnostic sensitivity among sub-groups of age or were related to other factors (i.e., event characteristics).

Based on a theory of mind model (Flavell, Green, Flavell, Harris, & Astington, 1995), Sprung and Harris (2010) conducted one of the few studies on intrusive thoughts in children aged 5-9 years after Hurricane Katrina. They found that over 90% of children in their study reported unwanted, negative intrusive thoughts 1 year post-hurricane. They also found that language development and the child's "knowledge about thinking" was significantly associated with the reporting of unwanted intrusive thoughts. Sprung and Harris (2010) reported two possible interpretations of these results. First, children who have not yet developed "knowledge about thinking" did not experience intrusive thoughts. Equally plausible is that children were unable to identify and report intrusive thoughts due to their limited cognitive understanding. Either explanation, however, supported the concern that intrusive thoughts may not be adequately sensitive to younger children who have not developed this cognitive capacity.

In a recent study, Sachser, Berliner, et al. (2017) highlighted that "flashbacks" may not be developmentally sensitive in children. They found that children had difficulty meeting the criteria for the proposed ICD-11 intrusion cluster which was comprised of only two symptoms: flashbacks and distressing dreams. However, when children were provided with the option to endorse the symptom "intrusive memories" in addition to flashbacks and distressing dreams, they found that children were more likely to meet the PTSD diagnosis. Sachser, Berliner, et al. (2017) argued that "intrusive memories" was a more developmentally appropriate PTSD intrusion symptom. They suggested that flashbacks were not only less prevalent in children and adolescents but were more difficult to detect even if present. La Greca, Danzi, and Chan (2017) also provided some support for this view. Danzi and La Greca (2016) found that children in their study endorsed the proposed ICD-11 intrusion cluster at a much lower rate than they endorsed the DSM-IV and DSM-5 intrusion clusters. Both the DSM-IV and DSM-5 intrusion clusters are comprised of a wider array of intrusion symptoms than the two symptoms contained in the proposed ICD-11 intrusion cluster. Consequently, the study results of Danzi and La Greca (2016) also suggest that the proposed

ICD-11 intrusion cluster may not be developmentally sensitive or adequately reflect how children aged 7-14 years express symptoms of intrusion.

Few studies have explored the symptom of "distressing dreams" but those that have reported contrasting findings. Boelen and Spuij (2013) in a study of children who experienced the death of a loved one found that not only were distressing dreams one of the least endorsed items (17%) but also performed poorly in distinguishing caseness. In contrast, in a study of children aged 8-18 years exposed to road traffic accidents, Wittmann, Zehnder, Schredl, Jenni, and Landolt (2010) found almost one third of the sample endorsed this symptom. Given Wittmann et al. (2010) assessed for nightmares via standardised interview whereas (Boelen & Spuij, 2013) assessed via self-report measure, this along with the differences in trauma type, may have contributed to the discrepant findings.

Taken together, these studies suggest that intrusion symptoms are a characteristic component of PTSD symptom expression in children aged 7-14 years. However, the research regarding age-related differences in the expression of intrusion symptoms remains uncertain.

2.3.4. Effortful Avoidance and Numbing Symptoms

Paediatric researchers have questioned the developmental appropriateness of avoidance and numbing symptoms as well as the ability to accurately identify symptoms which are internalised (Scheeringa, 2011). They have argued that the language and cognitive capacities of children may not be sufficiently developed to report these symptoms and caregivers may be unable to observe them (Friedman, 2013; Pynoos et al., 2009).

2.3.4.1. *Effortful Avoidance Symptoms*

At least one symptom of effortful avoidance is now required to meet PTSD criteria (American Psychiatric Association, 2013b). This change is of particular significance for children as it is uncertain at what age children have enough control over their daily routine to be able to display observable avoidance symptoms (Pynoos et al., 2009), or the language skills necessary to communicate this symptom to others (Scheeringa, 2011). As a result of these developmental concerns, the requirement to endorse at least one symptom of effortful avoidance was not included in the DSM-5 PTSD diagnosis for children 6 years and younger but it remains in place for children 7 years and older. It is uncertain how this requirement will impact the developmental sensitivity of the PTSD diagnosis in children aged 7-14 years.

Although the requirement to endorse at least one symptom of effortful avoidance was not tested in children prior to its inclusion in the DSM-5, several studies have demonstrated

that effortful avoidance symptoms were commonly endorsed in children over 11 years (Bruce, Gumley, Isham, Fearon, & Phipps, 2011; Dogan, 2011; Kaplan et al., 2013; Mannert et al., 2014). Studies have also shown that effortful avoidance symptoms can be associated with impairments in functioning (Boelen & Spuij, 2013; Kassam-Adams, Marsac, & Cirilli, 2010) or with a lower likelihood of trauma-focused treatment completion (Murphy et al., 2014). Given that research on the presence of effortful avoidance in children aged 7-10 years is sparse, no further conclusions can be drawn on age-related differences in the expression of this symptom.

In contrast to these findings and consistent with adult literature (de Jong, Komproe, Van Ommeren, & et al., 2001; Marsella, Friedman, Gerrity, & Scurfield, 1996; Norris, Van Landingham, & Vu, 2009), emerging evidence regarding children suggests that the expression and the validity of effortful avoidance symptoms may vary in non-Western cultures (Familiar et al., 2014; Kohrt et al., 2011; Palosaari, Punamäki, Diab, & Qouta, 2013; Soysa, 2013). Using a qualitative approach, Kohrt et al. (2011) conducted a validation study of the Child PTSD Symptom Scale (CPSS) with Nepalese children in a post-war setting. Kohrt et al. (2011) found that avoidance "of people, places and activities that recall the traumatic event" was a normal response to trauma because it should be expected that people would avoid dangerous places and people after a war. Study results also found that it was considered desirable to avoid places of trauma or violence due to cultural beliefs about the presence of spirits which could harm people. Therefore, despite the common endorsement of effortful avoidance symptoms in this population, Kohrt et al. (2011) argued that they may not be indicative of pathology, and may overestimate the prevalence of PTSD. A similar argument was made by Palosaari et al. (2013) who found avoidance symptoms were not a consistent part of the latent structure of post-traumatic stress in a study of conflict-affected Palestinian children (aged 10-12 years). Palosaari et al. (2013) suggested that during ongoing conflict, symptoms of effortful avoidance may not discriminate between an adaptive and a maladaptive response to trauma.

Overall, current research supports that effortful avoidance symptoms are commonly endorsed in older children and may warrant specific clinical attention due to their potential to impact treatment completion and/or functional impairment. However, caution is indicated in viewing effortful avoidance symptoms as an indicator of pathology in non-Western cultures.

2.3.4.2. *Symptoms of Numbing or "Passive Avoidance"*

The DSM-IV identified detachment, restricted range of affect, loss of interest, and the inability to recall an important aspect of the trauma as numbing symptoms, now incorporated within the DSM-5 symptom cluster "negative alterations in cognitions and mood". This group of symptoms has received considerable interest and commentary in adults and children (Asmundson, Stapleton, & Taylor, 2004; Feeny, Zoellner, Fitzgibbons, & Foa, 2000; Litz, 1992; Scheeringa, 2011). In children, researchers have noted that these highly internalised symptoms may be difficult for parents to observe or may be developmentally inappropriate (Scheeringa, 2011). Paediatric empirical research on the majority of these symptoms is still sparse despite continued concerns regarding their validity. Based on their study of Sri Lankan children exposed to either a tsunami or war, Soysa (2013) concluded that numbing symptoms were of less importance to the expression of PTSD in Sri Lankan children and may reflect a cultural variation in the expression of PTSD. A similar conclusion was reached by Familiar et al. (2014). Boelen and Spuij (2013) found that "detachment or estrangement" was one of the least endorsed symptoms among children with bereavement-related PTSD (13%) and Kohrt et al. (2011) found that "loss of interest" may not be indicative of distress in war-exposed Nepalese children.

The symptom, inability to recall an important aspect of the trauma, has been the focus of several recent studies leading many researchers to recommend the exclusion of this symptom from the diagnosis of children (Boelen & Spuij, 2013; Dow, Kenardy, Le Brocque, & Long, 2013; Iselin et al., 2010; Kassam-Adams et al., 2010). Both Dow et al. (2013) and Iselin et al. (2010) found that this symptom, when used as part of an alternative algorithm for PTSD in children (PTSD-AA), over-identified PTSD in children exposed to medical trauma. These findings called into question whether this symptom represented psychogenic amnesia or instead, alterations in consciousness due to a medical condition or medication side-effects.

Overall, the limited research on the expression of numbing symptoms in children aged 7-14 years suggests that numbing symptoms are not frequently manifested nor a core part of PTSD symptom expression in this age-range. The extent to which this lack of endorsement may be due to difficulties in identifying these symptoms as a result of their internalised nature is uncertain.

2.3.5. Negative Alternations in Cognitions and Mood

The DSM-5 added three new symptoms to the reformulated, negative alterations in cognitions and mood cluster. These included negative emotional state (i.e., guilt, shame, and despair); distorted cognitions of blame regarding the trauma; and persistent and exaggerated negative beliefs or expectations about themselves, others, or the world.

2.3.5.1. *Negative Emotional State*

Recently, several studies have examined the importance of peri-traumatic responses in the diagnosis of children yielding mixed findings. Consistent with prior research, several studies found a wide range of peri-traumatic responses were highly correlated with exposure and PTSD symptom severity including shame (Feiring & Taska, 2005) and disgust (Dyb et al., 2011), although not all of these responses were independently predictive of later PTSD (Dyb et al., 2011).

Despite mixed findings on the predictive validity of peri-traumatic emotions in the diagnosis of PTSD (Dow et al., 2013; Kaplan et al., 2013; Wei et al., 2013), this research demonstrated the early presence of a wide range of negative emotional states in children exposed to trauma. However, these symptoms may only be transitory reactions to acute stress and we cannot assume that early negative emotions will evolve into enduring PTSD symptoms.

Only one recent study has examined negative emotional state in children within the PTSD diagnostic time frame. In their investigation of the validity of complex PTSD in 155 trauma-exposed, treatment-seeking children between the aged of 7-17 years, Sachser, Keller, and Goldbeck (2017) included items regarding problems with emotion regulation in their latent class analyses. They found 41% of the sample were identified to be in a complex PTSD latent class with high probabilities of endorsing guilt, temper outbursts, and hurt feelings. However, the majority of children in this class were over 10 years.

In addition, it should be noted that there is a lack of clarity in the DSM-5 PTSD criteria regarding the distinction between "persistent negative emotional state" and the existing intrusion symptom which requires "intense or prolonged psychological distress" at exposure to trauma reminders (American Psychiatric Association, 2013, p. 271). Although one plausible interpretation is that the former symptom refers to emotional states that persist in the absence of trauma reminders, and the latter occurs as a result of trauma reminders, this distinction would be subject to the particular evaluator's interpretation. Furthermore, it is

likely that caregivers may not understand the distinctions between these two symptoms, leading to inaccuracies in symptom reporting. Further research will need to carefully evaluate if this new symptom could lead to the over-identification of children with PTSD.

2.3.5.2. *Distorted Cognitions about the Trauma and Negative Beliefs/Expectations*

Several studies have demonstrated that post-traumatic cognitions are predictive of the severity and chronicity of PTSD symptoms (Hitchcock, 2015; Liu & Chen, 2015; Ma et al., 2011; Palosaari et al., 2013; Ponnamperuma & Nicolson, 2016), and may play an influential role in the maintenance of PTSD. In a longitudinal study with war-exposed Palestinian children aged 10-12 years, Palosaari et al. (2013) found that high levels of post-traumatic cognitions at 3 months post exposure to trauma significantly predicted a worsening of PTSD symptoms 5 and 11 months post-trauma. In a prospective study with children aged 7-17 years, Hitchcock et al. (2015) found that post-traumatic cognitions measured at 1-month post-trauma exposure predicted PTSD severity 6 months later.

Taken together, these findings suggest that the two new cognitive symptoms in DSM-5 (distorted cognitions and negative beliefs/expectations) appear to be an important part of PTSD symptom expression in older children. A key limitation of these studies, however, is that the majority of the participants were aged 11 years or older; sustaining a key gap in knowledge on the expression of this symptom in children aged 7-10 years. Furthermore, there is limited validity for the symptom negative emotions in children aged 7-14 years.

2.3.6. Symptoms of Arousal

Arousal symptoms have not been a strong focus of recent research. Dow et al. (2013) found that hypervigilance and physiological reactivity to trauma related cues were two of the most endorsed symptoms (46% and 34% of sample, respectively) in children exposed to medical trauma. Paediatric findings regarding the new PTSD symptom, self-destructive or reckless behaviour, to our knowledge, have not been published. However, in a longitudinal study of children aged 8-18 years, (Sullivan, 2017) found the severity of intrusion symptoms after a residential fire were predictive of the severity of aggression severity measured at 8 months and 11 months after exposure; strengthening evidence that anger and irritability may form part of PTSD symptom expression in this age-group.

2.3.7. Functional Impairment

A significant theme that emerged from this review of the literature is the significant level of functional impairment in many trauma-exposed children with PTSD symptoms who

did not meet the PTSD diagnostic threshold (Dow et al., 2013; Iselin et al., 2010; Kaplan et al., 2013; Mikolajewski et al., 2017; Sachser & Goldbeck, 2016). It is critical to understand why these children are impaired and if particular PTSD symptoms are driving impairment. Although functional impairment is required to meet the DSM-5 diagnostic criteria for PTSD, the majority of the studies in this review did not assess for or report the level of functional impairment.

2.4. Discussion and Summary of Findings

Our aim was to increase understanding of PTSD symptom expression and the developmental sensitivity of PTSD symptoms in children aged 7-14 years. We found the majority of included studies did not distinguish between children with and without substantial PTSD symptoms when reporting on symptom expression. Therefore, our ability to draw conclusions about characteristic symptom expression and the symptoms indicative of caseness was limited. Nevertheless, this scoping review can provide important insights on the developmental sensitivity of particular PTSD symptoms and research gaps in the current evidence base.

Intrusion symptoms are a characteristic component of PTSD symptom expression in children aged 7-14 years in both Western and non-Western cultures (Familiar et al., 2014; Nixon et al., 2013; Soysa, 2013). Two symptoms, in particular, were found to occur frequently in trauma-exposed children: 1) Distressing recollections of the trauma, and 2) Distress at reminders of the trauma. One study also reported that these symptoms differentiated PTSD caseness (Boelen & Spuij, 2013). Effortful avoidance symptoms were also commonly endorsed in children over 11 years and have also been associated with functional impairment (Boelen & Spuij, 2013; Kaplan et al., 2013; Kassam-Adams et al., 2010). They may also negatively influence treatment completion in some trauma-exposed populations (Murphy et al., 2014). In non-Westernized populations, however, effortful avoidance symptoms may not be indicative of distress (Kohrt et al., 2011; Palosaari et al., 2013).

Although research on most symptoms of numbing continues to be sparse, several studies have demonstrated that the symptom, inability to recall an important aspect of the trauma, may not be indicative of psychogenic amnesia in children exposed to medical trauma (Dow et al., 2013; Iselin et al., 2010; Kassam-Adams et al., 2010). Studies in non-Western populations have also raised uncertainty about the developmental expression of numbing

symptoms in this age group due to their low endorsement in comparison to other PTSD symptoms. However, the low endorsement of numbing symptoms could also be due to inadequate cross-cultural assessment methods of these complex and unfamiliar symptoms.

Although research on peri-traumatic responses has shown that children do experience a wide range of negative emotions close to the time of trauma (Chou, Su, Wu, & Chen, 2011; Dyb et al., 2011; Verlinden et al., 2013) it is still uncertain whether negative emotional state forms part of the PTSD symptom expression in this age group. There is strong support for the saliency of the two new cognitive symptoms distorted cognitions, and negative expectations as a part of PTSD symptom expression in children 11 years and older.

2.5. Limitations

The most important limitation of this review is that this is a scoping review and not a systematic review. As such, we did not critically appraise the quality of the studies or provide quantitative analysis of results. Furthermore, it is limited to research published in the past 8 years.

For the studies that included a wider age range, we required a mean age between 7-13.9 years. This way, we ensured that there were substantial portions of children within 7-14 years for each included study. Nevertheless, because the studies encompassed a wider age-range, study results may have masked age-related differences in PTSD expression. Although we separately examined the 12 studies that focused exclusively on children between the ages of 7-14 years, due to study heterogeneity, we were unable to draw further conclusions based solely on these studies.

A broader limitation of this review, which mirrors a limitation in the field of paediatric PTSD research, is that this review only examined PTSD symptoms outlined in the DSM. There may be a wider range of PTSD symptoms that children experience which are not consistently assessed and which could prove to be as, or even more important than some current PTSD symptoms. As research progresses, additional symptoms may be identified that form an important part of the diagnostic picture. For example, some researchers have noted the importance of somatic symptoms as an expression of post-traumatic stress among diverse cultures (Hinton, Nickerson, & Bryant, 2011). As research in this field progresses, additional symptoms may be identified that form an important part of the diagnostic picture.

2.6. Areas for Further Research

Although important strides to understanding PTSD in children aged 7-14 years have been made, a number of significant gaps remain. First, given the limited recent research within this age range, additional studies which compare symptom presentations across discrete developmental periods (i.e., 7-10 years, 11-12 years) are necessary to unmask potential age-related differences. Since the majority of participants in the studies were 10 years and older, research on PTSD symptom expression in children aged 7-10 years is particularly critical.

Second, the majority of research did not distinguish between PTSD symptoms present in children with a PTSD diagnosis, sub-threshold PTSD, or children with individual symptoms. Therefore, our ability to understand core PTSD symptom expression in this age group was diminished. Research on which symptoms or symptom clusters are most predictive of caseness, chronicity, or functional impairment could aid in the creation of more sensitive algorithms and more effective interventions.

Third, additional research on the new requirement of one effortful avoidance symptom and its impact on PTSD prevalence in this age group is needed. This is of particular importance given that the endorsement of effortful avoidance is now required for diagnosis. Fourth, given that twelve of the twenty PTSD symptoms relate to internalised states, more research on how these symptoms manifest in children and the capacity of children to self-report them is also needed. Fifth, given the substantial number of children who were functionally impaired but do not meet PTSD diagnostic criteria, it is essential to understand the factors that may drive functional impairment in trauma-exposed children.

Last, recent studies have demonstrated potential cultural variability in the expression of PTSD symptoms particularly in the area of effortful avoidance and symptoms of numbing (Familiar et al., 2014; Kohrt et al., 2011; Palosaari et al., 2013; Soysa, 2013; Vásquez et al., 2012). Although it is well established that trauma-exposed children from non-Western cultures experience a range of PTSD symptoms, the validity of the current algorithm and the full spectrum of PTSD symptom expression in non-Western cultures requires further scrutiny. One way to achieve this is to not only measure the presence of PTSD symptoms but to also measure their association with locally validated measures of functional impairment (e.g., Morley & Kohrt, 2013). Alternatively, the use of a mixed method research design (e.g., Kohrt et al., 2011) could establish not only the presence of PTSD symptoms but also whether

they represent pathology. It cannot be assumed that PTSD symptoms in children have the same meaning across different cultures (Kleinman, 1987).

2.7. Implications of Current Research

This scoping review highlights several implications for paediatric PTSD. First, effortful avoidance symptoms may merit particular clinical attention in children aged 11 years and older due to their potential association with functional impairment and ability to influence treatment. However, it cannot be assumed that effortful avoidance symptoms are indicative of pathology in non-Western settings.

Second, as research suggests that avoidance and numbing symptoms may not be a prominent feature of PTSD in children from non-Western cultures, more attention should be paid to the severity of arousal and intrusion symptoms, as well as sub-threshold PTSD in cross-cultural settings. Variations in symptom presentation could prevent significantly traumatised children from reaching the PTSD diagnostic threshold, even though they may benefit from trauma-focused treatment.

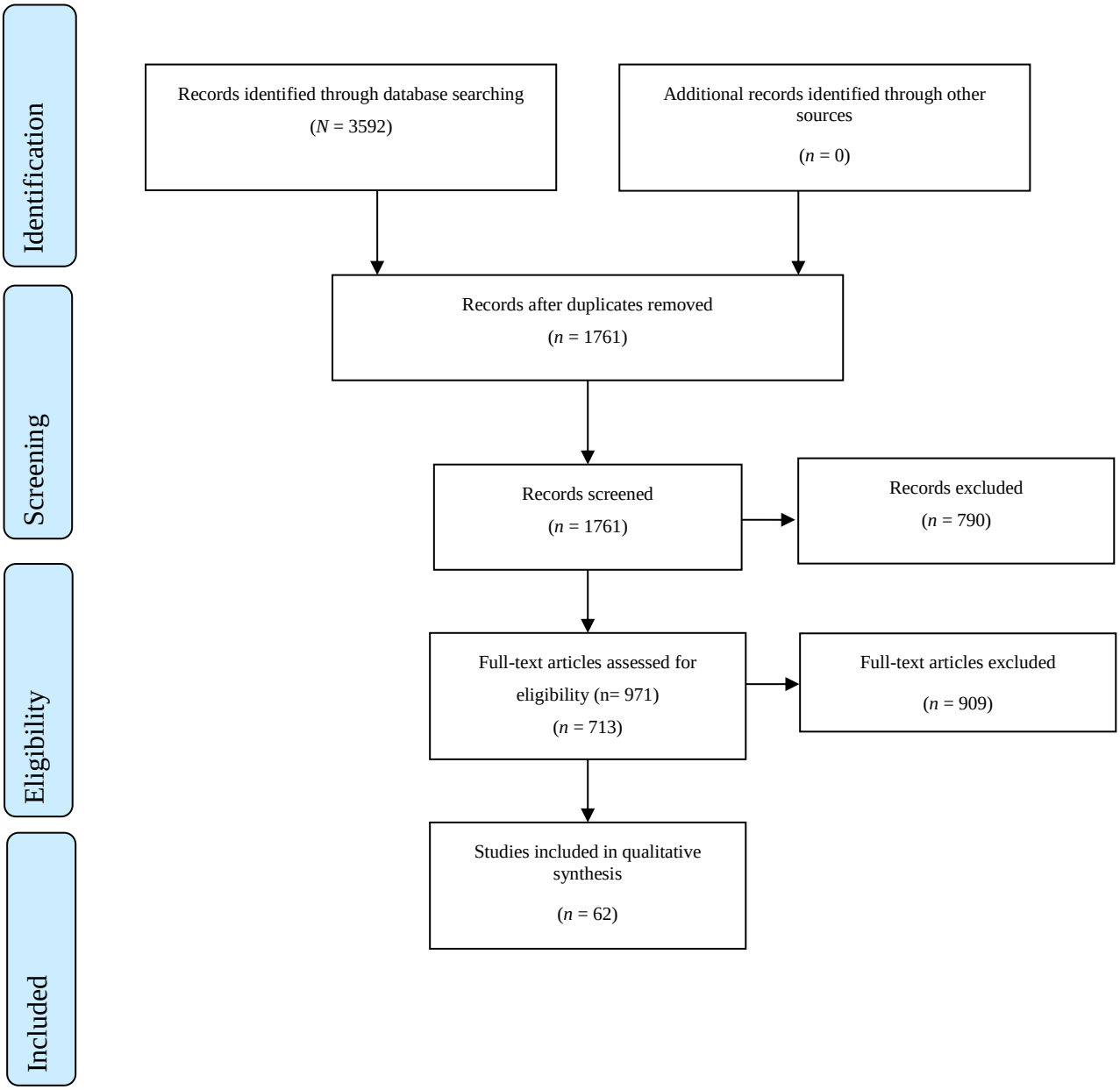
Third, in children with medical trauma, the symptom, inability to recall an important aspect of the trauma, merits elimination from diagnostic criteria as it may result in the over-diagnosis of children with PTSD.

Lastly, the diagnostic sensitivity of the DSM-5 PTSD diagnosis for children aged 7-14 years remains uncertain due to its heavy emphasis on the ability of children to be able to self-report a number of internalising symptoms. As such, children with significant functional impairment and sub-threshold symptoms should also be considered for trauma-focused treatment.

This scoping review has established the breadth of the most recent research on PTSD symptom expression in children aged 7-14 years and has highlighted patterns of research findings which merit further consideration. A particular strength of this review is that it has not been limited to a particular type of trauma exposure as with previous reviews. This review has gathered studies across a range of trauma types in order to map the consistency and variations in the expression of PTSD symptoms. Given that we apply one set of diagnostic criteria to all trauma types and across all cultures, bringing together the most recent research across these boundaries is critical to furthering our understanding of the manifestation of PTSD in children aged 7-14 years.

Chapter 2: PTSD in Children aged 7-14 years and Implications for Diagnosis: A Systematic Scoping Review

Figure 2-1 PRISMA Flow Diagram



Chapter 3. Age-Related Differences in PTSD Symptom Expression in Children aged 7-14 years

3.1. Abstract

The DSM-5 introduced substantial changes to the PTSD diagnostic criteria. Despite these changes applying to children 7 years older, no research was undertaken to examine the diagnostic validity of these changes in children. A substantial body of research exists which has demonstrated that the DSM-IV PTSD diagnosis lacked sensitivity in diagnosing children 6 years and younger (De Young, Kenardy, & Cobham, 2011b; Meiser-Stedman et al., 2008; Scheeringa et al., 2003). Much less is known about PTSD symptom expression and the sensitivity of the PTSD diagnosis for children aged 7-14 years (Scheeringa et al., 2011). The aim of this study was to explore: 1) How PTSD symptoms relate to functional impairment and, 2) Age-related differences in PTSD symptom presentation between pre-adolescents and adolescents. We used secondary data from an international archive of studies which included 757 trauma-exposed children aged 7-14 years recruited after hospital admission. Functional impairment rates were 39% and 36% in pre-adolescent and adolescent age-groups, respectively. The study found age-related differences in the PTSD symptoms which were predictive of functional impairment. The study also found that low levels of PTSD symptoms were predictive of functional impairment, even in the absence of a PTSD diagnosis. This research highlighted the need to develop paediatric diagnostic models to better account for age-related differences in PTSD symptom presentation. This would facilitate the development of more effective treatment models as well as improve our ability to identify trauma-exposed children in need of clinical attention.

3.2. Introduction

Each year, millions of children are exposed to potentially traumatic events worldwide. Reported rates of lifetime exposure in childhood have varied from 15% (Cuffe et al., 1998) to more than 68% (Copeland et al., 2007). Posttraumatic stress disorder (PTSD) is one of the most common disorders to be diagnosed following exposure to trauma (DiMauro et al., 2014; Norris et al., 2002). PTSD causes substantial distress and has the potential to adversely impact children's long-term social, emotional, and physical development and well-being (Fairbank & Fairbank, 2009; Pynoos et al., 2009; Seng et al., 2005). In a recent meta-analysis, Alisic et al. (2014) estimated the PTSD incidence rate after exposure to trauma for children and adolescents to be 16%. The researchers acknowledged that this rate may, in fact, under-estimate the incidence of PTSD as significant groups of trauma-exposed children who were more vulnerable to developing PTSD (i.e. children from war/conflict, children with pre-existing mental health problems) were excluded from the analysis.

In addition to children with PTSD, there exists a substantial number of trauma-exposed children with sub-threshold PTSD who are functionally impaired (Copeland et al., 2007; Dow, Kenardy, Le Brocque, & Long, 2012; Iselin et al., 2010; Kaplan et al., 2013; Mikolajewski et al., 2017; Schäfer et al., 2006). Several researchers have argued that children with sub-threshold PTSD may have been under-diagnosed due to the lack of diagnostic sensitivity in the DSM-IV PTSD diagnosis (Iselin et al., 2010; Schäfer et al., 2006; Scheeringa et al., 2011). For example, in a landmark study with children aged 7-14 years, Carrion et al. (2002) examined the differences in functional impairment and distress between children who met full DSM-IV criteria for PTSD and those who had sub-threshold PTSD. The researchers found that children who had sub-threshold PTSD (defined as meeting two out of the three symptom clusters) did not differ in their level of functional impairment, distress, or rate of co-morbidity from children who met full PTSD criteria. Schäfer et al. (2006) also observed that although only one child in their cohort of 72 children (aged 8-18 years) met the DSM-IV PTSD criteria three months post event, several of the children self-reported significant distress and functional impairment. The authors argued that their results called into question the appropriateness of applying adult PTSD criteria to children.

In addition to highlighting the need for increased research into the sensitivity of the PTSD diagnosis in children 7-14 years, these studies also highlighted the important, yet understudied role, of functional impairment. Functional impairment refers to activity limitations or participation restrictions in important domains of life (i.e., school) (ÜStÜN & Kennedy, 2009; World Health Organization, 2015) and is a useful way of identifying how a diagnosis impacts on an individual's ability to function in different areas of their life (i.e., family, school, community). Beyond

usefulness in assessing diagnostic impact, some studies have also shown that functional impairment in and of itself is an important factor in long-term mental health (Angold, Costello, Farmer, Burns, & Erkanli, 1999; Costello, Angold, & Keeler, 1999).

For example, in a longitudinal study on the development of mental health disorders in children aged 9 to13 years, Angold et al. (1999) found a 9.6% prevalence rate of symptomatic impairment for children who did not meet diagnostic criteria for any DSM-III-R psychiatric disorder. Symptomatic impairment was defined as psychosocial impairment resulting from one or more psychiatric symptoms. The study found that undiagnosed children with symptomatic impairment were as "disturbed" as children who met diagnostic thresholds without impairment and more "disturbed" than children without diagnosis or impairment even one year later. Costello et al. (1999) conducted a longitudinal study with children which examined a variety of different DSM-III diagnoses including PTSD. They compared the mental health outcomes of children with sub-threshold versus full DSM-III diagnoses five years later. Their results demonstrated that children with sub-threshold diagnoses and impairment were five times as likely to have severe emotional disturbance in adolescence as healthy children or children with sub-threshold diagnosis but no impairment (OR 5.2 CI 1.2 – 22.4, $p < .05$). Taken together, these studies provide strong evidence that functional impairment in the absence of a PTSD diagnosis places children at increased risk of adverse mental health outcomes.

3.2.1. Purpose of the Study

The purpose of this study was to: 1) Examine how PTSD symptoms relate to functional impairment in children aged 7-14 years, and 2) Explore age-related differences in PTSD symptom presentations.

3.3. Methodology

This study used an Integrative Data Analysis (IDA) approach (Curran & Hussong, 2009) to pool and analyse data from independent studies drawn from the PTSD after Acute Child Trauma (PACT) Data Archive. PACT is an international archive of investigator-provided, de-identified datasets from prospective studies of children exposed to an acute trauma. The archive currently contains data from 23 studies and four countries (Australia, Switzerland, United Kingdom, and USA). For the current analyses, we included nine studies from four countries with a total of 757 children aged 7-14 years. Please see Table 3-1 and Table 3-2 for study and sample characteristics.

Each dataset includes information on basic demographics, trauma characteristics, one or more potential predictors of ongoing traumatic stress assessed soon after a traumatic event, and at least one measurement of traumatic stress symptoms at a later time point. Advantages of using the IDA

for these analyses included increased statistical power and increased sample heterogeneity (Bainter & Curran, 2014; Curran & Hussong, 2009).

Although the studies in the PACT Data Archive used a range of different measures to assess traumatic stress symptoms and functional impairment, we chose only the studies that used a "gold standard" diagnostic interview administered between 4 weeks to 1 year after exposure to a DSM-IV defined A1 trauma to assess PTSD symptoms and concurrent functional impairment. In each study, children were recruited for participation based on their exposure to a potentially traumatic event (i.e., non-mental health treatment referred samples) after they sought medical treatment at a hospital. None of the studies we used required participants to endorse a minimum level of symptoms or functional impairment as a condition of inclusion. It is important to note that, although the DSM-5 PTSD criteria has narrowed the A1 criteria to exclude particular types of events (i.e., death of caregiver after illness), the participants of our study would also meet the A1 criteria as defined by the DSM-5 PTSD diagnosis.

Table 3-1 Study Characteristics: Datasets Included in Analyses

n	Country	Study Setting	Trauma Type
169	USA	Hospital	Traffic-related injury
130	Australia	Hospital	Unintentional Injury
78	Australia	Hospital	Unintentional Injury
156	Australia	Hospital	Traumatic Brain Injury
37	USA	Hospital	Hospitalised Injury
27	USA	Hospital	Hospitalised Injury
44	UK	Hospital	Motor Vehicle Accident
77	Australia	Hospital	Single Incident injury
39	Switzerland	Hospital	Motor Vehicle Accident

Note. Only the number of participants between 7-14 years of age from each study are shown.

Table 3-2 Sample Characteristics

Age-group	*n*	Gender (% males)	Unintentional Injury	Motor vehicle accidents	Other
Pre-Adolescent Group 7-11 Years	503	61%	82%	17%	3%
Adolescent Group 12-14 Years	254	74%	89%	9%	2%

3.3.1. The Clinician Administered PTSD Scale for Children and Adolescents (CAPS-CA)

The CAPS-CA (Nader et al., 1996) is a semi-structured diagnostic interview which is based on the adult Clinician Administered PTSD Scale (CAPS). The CAPS is considered a "gold standard" for assessing PTSD in people over the age of 15 years with good psychometric properties (Carrion et al., 2002). The PTSD interview component was based on the DSM-IV PTSD criteria and assessed both the intensity and frequency in the previous month of each of the 17 PTSD symptoms via child report. Each item was scored on a 5 point frequency scale (i.e. from 0 = "none of the time" to 4 = "most of the time") and a 5 point intensity scale (i.e. from 0 = "not a problem" to 4 = "a big problem, I have to stop what I am doing"). Following the CAPS-CA scoring rules, a

minimum frequency score of "1" and a minimum intensity score of "2" was required for a symptom to be scored as present.

3.3.2. Anxiety Disorders Interview Schedule – Parent Version

The ADIS-P (Albano & Silverman, 1996) is a semi-structured interview for the diagnosis of anxiety and related disorders in children and adolescents which is based on the adult Anxiety Disorders Interview Schedule (ADIS) (Di Nardo, O'Brien, Barlow, Waddell, & Blanchard, 1983). The PTSD interview component is based on the DSM-IV PTSD criteria and assesses the presence or absence of each of the 17 PTSD symptoms via caregiver report. Each item was scored as either "yes", "no", or "other". Only "yes" responses indicated symptom presence. Although no data on the validity and reliability of the ADIS-P specific to diagnosing PTSD in children is available, the ADIS was found to be valid and reliable in diagnosing PTSD in Vietnam veterans (Blanchard, Gerardi, Kolb, & Barlow, 1986).

3.3.3. Functional Impairment

Functional impairment in relation to PTSD symptoms was assessed through four questions assessing impairment in four different domains (subjective distress, social functioning, scholastic functioning, and developmental functioning) on the CAPS-CA (i.e., "In the past month, did the PTSD symptoms/problems you've told me about make it harder for you to do your schoolwork or to do well at school? Was this a change or were you always like that?"). For the CAPS-CA, functional impairment was considered present if at least one of the CAPS-CA impairment questions was scored as "yes" according to the CAPS-CA scoring rules. On the ADIS-P, functional impairment was assessed through a single question ("How much has this problem interfered with your child's friendships, caused problems at school or at home, and stopped your children from the doing the things he or she would like to do?"). For the ADIS-P, functional impairment was considered present if the impairment question was scored as greater than four according to the ADIS-P scoring rules (0 = "none", 4 = "some", 8 = "very very much"). The CAPS-CA and ADIS-P questions were then recoded into a single dichotomised functional impairment variable. It should be noted that functional impairment was assessed on the CAPS-CA via child report or on the ADIS-P via caregiver report.

3.3.4. Harmonisation of Symptoms across Measures

PTSD was assessed either via the CAPS-CA (child report, 64% of participants) or via the ADIS-P (caregiver report, 36% of participants). Both diagnostic measures had 17 items, each corresponding to the 17 PTSD symptoms from the DSM-IV. We dichotomised the item ratings according to the scoring rules of each measure for symptom presence and then combined responses

for these items from both instruments. We also created a dichotomous variable for the presence/absence of concurrent functional impairment based on the impairment questions in each instrument. We followed the scoring rule of each measure to determine the presence of functional impairment. After the pooling of data, our dataset contained 17 dichotomised items which assessed for 17 PTSD symptoms from all nine studies, in addition to one dichotomised item assessing for functional impairment from eight of the nine studies. Functional impairment was assessed in all but one study. Based on the dichotomised PTSD symptom items, we also created a variable counting the number of PTSD symptoms present with potential scores ranging from 0-17 for use in the receiver operator characteristics (ROC) curve analysis. This method of harmonising and pooling data across multiple studies has been used previously (Kassam-Adams et al., 2012).

3.3.5. DSM-5 PTSD Diagnosis for Children 6 Years and Younger

The DSM-5 PTSD diagnosis for children 6 years and younger is based on the PTSD Alternative Algorithm (PTSD-AA) which has demonstrated superior validity with children 6 years and younger (Scheeringa et al., 2012). Additional research has also suggested that this algorithm may be more sensitive in identifying children aged 7-14 years with PTSD than the DSM-IV PTSD criteria (Iselin et al., 2010; Meiser-Stedman et al., 2008; Mikolajewski et al., 2017) or the DSM-5 PTSD criteria (Danzi & La Greca, 2017). Therefore, we used a modified version of the DSM-5 PTSD algorithm for children 6 years and younger to calculate PTSD prevalence rates. It should be noted that although the DSM-5 PTSD diagnosis added three new symptoms (distorted cognitions, negative emotional state, and reckless or self-destructive behaviour), only one of the new symptoms (negative emotional state) was included in DSM-5 PTSD for Children 6 Years and Younger. Furthermore, it should also be noted that our data was collected based on the DSM-IV wording of PTSD symptoms. Please see Table B1 in Appendix B for more specific information on each diagnostic algorithm.

3.3.6. DSM-5 Modified Algorithm

The DSM-5 Modified Algorithm (DSM-5 MA) is comprised of three symptom clusters: 1) Intrusion, 2) Avoidance and negative alternations in cognitions, and 3) Arousal/reactivity. Children are required to endorse four symptoms to meet the minimum PTSD symptom threshold. Notably, although the symptoms inability to recall an important aspect of the trauma, and detachment were removed from DSM-5 PTSD for Children 6 Years and Younger, we chose to retain them in the DSM-5 MA due to the older age of our sample and to obtain additional information on the validity of these symptoms in children aged 7-14 years. Given that the data collected was based on DSM-IV questionnaires, none of the three new DSM-5 PTSD symptoms (negative emotional state, distorted cognitions, and reckless or self-destructive behaviour) or the two new DSM-5 PTSD for

Children 6 Years and Younger symptoms (social withdrawal, and negative emotions) were included in the algorithms.

The DSM-5 MA was calculated in two different ways. In the first method we followed the symptom structure for DSM-5 PTSD for children 6 years and younger which required one symptom of intrusion, one symptom of either effortful avoidance or negative alterations in cognitions, and two symptoms of arousal/reactivity to meet criteria for diagnosis. In the second method, we followed the same algorithm one with one exception. In order to meet PTSD diagnosis, we required that at least one of the four PTSD symptoms endorsed was a symptom of effortful avoidance. The minimum four symptom threshold for diagnosis remained the same for both methods. Functional impairment was required to meet PTSD diagnosis in both methods.

3.3.7. Study Ethics

This study was approved by the Faculty of Medicine's Institutional Review Board at the University of Queensland. Each of the data sets in the PACT Data Archive underwent an Institutional Review Board or equivalent oversight body ethics review. The ethics reviews followed the protocols in each respective country and institution prior to the collection of data.

3.3.8. Data Analysis

We divided the sample into two age sub-groups: Pre-Adolescent Group (7-11 years) and Adolescent Group (12-14 years), in order to explore differences that may exist between pre-pubertal and pubertal children. Twelve years marks a natural delineation between pre-adolescence and adolescence in Western society. It is also often accompanied by a move to a new school and changes to a wider peer group. Each analysis was performed on the entire group, and then separately on each age sub-group. Only sub-group results are reported below. All analyses were conducted in SPSS v24.

3.3.8.1. *Missing Values*

We examined the percentage of missing values for each of the 17 DSM-IV PTSD items and found the missing percentage for each PTSD item ranged from 15% to 17% for a total sample size of $N = 757$. We chose not to conduct multiple imputation of the missing values because we found that 135/168 cases (80%) with missing data had not completed the diagnostic questionnaire within the time point (1 month <1 year) that we were assessing. Consequently, all of the 17 PTSD items were missing in these cases. These cases were initially part of the study because the participants completed other measures which were not analysed in this study. We deleted 135 cases that had not completed the diagnostic questionnaire within the required timeframe, leaving a final sample of $N = 757$.

3.4. Results

3.4.1. Prevalence of Diagnosis and Functional Impairment

Even though the PTSD point prevalence rate was fairly low (15% for pre-adolescents, 9% for adolescents), the prevalence of functional impairment was notably high at 39% in the Pre-Adolescent Group and 36% in the Adolescent Group. More than 30% of the sample in each age-group was functionally impaired but did not meet criteria for a PTSD diagnosis. See Table 3-3 for prevalence rates.

Table 3-3 Point Prevalence Rates of PTSD and Functional Impairment

Age-Group	*n*	DSM-IV	DSM-5 MA	Functional Impairment	Functional Impairment No Diagnosis
Total Group (7-14 years)	757	6%	13%	38%	26%
Pre-Adolescent Group (7-11 years)	503	6%	15%	39%	30%
Adolescent Group (12-14 years)	254	4%	9%	36%	31%

3.4.2. Individual Symptoms and Association with Age

We examined symptom frequencies to determine which symptoms were most frequently endorsed. The most frequent symptoms endorsed overall were inability to recall an important aspect of the trauma, irritability, difficulty concentrating, and hypervigilance. It is notable that inability to recall an important aspect of the trauma was the most frequently endorsed symptom in both age groups. Prior research has demonstrated that this symptom is frequently endorsed in children who have experienced medical trauma (Dow, Kenardy, Le Brocque, & Long, 2013; Iselin, Le Brocque, Kenardy, Anderson, & McKinlay, 2010) but not frequently endorsed in children who have experienced other types of trauma (Boelen & Spuij, 2013). Researchers have argued that this symptom fails to distinguish memory difficulties as a result of psychogenic amnesia and those due to medical symptoms (e.g., alterations in consciousness or medication side-effects) and has resulted in the over-identification of PTSD in children who have experienced medical trauma. Given that this sample is primarily comprised of participants exposed to physical injury, these results suggest that this symptom may have been over-endorsed due to confusion with medical symptoms.

We calculated the strength of the association between symptom frequency and age-group to explore age-related differences in symptom presentation. Most symptoms had non-significant

correlations with age-group. Although some symptoms had statistically significant correlations, the correlations were weak. Therefore, we concluded that there was no clinically meaningful relationship between the rate of endorsement of individual PTSD symptoms and child age-group. See Table 3-6 and Table 3-7 for further details.

3.4.3. Individual Symptoms and Association with Functional impairment

We studied the extent to which PTSD symptoms predicted functional impairment using binary logistic regression while controlling for gender. Previous research has suggested gender-related differences in the expression of PTSD (Armour, Elhai, et al., 2011). The 17 PTSD symptoms and gender were entered simultaneously as independent variables with functional impairment as the dependent variable. The *p* value was set at < .05.

3.4.3.1. *Multicollinearity*

A key assumption in binary logistic regression analysis is the assumption of independence between independent variables (Fields, 2013). In order to test that this assumption was met, we checked the data for multicollinearity in two ways. First, the correlation matrix was examined for pairwise correlations greater than or equal to .80. We did not find any correlations higher than .50 in either age-group. Next, we tested for interdependencies among several variables, by examining the tolerance, variance inflation factors (VIFs), condition indexes, and the proportion of variance of each predictor's regression coefficient that was attributed to each eigenvalue (Midi, Sarkar, & Rana, 2010). We concluded from the results that multicollinearity was not present in either age-group.

3.4.3.2. *Model Fit*

We used the Hosmer and Lemeshow Test to confirm model fit. After examining standardised residuals and points of leverage for each case, we used Cooks distance values greater than one to identify cases exerting an undue influence over the parameters of the model (R. D. Cook & Weisberg, 1982; Fields, 2013). Cooks distance (R. D. Cook, 1977) is a summary measure of the overall influence of a case on a model. We conducted a sensitivity analysis omitting cases with a Cook's distance greater than one to observe if there were any significant changes to the model. Results are reported separately for each age-group below.

3.4.4. Pre-Adolescent Group (7-11 years)

The model as a whole explained between 39% (Cox and Snell R^2) and 53% (Nagelkerke R^2) of the variance in functional impairment in children in the Pre-Adolescent Group. An omnibus test of the model indicated that the endorsement of PTSD symptoms was significantly related to functional impairment ($x^2 = 212.94$, *df* 18 $p < .001$). The model had a high predictive value and correctly classified 81% of cases. The ability of the model to accurately classify children with

functional impairment was lower (67%) than the ability to classify children without functional impairment (90%). There were 16 standardised residuals with values greater than 2.5 which were kept in the analysis. We conducted a sensitivity analysis by omitting one case with a Cooks distance of greater than one and repeating the binary regression analysis. The results demonstrated no significant change to the overall model. Consequently, we have only reported the results of the model including all cases.

As shown in Table 3-4, only six of the independent variables made a unique statistically significant contribution to the model (irritability, difficulty concentrating, psychological distress at cues, physiological reactivity, hypervigilance, and avoidance of thoughts or feelings were significantly associated with the presence of functional impairment). The strongest predictor for functional impairment was difficulty concentrating, with an odds ratio of 5.58 (95% CI for OR= 2.70 – 11.55, $p < .001$). This indicated that pre-adolescent children with difficulty concentrating, the odds of having functional impairment were more than five times greater than children who did not have this symptom, after controlling for other factors in the model. Gender was non-significant.

Table 3-4 Logistic Regression PTSD Symptoms and Functional Impairment:

Pre-Adolescent Group *n* = 503

Independent Variables	B	*S.E.*	Wald	*df*	*p*	Odds Ratio (OR)	95% C.I. for OR	
							Lower	Upper
Intrusive memories	0.42	0.40	1.12	1	.290	1.53	0.70	3.35
Distressing dreams	0.44	0.46	0.90	1	.344	1.55	0.63	3.83
Dissociative reactions	0.59	0.37	2.58	1	.108	1.80	0.88	3.68
Psychological distress at cues	**1.35**	**0.40**	**11.57**	**1**	**.001**	**3.84**	**1.77**	**8.35**
Physiological reactivity	**1.24**	**0.56**	**4.99**	**1**	**.025**	**3.46**	**1.17**	**10.25**
Avoidance of thoughts/feelings	**0.68**	**0.33**	**4.17**	**1**	**.041**	**1.97**	**1.03**	**3.76**
Avoidance of activities	0.34	0.34	0.98	1	.323	1.40	0.72	2.74
Inability to recall an important aspect of the trauma	0.34	0.27	1.59	1	.208	1.41	0.83	2.40
Loss of interest	0.52	0.42	1.51	1	.220	1.68	0.73	3.86
Detachment	0.18	0.58	0.10	1	.752	1.20	0.39	3.75
Restricted affect	-0.17	0.60	0.08	1	.785	0.85	0.26	2.77
Foreshortened future	1.09	0.83	1.74	1	.187	2.97	0.59	14.98
Difficulty sleeping	0.15	0.40	0.14	1	.713	1.16	0.53	2.55
Irritability	**1.38**	**0.31**	**20.13**	**1**	**<.001**	**3.97**	**2.17**	**7.25**
Difficulty concentrating	**1.72**	**0.37**	**21.46**	**1**	**<.001**	**5.58**	**2.70**	**11.55**
Hypervigilance	**0.70**	**0.35**	**3.99**	**1**	**.046**	**2.01**	**1.01**	**3.97**
Exaggerated startle	0.19	0.45	0.18	1	.668	1.21	0.50	2.93
Gender	0.06	0.28	0.05	1	.818	1.07	0.62	1.84

3.4.5. Adolescent Group (12-14 years)

An omnibus test of the model for the Adolescent Group indicated that the endorsement of PTSD symptoms was also significantly related to functional impairment ($x^2 = 88.90$, *df* 18, $n = 214$, $p < .001$). Four of the independent variables made a unique statistically significant contribution to the model. Avoidance of thoughts or feelings, loss of interest, irritability, and difficulty

concentrating were significantly associated with the presence of functional impairment. The strongest predictor for functional impairment in adolescent children was effortful avoidance of thoughts and feelings, with an unusually high odds ratio of 57.29 (95% CI for OR = 4.4 – 753.06, p = .002). This indicated children who avoided thoughts or feelings regarding the traumatic event had 57 times greater odds of having functional impairment than children who did not have this symptom, after controlling for other factors in the model.

Upon further examination of the residuals, we found five cases with a Cook's distance of greater than one. In order to assess if the cases were exerting an undue influence on the model parameters, we conducted a sensitivity analysis omitting these five cases. There were eight standardised residuals with values greater than 2.5 which were kept in the analysis. As the new model showed significant differences with the previous model, we concluded that the five cases exerted an undue influence on the previous model, and therefore we have reported only the full results of the model (Model Two) excluding these cases.

3.4.5.1. *Model Two*

The model as a whole explained between 42% (Cox and Snell R^2) and 58% (Nagelkerke R^2) of the variance in functional impairment. An omnibus test of the model for the Adolescent Group indicated that the endorsement of PTSD symptoms was significantly related to functional impairment (x^2 = 115.36, *df* 18, n = 209, p < .001). Similar to the Pre-Adolescent Group, the model had a high predictive value and correctly classified 84% of the cases overall. The ability of the model to accurately classify children with functional impairment was much lower (68%) than the ability to classify children without functional impairment (93%).

As shown in Table 3-5 only four of the independent variables made a unique statistically significant contribution to the model (loss of interest, difficulty sleeping, irritability, and difficulty concentrating). Once the influential cases were omitted, difficulty sleeping became significant as a predictor, and avoidance of thoughts or feelings was unable to be estimated due to a low cell count. Only one participant endorsed avoidance of thoughts/feelings and they reported they were not functionally impaired, whereas the other 18 participants who endorsed avoidance of thoughts/feelings were all functionally impaired. Due to the low cell count, we did not report the results for avoidance of thoughts and feelings in Table 3-5.

The strongest predictor for functional impairment was loss of interest with an odds ratio of 22.89 (95% CI for OR= 3.81 – 137.61, p = .001) indicating that children who endorsed this symptom had almost 23 times greater odds of being functionally impaired than children who did not, after controlling for other factors in the model. In addition, the symptoms psychological

distress at cues, exaggerated startle, and hypervigilance also approached significance as predictors in this model. Once again, gender was non-significant.

Table 3-5 Logistic Regression PTSD Symptoms and Functional Impairment: Adolescent Group

Independent Variables	B	*S.E.*	Wald	*df*	*p*	Odds Ratio (OR)	95% C.I. for OR	
							Lower	Upper
Gender	0.17	0.53	0.10	1	.748	1.19	0.42	3.36
Intrusive memories	0.26	1.02	0.06	1	.800	1.30	0.17	9.64
Distressing dreams	-1.46	1.05	1.95	1	.163	0.23	0.03	1.81
Dissociative reactions	-0.80	0.86	0.87	1	.350	0.45	0.08	2.41
Psychological distress at cues	2.04	1.13	3.24	1	.072	7.69	0.83	70.84
Physiological reactivity	1.54	1.43	1.16	1	.281	4.67	0.28	77.12
[1]Avoidance of thoughts/feelings	-	-	-	-	-	-	-	-
Avoidance of activities	-0.13	0.99	0.02	1	.895	0.88	0.13	6.12
Inability to recall an important aspect of the trauma	0.37	0.43	0.71	1	.400	1.44	0.61	3.38
Loss of interest	**3.13**	**0.92**	**11.70**	**1**	**.001**	**22.89**	**3.81**	**137.61**
Detachment	-1.03	0.87	1.40	1	.237	0.36	0.06	1.97
Restricted affect	0.54	1.06	0.27	1	.606	1.72	0.22	13.70
Foreshortened future	-1.12	2.99	0.14	1	.709	0.33	0.00	114.01
Difficulty sleeping	**1.57**	**0.58**	**7.40**	**1**	**.007**	**4.80**	**1.55**	**14.88**
Irritability	**1.41**	**0.46**	**9.32**	**1**	**.002**	**4.12**	**1.66**	**10.21**
Difficulty concentrating	**1.42**	**0.55**	**6.65**	**1**	**.010**	**4.14**	**1.41**	**12.19**
Hypervigilance	1.50	0.80	3.49	1	.062	4.47	0.93	21.55
Exaggerated startle	1.47	0.79	3.46	1	.063	4.34	0.92	20.35

[1] Unable to be estimated due to low cell count

3.4.6. Evaluation of Predictive Value

In the final step of the analysis, we examined how well the number of PTSD symptoms endorsed could separate children with and without functional impairment. A ROC curve analysis was conducted. ROC graphs were generated where sensitivity was plotted against one minus the specificity. ROC curves represent the relationship between the true positive rate of functional

impairment and the true negative rate for the number of symptoms tested. In addition, we computed an overall statistic of utility measuring the area under the curve (c-statistic; AUC) to provide a comparison of the benefit of different symptom cut points. Theoretical AUC values range from 0.5 (no better than chance) to 1.0 (perfect) (N. R. Cook, 2008). In the ROC curve analysis, the dichotomous classification was functional impairment status and the number of DSM-IV PTSD symptoms endorsed was the test variable.

For children in the Pre-Adolescent Group, the area under the curve was .86 [CI .82 - .89]. The best cut-off for sensitivity and specificity was 2.5 symptoms with a sensitivity of .78 and 1-specificity at 0.76. For the adolescent group, the area under the curve was .80 [CI .74 -.87]. The best cut-off for sensitivity and specificity was 1.5 symptoms (sensitivity of .78 and 1-specificity at .70). See Figure 3-1 and Figure 3-2 for additional information.

3.5. Discussion and Clinical Recommendations

This study has made several important contributions to our knowledge regarding the relationship between PTSD symptoms, functional impairment, and diagnosis. It carries important implications for assessment and intervention. First, in our examination of differences in PTSD prevalence rates between pre-adolescents and adolescents, we found that pre-adolescent children had significantly higher PTSD prevalence rates (15%) as compared to adolescent children (9%) when the DSM-5 MA was used. More notable, however, was the finding that more than 30% of children in each age-group were functionally impaired and did not meet PTSD diagnostic criteria. The high level of functional impairment in this sample is all the more striking when you consider that this is a trauma-exposed, prospective sample and not a treatment-seeking sample.

Consistent with previous research (Carrion et al., 2002; Mikolajewski et al., 2017), this finding has emphasised the need for researchers and clinicians to pay close attention to the presence of functional impairment when screening or assessing children for intervention even in the absence of a PTSD diagnosis. It has demonstrated that if the only criterion we use to determine if a trauma-exposed child warrants treatment is whether they meet PTSD diagnostic criteria, a significant number of children who are functionally impaired will be missed. The fact that this study used the more liberal and diagnostically sensitive DSM-5 MA to diagnose children further validates the argument that meeting a PTSD diagnostic algorithm is not sufficient to identify the majority of trauma-exposed children who warrant attention and care; and is consistent with research conducted with children 6 years and younger (Scheeringa et al., 2005).

Second, although the study results did not allow us to draw conclusions about the causes of functional impairment in children apart from the association with PTSD symptoms, they did shed

further light on how symptom expression may contribute to functional impairment. The results of the binary logistic regression provided additional evidence that functional impairment varied not only according to the particular PTSD symptoms endorsed but was also influenced by the developmental stage of the child. Even though there was some symptom overlap, the strongest symptoms predicting functional impairment in the binary regression models varied by age-group. Symptoms from intrusion, arousal/reactivity, and avoidance/numbing clusters were predictive of functional impairment in the Pre-Adolescent Group whereas only symptoms of arousal/reactivity and one symptom of numbing (loss of interest) were predictive of functional impairment in the Adolescent Group. These differences were all the more remarkable given that there was no clinically meaningful difference between age-groups in the rate of symptom endorsement. Previous research has also demonstrated that particular PTSD symptoms are more influential than others with regards to functional impairment and PTSD severity (Ayer et al., 2011; Carrion et al., 2002), natural recovery (Schell, Marshall, & Jaycox, 2004), or in activating or maintaining other PTSD symptoms (Russell, 2017; Schell et al., 2004). These results established that even when children across different ages endorse the same symptoms, the symptoms can have a very different influence on the course of PTSD and functional impairment.

It is possible that the association between PTSD symptoms and functional impairment was influenced by external factors (i.e., psychiatric comorbidity, social, or environmental factors) as well as the PTSD symptoms. Furthermore, given that our research was cross-sectional, an alternative view would be that functional impairment influenced the development of PTSD symptoms. However, it is important to note that the diagnostic interviews conducted in this research specifically asked caregivers how PTSD symptoms were interfering with their child's functioning, or asked children to report how much they were "bothered" by their PTSD symptoms, or whether the PTSD symptoms made it "harder" to function in different domains. We believe that asking caregivers and children to rate the degree to which PTSD symptoms directly influenced functional impairment has provided strong evidence that PTSD symptoms contributed to functional impairment.

Third, these results have added clarity on paediatric PTSD symptoms. In particular, this study has confirmed previous paediatric research (Ayer et al., 2011; Carrion et al., 2002) linking loss of interest with functional impairment. Our study indicated that this symptom merits particular attention in adolescents as they had 23 times greater odds [CI 3.81 – 137.61, $p = .001$] of being functionally impaired if they endorsed this symptom than if they did not. This finding has particular importance because as a non-specific PTSD symptom, loss of interest may not be naturally linked with trauma-related pathology or seen as a symptom worthy of clinical attention

when it presents in family or academic settings. Instead, it could be misinterpreted by other adults as a wilful attitude or careless disregard towards school or relationships, especially given the adolescent age-group. Given that this symptom is a non-specific PTSD symptom that is often present in those diagnosed with depression, we should also consider the possibility that this symptom may be predictive of functional impairment due to comorbid depression. Indeed, the other PTSD symptoms which were most predictive of functional impairment in adolescents (difficulty sleeping, difficulty concentrating, and irritability) were also symptoms commonly present in people with depression. Although it was beyond the scope of this study to examine psychiatric comorbidity, this is an important area for future investigation.

Fourth, this study has provided additional evidence on the validity of effortful avoidance symptoms in children aged 7-14 years, and specifically, in pre-adolescent children aged 7-11 years. This finding is of particular importance given that the DSM-5 PTSD criteria now requires at least one symptom of effortful avoidance in order to meet the diagnostic threshold (American Psychiatric Association, 2013b). Although the impact of this new requirement on the developmental sensitivity of the DSM-5 PTSD diagnosis remains untested and therefore uncertain, it is significant that almost 25% of children in both age-groups endorsed symptoms of effortful avoidance and that they were predictive of functional impairment in pre-adolescent children. These results have provided additional evidence that effortful avoidance symptoms are an important component of PTSD symptom expression.

Previous research on effortful avoidance symptoms in children has also demonstrated they were commonly endorsed (Bruce et al., 2011; Dogan, 2011; Kaplan et al., 2013; Mannert et al., 2014) and could be associated with functional impairment (Boelen & Spuij, 2013; Kassam-Adams et al., 2010), but this research was primarily conducted with children 11 years and older. Therefore, this study has extended previous findings regarding the association between effortful avoidance symptoms and functional impairment to trauma-exposed children aged 7-10 years.

Fifth, in the ROC curve analysis, this study found that 2.5 symptoms for pre-adolescents and 1.5 symptoms for adolescents, were the best cut-off scores for the number of symptoms which separated children with and without functional impairment. These results have strengthened the argument that children with PTSD symptoms that fall significantly short of meeting diagnostic criteria (i.e. 2.5 symptoms versus 6 symptoms required for the DSM-5 PTSD diagnosis) may still have functional impairment and warrant clinical attention. These findings are consistent with previous research which has shown that sub-threshold PTSD symptoms can result in clinically

significant functional impairment which warrants attention (Carrion et al., 2002; Mikolajewski et al., 2017).

Considered together, these findings also raise intriguing questions regarding the best model with which to diagnose PTSD in children aged 7-14 years. On one hand, these results are in line with previous research indicating the importance of particular PTSD symptoms over others (Ayer et al., 2011; Carrion et al., 2002; Schell et al., 2004), and thus support the notion of adhering to a diagnostic algorithm which recognises the saliency of particular symptoms in the PTSD diagnosis. On the other hand, these findings also show that the particular symptoms which are the most salient in paediatric PTSD vary at different developmental periods.

The recent and innovative work of Ayer et al. (2011) highlighted the variability in symptom saliency over the course of one year using latent class analysis in a longitudinal study of trauma-exposed adolescents. Ayer et al. (2011) found that the symptoms characterising the severe PTSD class changed from numbing and arousal at time one, to intrusion, avoidance, and arousal at one year follow up, with the latent class remaining strongly associated with functional impairment at both time points. This variability in symptom structure even within the same developmental period suggests that requiring adherence to a particular algorithm will inevitably lead to a lack of sensitivity for many children due to developmental variation. Future research should consider exploring whether requiring a minimum number of PTSD symptoms in any constellation along with functional impairment could be a more valid and parsimonious diagnostic model to consider for this age-group. One of the complexities of this approach, however, would be to balance sensitivity with specificity. For example, if children only needed to endorse six PTSD symptoms in any configuration to obtain a PTSD diagnosis, it is possible that a diagnosis of depression emerging after trauma-exposure could be misdiagnosed as PTSD with the endorsement of six non-specific DSM-5 PTSD symptoms. Identifying the optimal minimum symptom threshold and developmentally sensitive PTSD criteria for this age-group while considering developmental variation and specificity poses a critical challenge for future research.

Three preliminary clinical recommendations can be made from the results of this study: First, given that a low level of PTSD symptoms was found to be predictive of functional impairment, it is important when identifying trauma-exposed children in need of treatment that they are screened for functional impairment, regardless of the number of PTSD symptoms endorsed. Second, given the high prevalence of functional impairment in our sample and the risk it poses for adverse outcomes (Costello et al., 1999), studies should include functional impairment in addition to PTSD symptom reduction as an outcome to evaluate treatment effectiveness. It cannot be

assumed that symptom reduction and PTSD diagnosis remission in and of itself is not sufficient for improved functioning. Third, our results suggest that tailoring interventions to the particular symptoms which are most associated with functional impairment may yield quicker and stronger treatment benefits.

3.6. Limitations and Areas for Further Research

This study has strengthened previous research highlighting the significance of functional impairment even in the absence of meeting full PTSD diagnostic criteria in children aged 7-14 years (Carrion et al., 2002; Meiser-Stedman et al., 2008). It has also brought to light important age-related differences in the relationship between PTSD symptoms and functional impairment resulting in important clinical and research implications. However, there are several limitations that should be taken into account when considering these results.

First, given that this study relied on cross-sectional data, we are unable to conclude that a causal relationship exists between PTSD symptoms and functional impairment. Future studies should strengthen these findings by using longitudinal designs to examine causal relationships between PTSD symptoms and functional impairment as well as the factors that contribute to the long-term maintenance of functional impairment.

Second, the diagnostic measures that were used to assess PTSD symptoms were based on the DSM-IV PTSD diagnosis. Consequently, we were unable to assess the presence of the three new DSM-5 PTSD symptoms (negative emotional state, distorted cognitions, and reckless or self-destructive behaviour) or the new symptom (social withdrawal) contained in DSM-5 PTSD for Children 6 Years and Younger. Therefore, it is unknown how these symptoms may influence functional impairment or contribute to age-related differences. In addition, because these additional symptoms were not assessed, it is possible that the PTSD prevalence rate was under-estimated in this sample.

Third, in order to harmonise the two different diagnostic interview measures, we dichotomised the data. Consequently, this study was unable to assess how varying degrees of symptom severity may have influenced symptoms and their association with functional impairment. Previous research has demonstrated that symptom severity may play a larger role in driving functional impairment than merely symptom frequency or the number of different symptoms present (Carrion et al., 2002; J. Cohen & Scheeringa, 2009). Consequently, an important way to extend this research would be to explore symptom severity as well as the influence of the number and types of symptoms endorsed, and their association with functional impairment.

Fourth, the high level of endorsement of the symptom, inability to recall an important aspect of the trauma, suggests concerns regarding its' validity in children and adolescents exposed to medical trauma, even with the use of "gold standard" diagnostic instruments. It is possible that the inclusion of this symptom introduced bias into the results of this study. Additional research should test algorithms with and without this symptom with participants exposed to medical and non-medical traumas to investigate this issue further.

It is also essential to acknowledge limits to the generalisability of this study. The majority of the children in this sample experienced unintentional injury as the index trauma event. We cannot assume that children who experience other types of trauma such as interpersonal violence or disasters will manifest symptoms and functional impairment in the same manner. Consequently, additional research across a diverse range of traumas should be undertaken.

Furthermore, although this research has combined data from nine different studies across four different countries, the participants are all from Western nations. We also cannot assume that the relationship between PTSD symptoms and functional impairment as well as age-related differences will manifest in the same manner in non-Western cultures. For example, Kohrt et al. (2011) demonstrated that symptoms of effortful avoidance may not be a valid indicator of post-traumatic pathology among war-exposed youth in Nepal. Consequently, replication of this study in non-Western settings is important to further our understanding of how PTSD and functional impairment manifests in this age-group in diverse populations.

In addition, given that the binary regression model was only able to correctly classify 67% of functionally impaired pre-adolescent children and 68% of functionally impaired adolescents, it seems likely that factors in addition to PTSD symptoms are contributing to functional impairment in children aged 7-14 years. More research is needed to examine the impact of physical injury, co-morbid psychiatric disorders, social, and environmental factors on PTSD symptoms and functional impairment. Of course, pre-existing functional impairment prior to trauma exposure also cannot be ruled out.

Finally, this study was unable to assess the ways in which children were functionally impaired or the severity of their functional impairment. Furthermore, the assessment of functional impairment was limited to the measures contained in the PACT data archive which was either a one item dichotomised assessment (CAPS-CA) or a four-item dichotomised of functional impairment (ADIS-P). Future research should use more comprehensive measures which assess functional impairment across a variety of domains in order to determine not only which symptoms or profiles are associated with functional impairment, but in which domains children are experiencing the

greatest functional impairment. Understanding how symptoms may contribute to particular types or severity of functional impairment in children is an important step towards developing more effective interventions for children experiencing PTSD.

This study examined age-related differences in PTSD symptom presentation in children aged 7-14 years, as well as the association between PTSD symptoms and functional impairment. The combined use of binary logistic regression, ROC curve analysis and univariate analyses to examine PTSD symptoms and functional impairment has provided strong evidence on the existence of age-related differences in symptom expression between pre-adolescent and adolescent children and the importance of functional impairment. Our results clearly illustrated the need to develop PTSD diagnostic algorithms that incorporate age-related variations in symptom expression for children aged 7-14 years. In doing so, these results have contributed new knowledge regarding PTSD in a vulnerable and under-studied population.

Table 3-6 Association between Symptom Frequency and Age-Group

PTSD Symptoms	Prevalence 7-11 years (%)	*n*	Prevalence 12-14 years (%)	*n*	X^2	*p*
Intrusive memories	16%	497	11%	251	3.62	.057
Distressing dreams	**14%**	**503**	**8%**	**254**	**5.24**	**.022**
Dissociative reactions	**17%**	**497**	**11%**	**251**	**4.70**	**.030**
Psychological distress at cues	**19%**	**502**	**8%**	**253**	**15.82**	**<.001**
Physiological reactivity	10%	503	7%	253	1.93	.165
Avoidance of thoughts/feelings	**23%**	**500**	**9%**	**253**	**21.21**	**<.001**
Avoidance of activities	**21%**	**501**	**12%**	**252**	**7.82**	**.005**
Inability to recall an important aspect of the trauma	43%	501	45%	251	0.30	.582
Loss of interest	10%	501	11%	251	0.26	.612
Detachment	6%	501	8%	253	1.43	.233
Restricted affect	7%	499	6%	253	0.22	.642
Foreshortened future	6%	492	6%	251	0.00	.964
Difficulty sleeping	16%	499	20%	252	1.70	.193
Irritability	29%	498	26%	251	0.66	.418
Difficulty concentrating	18%	499	13%	252	2.72	.099
Hypervigilance	**18%**	**499**	**11%**	**252**	**6.38**	**.012**
Exaggerated startle	**13%**	**499**	**8%**	**252**	**4.32**	**.038**

Table 3-7 Ranking of Correlations between Symptom Frequency and Age-Group

PTSD Symptom	Phi	*p*
Difficulty sleeping	0.05	.193
Detachment	0.04	.233
Inability to recall an important aspect of the trauma	0.02	.582
Loss of interest	0.02	.612
Foreshortened future	0.00	.964
Restricted affect	-0.02	.642
Irritability	-0.03	.418
Physiological reactivity	-0.05	.165
Difficulty concentrating	-0.06	.099
Intrusive memories	-0.07	.057
Exaggerated startle	**-0.08**	**.038**
Dissociative reaction	**-0.08**	**.030**
Distressing dreams	**-0.08**	**.022**
Hypervigilance	**-0.09**	**.012**
Avoidance of thoughts/feelings	**-0.10**	**.005**
Physiological distress at cues	**-0.14**	**<.001**
Avoidance of activities	**-0.17**	**<.001**

Figure 3-1 ROC Curve: Pre-Adolescent Group (Aged 7-11 Years)

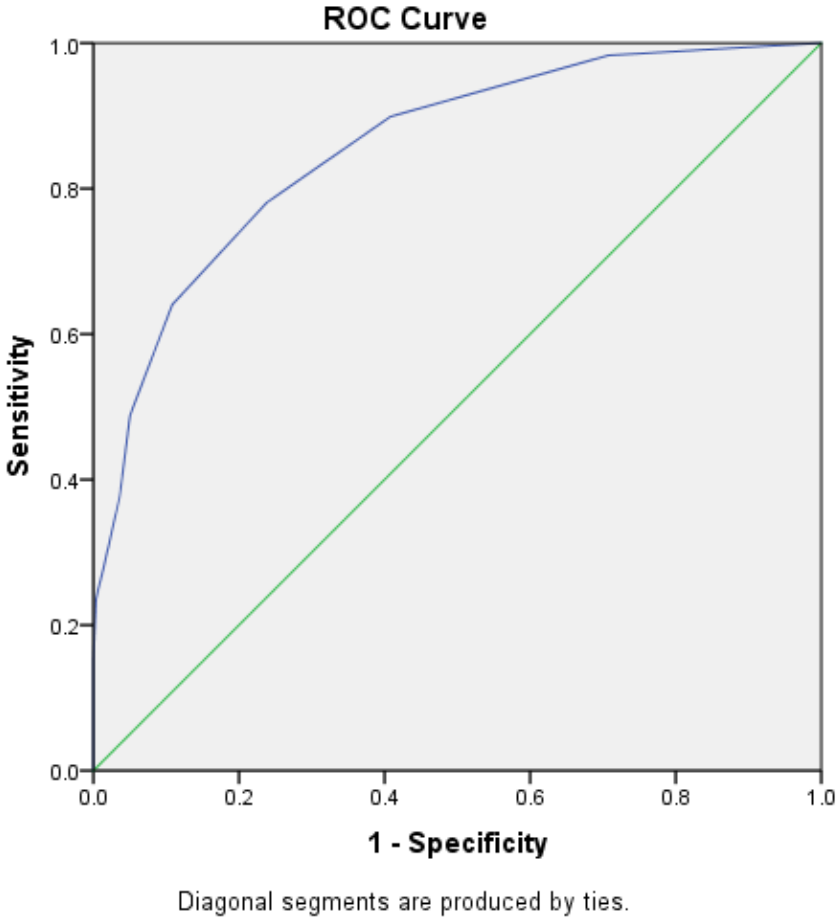


Table 3-8 Coordinates of the Curve: Pre-Adolescent Group (7-11 Years)

Positive if Greater Than or Equal To	Sensitivity	1 - Specificity	Specificity
-1	1	1	0
0.5	0.983	0.708	0.29
1.5	0.899	0.408	0.59
2.5	0.781	0.238	0.76
3.5	0.64	0.108	0.89
4.5	0.489	0.051	0.95
5.5	0.376	0.036	0.96
6.5	0.281	0.014	0.99
7.5	0.236	0.004	1
8.5	0.152	0	1
9.5	0.101	0	1
10.5	0.067	0	1

Figure 3-2 ROC Curve: Adolescent Group (12-14 Years)

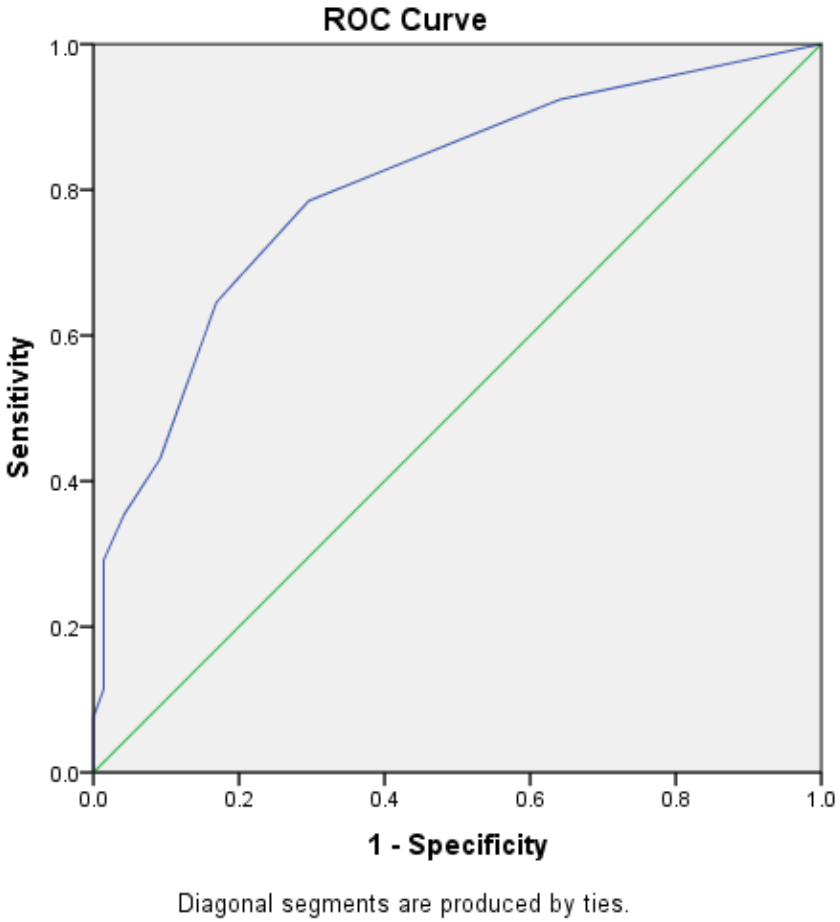


Table 3-9 Coordinates of the Curve: Adolescent Group (12-14 Years)

Positive if Greater Than or Equal To	Sensitivity	1 - Specificity	Specificity
-1	1	1	0
0.5	0.92	0.64	0.36
1.5	0.78	0.3	0.7
2.5	0.65	0.17	0.83
3.5	0.43	0.09	0.91
4.5	0.35	0.04	0.96
5.5	0.29	0.01	0.99
6.5	0.2	0.01	0.99
7.5	0.11	0.01	0.99
9	0.08	0	1
10.5	0.05	0	1
12	0.04	0	1
13.5	0.01	0	1
15	0	0	1

Chapter 4. Latent Class Structure of PTSD Symptoms in Children aged 7-14 years

4.1. Abstract

Children aged 7-14 years are undergoing rapid development in all facets of their lives. It is possible that the manner in which PTSD manifests in children may vary not only from adults but also at different stages of child development. The purpose of this study was to use latent class analyses to: 1) Examine PTSD symptom heterogeneity in children aged 7-14 years after exposure to trauma, 2) Explore potential age-related differences in symptom profiles of children in the following age groups: Young Group (7-9 years), Latency Group (10-11 years), and Adolescent Group (12-14 years) and, 3) Examine which symptom profiles have the strongest relationship with functional impairment and the PTSD diagnosis. The sample included 757 children (35% females, 65% males) from nine different studies conducted in four countries (Australia, Switzerland, United Kingdom, and United States), drawn from an international archive of de-identified datasets. The study found important age-related differences in the PTSD symptom profiles most associated with functional impairment. The symptom profiles most associated with functional impairment did not align with the symptom structure of the DSM-5 PTSD diagnosis which is currently applied to this age-group. It also highlighted the presence of significant functional impairment in children in the absence of a PTSD diagnosis and with a low level of symptom presence. Consequently, it has provided additional evidence that the DSM-5 PTSD diagnosis may not be sensitive for children aged 7-14 years.

4.2. Introduction

Each year, millions of children are exposed to potentially traumatic events world-wide (Copeland et al., 2007; Cuffe et al., 1998). Posttraumatic Stress Disorder (PTSD) is one of the most common disorders to be diagnosed following exposure to trauma (DiMauro et al., 2014; Norris et al., 2002). It causes substantial distress and has the potential to adversely impact children's long-term social, emotional, and physical development and well-being (Fairbank & Fairbank, 2009; Pynoos et al., 2009; Seng et al., 2005). It has been recognised for many years that symptoms of mental health disorder may manifest differently in children than they do in adults (Scheeringa et al., 2011). In fact, a substantial body of research now exists which has demonstrated that the Diagnostic and Statistical Manual IV (DSM-IV) PTSD diagnostic criteria lack sensitivity in diagnosing children 6 years and younger (Levendosky et al., 2002; Meiser-Stedman et al., 2008; Ohmi et al., 2002; Scheeringa, 2003; Scheeringa & Zeanah, 2008; Scheeringa et al., 2011). As a result, an alternative set of diagnostic criteria for children aged 6 years and younger are available (American Psychiatric Association, 2013a).

The research on the diagnostic validity of PTSD in children aged 7-14 years is more limited than the research that has been conducted with younger children (Carrion et al., 2002; Copeland et al., 2007; Iselin et al., 2010; Meiser-Stedman et al., 2008; Schäfer et al., 2006), and therefore was considered less compelling to warrant modifications to the DSM-5 (Friedman, 2013). Consequently, the criteria for diagnosing PTSD in children 7 years and older remains the same as that of diagnosing adults with PTSD (American Psychiatric Association, 2013a). However, previous research has raised doubts regarding the developmental appropriateness of particular PTSD symptoms in children (Blom & Oberink, 2012), the validity of the diagnostic algorithm (Copeland et al., 2007; Iselin et al., 2010; Scheeringa et al., 2011) as well as whether the six symptom minimum required to meet diagnostic threshold is sensitive enough to include all children experiencing significant post-traumatic stress and who warrant a diagnosis (Carrion et al., 2002).

The purpose of this study was to use Latent Class Analysis to:

1. Examine PTSD symptom heterogeneity in children aged 7-14 years after exposure to trauma,
2. Explore potential age-related differences in symptom profiles of children in the following age-groups: Young Group (7-9 years), Latency Group (10-11 years), and Adolescent Group (12-14 years),
3. Examine which symptom profiles have the strongest relationship with functional impairment and the PTSD diagnosis.

We chose to divide our sample into these age-ranges because they naturally delineate different developmental periods (i.e., early school years, middle school years, and early adolescence, respectively) where changes in social, educational, and emotional dimensions may affect the way PTSD symptoms are expressed. In addition, we chose to sub-divide the pre-adolescent group (ages 7-11 years) used in the previous study examining age-related differences in PTSD symptom presentations; into a Young Group (7-9 years) and a Latency Group (10-11 years). This was in order to explore more subtle differences that may be present in PTSD symptom profiles as children progress from pre-adolescence to adolescence.

4.3. Methodology

Latent class analysis (LCA) is a sub-type of structural equation modelling that uses data from individual participants to identify hidden sub-groups of people with similar response patterns to the variables of interest. In contrast to other methods, LCA does not rely on cut-off scores or a particular diagnostic algorithm to classify individual post-trauma responses into binary diagnostic categories. Instead, it uses a multivariate approach to group children according to similar symptom presentations regardless of whether their symptoms align with a particular algorithm. LCA is based on the assumption that there is an underlying latent categorical variable which determines latent class membership. The use of LCA allowed us to explore common PTSD symptom profiles in children, qualitative differences in symptom profiles that may be present at different developmental stages, and the relationship of these profiles to functional impairment. To our knowledge, this is the first prospective study to use LCA to explore age-related differences in PTSD symptom profiles in children aged 7-14 years.

This study used an Integrative Data Analysis (IDA) approach (Curran & Hussong, 2009) to pool and analyse data from independent studies drawn from the PTSD after Acute Child Trauma (PACT) Data Archive. PACT is an international archive of de-identified data sets from prospective research studies of children exposed to an acute, potentially traumatic event. Currently, the archive

contains 23 data sets from four different countries (Australia, Switzerland, UK, and US). Each dataset included basic information on demographics, trauma characteristics, one or more potential predictors of ongoing traumatic stress assessed soon after a traumatic event and at least one measurement of traumatic stress symptoms at a later time point (Kassam-Adams et al., 2012). Advantages of using the IDA for these analyses included increased statistical power and increased sample heterogeneity (Bainter & Curran, 2014; Curran & Hussong, 2009).

Studies in the PACT database varied on the type of traumatic stress measure used and the time points after trauma exposure that PTSD was assessed. We chose to include only studies that administered a standardised diagnostic interview, (either the Clinician Administered PTSD Scale for Children and Adolescents (CAPS-CA) (Nader et al., 1996) or the Anxiety Disorders Interview Schedule – Parent Version (ADIS-P) (Albano & Silverman, 1996) after exposure to a DSM-IV defined A1 traumatic event. All studies assessed PTSD symptoms and concurrent functional impairment between four weeks to 1 year after exposure. In each study, children were recruited for participation based on their exposure to a potentially traumatic event (i.e., non-mental health treatment referred samples) after they sought medical treatment at a hospital. None of the studies we used required participants to endorse a minimum level of symptoms or functional impairment as a condition of inclusion. It is important to note that although the DSM-5 PTSD criteria has narrowed the A1 criteria to exclude particular types of events (i.e., death of caregiver after illness); the participants of our study would still meet the A1 criteria as defined by the DSM-5 PTSD diagnosis.

The final combined sample for this study consisted of 757 children (35% females, 65% males) drawn from nine different studies conducted in four countries (Australia, Switzerland, United Kingdom, and United States). The mean age of the overall sample was 10.6 years (SD 2.1). Only participants aged 7 -14 years were selected from each individual study. Please see Table 4-1 and Table 4-2 for study and sample characteristics.

4.3.1. Measures and Outcome Variables

4.3.1.1. *The Clinician Administered PTSD Scale for Children and Adolescents*

The CAPS-CA (Nader et al., 1996) is a semi-structured diagnostic interview to assess PTSD. It is based on the adult Clinician Administered PTSD Scale which is considered a "gold standard" for assessing PTSD in people over the age of 15 years, with good psychometric properties (Carrion et al., 2002). The PTSD interview component was based on the DSM-IV PTSD criteria and assessed both the intensity and frequency of each of the 17 PTSD symptoms over the previous month via child report. Each item is scored on a 5-point frequency scale (i.e., from 0 = "none of the

time" to 4 = "most of the time") and a 5 point intensity scale (i.e., from 0 = "not a problem" to 4 = "a big problem, I have to stop what I am doing"). A minimum frequency score of one and a minimum intensity score of two is required for a symptom to be scored as present.

4.3.1.2. *Anxiety Disorder Interview Schedule –Parent (ADIS-P)*

The ADIS-P (Albano & Silverman, 1996) is a semi-structured interview for the diagnosis of anxiety and related disorders in children and adolescents which is based on the adult Anxiety Disorders Interview Schedule (ADIS) (Di Nardo et al., 1983). The PTSD interview component is based on the DSM-IV PTSD criteria and assesses the presence or absence of each of the 17 PTSD symptoms via caregiver report. Each item was scored as either "yes", "no", or "other". Only "yes" responses indicated symptom presence. Although no data on the validity and reliability of the ADIS-P specific to diagnosing PTSD in children is available, the ADIS was found to be valid and reliable in diagnosing PTSD in Vietnam veterans (Blanchard et al., 1986).

4.3.1.3. *Functional Impairment*

Functional impairment in relation to PTSD symptoms was assessed through four questions assessing impairment in four different domains (subjective distress, social functioning, scholastic functioning, and developmental functioning) on the CAPS-CA (i.e., "In the past month, did the PTSD symptoms/problems you've told me about make it harder for you to do your schoolwork or to do well at school? Was this a change or were you always like that?"). For the CAPS-CA, functional impairment was considered present if at least one of the CAPS-CA impairment questions was scored as "yes" according to the CAPS-CA scoring rules. Functional impairment was assessed through a single question on the ADIS-P ("How much has this problem interfered with your child's friendships, caused problems at school or at home, and stopped your children from the doing the things he or she would like to do?"). For the ADIS-P, functional impairment was considered present if the impairment question was scored as greater than four according to the ADIS-P scoring rules (0 = "none", 4 = "some", 8 = "very very much"). The CAPS-CA and ADIS-P questions were then recoded into a single dichotomised functional impairment variable. It should be noted that functional impairment was assessed on the CAPS-CA via child report or on the ADIS-P via caregiver report.

4.3.1.4. *Harmonisation of Symptoms across Measures*

PTSD was assessed either via the CAPS-CA (child report, 64% of participants) or via the ADIS-P (caregiver report, 36% of participants). Both diagnostic measures had 17 items, each corresponding to the 17 PTSD symptoms from the DSM-IV. We dichotomised the item ratings according to the scoring rules of each measure for symptom presence and then combined responses

for these items from both instruments. We also created a dichotomous variable for the presence/absence of concurrent functional impairment based on the impairment questions in each instrument. We followed the scoring rule of each measure to determine the presence of functional impairment. After the pooling of data, our dataset contained 17 dichotomised items which assessed for 17 PTSD symptoms from all nine studies, in addition to one dichotomised item assessing for functional impairment from eight of the nine studies. Functional impairment was assessed in all but one study. This method of harmonising and pooling data across multiple studies has been used previously (Kassam-Adams et al., 2012).

4.3.1.5. *DSM-5 PTSD Diagnosis for Children 6 Years and Younger*

The DSM-5 PTSD diagnosis for children 6 years and younger is based on the PTSD Alternative Algorithm (PTSD-AA) which has demonstrated superior validity with children 6 years and younger (Scheeringa et al., 2012). Additional research has also suggested that this algorithm may be more sensitive in identifying children aged 7-14 years with PTSD than the DSM-IV PTSD criteria (Danzi & La Greca, 2017; Iselin et al., 2010; Meiser-Stedman et al., 2008; Mikolajewski et al., 2017) or the DSM-5 PTSD criteria (Danzi & La Greca, 2017). Therefore, we used a modified version of the DSM-5 PTSD algorithm for children 6 years and younger to calculate PTSD prevalence rates and approximate a PTSD diagnosis. It should be noted that although the DSM-5 PTSD diagnosis added three new symptoms (distorted cognitions, negative emotional state, and reckless or self-destructive behaviour), only one of those new symptoms (negative emotional state) was included in DSM-5 PTSD for Children 6 Years and Younger. Furthermore, it should also be noted that our data was collected based on the DSM-IV wording of PTSD symptoms. Please see Table B1 in Appendix B for more specific information on each diagnostic algorithm.

4.3.1.6. *DSM-5 Modified Algorithm*

Similar to the DSM-5 PTSD for Children 6 Years and Younger, the DSM-5 Modified Algorithm (DSM-5 MA) is comprised of three symptom clusters: 1) Intrusion, 2) Avoidance and negative alternations in cognitions, and 3) Arousal/reactivity. Children are required to endorse four symptoms to meet the minimum PTSD symptom threshold. Notably, although the symptoms inability to recall an important aspect of the trauma, and detachment were removed from DSM-5 PTSD for Children 6 Years and Younger, we chose to retain them in the DSM-5 MA given the older age of our sample and to obtain additional information on the validity of these symptoms in children aged 7-14 years. Given that the data collected was based on DSM-IV questionnaires, none of the three new DSM-5 PTSD symptoms (negative emotional state, distorted cognitions, and reckless or self-destructive behaviour) or the two new DSM-5 PTSD for Children 6 Years and

Younger symptoms (social withdrawal, and negative emotional state) were included in our algorithms.

The DSM-5 MA was calculated in two different ways. In the first method we followed the symptom structure for DSM-5 PTSD for Children 6 Years and Younger which required one symptom of intrusion, one symptom of either effortful avoidance or negative alterations in cognitions, and two symptoms of arousal/reactivity to meet criteria for diagnosis. In the second method, we followed the same algorithm with one exception. In order to meet PTSD diagnosis, we required that at least one of the four PTSD symptoms endorsed was a symptom of effortful avoidance. The minimum four symptom threshold for diagnosis remained the same for both methods. Functional impairment was required to meet PTSD diagnosis in both methods.

4.3.2. Study Ethics

This study was approved by the Faculty of Medicine's Institutional Review Board at the University of Queensland. All of the data sets stored in the PACT Data Archive underwent an Institutional Review Board or equivalent oversight body ethics review per the protocols in each respective country and institution prior to the collection of data.

4.3.3. Settings

Table 4-1 Study Characteristics. Datasets Included in Analyses

n	Country	Study Setting	Trauma Type
169	USA	Hospital	Traffic-related injury
130	Australia	Hospital	Unintentional Injury
78	Australia	Hospital	Unintentional Injury
156	Australia	Hospital	Traumatic Brain Injury
37	USA	Hospital	Hospitalised Injury
27	USA	Hospital	Hospitalised Injury
44	UK	Hospital	Motor Vehicle Accident
77	Australia	Hospital	Single Incident injury
39	Switzerland	Hospital	Motor Vehicle Accident

Note. Only the number of participants between 7-14 years of age from each study are shown.

Table 4-2 Sample Characteristics (*n* = 757)

Age Group	*n*	Gender (% males)	Unintentional Injury %	Motor vehicle accidents %
Young Group 7-9 years	292	60	68	32
Latency Group 10-12 years	211	63	69	31
Adolescent Group 12-14 years	254	74	65	35

4.3.4. Analysis of Data

4.3.4.1. *Missing Data*

We examined the percentage of missing values for each of the 17 DSM-IV PTSD items and found the missing percentage for each PTSD item ranged from 15% to 17% from a total sample size of $N = 757$. We chose not to conduct multiple imputation of the missing values because we found that 135/168 cases (80%) with missing data had not completed the diagnostic questionnaire within the time point (1 month to < 1 year) that we were assessing. Consequently, all of the 17 PTSD items were missing in these cases. These cases were initially part of the study because the participants completed other measures which were not analysed in this study. We deleted 135 cases that did not complete the questionnaire within the required timeframe from the dataset. Listwise deletion was used for all analyses.

4.3.4.2. *Latent Class Analysis Data Analytic Strategy*

LCA was conducted in an exploratory manner. No assumptions were made about latent class structure or number of latent classes *a priori* due to the limited research that has been conducted with children in this age-range. LCA models were built in a series of steps beginning with the specification of a one class model, and then systematically increasing the number of classes until there was no further improvement to the model. The best class solution was then chosen based on a combination of fit statistics, interpretability, and parsimony. As there was not a single fit statistic to determine the optimal class solution in LCA, several different fit indices were examined: 1) Akaike Information Criterion (AIC) (Akaike, 1987), 2) Bayesian Information Criterion (BIC) (Schwarz, 1978), and 3) Sample Size Adjusted BIC (SABIC) (Sclove, 1987). An optimal class solution will have the lowest value on all of these fit indices. We also examined relative fit using the Parametric Bootstrap Likelihood Ratio Test (BLRT) (McLachlan & Peel, 2005) and the Vuong-Lo-Mendell-Rubin Likelihood Ratio Test (Lo, Mendell, & Rubin, 2001). A *p*-value of < .05 on

either test suggested that the estimated model provided a better fit relative to the former model with one less class.

Given the absence of a clear-cut rule for the use of fit statistics with discrepant findings in class enumeration, we gave primary weight to the SABIC and the BLRT. This decision was based on the results of a simulation study (Nylund, Asparouhov, & Muthén, 2007) in which both out-performed the other fit indices for LCA with categorical data. All analyses were conducted using Mplus Version 8 with mixture-add on (Muthén, 1998-2017).

4.3.5. Latent Class Analysis Model

We built four separate LCA models: 1) Total Group (7-14 years), 2) Young Group (7- 9 years), 3) Latency Group (10-11 years), and 4) Adolescent Group (12-14 years). See Table 4-2 for additional information on each age-group. The 17 symptoms which comprised the DSM-IV PTSD diagnosis (coded dichotomously for presence or absence) were used in each LCA model. The LCA models were estimated using maximum likelihood method with robust standard errors (MLR) with 1000 initial random starts, 250 final stage optimisations, and a maximum of 50 iterations for each optimisation to determine if the best log-likelihood value was obtained and replicated. A total of 500 bootstrap draws were used in the Parametric Bootstrap Likelihood Ratio Test (BLRT) with 50 initial stage random starts and 20 final stage optimisations for both the (k-1)-class model and the k-class model. We estimated latent class models ranging from one to four classes. Larger latent class models were not estimated due to small class sizes in the four-class model and the interpretability of the solution.

4.4. Results

A three-class solution presented the optimal fit across all age-groups. Although each latent class analysis was conducted independently, we encountered similar data-related issues that informed how we chose the optimal fit solutions for each age sub-group. Therefore, the process to determine the best fitting solution will be summarised here for all models. In the next section, we will discuss the findings for each latent class model separately.

The fit indices for all latent class solutions by age-group are presented in Table 4-3 - Table 4-6. Due to low symptom endorsement which resulted in data sparseness, some values in both the three and four-class solutions across all age-groups were set at extreme values. The SABIC and the BLRT showed the four-class model to be the best class solution for every age-group, however, there were a high number of bivariate residuals (BVRs) in each of the latent class solutions (bivariate Pearson chi square > = 3.84). This demonstrated a potential violation of the local independence assumption and may have introduced bias into the results by over-estimating the number of classes

(Oberski, van Kollenburg, & Vermunt, 2013). We attempted to correct this by re-running the three and four-class solutions for every age-group while fixing the five largest BVRs to zero. However, due to data sparseness, we were unable to replicate the log likelihood value in either the three or four-class solution. Therefore, on the basis of this potential bias, the size of the latent classes in the three versus four-class solutions, interpretability, and parsimony, we selected the three-class solution as optimal, while leaving the bivariate residuals unconstrained.

In the Latency Group (10-11 years), the decision to fit a three-class solution was less clear-cut than with the other age-groups. When we examined the three-class solution, we noted that although every latent class had large class sizes (23%, 24%, and 54%), the differences between the two classes with the highest item response probabilities were not as evident. Unlike the Young and Adolescent Groups, there were no latent classes which contained symptoms with high item response probabilities. We also found poor class separation between the two classes with the highest item response probabilities as well as low homogeneity. Although it could be argued that a two-class model which had both high homogeneity and good class separation may have provided a better fit to the data for reasons of parsimony and interpretability, we selected the three-class model as the optimal fit for two main reasons. First, it was necessary to facilitate comparisons of age-related differences across the three latent class models. Second, maintaining three latent classes in this age-group would allow us to explore which of these symptom profiles were most associated with functional impairment.

4.4.1. Item Response Probabilities

In the initial stage, we examined the item response probabilities for each latent class model separately. We considered item response probabilities between .0 - .34 as a low level of symptom endorsement, .35 - .64 as a medium level of symptom endorsement and values between .65 – 1.0 as a high level of symptom endorsement.

4.4.2. Total Group Aged 7-14 Years

As described above, the three-class model provided the best fit. Class 1 (High Symptom Class) is characterised by medium and high levels of endorsement of several PTSD symptoms (intrusion symptoms, effortful avoidance, and irritability). In contrast, Class 3 (Low Symptom Class) was characterised by low probability of endorsement of all PTSD symptoms with the exception of inability to recall an important aspect of the trauma. Class 2 (Some Symptoms Class) was characterised by a probability of endorsement between the levels of Class 1 and Class 3 with only two symptoms (inability to recall an important aspect of the trauma, and irritability) with a medium probability of endorsement). Both the Low Symptom and Some Symptoms classes had

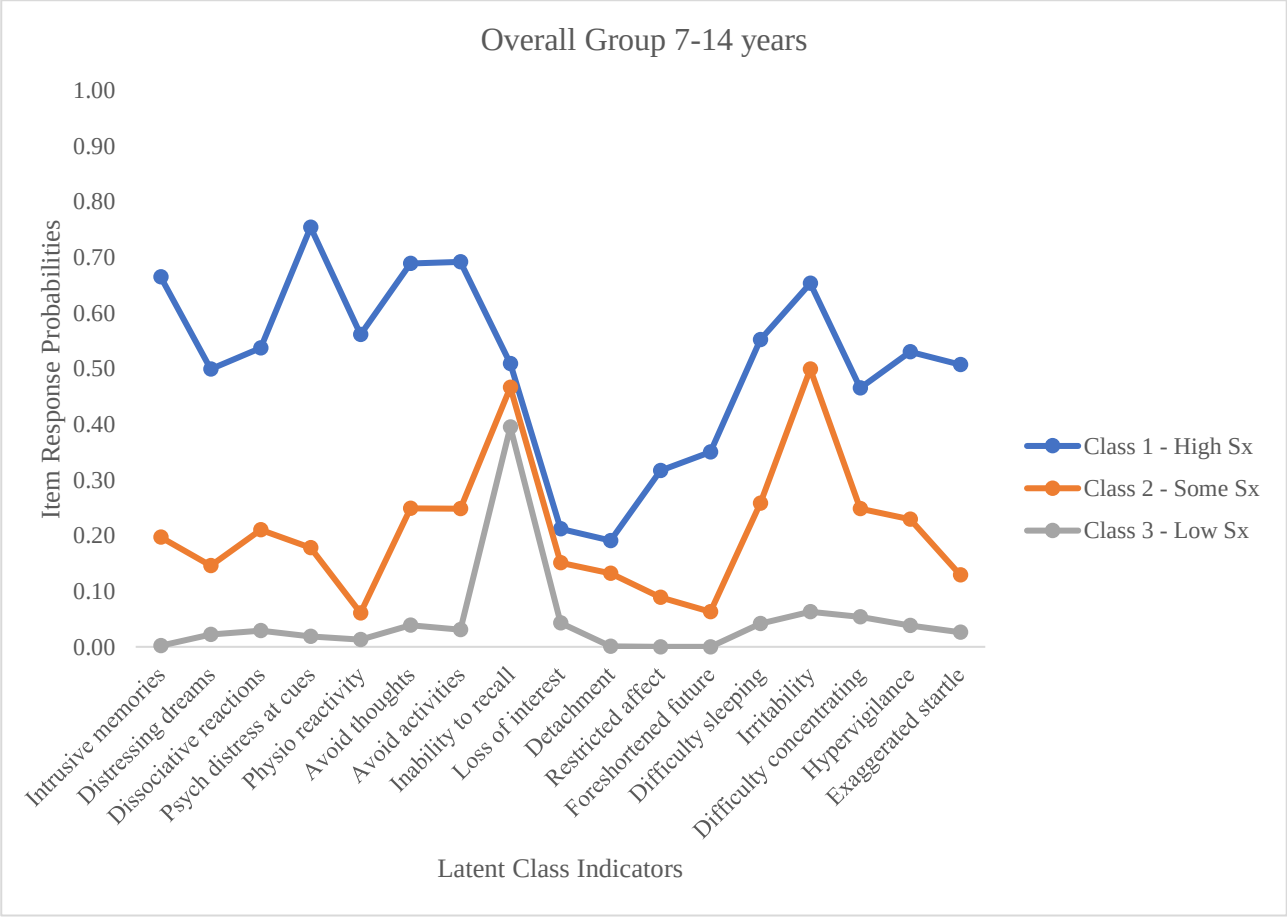
high homogeneity whereas the High Symptom Class had low homogeneity. Good class separation was noted for each class. The fit indices for the latent class solution are presented in Table 4-3.

Table 4-3 Fit Statistics for Total Group Aged 7-14 years *N* = 757

Classes	AIC	BIC	SABIC	Entropy	LRT	Adjusted LRT	BLRT
1	10357.2	10435.9	10381.9				
2	9252.18	9414.21	9303.07	0.85	0.00	0.00	0.00
3	9134.04	**9379.39**	9211.1	0.74	0.20	0.20	0.00
4	**9087.12**	9415.8	**9190.35**	0.76	0.03	0.03	0.00

Figure 4-1 provides a graphical depiction of the three-class solution.

Figure 4-1 LCA Three-Class Solution – Total Group 7-14 years *N* = 757



4.4.3. Young Group (7- 9 years)

Class 1 (High Symptom Class) was characterised by a medium to very high endorsement of effortful avoidance and intrusion symptoms as well as low endorsement of two numbing symptoms (loss of interest and detachment). In contrast, Class 3 (Low Symptom Class) was characterised by a very low probability of endorsement of all PTSD symptoms with the exception of inability to recall an important aspect of the trauma. Class 2 (Some Symptoms Class) was characterised by a

probability of endorsement that was between Class 1 and Class 3 with only three symptoms (inability to recall an important aspect of the trauma, avoidance of thoughts and feelings, and irritability) with a medium probability of endorsement. The Low Symptom Class had high homogeneity whereas both the Some Symptoms and High Symptom Classes had low homogeneity. Good class separation was noted for each class.

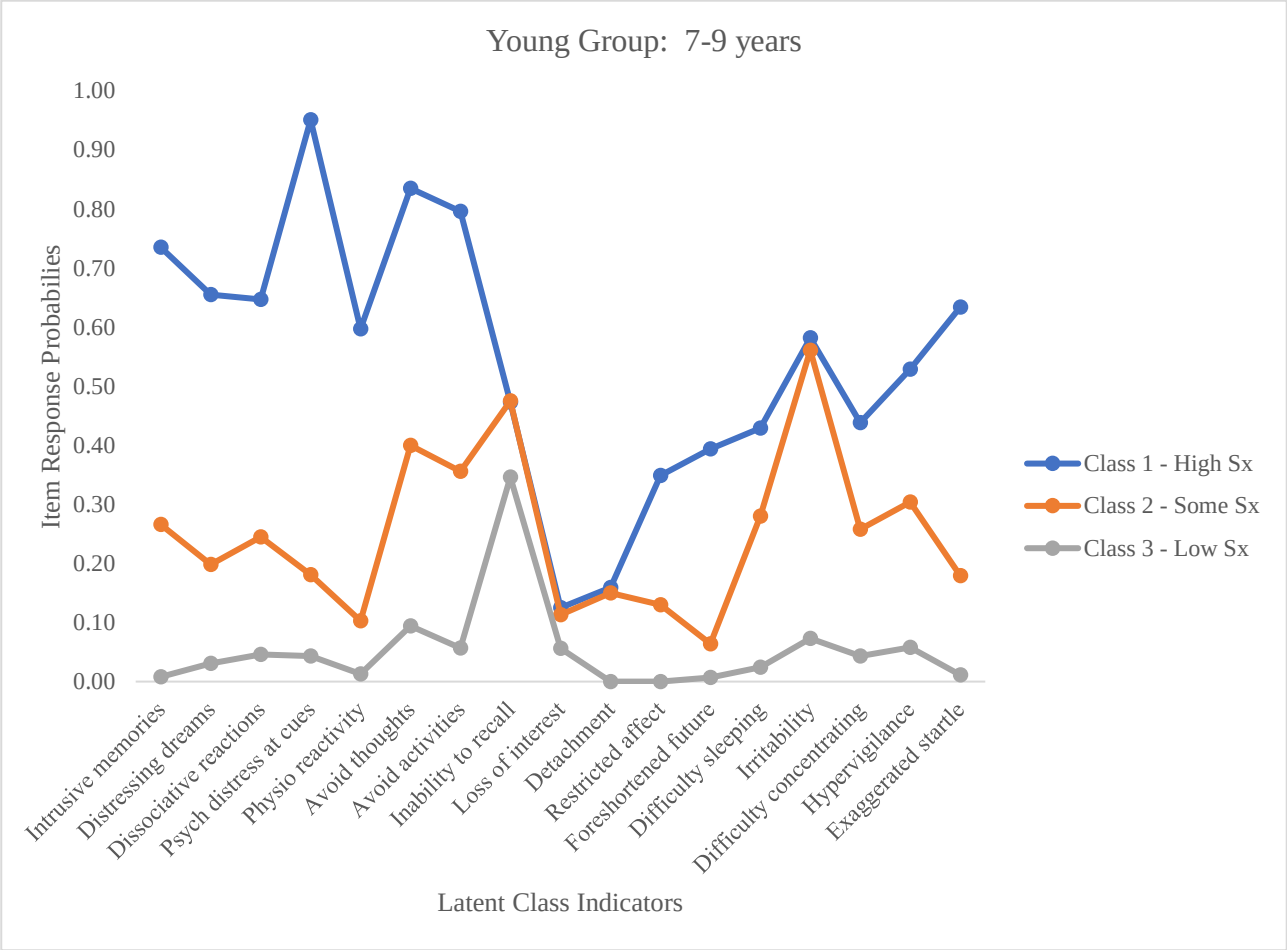
The fit indices are presented in Table 4-4

Table 4-4 Fit Statistics for Young Group Aged 7-9 Years *n* = 292

Classes	AIC	BIC	SABIC	Entropy	LRT	Adjusted LRT	BLRT
1	4365	4428	4374				
2	3858	3986	3875	0.86	0.00	0.00	0.00
3	3809	**4004**	3836	0.80	0.1229	0.1258	0.00
4	**3795**	4056	**3831**	0.85	0.1409	0.1439	0.04

Figure 4-2 provides a graphical depiction of the three-class solution.

Figure 4-2 LCA Three-Class Solution - Young Group 7-9 Years *n* = 292



4.4.4. Latency Group (10-11 Years)

The Diverse Symptom Class was distinguished by a medium level of endorsement of a wide range of symptoms from each of the four DSM-5 PTSD symptom clusters. Class 1 (Diverse Symptom Class) was characterised by medium and low levels of symptom endorsement. In contrast to the High Symptom Class in the Young and Adolescent Groups, the most commonly endorsed symptoms were intrusive memories, irritability, inability to recall an important aspect of the trauma, and efforts to avoid thoughts or feelings about the event. Although this class contained the highest item response probabilities for the Latency Group, it is notable that unlike the other age-groups, no symptom received a high level of endorsement in this class.

In contrast, Class 3 (Low Symptom Class) was characterised by a very low probability of endorsement of all PTSD symptoms with the exception of inability to recall an important aspect of the trauma. Similar to Class 1, Class 2 (Some Symptoms Class) was also characterised by medium to low endorsement of symptoms. However, in this class, only three symptoms (inability to recall an important aspect of the trauma, avoidance of thoughts and feelings, and irritability) fell within a medium level of endorsement. The Low Symptom Class had high homogeneity whereas both the

Some Symptoms and Diverse Symptom Classes had low homogeneity. Good class separation was noted for each class.

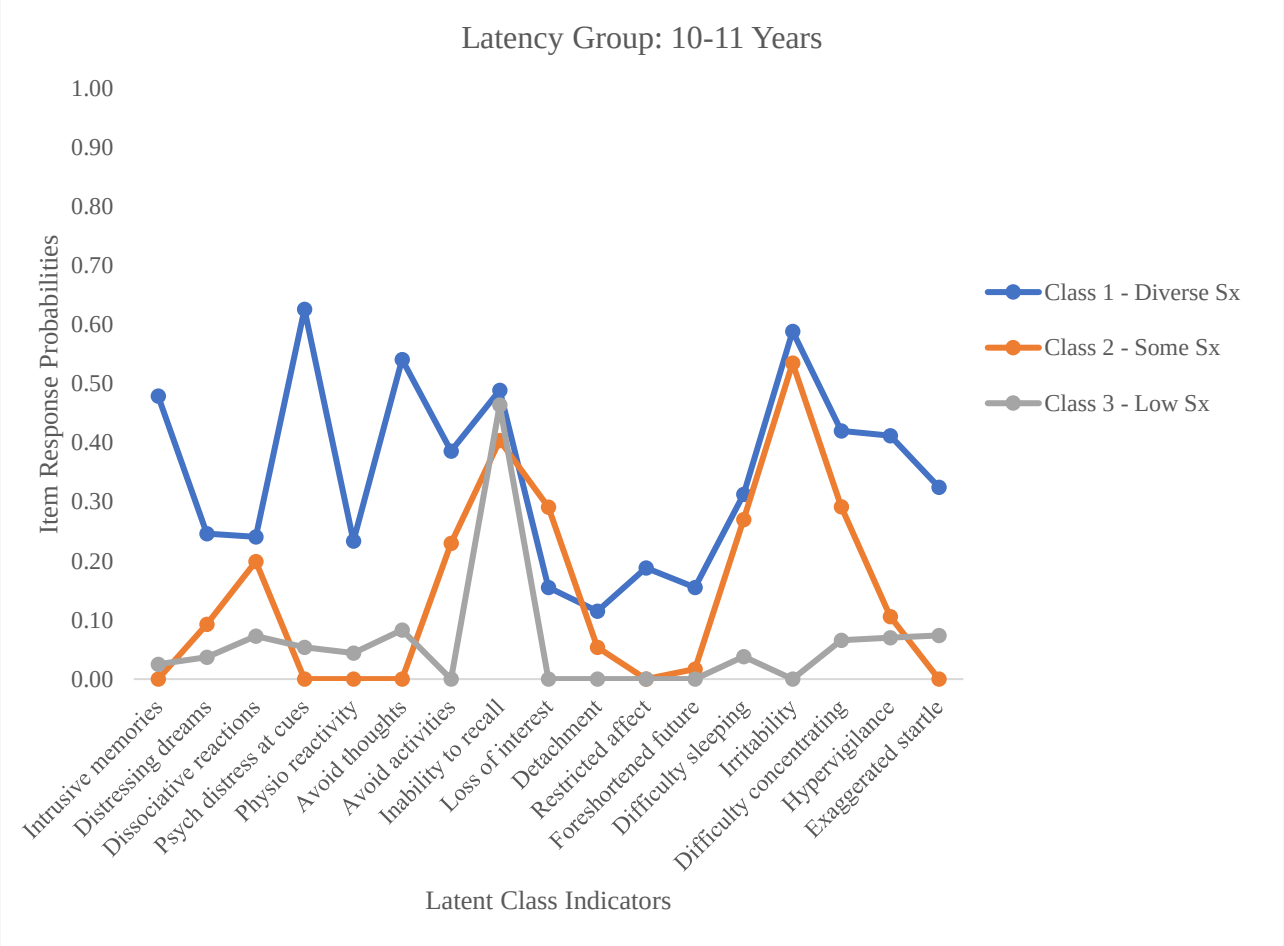
The fit indices for the latent class solution are presented in Table 4-5.

Table 4-5 Fit Statistics for Latency Group Aged 10-11 years *n* = 211

Total	AIC	BIC	SABIC	Entropy	LRT	Adjusted LRT	BLRT
1	2873.03	2930.02	2876.15				
2	2683.8	**2801.12**	2690.21	0.826	0.00	0.00	0.00
3	2663.23	2840.87	2672.94	0.802	0.01	0.01	0.00
4	**2654.81**	2892.79	**2667.82**	0.831	0.34	0.34	0.05

Figure 4-3 provides a graphical depiction of the three-class solution.

Figure 4-3 LCA Three-Class Solution - Latency Group Aged 10-11 years *n* = 211



4.4.5. Adolescent Group (12-14 years)

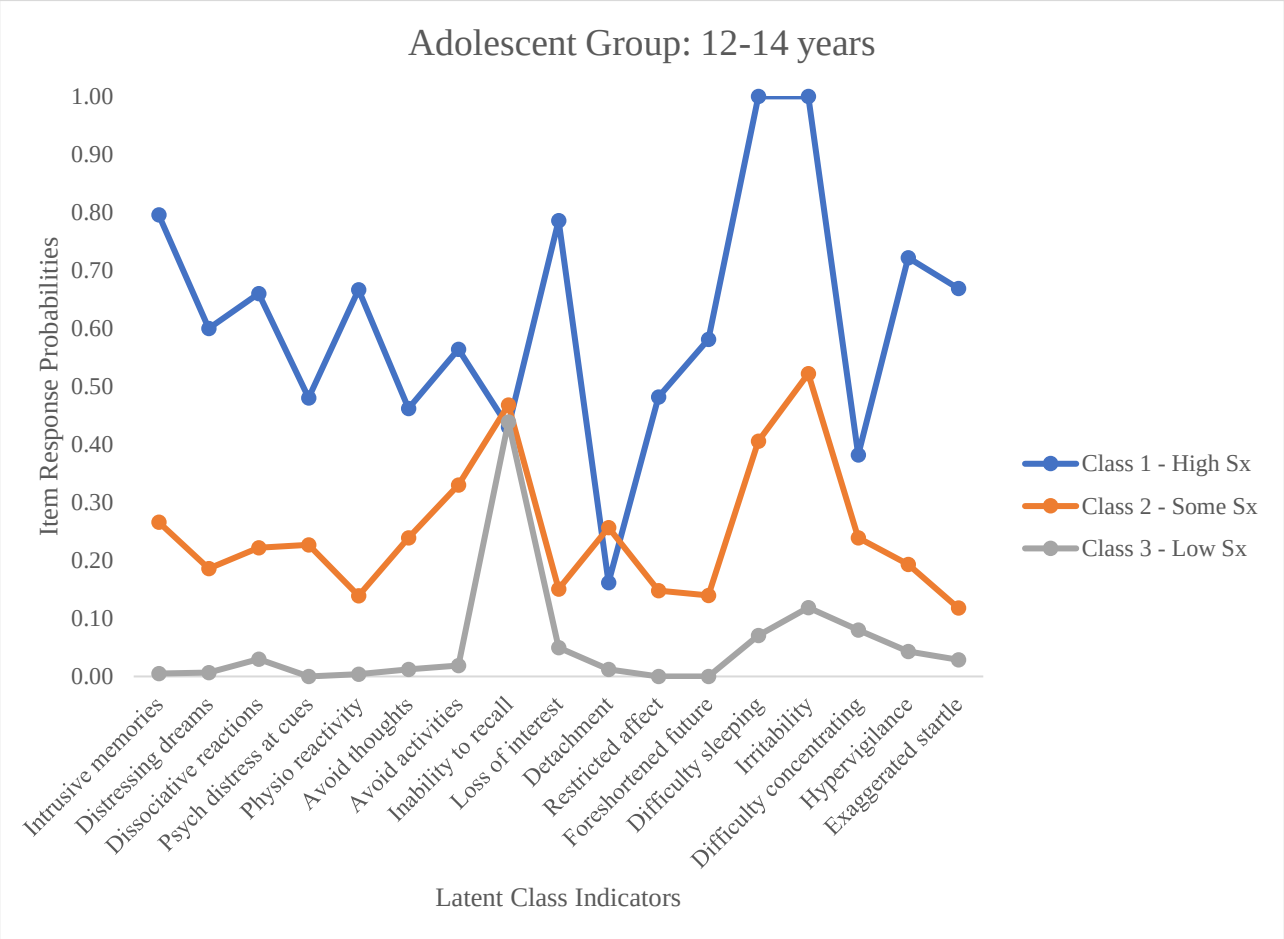
Class 1 (High Symptom Class) is characterised by a medium to very high probability of endorsement of several symptoms of arousal and intrusion, as well as the numbing symptom loss of interest. In contrast, Class 3 (Low Symptom Class) is characterised by a very low probability of endorsement of all PTSD symptoms with the exception of inability to recall an important aspect of the trauma. Class 2 (Some Symptom Class) is characterised by a probability of endorsement that was between Class 1 and Class 3 with only three symptoms (inability to recall an important aspect of the trauma, difficulty sleeping, and irritability) with a medium probability of endorsement. The Low Symptom and Some Symptoms Class had high and moderate homogeneity whereas the High Symptoms Class had low homogeneity. There was good class separation between each class. The fit indices for the latent class solution are presented in Table 4-6.

Table 4-6 Fit Statistics for Adolescent Group (Aged 12-14 years) *n* = 254

Total	AIC	BIC	SABIC	Entropy	LRT	Adjusted LRT	BLRT
1	3067.28	3127.42	3073.52				
2	2720.31	2844.12	2733.16	0.875	0.17	0.17	0.00
3	2690.12	2877.59	2709.57	0.866	0.05	0.05	0.00
4	2679.13	2930.28	2705.2	0.891	0.17	0.17	0.05

Figure 4-4 provides a graphical depiction of the three-class solution.

Figure 4-4 LCA Three-Class Solution Adolescent Group 12-14 years *n* = 254



4.4.6. Comparisons between Age-Groups

After identifying the best class solutions for each age-group and examining their symptom profiles, our next step was to compare these models across age-groups. The latent class structure may vary across age-groups in a number of ways. First, the number of latent classes may be

different between age-groups. However, even when the number of classes remains consistent across age-groups, there may be important qualitative differences in the types of symptoms that are endorsed, the frequency with which they are endorsed, and the size of the latent classes across different age-groups (Collins & Lanza, 2010). One method to test for group differences between latent class models is to conduct a multiple-group latent class analysis (Collins & Lanza, 2010). However, if measurement invariance cannot be established between each age-group, the multiple group analysis can result in invalid comparisons and may obscure important qualitative differences between ages (Collins & Lanza, 2010).

Given the important conceptual differences in the types of symptoms endorsed in each age-group, we determined that measurement invariance did not hold across the latent class models. Therefore, instead of conducting a multiple-group latent class analysis, we explored differences by calculating 95% confidence intervals for each item response probability and comparing them across latent class models. For example, we compared each item response probability in the High Symptom Class in the Young Group with each item response probability in the High Symptom Class in the Adolescent Group. Where the confidence intervals did not overlap, we determined there were significant differences in the probability of endorsement in that symptom between age-groups.

Our analyses revealed some age-related differences in the symptoms endorsed. Adolescent children endorsed irritability, trouble sleeping, and loss of interest significantly more frequently than the other age-groups. In fact, individuals in the Adolescent Group (12-14 years) had a 100% probability of endorsing symptoms of irritability and loss of interest. The Young Group (7-9 years) endorsed avoidance of activities, and several intrusion symptoms significantly more frequently than the Latency Group (10-11 years) but this difference was not significant between the Young and Adolescent Groups.

4.4.7. Class Membership and Association with Gender and Functional Impairment

In the final step of our analysis, we examined the association between class membership and functional impairment, PTSD diagnosis using the DSM-5 MA, and gender for each age-group by conducting an Equality Test of Probabilities across Latent Classes according to the Lanza, Tan, and Bray (2013) method. This method has been shown to out-perform other LCA approaches examining distal outcomes (Lanza et al., 2013). Analyses were conducted with the DCAT command in Mplus Version 8 (Muthén, 1998-2017).

4.4.7.1. *PTSD Prevalence Rates*

We calculated PTSD prevalence rates using the DSM-5 MA for each age-group and the total group. PTSD prevalence rates for the Total Group was 12%. Please see Table 4.1.

Table 4.1 PTSD Prevalence Rates by Age-Group

Age-Group	*n*	DSM-5 MA
Total Group (7-14 Years)	677	80 (12%)
Young Group (7-9 Years)	259	39 (15%)
Latency Group (10-11 Years)	197	24 (12%)
Adolescent Group (12-14 Years)	221	17 (8%)

4.4.7.2. *Gender*

In the Young and Adolescent Groups, females had greater odds of being in High Symptom Classes than in Low Symptom Classes. Similarly, in the Latency Group, females had greater odds of being in the Diverse Symptom Class as compared to the Low Symptom Class. See Table 4-7 for further information.

Table 4-7 Class Membership and Association with Gender

Latent Class	Probability	Odds Ratios	97.5% CI	
			Lower CI	Upper CI
Young Group*				
High Symptom Class	0.50	1.60	0.58	4.42
Some Symptoms Class	0.38	0.96	0.46	2.00
Low Symptom Class	0.39	1.00	1.00	1.00
Latency Group*				
Diverse Symptoms Class	0.39	1.04	0.50	2.19
Some Symptoms Class	0.32	0.75	0.33	1.71
Low Symptom Class	0.38	1.00	1.00	1.00
Adolescent Group*				
High Symptom Class	0.40	2.25	0.45	11.29
Some Symptoms Class	0.33	1.65	0.75	3.59
Low Symptom Class	0.23	1.00	1.00	1.00

*Reference gender = female.

4.4.7.3. *Functional Impairment and DSM-5 MA*

As expected, children in the High Symptom and Diverse Symptoms Classes had greater odds of meeting diagnosis with the DSM-5 MA and had greater odds of being functionally impaired. Children in the Low Symptom Classes had a very low probability of meeting diagnosis with the DSM-5 MA, or of having functional impairment. More striking, however, is that even though children in the Some Symptoms Class had a low probability of diagnosis, they much greater odds of being functionally impaired than the Low Symptom Class, in every age-group. In fact, in the Young Group, even though none of the children in the Some Symptoms Class met criteria using the DSM-5 MA, the odds of being functionally impaired were 24.5 times greater when compared with the Low Symptom Class. In addition, even though no children met criteria for diagnosis in the Low Symptom Class across all age-groups, there was still a small but significant percentage of children who were functionally impaired in the Low Symptom Class in every age-group (functional

impairment ranged 3% to 14%). Although 3% represents a small number of children in this sample, at a population level, it could represent thousands of children. Consequently, we consider 3% to be a clinically meaningful percentage of children. See Table 4-8 and Table 4-9 for further information.

Table 4-8 Class Membership and Association with Functional Impairment

Latent Class	Probability	Odds Ratio	97.5% CI	
			Lower CI	Upper CI
Young Group				
High Symptom Class	1.00	*	1.00	1.00
Some Symptoms Class	0.75	24.52	9.01	66.68
Low Symptom Class	0.11	1.00	1.00	1.00
Latency Group				
Diverse Symptoms Class	0.82	137.75	6.40	> 353.51[1]
Some Symptoms Class	0.53	35.52	1.36	926.46
Low Symptom Class	0.03	1.00	1.00	1.00
Adolescent Group				
High Symptom Class	0.86	40.19	4.68	345.00
Some Symptoms Class	0.71	15.64	5.20	47.06
Low Symptom Class	0.14	1.00	1.00	1.00

* This class had 100% probability of functional impairment and therefore OR could not be calculated.

1 Program did not estimate as upper CI was too high. Therefore we calculated as OR +SE.

Table 4-9 Class Membership and Association with DSM-5 MA

Latent Class	Probability	Odds Ratios	97.5% CI	
			Lower CI	Upper CI
Young Group				
High Symptom Class	0.91	***		
Some Symptoms Class	0.00	***		
Low Symptom Class	0.00	1.00	1.00	1.00
Latency Group				
Diverse Symptoms Class	0.60	***		
Some Symptoms Class	0.05	***		
Low Symptom Class	0.00	1.00	1.00	1.00
Adolescent Group				
High Symptom Class	0.93	***		
Some Symptoms Class	0.15	***		
Low Symptom Class	0.00	1.00	1.00	1.00

***OR was unable to be calculated because no children in the reference class met DSM-5 MA criteria.

4.5. Discussion

This study has made several important contributions to our knowledge of how children aged 7-14 years manifest PTSD symptoms and presents a number of important implications for research, diagnosis, and treatment. First, we were able to test the most common PTSD symptom profiles in children aged 7-14 years which, to the best of our knowledge, is one of the first studies to do so using an LCA approach. When we examined the sample as a whole, we found the symptom profile that was most associated with functional impairment had a high probability of endorsing symptoms of intrusion, effortful avoidance, and irritability; a medium probability of endorsing symptoms of arousal, and a low probability of endorsing symptoms of numbing. It is noteworthy that this symptom profile did not accord with the DSM-5 PTSD diagnosis which is currently applied to children aged 7-14 years.

Second, this study has highlighted some age-related differences in symptom profiles in children. Specifically, the High Symptom Class profile associated with the most functional impairment for children in the Young Group (7-9 years) was characterised by a combination of effortful avoidance and intrusion symptoms, and very few symptoms of numbing or arousal. In contrast, the High Symptom Class profile associated with the most functional impairment in the

Adolescent Group (12-14 years) was predominantly characterised by symptoms of arousal and one symptom of numbing. In particular, irritability and loss of interest, were symptoms that were endorsed by all of the adolescents in the High Symptom Class and consequently warrant further clinical attention in this age-group. The symptom profile most associated with functional impairment in the Latency Group (10-11 years) was characterised by a much more diverse array of symptoms across all PTSD symptom clusters with no particular symptoms dominating.

Third, this study supports the results of previous research regarding the symptom, inability to recall an important aspect of the trauma. Previous research has indicated the symptom may not be able to differentiate between psychogenic amnesia in children and physical symptoms, potentially leading to the over-identification of children with PTSD (Dow et al., 2013; Iselin et al., 2010). In the current study, this symptom was endorsed with similar frequency across all classes with every age-group. Given that the majority of children in this sample were exposed to unintentional injury or medical related trauma, the frequent occurrence of this symptom in all latent classes suggests that it may be reflecting physical symptoms or medication side effects instead of PTSD related pathology. These results have added weight to previous recommendations by researchers (Boelen & Spuij, 2013; Dow et al., 2013; Iselin et al., 2010; Kassam-Adams et al., 2010) to remove this symptom from the diagnostic algorithm in children.

Fourth, this study has also demonstrated the relatively low occurrence of most numbing symptoms in the Young and Latency Groups, even with highly symptomatic and functionally impaired children. In addition, the symptom, detachment, had a very low probability of endorsement across all age-groups and all latent classes. These results were consistent with previous research (Danzi & La Greca, 2017; Familiar et al., 2014; Soysa, 2013). This finding has supported Scheeringa et al. (2011)'s argument that numbing symptoms in pre-adolescent children may be difficult for caregivers to observe, and for children to report on due to their highly internalised nature. The low prevalence of numbing symptoms in both pre-adolescent groups carries a significant diagnostic implication. In the DSM-5 PTSD diagnosis, numbing symptoms are now contained within the cluster, negative alterations in cognitions and mood, and form four of the seven symptoms in this cluster. If we accept that numbing symptoms may not form part of the standard PTSD symptom profile for children in this age range as these results suggest, it leaves children required to endorse two out of the three cognitive/mood symptoms in this cluster in order to meet PTSD criteria. These new cognitive/mood symptoms were not tested for validity in this age-group prior to their inclusion in the DSM-5 (Kilpatrick et al., 2013; Miller et al., 2013). We would suggest that due to the internalised nature of these new cognitive/mood symptoms, it remains unclear whether they can be observed by caregivers or self-reported by trauma-exposed children.

These findings highlight the current uncertainty of whether the DSM-5 PTSD algorithm is of adequate sensitivity for children aged 7-14 years, and for pre-adolescent children in particular.

Fifth, this study has provided strong evidence of the validity of effortful avoidance symptoms in children aged 7-9 years. Our findings have demonstrated that effortful avoidance symptoms were a part of the PTSD symptom profile in which children were most likely to be diagnosed with PTSD and to be functionally impaired. This finding is of particular importance given previous doubts raised by researchers regarding the validity of effortful avoidance symptoms in children (Pynoos et al., 2009; Salmon & Bryant, 2002) and the new DSM-5 PTSD requirement to endorse at least one symptom of effortful avoidance in order to meet the diagnostic threshold (American Psychiatric Association, 2013a). Although these findings are encouraging, the developmental sensitivity of the new effortful avoidance requirement in these three age-groups remains untested and therefore uncertain.

Sixth, this study found that females had greater odds of belonging to the most symptomatic latent class in every age-group. The increased vulnerability of females in our sample to manifest significant PTSD symptoms has highlighted the clinical importance for future research in this area.

Lastly, these findings highlighted the presence of significant functional impairment in children even in the absence of a PTSD diagnosis and with a low level of symptom presence. Of course, the study results did not allow us to draw conclusions about the causes of this functional impairment apart from the association with PTSD symptoms. There are a number of factors that may drive functional impairment in trauma-exposed children such as physical injury, psychiatric comorbidity, social and environmental factors, in addition to PTSD symptoms per se. It is also possible that there may be particular PTSD symptoms that have outsized influences on functional impairment which could explain why children in the Some Symptom classes had a low probability of a PTSD diagnosis yet had greater odds of being functionally impaired when compared with children in the Low Symptom classes. Pre-existing functional impairment prior to trauma exposure also cannot be ruled out.

Regardless of the cause of functional impairment, this study demonstrated that if the only criterion we use to determine if a trauma-exposed child warrants treatment is whether they meet PTSD diagnostic criteria, a significant number of children who warrant attention and care will be missed. In fact, the High Symptom/Diverse Symptom Class was the smallest class across every age sub-group (11.0%, 24%, 4%) as well as for the overall group (10%) highlighting the need to focus on sub-threshold diagnoses to identify the majority of children experiencing significant post-traumatic stress symptoms. This study has used the more liberal and diagnostically sensitive DSM-

5 MA to identify children who met PTSD diagnostic criteria, which further validates the argument that meeting a PTSD diagnostic algorithm is not sufficient to identify the majority of trauma-exposed children who warrant attention and care.

4.6. Limitations and Areas for Further Research

This study provided evidence on age-related differences in symptom profiles between children aged 7-14 years. However, these results should be considered in the context of several limitations.

First, the diagnostic measures that were used to assess PTSD symptoms were based on the DSM-IV PTSD diagnosis. Consequently, we were unable to assess the presence of the three new DSM-5 PTSD symptoms (negative emotional state, distorted cognitions, and reckless or self-destructive behaviour) or the new symptom (social withdrawal) contained in DSM-5 PTSD for Children 6 Years and Younger. Therefore, it is unknown how these additional symptoms may have influenced symptom profiles or contributed to age-related differences. In addition, because these additional symptoms were not assessed, it is possible that the PTSD prevalence rate may be under-estimated in this sample. Consequently, future research exploring how PTSD symptoms are manifested in trauma-exposed children in this age-range should include all current DSM-5 PTSD symptoms.

Second, in order to harmonise the two different diagnostic interview measures, we dichotomised the data. Consequently, this study was unable to assess how varying degrees of symptom severity may have influenced symptom profiles and their association with functional impairment. It is possible that along with both the type and number of symptoms endorsed, that symptom severity and symptom frequency would influence a child's level of post-trauma functional impairment as well as how symptoms may group together in a profile. Consequently, an important way to extend this research would be to conduct a latent profile analysis to explore not only the influence of the number and types of symptoms endorsed but also their severity.

In addition, it is important to highlight that because our sample was drawn from hospitals and was not comprised of treatment-referred participants, there was a relatively low prevalence of the PTSD diagnosis (12% overall) as well as low rates of symptom endorsement. A strength of conducting prospective research with a trauma-exposed population is that it allows us to assess PTSD symptoms even when they do not meet pre-determined diagnostic algorithms or screening criteria. Restricting research samples to children who have been referred for treatment could inadvertently exclude children experiencing substantial post-traumatic stress who have not been identified because their symptoms do not conform to pre-determined criteria. Nevertheless, the low

rates of symptom endorsement in this sample resulted in data sparseness which did not allow us to take into account all potential variations in symptom patterns. In addition, due to data sparseness we were unable to constrain the influence of bivariate residuals in estimating the number of latent classes. Although we attempted to correct the potential bias of class over-estimation by choosing the three versus four-class solution, we cannot be certain that this bias was fully corrected. Consequently, we recommend that this research is replicated with more symptomatic children (i.e., clinical population) in order to obtain a fuller understanding of potential variations in PTSD symptom profiles.

It is also essential to acknowledge limits to the generalisability of this study. The majority of the children in this sample experienced unintentional injury as the index trauma event. We cannot assume that children who experience other types of trauma such as interpersonal violence or disasters will manifest symptoms in the same manner. Consequently, additional research across a diverse range of traumas should be undertaken.

Furthermore, although this research has combined data from nine different studies across four different countries, the participants were all from Western nations. We also cannot assume that PTSD symptom profiles and age-related differences will manifest in the same manner in non-Western cultures. For example, Kohrt et al. (2011) demonstrated that symptoms of effortful avoidance may not be a valid indicator of post-traumatic pathology among war-exposed youth in Nepal. Consequently, replication of this study in non-Western settings is important to further our understanding of how PTSD manifests in this age-group. It is also important to note that females made up approximately one third of our sample. Therefore, we were unable to fully explore gender differences in PTSD symptom profiles. Future research should also focus on whether symptom profiles remain invariant across gender.

Finally, this study was unable to assess the ways in which children were functionally impaired or the severity of their functional impairment. The assessment of functional impairment was limited to the measures contained in the PACT data archive which was either a one item dichotomised assessment (CAPS-CA) or a four-item dichotomised of functional impairment (ADIS-P). Future research should use more comprehensive measures which assess functional impairment across a variety of domains in order to determine not only which symptoms or profiles are associated with impairment, but in which domains children are experiencing the greatest functional impairment. Understanding how symptoms and symptom profiles may contribute to particular types and severity of functional impairment in children is an important step towards developing more effective interventions for children experiencing PTSD.

4.7. Conclusion

This study used "gold standard" diagnostic interviews for the assessment of PTSD and functional impairment, as well as a large international sample of participants. Separate LCAs were conducted with children in three developmental stages in order to understand age-related differences in PTSD symptom presentations. The use of LCA has provided important evidence on the heterogeneous nature of PTSD symptom presentations in children aged 7- 14 years which did not appear to conform to the DSM-5 PTSD algorithm currently applied to this age-group. Not only did this study highlight the need for additional research to examine whether the use of the DSM-5 PTSD algorithm is adequately sensitive for this age-group, but it has also demonstrated the importance of looking beyond diagnostic algorithms in determining which trauma-exposed children need attention and care.

Chapter 5. Symptoms of Effortful Avoidance in Trauma-Exposed Children aged 7-14 years, and Implications for the PTSD Diagnosis

5.1. Abstract

The DSM-5 introduced substantial changes to the PTSD diagnostic criteria which apply to adults as well as children aged 7 years and older. One of the key changes is the requirement to endorse at least one symptom of effortful avoidance to qualify for the PTSD diagnosis. Due to developmental sensitivity concerns, symptoms of effortful avoidance were not required to be endorsed in the alternative PTSD criteria developed for children 6 years and younger, but the requirement remains for children 7 years and older (American Psychiatric Association, 2013a). However, as the effortful avoidance requirement was not tested with children prior to its inclusion in the DSM-5 PTSD diagnosis, it is uncertain if it would reduce the developmental sensitivity of the diagnosis for children 7 years and older. A lack of developmental sensitivity in PTSD criteria could delay the early identification of children with PTSD and preclude their eligibility for treatment. The purpose of this study was to explore age-related differences between three groups of children (Young Group 7-9 years, Latency Group 10-11 years, Adolescent Group 12-14 years), regarding: 1) The impact of the requirement to endorse one symptom of effortful avoidance on PTSD prevalence rates and, 2) The saliency of the effortful avoidance symptom cluster and its relationship to functional impairment. Our results showed that the effortful avoidance requirement did not reduce the developmental sensitivity of the PTSD diagnosis for the majority of children in this sample. However, it did prevent a small but clinically significant minority of children (2%) from meeting the PTSD diagnosis in every age-group.

5.2. Introduction

A number of significant changes have been introduced to the PTSD diagnosis in the fifth and latest edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychiatric Association, 2013b; Miller et al., 2013). One of the most salient is its reconceptualisation from an anxiety-based disorder primarily driven by fear-circuitry to a disorder that encompasses a broader range of negative alterations to emotions, cognition and behaviour (American Psychiatric Association, 2013b). Along with this reconceptualisation, the PTSD diagnosis was changed from a three factor model (re-experiencing, hyperarousal and avoidance/numbing) to a four factor model of intrusion, effortful avoidance, negative alterations in cognitions and mood, and arousal/reactivity.

In the DSM-IV, avoidance and numbing symptoms were contained in a single cluster (American Psychiatric Association, 1994) However, due to research which demonstrated that avoidance and numbing symptoms had different underlying dimensions (Anthony, Lonigan, & Hecht, 1999; Asmundson et al., 2004; Friedman, Resick, Bryant, & Brewin, 2011; Kassam-Adams et al., 2010), they were separated into two different clusters in the DSM-5. Numbing symptoms were combined with two new symptoms to form the negative alterations in cognitions and mood cluster whereas the two symptoms of effortful avoidance formed the effortful avoidance cluster. These changes in factor structure led to the new requirement to endorse at least one symptom of effortful avoidance in order to qualify for the PTSD diagnosis.

Given that the avoidance and numbing cluster in the DSM-IV was criticised by a number of paediatric researchers for lacking developmental sensitivity towards children (Scheeringa, Wright, Hunt, & Zeanah, 2006; Scheeringa et al., 2011), it is plausible that the reformulation into two separate clusters may have increased the developmental sensitivity of the diagnosis for children. It is also possible, however, that the new requirement to endorse at least one out of two symptoms of effortful avoidance may have reduced the developmental sensitivity of the DSM-5 PTSD diagnosis. As no children younger than 15 years were included in the DSM-5 field trials (Kilpatrick et al., 2013; Miller et al., 2013), this requirement was not tested with children aged 7-14 years prior to its inclusion in the DSM-5. Consequently, more research is needed to determine how this requirement to endorse at least one symptom of effortful avoidance may impact upon the developmental sensitivity of the DSM-5 PTSD diagnosis in children aged 7-14 years.

Researchers and clinicians have previously expressed concern regarding the developmental sensitivity of symptoms of effortful avoidance in children (Pynoos et al., 2009; Salmon & Bryant, 2002; Scheeringa, 2011; Scheeringa et al., 2003). They have argued that children may not be able

to manifest these symptoms due to little control over their daily activities (e.g., whether or not they attend school or ride in a motor vehicle) (Pynoos et al., 2009). Pynoos et al. (2009) suggested that effortful avoidance symptoms may be expressed in school-aged children as new fears and therefore may be missed by caregivers. Furthermore, given that one of the two effortful avoidance symptoms (avoidance of thoughts/feelings) is internalised, researchers have also expressed doubt whether caregivers would be able to observe this symptom directly in children or whether children with developing language skills would be able or willing to report the avoidance of thoughts/feelings (Friedman, 2013; Pynoos et al., 2009; Scheeringa, 2011). As a result of these developmental concerns, the requirement to endorse at least one symptom of effortful avoidance was not included in the DSM-5 PTSD for Children 6 Years and Younger (American Psychiatric Association, 2013b). However, because the criteria for diagnosing PTSD for children 7 years and older remains the same as that of diagnosing adults; children 7 years and older are now required to endorse at least one symptom of effortful avoidance in order to obtain a PTSD diagnosis.

The majority of research on effortful avoidance symptoms in children has been conducted with children 11 years and older (e.g., Carrion et al., 2002; Kassam-Adams et al., 2010; Landolt, Boehler, Schwager, Schallberger, & Nuessli, 1998). These studies have demonstrated that effortful avoidance symptoms are commonly endorsed after trauma-exposure. Some studies have also shown a link between effortful avoidance symptoms and functional impairment (Boelen & Spuij, 2013; Carrion et al., 2002; Kassam-Adams et al., 2010). For example, Kassam-Adams et al. (2010) found that symptoms of effortful avoidance were associated with functional impairment, general health, and the number of school days missed in two separate trauma-exposed samples. Similarly, Carrion et al. (2002) demonstrated that the symptom, avoidance of thoughts/feelings was predictive of functional impairment. In addition, Murphy et al. (2014) found that effortful avoidance symptoms may have been linked to a lower likelihood of treatment completion in children exposed to sexual trauma.

Overall, current research supports that effortful avoidance symptoms are commonly endorsed in children 11 years and older, and may warrant specific clinical attention due to their potential to impact treatment completion and/or functional impairment. However, knowledge remains scarce regarding the expression of effortful avoidance symptoms in children younger than 11 years, pointing to the need for further research in this age-group.

Moreover, despite the importance of effortful avoidance symptoms in the DSM-5 PTSD algorithm, there is little research to date on how the new requirement impacts upon the sensitivity of the DSM-5 diagnoses in children aged 7-14 years. In a recent study examining diagnostic

sensitivity between the DSM-IV and DSM-5 PTSD diagnosis in children aged 7-12 years, Mikolajewski et al. (2017) concluded that the DSM-5 PTSD diagnosis was more developmentally sensitive for 7-12 year olds than the previous DSM-IV PTSD diagnosis. They found that that the DSM-5 PTSD diagnosis identified 17% more children with substantial PTSD symptoms and functional impairment than the DSM-IV diagnosis. They also reported that 80% of children endorsed the effortful avoidance symptom cluster in the DSM-5 as compared to only 40% of children who endorsed the avoidance/numbing cluster in the DSM-IV, a key reason for the higher DSM-5 PTSD prevalence rate. Consequently, the authors concluded that their study provided preliminary evidence to support the changes made to the DSM-5 PTSD diagnosis for children aged 7-12 years.

In contrast to the findings of Mikolajewski et al. (2017), Danzi and La Greca (2016) found lower diagnostic prevalence rates using DSM-5 criteria as compared to the DSM-IV criteria in children aged 7-11 years exposed to disasters. Furthermore, when Danzi and La Greca (2016) examined the suitability of three different diagnostic systems [DSM-IV, DSM-5, and the proposed International Classification of Diseases 11 (ICD-11) criteria (World Health Organization, 2015)], they found that each system identified PTSD in different children with poor overlap between the systems. Even more remarkable was that almost no new cases of PTSD were identified using the DSM-5 PTSD diagnosis compared to the DSM-IV PTSD diagnosis. Consequently, and in sharp contrast to Mikolajewski et al. (2017), Danzi and La Greca (2016) recommended caution in the use of the DSM-5 PTSD diagnosis with pre-adolescent youth. In another study extending their earlier findings, (Danzi & La Greca, 2017) compared the DSM-5 PTSD for Children 6 Years and Younger with the DSM-5 PTSD criteria in the same sample of pre-adolescent children. Their findings demonstrated that the DSM-5 PTSD for Children 6 Years and Younger identified more children who may have warranted a PTSD diagnosis than the DSM-5 PTSD criteria. Furthermore, the main difference in diagnostic rates was due to a lower endorsement rate of the effortful avoidance and negative alterations in cognitions and mood clusters in the DSM-5. Although it is not possible to determine which factor (i.e., higher symptom thresholds or the lack of endorsement of particular symptoms) were the main contributors to lower diagnostic rates, these findings highlight the need for further research to identify the specific diagnostic requirements which may contribute to under-diagnosis due to a lack of developmental sensitivity.

Interestingly, Carmassi et al. (2013) reanalysed data from an earlier study with adolescent earthquake survivors aged 17-18 years. Carmassi et al. (2013) examined agreement rates between children diagnosed with the DSM-IV TR and with the DSM-5 PTSD algorithms. Although they found a high degree of overlap between the children diagnosed by both algorithms (87.11%), they

also found that 12.5% of adolescents who met criteria for DSM-IV were unable to meet the criteria for DSM-5 because they did not endorse at least one symptom of effortful avoidance.

These varied findings demonstrate that the developmental sensitivity of the effortful avoidance requirement merits further scrutiny. A lack of developmental sensitivity could delay the identification of children with PTSD and preclude their eligibility for treatment. In the DSM-5 PTSD for Children 6 Years and Younger subtype, children have the option of endorsing symptoms of effortful avoidance to meet the PTSD diagnostic threshold of four symptoms. However, it is possible for children aged 6 years and younger to meet PTSD diagnostic criteria without endorsing any symptoms of effortful avoidance. Extending this approach to children 7-14 years may increase the sensitivity of the PTSD diagnosis for this age-group.

The purpose of this study was to:

1) Examine the impact of the requirement to endorse one symptom of effortful avoidance on PTSD prevalence rates across three age-groups of children: Young Group (7-9 years), Latency Group (10-11 years), and Adolescent Group (12-14 years),
2) Examine the saliency of the effortful avoidance symptom cluster and its relationship to functional impairment across three age-groups of children: Young Group (7-9 years), Latency Group (10-11 years), and Adolescent Group (12-14 years).

In order to investigate fine-grained developmental variations in the developmental sensitivity of this PTSD symptom, we chose to divide our sample into three age-groups: 7-9 years, 10-11 years, and 12-14 years. We chose these age-ranges because they naturally delineate different developmental periods (i.e., early school years, middle school years, and early adolescence, respectively) where changes in social, educational, and emotional dimensions could affect the way PTSD symptoms are expressed. In this study, developmental sensitivity was defined as a PTSD symptom which is valid and reliable in children ages 7-14 years.

5.3. Methodology

This study used an Integrative Data Analysis (IDA) approach (Curran & Hussong, 2009) to pool and analyse data from independent studies drawn from the PTSD after Acute Child Trauma (PACT) Data Archive. PACT is an international archive of investigator-provided, de-identified datasets from prospective studies of children exposed to an acute trauma. The data archive currently contains data from 23 studies and four countries (Australia, Switzerland, United Kingdom, and USA). Each dataset includes information on basic demographics, trauma characteristics, one or more potential predictors of ongoing traumatic stress assessed soon after a traumatic event, and at

least one measurement of traumatic stress symptoms at a later time point. Advantages of using the IDA for these analyses included increased statistical power and increased sample heterogeneity (Bainter & Curran, 2014; Curran & Hussong, 2009).

Although the studies in the PACT Data Archive used a range of different measures to assess traumatic stress symptoms and functional impairment, we chose only the studies that used a "gold standard" diagnostic interview administered between 4 weeks to 1 year after exposure to a DSM-IV defined A1 trauma to assess PTSD symptoms and concurrent functional impairment. In each study, children were recruited for participation based on their exposure to a potentially traumatic event (i.e., non-mental health treatment referred samples) after they sought medical treatment at a hospital. None of the studies we used required participants to endorse a minimum level of symptoms or functional impairment as a condition of inclusion. It is important to note that although the DSM-5 PTSD criteria has narrowed the A1 criteria to exclude particular types of events (i.e., death of caregiver after illness), the participants of our study would also meet the A1 criteria as defined by the DSM-5 PTSD diagnosis.

For the current analyses, we identified nine studies from four countries. Our sample included a total of 757 children aged 7-14 years. Please see Table 5-1 and Table 5-2 for study and sample characteristics.

Table 5-1 Study Characteristics

n	Country	Study Setting	Trauma Type
169	USA	Hospital	Traffic-related injury
130	Australia	Hospital	Unintentional Injury
78	Australia	Hospital	Unintentional Injury
156	Australia	Hospital	Traumatic Brain Injury
37	USA	Hospital	Hospitalised Injury
27	USA	Hospital	Hospitalised Injury
44	UK	Hospital	Motor Vehicle Accident
77	Australia	Hospital	Single Incident injury
39	Switzerland	Hospital	Motor Vehicle Accident

Note. Only the participants between 7-14 years of age from each study are shown.

Table 5-2 Sample Characteristics

Age Group	*n*	Gender (% males)	Unintentional Injury %	Motor vehicle accidents %
Young Group 7-9 years	292	60	68	32
Latency Group 10-12 years	211	63	69	31
Adolescent Group 12-14 years	254	74	65	35

5.3.1. The Clinician Administered PTSD Scale for Children and Adolescents

The CAPS-CA (Nader et al., 1996) is a semi-structured interview for the diagnosis of anxiety and related disorders in children and adolescents based on the adult Clinician Administered PTSD Scale (CAPS). The CAPS is considered a "gold standard" for assessing PTSD in people over the age of 15 years with good psychometric properties (Carrion et al., 2002). The PTSD interview component was based on the DSM-IV PTSD criteria and assessed both the intensity and frequency of each of the 17 PTSD symptoms for the previous month via child report. Each item was scored

on a 5-point frequency scale (i.e. from 0 = "none of the time" to 4 = "most of the time") and a 5 point intensity scale (i.e. from 0 = "not a problem" to 4 = "a big problem, I have to stop what I am doing"). Following the CAPS-CA scoring rules, a minimum frequency score of "1" and a minimum intensity score of "2" was required for a symptom to be scored as present.

5.3.2. Anxiety Disorder Interview Schedule –Parent (P-ADIS)

The ADIS-P (Albano & Silverman, 1996) is a semi-structured interview for the diagnosis of anxiety and related disorders in children and adolescents which is based on the adult Anxiety Disorders Interview Schedule (ADIS) (Di Nardo et al., 1983). The PTSD interview component is based on the DSM-IV PTSD criteria and assesses the presence or absence of each of the 17 PTSD symptoms. Each item was scored as either "yes", "no", or "other". Only "yes" responses indicated symptom presence. Although no data on the validity and reliability of the ADIS-P specific to diagnosing PTSD in children is available, the ADIS was found to be valid and reliable in diagnosing PTSD in Vietnam veterans (Blanchard et al., 1986).

5.3.3. Functional Impairment

Functional impairment in relation to PTSD symptoms was assessed through four questions assessing impairment in four different domains (subjective distress, social functioning, scholastic functioning, and developmental functioning) on the CAPS-CA (i.e., "In the past month, did the PTSD symptoms/problems you've told me about make it harder for you to do your schoolwork or to do well at school? Was this a change or were you always like that?"). For the CAPS-CA, functional impairment was considered present if at least one of the CAPS-CA impairment questions was scored as "yes" according to the CAPS-CA scoring rules. Functional impairment was assessed through a single question on the ADIS-P ("How much has this problem interfered with your child's friendships, caused problems at school or at home, and stopped your children from the doing the things he or she would like to do?"). For the ADIS-P, functional impairment was considered present if the impairment question was scored as greater than four according to the ADIS-P scoring rules (0 = "none", 4 = "some", 8 = "very very much"). The CAPS-CA and ADIS-P questions were then recoded into a single dichotomised functional impairment variable. It should be noted that functional impairment was assessed on the CAPS-CA via child report or on the ADIS-P via caregiver report.

5.3.4. Harmonisation of Symptoms across Measures

PTSD was assessed either via the CAPS-CA (child report, 64% of participants) or via the ADIS-P (caregiver report, 36% of participants). Both diagnostic measures had 17 items, each corresponding to the 17 PTSD symptoms from the DSM-IV. We dichotomised the item ratings

according to the scoring rules of each measure for symptom presence and then combined responses for these items from both instruments. We also created a dichotomous variable for the presence/absence of concurrent functional impairment based on the impairment questions from each instrument. We followed the scoring rule of each measure to determine the presence of functional impairment. After the pooling of data, our dataset contained 17 dichotomised items which assessed for 17 PTSD symptoms from all nine studies, in addition to one dichotomised item assessing for functional impairment from eight of the nine studies. Functional impairment was assessed in all but one study. This method of harmonising and pooling data across multiple studies has been used previously (Kassam-Adams et al., 2012).

5.3.5. DSM-5 PTSD for Children 6 Years and Younger

The DSM-5 PTSD diagnosis for Children 6 Years and Younger is based on the PTSD Alternative Algorithm (PTSD-AA) which has demonstrated superior validity with children 6 years and younger (Scheeringa et al., 2012). Additional research has also suggested that this algorithm may be more sensitive in identifying children aged 7-14 years with PTSD than either the DSM-IV PTSD criteria (Iselin et al., 2010; Meiser-Stedman et al., 2008; Mikolajewski et al., 2017) or the DSM-5 PTSD criteria (Danzi & La Greca, 2017). Therefore, we used a modified version of the DSM-5 PTSD algorithm for children 6 years and younger to calculate PTSD prevalence rates. It should be noted that although the DSM-5 PTSD diagnosis added three new symptoms (distorted cognitions, negative emotional state, and reckless or self-destructive behaviour), only one of the new symptoms (negative emotional state) was included in DSM-5 PTSD for Children 6 Years and Younger. Furthermore, it should also be noted that our data was collected based on the DSM-IV wording of PTSD symptoms. Please see Table B1 in Appendix B for more specific information on each diagnostic algorithm.

5.3.6. DSM-5 Modified Algorithm

The DSM-5 Modified Algorithm (DSM-5 MA) is comprised of three symptom clusters: 1) Intrusion, 2) Avoidance and negative alternations in cognitions, and 3) Arousal/reactivity. Children are required to endorse four symptoms to meet the minimum PTSD symptom threshold. Notably, although the symptoms inability to recall an important aspect of the trauma, and detachment were removed from DSM-5 PTSD for Children 6 Years and Younger, we chose to retain them in the DSM-5 MA given the older age of our sample and to obtain additional information on the validity of these symptoms in children aged 7-14 years. Given that the data collected was based on DSM-IV questionnaires, none of the three new DSM-5 PTSD symptoms (negative emotional state, distorted cognitions, and reckless or self-destructive behaviour) or the two new DSM-5 PTSD for

Children 6 Years and Younger symptoms (social withdrawal, and negative emotional state) were included in our algorithms.

The DSM-5 MA was calculated in two different ways. In the first method we followed the symptom structure for DSM-5 PTSD for Children 6 Years and Younger which required one symptom of intrusion, one symptom of either effortful avoidance or negative alterations in cognitions, and two symptoms of arousal/reactivity to meet criteria for diagnosis. In the second method, we followed the same algorithm with one exception. In order to meet PTSD diagnosis, we required that at least one of the four PTSD symptoms endorsed was a symptom of effortful avoidance. The minimum four symptom threshold for diagnosis remained the same for both methods. Functional impairment was required to meet PTSD diagnosis in both methods. Please Table 5-1 and Table 5-2 for sample and study characteristics.

5.3.7. Study Ethics

This study was approved by the Faculty of Medicine's Institutional Review Board at the University of Queensland. All of the data sets stored in the PACT Data Archive underwent an Institutional Review Board or equivalent ethics review per the protocols in each respective country and institution prior to the collection of data.

5.3.8. Data Analysis

We divided the sample into three age sub-groups: Young Group (7-9 years), Latency Group (10-11 years), and the Adolescent Group (12-14 years) in order to explore differences in the saliency of effortful avoidance symptoms that may exist at different stages of development. Each analysis was performed on the entire group, and then separately on each age sub-group. Only sub-group results are reported below. All analyses were conducted in SPSS v24.

5.3.8.1. *Missing Values*

We examined the percentage of missing values for each of the 17 DSM-IV PTSD items and found the missing percentage for each PTSD item ranged from 15 % to 17% from a total sample size of $N = 757$. We chose not to conduct multiple imputation of the missing values because we found that 135/168 cases (80%) with missing data had not completed the diagnostic questionnaire within the time point (1 month to < 1 year) that we were assessing. Consequently, all of the 17 PTSD items were missing in these cases. These cases were initially part of the study because the participants completed other measures which were not analysed in this study. We deleted 135 cases that did not complete the questionnaire within the required timeframe from the dataset.

5.3.8.2. *Multicollinearity*

A key assumption in binary logistic regression analysis is the assumption of independence between independent variables (Fields, 2013). In order to test that this assumption was met, we checked the data for multicollinearity in two ways. First, we checked if the correlation matrix contained pairwise correlations greater than or equal to .80. Although we did not find any correlations higher than .50 in any of the age-groups, it was possible for interdependencies to still exist among several variables (Midi et al., 2010). Therefore, we also examined the tolerance, variance inflation factors (VIFs), condition indexes, and the proportion of variance of each predictor's regression coefficient that is attributed to each eigenvalue (Midi et al., 2010). We concluded from the results that multicollinearity was not present in any age-group.

5.3.8.3. *Model Fit*

We used the Hosmer and Lemeshow Test to confirm model fit. After examining standardised residuals and points of leverage for each case, we used Cooks distance values greater than one to identify cases exerting an undue influence over the parameters of the model, as recommended by R. D. Cook and Weisberg (1982). Cooks distance (R. D. Cook, 1977) is a summary measure of the overall influence of a case on a model. None of the models contained cases which had a Cooks distance value of > 1.0. Therefore, we concluded that there were no cases exerting undue influence in any of the models.

5.4. Results

First, we present PTSD prevalence rates calculated with and without the requirement to endorse one symptom of effortful avoidance. Next, we present the relationship between the effortful avoidance symptom cluster and functional impairment, and the accuracy of the effortful avoidance symptom cluster to classify cases with functional impairment using binary logistic regression analysis.

5.4.1. Effortful Avoidance Symptoms and PTSD Prevalence

We examined prevalence rates for each of the DSM-5 PTSD symptom clusters separately by age-group. See Table 5-3. Next, we examined PTSD prevalence rates with and without the requirement to endorse one effortful avoidance symptom. We calculated PTSD prevalence rates in the overall group as well as separately across all three age sub-groups to explore any developmental differences in the diagnostic sensitivity of the effortful avoidance requirement. We found that in all age-groups, there was a small number of children (17 children overall) who did not meet the PTSD diagnosis as a result of the requirement to endorse one symptom of effortful avoidance despite having a minimum of four PTSD symptoms and functional impairment. Although 17 children are

only equivalent to 3% of our overall sample of children, at a population level this could represent thousands of children annually who are under-diagnosed. Therefore, we consider 3% to represent a clinically meaningful number of children. See Table 5-4.

Table 5-3 Prevalence Rates of DSM-5 Symptom Clusters by Age-Group

Age-Group	Intrusion Cluster	Effortful Avoidance Cluster	Negative Alterations to Cognitions and Mood Cluster	Arousal and Reactivity Cluster
Total Group (7-14 years) N=757	258 (34%)	206 (27%)	92 (12%)	189 (25%)
Young Group (7-9 years) N=292	114 (39%)	111 (38%)	38 (13%)	73 (25%)
Latency Group (10-11 years) N=211	83 (39%)	54 (26%)	21 (10%)	60 (28%)
Adolescent Group (12-14 years) N=254	61 (24%)	41 (16%)	33 (13%)	56 (22%)

Table 5-4 PTSD Point Prevalence Rates by Age-Group

Age-Group	*n*	DSM-5 MA	DSM-5 MA with Effortful Avoidance
Total Group (7-14 Years)	677	80 (12%)	63 (9%)
Young Group (7-9 Years)	259	39 (15%)	35 (14%)
Latency Group (10-11 Years)	197	24 (12%)	17 (9%)
Adolescent Group (12-14 Years)	221	17 (8%)	11 (5%)

5.4.2. DSM-5 Diagnostic Clusters and Association with Functional Impairment

Next, we examined the extent to which the DSM-5 effortful avoidance cluster, predicted functional impairment in comparison to the other three DSM-5 symptom clusters using binary logistic regression. We summed the dichotomised items for each symptom cluster and then recoded each symptom cluster as a binary variable. The symptom cluster was considered endorsed if the minimum number of symptoms for each cluster was endorsed according to the DSM-5 PTSD algorithm. For example, the DSM-5 PTSD algorithm requires a minimum of two symptoms for the negative alteration to cognitions and mood cluster. If the participant endorsed at least two

symptoms from this cluster, the symptom cluster was entered as "1" in the binary logistic regression. We entered all four DSM-5 symptom clusters and gender simultaneously as independent variables with functional impairment entered as the dependent variable. The *p* value was set at .05. In order to explore age-related differences in the relationship between effortful avoidance and functional impairment, the binary logistic regression was conducted separately for each age-group.

5.4.2.1. *Young Group (7-9 years)*

The model as a whole explained between 33% (Cox and Snell R^2) and 44% (Nagelkerke R^2) of the variance in functional impairment in children in the Young Group. An omnibus test of the model indicated that the endorsement of PTSD symptom clusters was significantly related to functional impairment ($x^2 = 91.280$, $p < .001$). The model had a high predictive value and correctly classified 78% of cases of children with functional impairment . The model's ability to accurately classify children with functional impairment was lower (66%) than its ability to classify children without functional impairment (87%). There were 16 standardised residuals (7% of cases) with values greater than 1.96 which were kept in the analysis.

As shown in Table 5-5, three of the four independent variables (intrusion, effortful avoidance, and arousal/reactivity clusters) made a unique statistically significant contribution to the model. The strongest predictor of functional impairment was endorsement of the arousal/reactivity cluster, with an odds ratio of 6.35 (95% CI for OR = 2.6 - 15.51, $p = .001$). This indicated that the odds of being functionally impaired were more than six times greater for young children who endorsed the arousal/reactivity cluster than children who did not endorse this symptom cluster, after controlling for other factors in the model.

Table 5-5 PTSD Symptom Clusters and Functional Impairment: Young Group 7-9 Years, *n* = 231

Independent Variables	B	*S.E.*	Wald	*df*	*p*	Odds Ratio (OR)	95% C.I. for OR	
							Lower	Upper
Gender	-0.20	0.35	0.32	1.00	.57	0.82	0.42	1.62
Intrusion Symptom Cluster	1.25	0.35	12.77	1.00	**<.001**	**3.49**	**1.76**	**6.92**
Effortful Avoidance Symptom Cluster	1.29	0.36	12.88	1.00	**<.001**	**3.64**	**1.80**	**7.38**
Negative Alterations in Cognitions and Mood Symptom Cluster	-0.02	0.56	0.00	1.00	.977	0.98	0.33	2.95
Arousal/Reactivity Symptom Cluster	1.85	0.46	16.49	1.00	**<.001**	**6.35**	**2.60**	**15.51**

5.4.2.2. *Latency Group (10-11 years)*

The model as a whole explained between 29% (Cox and Snell R^2) and 40% (Nagelkerke R^2) of the variance in functional impairment in children in the Latency Group. An omnibus test of the model indicated that the endorsement of PTSD symptom clusters was significantly related to functional impairment ($x^2 = 62.858$, $p < .001$). The model had a high predictive value and correctly classified 79% of cases of children with functional impairment. The model's ability to accurately classify children with functional impairment was lower (63%) than its ability to classify children without functional impairment (88%). There were 17 (9% of cases) standardised residuals with values greater than 1.96 which were kept in the analysis.

As shown in Table 5-6, two of the four independent variables (intrusion and arousal/reactivity symptom clusters) made a unique statistically significant contribution to the

model. The strongest predictor of functional impairment was the arousal/reactivity cluster, with an odds ratio of 9.95 (95% CI for OR = 4.49 - 22.08, $p < .001$). This indicated that the odds of having functional impairment were more than nine times greater for children in the Latency Group who endorsed the arousal cluster than for children who did not endorse this symptom cluster, after controlling for other factors in the model.

Table 5-6 PTSD Symptom Clusters and Functional Impairment: Latency Group

10-11 years, n = 181

Independent Variables	B	*S.E.*	Wald	*df*	*p*	Odds Ratio (OR)	95% CI for OR	
							Lower	Upper
Gender	-0.06	0.41	0.02	1.00	.892	0.95	0.42	2.11
Intrusion Symptom Cluster	0.79	0.41	3.71	1.00	**.054**	**2.21**	**0.99**	**4.93**
Effortful Avoidance Symptom Cluster	0.35	0.46	0.60	1.00	.440	1.42	0.58	3.47
Negative Alterations in Cognitions and Mood Symptom Cluster	0.83	0.64	1.68	1.00	.195	2.29	0.65	7.99
Arousal/Reactivity Symptom Cluster	2.30	0.41	31.95	1.00	**<.001**	**9.95**	**4.49**	**22.08**

5.4.2.3. *Adolescent Group (12-14 years)*

The model as a whole explained between 25% (Cox and Snell R^2) and 35% (Nagelkerke R^2) of the variance in functional impairment in children in the Adolescent Group. An omnibus test of the model indicated that the endorsement of DSM-5 PTSD symptom clusters was significantly related to functional impairment ($x^2 = 64.407$, $p < .001$). The model had a high predictive value and correctly classified 79% of cases of children with functional impairment. The model's ability to accurately classify children with functional impairment was lower (66%) than its ability to classify children without functional impairment (86%). There were 24 standardised residuals (8% of cases) with values greater than 1.96 which were kept in the analysis.

As shown in Table 5-7, two of the four independent variables (effortful avoidance and arousal/reactivity symptom clusters) made a unique statistically significant contribution to the model. The strongest predictor of functional impairment was the arousal/reactivity symptom cluster, with an odds ratio of 6.66 (95% CI for OR = 2.95 - 15.06, $p < .001$). This indicated that the odds of having functional impairment were more than six times greater for adolescent children who endorsed the DSM-5 arousal/reactivity cluster than for children who did not endorse this symptom cluster, after controlling for other factors in the model.

Table 5-7 PTSD Symptom Clusters and Functional Impairment: Adolescent Group 12-14 years, *n* = 221

Independent Variables	B	*S.E.*	Wald	*df*	*p*	Odds Ratio (OR)	95% C.I. for OR	
							Lower	Upper
Gender	0.02	0.40	0.00	1.00	.965	1.02	0.47	2.22
Intrusion Symptom Cluster	0.52	0.45	1.33	1.00	.249	1.68	0.70	4.06
Effortful Avoidance Symptom Cluster	1.62	0.52	9.91	1.00	**.002**	**5.06**	**1.85**	**13.89**
Negative Alterations in Cognitions and Mood Symptom Cluster	0.51	0.53	0.90	1.00	.343	1.66	0.58	4.72
Arousal/Reactivity Symptom Cluster	1.90	0.42	20.75	1.00	**<.001**	**6.66**	**2.95**	**15.06**

5.5. Discussion

This study has advanced our understanding of the saliency of symptoms of effortful avoidance in the diagnosis of PTSD across three different developmental stages. This knowledge carries important clinical and diagnostic implications and has illuminated areas for further research.

First, it has provided strong evidence that effortful avoidance symptoms form a characteristic part of PTSD symptom expression across all three age-groups of children. Furthermore, it has demonstrated that the requirement to endorse at least one symptom of effortful

avoidance has not reduced the developmental sensitivity of this diagnosis for the majority of children in our sample. This is a particularly important finding for children in the Young Group (7-9 years) given the prior doubts expressed by a number of researchers regarding the reporting of internalising symptoms (Friedman, 2013; Pynoos et al., 2009; Scheeringa et al., 2011), and the scarcity of research conducted with this age-group. Second, an important consideration for developmental sensitivity in paediatric PTSD is to ensure that PTSD symptoms can be assessed in one of two ways: 1) self-report by children with limited language development, or 2) identified and reported by caregivers. This study has provided evidence that symptoms of effortful avoidance can be assessed by clinicians via diagnostic interview in children 7 years and older and that both children and caregivers were able to report symptoms of effortful avoidance. Given that we used diagnostic interviews completed by either child or caregiver report in our sample, it was not possible to draw conclusions regarding any differences in endorsement rates related to the type of informant. This is an important area for further investigation.

Third, this study has also identified that the requirement to endorse one symptom of effortful avoidance in order to meet PTSD diagnostic criteria has prevented a small but clinically significant minority of children from meeting the PTSD diagnosis in every age-group. It is important to highlight that the children who were unable to meet PTSD diagnosis due to this requirement still endorsed a minimum of four PTSD symptoms across three symptom clusters (intrusion, negative alterations in cognitions, and arousal/reactivity), as well as functional impairment.

One way to interpret this finding is to conclude that the requirement to endorse one symptom of effortful avoidance reduces the developmental sensitivity of the diagnosis because it prevents a clinically significant number of children who merit a PTSD diagnosis due to significant impairment in functioning from receiving one. This interpretation can be understood in context with the growing adult and paediatric research demonstrating the heterogeneity of the PTSD diagnosis (Ayer et al., 2011; DiMauro et al., 2014; Galatzer-Levy & Bryant, 2013; Shevlin & Elklit, 2012). Specifically, a number of recent studies have demonstrated that PTSD symptom expression varies based on a number of factors including the type of trauma experienced (DiMauro et al., 2014; Shevlin & Elklit, 2012), the age and developmental stage of the child (Ayer et al., 2011), and prior trauma history (Wolf et al., 2012). Arguably, due to heterogeneity in symptom expression, not all children aged 7-14 years with PTSD will present with symptoms of effortful avoidance. As such, the requirement to endorse effortful avoidance may unnecessarily prevent some children who merit a PTSD diagnosis from receiving one, resulting in potential exclusion from needed treatment.

However, an alternative way to interpret this finding is to classify the small number of children who were excluded from diagnosis as children with sub-threshold PTSD. Children with sub-threshold PTSD may warrant clinical intervention but do not merit a PTSD diagnosis. Lending support to this interpretation, past research has demonstrated that a substantial number of trauma-exposed adults and children with sub-threshold PTSD are also functionally impaired (Marshall et al., 2001; McLaughlin et al., 2015). Studies which have shown differences in either symptom severity or level of functional impairment between those with PTSD and sub-threshold PTSD (Angold et al., 1999; McLaughlin et al., 2015; Mikolajewski et al., 2017) bolster the argument that these groups are clinically distinct.

It could also be argued that, since we used the less stringent DSM-5 MA to assess PTSD, these children would not have met the full DSM-5 PTSD diagnostic criteria for other reasons (i.e., not meeting the two symptom requirement of the negative alterations to cognitions and mood cluster). This interpretation would suggest that the effortful avoidance requirement in the DSM-5 PTSD diagnosis has only excluded children who would be unable to meet a PTSD diagnosis for other reasons, and is therefore adequately sensitive for children aged 7-14 years.

All of these interpretations point to a broader uncertainty and debate regarding the correct symptom threshold to demarcate the boundary between sub-threshold PTSD and PTSD in children aged 7-14 years. Additional research is needed before firm conclusions can be drawn on this matter.

This study has also provided evidence regarding age-related differences in the saliency of the effortful avoidance symptom cluster in PTSD expression. In both Young and Adolescent Groups, this symptom cluster was significantly predictive of functional impairment. However, in the Latency Group (10-11 years), this symptom cluster, although endorsed by almost one fourth of children (24%), was not predictive of functional impairment. These findings highlight that the clinical significance of the effortful avoidance symptom cluster varies across age-groups. These findings suggest that effortful avoidance symptoms may be more relevant as a focus for treatment in the Young and Adolescent Groups.

Fourth, a notable finding in this study is the saliency of arousal symptoms and how they may contribute to functional impairment in trauma-exposed children. The arousal/reactivity symptom cluster was the strongest predictor of functional impairment across every age-group. Previous research has also highlighted the saliency of arousal symptoms in adult PTSD (Chemtob, Roitblat, Hamada, Carlson, & Twentyman, 1988; Schell et al., 2004) and paediatric PTSD (Allwood, Bell, & Horan, 2011; Russell, 2017; Soysa, 2013; Weems, Saltzman, Reiss, & Carrion,

2003). One explanation for the saliency of arousal symptoms across all age-groups could be their potential to interfere with the developing brain. Van der Kolk (2003) argued that when children are in a state of physiological arousal, they are less capable of organising and processing new information, and are more emotionally reactive to stressful situations. As children are required to spend a significant portion of their day learning new information in school and are still developing skills in affect regulation, it is plausible that arousal symptoms may interfere with these key tasks, creating pronounced difficulties in academic and social settings. Of course, additional research is needed to test this theory. Regardless of the reason for their saliency, these results suggest that prioritising arousal symptoms in treatment may yield important benefits.

5.6. Limitations and Areas for Further Research

This study has strengthened our understanding of the saliency of effortful avoidance symptoms in children aged 7-14 years. However, there are a number of limitations which should be considered when interpreting these findings.

First, PTSD prevalence and symptom endorsement rates may have been under-estimated in this sample for a number of reasons. First, the diagnostic measures that were used to assess PTSD symptoms were based on the DSM-IV PTSD diagnosis. Consequently, we were unable to assess the presence of the three new DSM-5 PTSD symptoms (negative emotional state, distorted cognitions, and reckless or self-destructive behaviour) or the new symptom, social withdrawal, from DSM-5 PTSD for Children 6 Years and Younger. It follows that if children had the option to endorse additional PTSD symptoms, more children may have met PTSD criteria. In addition, although "gold standard" diagnostic interviews were used, these interviews were based solely on a single report by either caregivers or children. Previous studies have shown that caregivers and children tend to report different symptoms and the most accurate reporting derives from combining both caregiver and child report (Scheeringa et al., 2006). Consequently, the endorsement of particular symptoms (i.e., internalising symptoms) may have been under-reported. Future research exploring the impact of the effortful avoidance requirement on prevalence and developmental sensitivity should include all current DSM-5 PTSD symptoms combining both caregiver and child report.

Second, in order to harmonise the two different diagnostic interview measures, we dichotomised the data. Consequently, we were not able to assess whether there were differences in the levels of either symptom severity or functional impairment between the children with substantial PTSD symptoms who were excluded from diagnosis and those who met PTSD diagnostic criteria. It is possible that those who were excluded from diagnosis exhibited PTSD

symptoms of lesser severity and therefore were appropriately screened out by the effortful avoidance requirement.

This possibility raises a broader question regarding diagnostic algorithms and the most valid one for use with children aged 7-14 years. Future research should examine if children who endorse the minimum threshold of six PTSD symptoms in an algorithm which doesn't accord with the current DSM-5 PTSD diagnosis, substantially differ in severity of functional impairment, comorbidity, or prognosis from those children whose PTSD symptoms align with the current DSM-5 algorithm. Galatzer-Levy and Bryant (2013) have already expressed concern with regards to the number of false negatives that the DSM PTSD diagnosis produces in adults. Given the heightened importance and benefits of early intervention in children who experience mental health problems (Durlak & Wells, 1998), this research is essential before we assume that children who present with differing PTSD symptom presentations do not merit a diagnosis.

Third, given that this study relied on cross-sectional data, we were unable to conclude that a causal relationship existed between the endorsement of PTSD symptom clusters and functional impairment. Future studies should strengthen these findings by using longitudinal designs to examine causal relationships between symptom clusters and functional impairment across different developmental stages. It is also essential to acknowledge limits to the generalisability of this study. The majority of the children in this sample experienced unintentional injury as the index trauma event. We cannot assume that children who experience other types of trauma such as interpersonal violence or disasters will manifest symptoms of effortful avoidance in the same manner. Consequently, additional research across a diverse range of traumas should be undertaken.

Although this research has combined data from nine different studies across four different countries, the participants are all from Western nations. We also cannot assume that the requirement to endorse symptoms of effortful avoidance will impact the sensitivity of the PTSD diagnosis in non-Western cultures in the same manner. Although it is beyond the scope of this study to examine the cross-cultural saliency of the effortful avoidance symptom in non-Western cultures, it should be noted that previous studies have shown that symptoms of effortful avoidance may not be a valid indicator of post-traumatic pathology but a characteristic of adaptive coping by those without PTSD (Kohrt et al., 2011; Palosaari et al., 2013). In addition, other studies have demonstrated that symptoms of effortful avoidance are less salient in the expression of PTSD in non-Western cultures (Familiar et al., 2014; Soysa, 2013). Consequently, replication of this study in non-Western settings is important.

5.7. Conclusion

This study used "gold standard" diagnostic interviews for the assessment of PTSD and functional impairment, as well as a large sample of participants drawn from nine different studies, spanning four different countries. A particular strength of this study was that it examined the impact of the effortful avoidance symptom requirement in children across three different age-groups to unmask age-related implications regarding diagnostic sensitivity and symptom saliency. It has demonstrated that the new requirement to endorse a symptom of effortful avoidance did not reduce the developmental sensitivity of the PTSD diagnosis for the majority of children aged 7-14 years in this sample. However, it has also drawn attention to a clinically significant minority of children for which this may have been the case.

These findings have highlighted the need to consider PTSD heterogeneity and age-related differences in the saliency of effortful avoidance symptoms. Future research should focus on improving our knowledge regarding distinctions between sub-threshold PTSD symptoms and PTSD in children aged 7-14 years to ensure that children experiencing PTSD are accurately identified and have access to treatment.

Chapter 6. Discussion

Chapter 6: Discussion

Each year, millions of children are exposed to potentially traumatic events world-wide. PTSD is one of the most common disorders to be diagnosed following exposure to trauma (DiMauro et al., 2014; Norris et al., 2002). PTSD causes substantial distress and has the potential to adversely impact children's long-term social, emotional, and physical development and well-being (Fairbank & Fairbank, 2009; Pynoos et al., 2009; Seng et al., 2005). It has been recognised for many years that symptoms of mental health disorders may manifest differently in children than they do in adults (Bennett, Modrowski, Kerig, & Chaplo, 2015; Scheeringa et al., 2011). Despite this, the DSM PTSD criteria were originally developed based only on the field testing of adults and adolescents over the age of 15 years (Blom & Oberink, 2012; Kilpatrick et al., 1998). Since then, both researchers and clinicians have raised doubts about the diagnostic validity of the DSM PTSD criteria for children and adolescents (Carrion et al., 2002; Danzi & La Greca, 2017). In fact, a substantial body of research has demonstrated that the DSM-IV PTSD diagnosis lacked sensitivity in diagnosing children 6 years and younger (Friedman, 2013; Levendosky et al., 2002; Meiser-Stedman et al., 2008; Ohmi et al., 2002; Scheeringa & Zeanah, 2008; Scheeringa et al., 2011; Scheeringa et al., 2003), and left a significant number of children who warranted a PTSD diagnosis due to significant impairment in functioning, undiagnosed.

As a result of this body of evidence, the DSM-5 introduced a new PTSD sub-type for children aged 6 years and younger (American Psychiatric Association, 2013b; Friedman, 2013). This sub-type was based on an alternative algorithm comprised of three symptom clusters (intrusion, avoidance/negative alterations to cognition, and arousal/reactivity) with a total of 16 possible PTSD symptoms. The algorithm was developed to provide increased diagnostic sensitivity for children 6 years and younger as compared to the DSM-5 PTSD algorithm. It required a minimum diagnostic threshold of four symptoms in contrast to the DSM-5 PTSD minimum diagnostic threshold of six symptoms (American Psychiatric Association, 2013b). It has also removed symptoms identified by previous researchers to lack developmental sensitivity (i.e., negative beliefs or expectations about oneself, others, or the world) and modified the wording of some PTSD symptoms to better represent age-related manifestations (i.e., constriction of play added as an example of loss of interest). The DSM-5 PTSD for Children 6 Years and Younger is based on the PTSD Alternative Algorithm (PTSD-AA) which demonstrated better sensitivity for children 6 years and younger in several research studies as compared to the DSM-IV PTSD diagnosis (De Young et al., 2011b; Friedman, 2013; Levendosky et al., 2002; Meiser-Stedman et al., 2008; Ohmi et al., 2002; Scheeringa & Zeanah, 2008; Scheeringa et al., 2011; Scheeringa et al., 2003).

Research on the diagnostic validity of PTSD in children aged 7-14 years, however was more limited than the research that has been conducted with children 6 years and younger (Carrion et al.,

2002; Copeland et al., 2007; Iselin et al., 2010; Meiser-Stedman et al., 2008; Schäfer et al., 2006) and evidence regarding the need for an alternative algorithm in this age-group less compelling (Blom & Oberink, 2012; Scheeringa et al., 2006; Scheeringa et al., 2011). Since the level of evidence did not meet the very high threshold that the DSM-5 Task Force required for change, the same PTSD criteria used to diagnose adults was also used with children aged 7 years and older (Friedman, 2013). This was problematic because, although significant changes were made from the DSM-IV criteria to the DSM-5 PTSD criteria, these changes were only tested with adults (Kilpatrick et al., 2013; Miller et al., 2013). Therefore, it is unknown whether the changes incorporated into the DSM-5 PTSD diagnosis have increased the developmental sensitivity of the diagnosis for children aged 7 years and older. Consequently, additional research was warranted to study the developmental manifestations of PTSD in children aged 7-14 years and the sensitivity of DSM-5 PTSD criteria for this age-group.

6.1. Thesis Aim and Research Questions

The overall aim of this thesis was to:

1) Advance empirical knowledge of PTSD expression in children and young persons aged 7-14 years and,
2) Explore age-related differences in PTSD symptom expression.

6.1.1. Major Findings

This chapter summarises and discusses the major findings and limitations of the three empirical studies included in this thesis. It concludes with diagnostic and clinical implications of the findings, and recommended directions for future research.

6.1.1.1. Main Findings and Discussion of Study 1: Age-related differences between symptoms and their association with functional impairment

The aim of this study was to:

1) Examine how PTSD symptoms relate to functional impairment in children, and

2) Explore age-related differences in PTSD symptom presentation.

This study divided the sample into two age-groups: Pre-adolescents (7-11 years) and adolescents (12-14 years), in order to explore age-related differences in symptom expression. First, I explored differences in the frequency with which symptoms were endorsed using univariate statistics. Next, I investigated age-related differences in the PTSD symptoms which were predictive of functional impairment through the use of binary logistic regression techniques. Last, I evaluated

the predictive value between the number of symptoms endorsed and functional impairment for pre-adolescents and adolescents using ROC curves.

The findings demonstrated that a high number of trauma-exposed children were functionally impaired (Pre-Adolescent Group, 30%; Adolescent Group, 31%) who did not meet criteria for PTSD even when a more diagnostically sensitive algorithm (DSM-5 MA) was used. Furthermore, the findings showed that a high incidence of functional impairment in the absence of diagnosis was consistent across both Pre-Adolescent and Adolescent Groups, which has also been well-supported in previous studies (Carrion et al., 2002; Meiser-Stedman et al., 2008; Sachser, Berliner, et al., 2017). However, the majority of studies which assessed functional impairment only did so after children met sub-threshold PTSD. Studies which have examined the prevalence of functional impairment without requiring participants to meet a minimum PTSD symptom threshold or a particular PTSD symptom algorithm are rare (e.g., Angold et al., 1999). Consequently, limited research is available regarding the prevalence of functional impairment in trauma-exposed children with low levels of PTSD symptoms.

Extending previous research from Carrion et al. (2002) and Meiser-Stedman et al. (2008) this study has shown that even a low level of PTSD symptoms can be associated with functional impairment. For example, in the ROC curve analysis, 2.5 symptoms for the Pre-Adolescent Group and 1.5 symptoms for the Adolescent Group were the best cut-off scores which separated children with and without functional impairment. This is a particularly significant finding because this number is well below the minimum symptom threshold counts for the PTSD diagnosis using either the DSM-5 PTSD for children 6 years and younger algorithm (4 symptoms) or the DSM-5 PTSD algorithm (6 symptoms) (American Psychiatric Association, 2013a). It is also below the symptom counts which are generally regarded as sub-threshold PTSD (Carrion et al., 2002; Marshall et al., 2001; McLaughlin et al., 2015). For example, Carrion et al. (2002) defined sub-threshold PTSD as children who met two out of three DSM-IV PTSD symptom clusters which required the endorsement of a minimum of one PTSD symptom per cluster. The results of this study have demonstrated the need to broaden our perspective to view functional impairment as an important problem affecting trauma-exposed children, and not predominantly as a tool with which to examine diagnostic sensitivity and sub-threshold PTSD.

In addition to recognising that even a low number of symptoms predicted functional impairment in children, the results from this study also showed that only particular symptoms were predictive of functional impairment, and therefore more salient in PTSD symptom expression. For example, the results of the binary logistic regression demonstrated that pre-adolescent children who endorsed the symptom difficulty concentrating, had 5.6 times greater odds [95% CI 2.70 – 11.55] of

functional impairment than those who did not. The idea that some symptoms are more influential than others in the course of PTSD is consistent with both adult (Armour, Fried, Deserno, Tsai, & Pietrzak, 2017; Schell et al., 2004) and paediatric research (Carrion et al., 2002). The finding that particular PTSD symptoms had outsized influences on functional impairment may also explain why low levels of PTSD symptoms (i.e., 1.5 or 2.5 symptoms) were predictive of functional impairment in this study.

Another key finding from this study was that specific PTSD symptoms which were more salient in PTSD symptom expression were, in part, influenced by the developmental stage of the child. Notwithstanding some symptom overlap, the strongest symptoms predicting functional impairment in the binary regression models varied by age-group. For example, whereas psychological distress at exposure to cues, and physiological reactivity, were predictive of functional impairment in pre-adolescents, these same symptoms were not predictive of functional impairment among adolescents. These differences were all the more remarkable given that there were no clinically meaningful differences between age-groups in the rates of symptom endorsement. These results have established that even when children across different ages endorse the same symptoms, they vary in their influence on functional impairment and therefore in their clinical significance.

Although this study cannot determine why particular symptoms were more functionally impairing and influential than others, it is useful to consider possible explanations. One contemporary perspective is the network conceptualisation of PTSD (McNally et al., 2015). This model assumes that some individual PTSD symptoms are more salient than others because they activate and influence other PTSD symptoms which then mutually reinforce one another. Recent studies have found theoretical support for the network model of PTSD in adult (Armour et al., 2017; Spiller et al., 2017) and paediatric samples (Russell, 2017). For example, Russell (2017) examined the network structure of two groups of children and adolescents aged 8-18 years who were exposed to disaster. They found that particular PTSD symptoms were more strongly linked with others and that these linkages varied across age-groups. However, given that the study was cross-sectional, the researchers did not posit a causal explanation for this.

Given that the ROC analyses in this study found as few as 2.5 symptoms were predictive of functional impairment in pre-adolescent children and 1.5 symptoms were predictive of functional impairment in adolescent children, it appears unlikely that this association with functional impairment is due to individual symptoms activating and maintaining other PTSD symptoms. Another explanation could be that the greater influence of a particular symptom on functional impairment is through interference with a child's ability to successfully master a developmental

task. For example, the symptom difficulty concentrating, may be particularly relevant in pre-adolescent children because it may interfere with their ability to regulate attention in school settings at a time when the increased mastery of this skill is expected and needed (Van der Kolk, 2003; Wong, 2008). These possible explanations require further research exploring the association between symptoms and functional impairment.

An alternative interpretation of the association between particular symptoms and functional impairment is to consider that functional impairment is not influenced by PTSD symptoms. Instead, it may be a result of external factors such as environmental stressors, psychiatric comorbidity, pain, or other unidentified variables. Furthermore, given that this research relied on cross-sectional data and it is not possible to conclude that a causal relationship exists between PTSD symptoms and functional impairment, it could also be argued that functional impairment influenced the development of PTSD symptoms. However, it is important to note that the diagnostic interviews conducted in this research specifically asked caregivers to report how PTSD symptoms were interfering with their child's functioning, or asked children to report how much they were "bothered" by the PTSD symptoms which were present. The specific linking of PTSD symptoms to functional impairment in diagnostic interviews provided strong evidence that the PTSD symptoms influenced functional impairment. However, it is also possible that factors in addition to PTSD symptoms contributed to functional impairment and these additional factors should be investigated in future research.

6.1.1.2. Main Findings and Discussion of Study 2: Age-related differences in PTSD symptom profiles

The aim of this study was to:

1) Examine PTSD symptom heterogeneity in children aged 7-14 years after exposure to trauma,
2) Explore potential age-related differences in symptom profiles of children in the following groups: Young Group (7-9 years), Latency Group (10-11 years), and Adolescent Group (12-14 years),
3) Examine which symptom profiles have the strongest relationship with functional impairment and the PTSD diagnosis.

Whereas the first study examined age-related differences in the importance of the number of symptoms present and the saliency of individual symptoms in PTSD expression, the second study

expanded this line of inquiry by exploring age-related differences in patterns of PTSD symptom endorsement. In addition to the Adolescent Group (12-14 years), I sub-divided the Pre-Adolescent Group into two separate age-groups: Young Group (7-9 years), and Latency Group (10-11 years). Then, I used structural equation modelling techniques to arrive at a more precise and nuanced understanding of PTSD symptom expression across three developmental stages. Next, I examined which symptom profiles had the strongest association with functional impairment and PTSD diagnosis by conducting an Equality Test of Probabilities across Latent Classes (Lanza et al., 2013).

Supporting and strengthening the results of the first study examining age-related differences in the saliency of individual symptoms, this study also demonstrated that there were qualitative differences in symptom profiles between each age-group and has contributed important new knowledge regarding these age-related differences. Using latent class analyses, this study found that the profiles most associated with functional impairment and PTSD diagnosis were characterised by symptoms of intrusion and effortful avoidance in the Young Group (7-9 years), symptoms from all PTSD clusters in the Latency Group (10-11 years), and symptoms of arousal/reactivity, intrusion, and loss of interest in the Adolescent Group (12-14 years). The qualitative differences that emerged between latent classes of the most symptomatic and functionally impaired children suggested that the PTSD construct is not based on a common pathway but on heterogeneous presentations across age-groups.

Another notable finding from this study was that across all age-groups and despite a low probability of diagnosis, children in the Some Symptoms Class had greater odds of functional impairment than children in the Low Symptom Class. In fact, in the Young Group, even though none of the children in the Some Symptom Class met diagnostic criteria, they were still at 24.5 times greater odds [97.5% CI 9.01 – 66.68] of functional impairment as compared to children in the Low Symptom Class. Furthermore, although there were no children who met criteria for diagnosis in the Low Symptom Class, there were still a small but significant percentage of children who were functionally impaired in every age-group (functional impairment ranged from 3% to 14%). These results strengthened the findings from the first study which also showed that even when children endorsed a small number of symptoms, these symptoms could contribute to functional impairment and warranted further attention. This study also found that females had greater odds of belonging to a symptomatic class than males in every age-group.

6.1.1.3. Main Findings and Discussion of Study 3: "Symptoms of effortful avoidance in trauma-exposed children aged 7-14 years and implications for diagnostic sensitivity"

The aim of this study was to:

1) Examine the impact of the requirement to endorse one symptom of effortful avoidance on PTSD prevalence rates and diagnostic sensitivity across three age-groups: Young Group (7-9 years), Latency Group (10-11 years), and Adolescent Group (12-14 years);
2) Examine the saliency of the effortful avoidance symptom cluster and its relationship to functional impairment across three age-groups: Young Group (7-9 years), Latency Group (10-11 years), and Adolescent Group (12-14 years).

The last two studies established that there was heterogeneity in PTSD symptom expression across three developmental stages. Therefore, findings from these studies established that the common pathway model which assumed all people experienced the same clusters of PTSD symptoms, was not supported by the evidence (Vibhakar, Kenardy, & Le Brocque, 2018). The final study examined symptom heterogeneity specific to the presence of effortful avoidance symptoms and their clinical significance. The new DSM-5 PTSD requirement to endorse at least one symptom of effortful avoidance in order to be diagnosed with PTSD is based on the tenuous assumption that all children with PTSD present with symptoms of effortful avoidance.

To test the impact of this requirement, I first calculated PTSD prevalence rates with and without the requirement to endorse effortful avoidance symptoms in the Young Group (7-9 years), Latency Group (10-11 years), and Adolescent Group (12-14 years). Next, I examined the clinical significance of the DSM-5 effortful avoidance cluster in each age-group by using binary logistic regression to determine which symptom clusters were most predictive of functional impairment.

This study found strong evidence that effortful avoidance symptoms formed a characteristic part of PTSD expression in all three age-groups of children. Further supporting the developmental sensitivity of this symptom, these findings also demonstrated that symptoms of effortful avoidance could be identified and assessed by clinicians via diagnostic interview in all three age-groups. At the same time, however, these results also demonstrated that effortful avoidance was not a part of PTSD symptom expression in a small but clinically significant minority of children who may have otherwise met the PTSD diagnosis. Furthermore, heterogeneity in the clinical significance of the effortful avoidance symptom cluster across age-groups was also demonstrated. For example, the effortful avoidance symptom cluster, although endorsed by almost one fourth of children in the Latency Group (10-11 years) was not predictive of functional impairment. In contrast, the effortful

avoidance symptom cluster was predictive of functional impairment in the Young (7-9 years) and Adolescent Groups (12-14 years).

An unexpected finding in this study was the clinical significance of the arousal/reactivity cluster. Out of the four DSM-5 symptom clusters, the arousal/reactivity cluster was the strongest predictor of functional impairment in every age-group. One explanation for this finding could be that symptoms of arousal/reactivity may interfere with the developing brain in a manner which hinders a child's ability to develop attention and affect regulation) (Van der Kolk, 2003; Wong, 2008), skills which are essential for learning and positive social relationships. Given that these skills are necessary for positive adaptation in multiple settings, symptoms of arousal and reactivity may exert a greater negative influence on children by interfering with their ability to master these skills.

6.2. Implications of Research

One of the overall aims of this research was to gain a comprehensive understanding of how post-traumatic stress is manifested in children aged 7-14 years which can be used to inform future diagnostic algorithms and to improve the early identification of trauma-exposed children needing care. The following section will outline the important diagnostic and clinical implications from this research.

6.2.1. Diagnostic Implications

These research findings highlight the uncertainty of whether the DSM-5 PTSD algorithm is of adequate sensitivity for children aged 7-14 years. In particular, the finding of a relatively low prevalence of numbing symptoms in children aged 7-11 years as compared to the adolescent age-group (ages 12 -14 years) suggests significant problems with developmental sensitivity in children aged 7-11 years. In the DSM-5, numbing symptoms are now contained within the cluster "negative alterations to cognitions and mood" and form four of the seven symptoms in this cluster. If we accept that numbing symptoms may not form part of the standard PTSD symptom profile for pre-adolescent children as these results suggest, it leaves children required to endorse at least two out of the three cognitive/mood symptoms in this cluster in order to meet PTSD criteria. These new or reformulated cognitive/mood symptoms were not tested for validity in this age-group prior to their inclusion in the DSM-5 (Kilpatrick et al., 2013; Miller et al., 2013). In addition, the internalised nature of these symptoms has raised concerns regarding their ability to be observed by caregivers or self-reported by children (Scheeringa, 2011). Adding to the evidence regarding the need for age-related modifications to the diagnostic algorithm, the findings have also demonstrated that the symptom, inability to recall an important aspect of the trauma, does not appear to be valid in

children aged 7-14 years which is consistent with previous research (Boelen & Spuij, 2013; Dow et al., 2013; Iselin et al., 2010; Kassam-Adams et al., 2010). Therefore, it should be removed from future PTSD algorithms pertaining to this age-group.

Although it is promising news that the new DSM-5 PTSD requirement to endorse at least one symptom of effortful avoidance did not reduce the developmental sensitivity of the PTSD diagnosis for the majority of children in this sample, it did lead to the diagnostic exclusion of a clinically significant minority of children (3%) who may have otherwise met PTSD criteria. Moreover, results highlighting that the clinical importance of individual PTSD symptoms and symptoms clusters varied across age-groups and developmental stages not only confirmed age-related differences in PTSD symptom expression but challenged the single pathway assumption on which the DSM-5 PTSD diagnosis was based (Andreasen, 2011). Furthermore, given that the PTSD symptom profiles most associated with functional impairment and diagnosis did not conform to the DSM-5 PTSD symptom structure in either the Young, Latency or Adolescent Groups indicates significant variability in PTSD symptom expression across childhood and adolescence. Taken together, these results suggest that alternative and more liberal diagnostic models should be considered for children aged 7-14 years in order to increase the sensitivity of the PTSD diagnosis for this age-group, and to account for differences in PTSD symptom expression as children develop.

I would recommend the adoption of a more liberal diagnostic algorithm for this age-group for two reasons. First, given the limited research which exists on symptom expression in this age-group, we do not yet have the knowledge to identify the core PTSD symptoms which should be included in symptom clusters for children 7 years and over. This lack of understanding of core PTSD symptom expression in children has been made evident by two recent studies comparing different PTSD algorithms in children (Danzi & La Greca, 2016; Sachser, Berliner, et al., 2017). Both studies demonstrated that the proposed ICD-11 criteria and the DSM-5 criteria identified different children with PTSD, with each algorithm missing children with substantial PTSD symptoms and functional impairment (Danzi & La Greca, 2016; Sachser, Berliner, et al., 2017). Consequently, the more stringent algorithms currently applied to children aged 7-14 years appear to under-diagnose children in this age-group. Second, the substantial risks of long-term adverse outcomes associated with PTSD (Fairbank & Fairbank, 2009; Seng et al., 2005) justify a more liberal and inclusive diagnostic approach with children. However, even if some children are over-diagnosed as a result of using more liberal diagnostic algorithms, there is minimal risk of harm given that mental health professionals would further assess the necessity of treatment. Furthermore, the potential benefits of early intervention for mental health problems are substantial (Durlak & Wells, 1998). In contrast, if children are under-diagnosed, they may not qualify for mental health

services in some health systems or have access to treatment trials (e.g., J. Cohen, Mannarino, & Knudsen, 2005) despite substantial PTSD symptoms and functional impairment, placing them at considerable risk for long-term adverse consequences (Fairbank & Fairbank, 2009). Of course, the long-term level of risk that under-diagnosis poses will be informed by the severity of functional impairment that a child is experiencing. As the evidence regarding PTSD expression in children advances, the diagnostic criteria should be further refined.

6.2.2. Clinical Implications

Given the presence of functional impairment in children with low levels of PTSD symptoms or with symptom expression that does not conform to DSM-5 PTSD, it is recommended that all trauma-exposed children are screened for functional impairment regardless of the number or type of PTSD symptoms they endorse. It is also recommended that clinical intervention should be accessible to children with sub-threshold PTSD or with a low number of PTSD symptoms who are also functionally impaired.

In addition, PTSD symptoms which have been shown to predict functional impairment should be considered as an increased focus in assessment and intervention. In particular, attention should be paid to the arousal/reactivity symptoms in all age-groups. In addition, loss of interest in adolescents and difficulty concentrating in pre-adolescent children should merit particular attention given that they were most predictive of functional impairment in those age-groups.

Finally, it is recommended that treatment outcome studies should not only focus on symptom reduction and diagnosis remission but should also assess functional impairment as an outcome. If an intervention reduces the number of PTSD symptoms so that a child no longer meets the PTSD diagnosis, but the child remains significantly functionally impaired, it could be argued that that the treatment was not as effective as would initially appear. The recommendation that treatment studies include clinically meaningful outcomes (i.e., reduction in functional impairment) in addition to symptom reduction has been previously proposed by multiple researchers (Becker, Chorpita, & Daleiden, 2011; Hoagwood, Jensen, Petti, & Burns, 1996; Kazdin, 2006; Layne, 2011) but not consistently heeded. For example, a recent systematic review of evidence-based PTSD treatments for maltreated children with the goal of examining treatment effectiveness with a "broad range of psychopathological outcomes" (Leenarts, Diehle, Doreleijers, Jansma, & Lindauer, 2013, p. 270), did not address functional impairment.

6.3. Future Research

These findings have identified a number of future directions for research. First, given the high prevalence of functional impairment in trauma-exposed children, it is essential that future

research addresses how trauma-exposed children may be functionally impaired and what factors drive and maintain functional impairment. In particular, understanding how symptoms may contribute to particular types of functional impairment in children is an important step towards developing more effective interventions. Furthermore, these findings should be replicated with more robust assessment measures which explore both the domains in which functional impairment is experienced and severity. In addition, as computational models evolve to compare symptom saliency and age-related changes to symptom networks over time, network analysis presents a promising area for research in identifying age-related differences in the saliency of particular symptoms.

Second, future research should focus on developing and testing paediatric diagnostic models to better account for age-related differences in PTSD symptom presentation. One possibility is to investigate whether extending DSM-5 PTSD for Children 6 Years and Younger to pre-adolescent children would be a more valid model for this age group. Given that two recent studies (Danzi & La Greca, 2017; Mikolajewski et al., 2017) have found this algorithm identified a larger percentage of children with several PTSD symptoms in combination with significant functional impairment, it may be more optimal for use with pre-adolescent children.

Another approach would be to investigate whether requiring a minimum number of PTSD symptoms in any constellation in conjunction with functional impairment is a more valid and parsimonious model for this age-group. This could be done by examining prevalence rates, impairment severity and comorbidity between various diagnostic algorithms to determine if the children and young persons identified by a straight symptom count are clinically distinct from those identified by other algorithms. The challenge to this approach would be to ensure that other disorders (i.e., depression or anxiety) are not misidentified as PTSD.

Although several recent studies have compared the sensitivity of different diagnostic algorithms (Danzi & La Greca, 2016; La Greca et al., 2017; Mikolajewski et al., 2017; Sachser, Berliner, et al., 2017), to this author's knowledge, no recent studies have included a straight symptom count with functional impairment in their comparisons. Importantly, several of the recent studies which compared different PTSD algorithms found poor overlap between them, with each algorithm identifying children with PTSD that were not identified by other models (Danzi & La Greca, 2016; La Greca et al., 2017; Sachser, Berliner, et al., 2017). These findings serve to underscore the imperative to develop a diagnostic model which recognises age-related symptom heterogeneity.

Third, given that this sample was drawn from a non-treatment referred population, it had a low prevalence of the PTSD diagnosis (12%) as well as low rates of symptom endorsement. A strength of conducting prospective research with a trauma-exposed population was that it allowed us to assess PTSD symptoms even when they did not meet pre-determined diagnostic algorithms or screening criteria. However, the low rates of symptom endorsement in this sample resulted in data sparseness which did not allow us to take into account all potential variations in symptom patterns. Therefore, it is recommended that this research is replicated with more symptomatic children (i.e., treatment-referred population) in order to obtain a fuller understanding of variations in PTSD symptom profiles. In addition, given that the three new PTSD symptoms (negative emotional state, distorted cognitions, and reckless or self-destructive behaviour) were not assessed in this sample, it is important that future research explore the developmental sensitivity of these symptoms, their clinical significance, and any age-related differences in their presentation.

Lastly, given a number of recent studies have demonstrated variability in symptom patterns based on the type of trauma (DiMauro et al., 2014; Shevlin & Elklit, 2012), and culture (Kohrt et al., 2011; Soysa, 2013), replication across a diverse range of traumas and cultures is important. Furthermore, research should also explore whether PTSD symptom presentation remains invariant across gender. Although gender was non-significant in relation to which PTSD symptoms were predictive of functional impairment, females had greater odds of belonging to the most symptomatic latent classes in every age-group. The increased vulnerability of females in this sample to manifest significant PTSD symptoms has highlighted the clinical importance for future research in this area. We cannot assume that symptom profiles, the clinical significance of particular PTSD symptoms, and the factors that drive and maintain functional impairment will remain constant across different populations.

6.4. Limitations

Although this research has made a number of important and original contributions to the study of paediatric PTSD, it needs to be considered in light of several limitations. First, given that this research relied on cross-sectional data, it is not possible to conclude that a causal relationship exists between PTSD symptoms and functional impairment. In addition, pre-existing functional impairment also cannot be ruled out. Future studies should strengthen these findings by using longitudinal designs to examine causal relationships between PTSD symptoms and functional impairment as well as additional factors that may contribute to the development and maintenance of functional impairment.

Second, the diagnostic measures that were used to assess PTSD symptoms were based on the DSM-IV PTSD diagnosis. Consequently, I was unable to assess the presence of the three new DSM-5 PTSD symptoms (negative emotional state, distorted cognitions, and reckless or self-destructive behaviour) or how they may influence functional impairment or contribute to age-related differences. In addition, because these three additional symptoms were not assessed, it is possible that the PTSD prevalence rate was under-estimated in this sample.

Another factor which may have contributed to the under-reporting of symptoms is that PTSD was assessed only by a single informant (64% by child report, 36% by caregiver report). Previous research has shown that a combination of both caregiver and child report resulted in the most accurate reporting of PTSD symptoms in children (Scheeringa et al., 2006) and that internalised symptoms may be under-reported by caregivers (Achenbach, McConaughy, & Howell, 1987). It is therefore possible that the low level of endorsement of numbing symptoms in children aged 7-11 years could be due to the under-reporting of highly internalised symptoms by caregivers instead of a low occurrence of these symptoms in this age-group (Achenbach et al., 1987). Nevertheless, even if some of the numbing symptoms were under-reported by caregivers in pre-adolescent children, this only strengthens the argument that numbing symptoms are difficult to distinguish in children and that the current DSM-5 PTSD algorithm is not adequately sensitive to identify children experiencing PTSD. In addition, given that the studies varied in whether they used child report or caregiver report to assess PTSD symptoms, it is unclear how this may have influenced the reporting of symptoms. Future studies which harmonise data across multiple studies should do so using the same type of informant to assess PTSD.

Third, this study was unable to assess the ways in which children were functionally impaired or the severity of their functional impairment. Furthermore, the assessment of functional impairment was limited to the measures contained in the PACT data archive which was either a one item dichotomised assessment (CAPS-CA) or a four-item dichotomised of functional impairment (ADIS-P). Future research should use more comprehensive measures which assess the severity of functional impairment across a variety of domains. Previous research has demonstrated that symptom severity may play a larger role in driving functional impairment than merely symptom frequency or the number of different symptoms present (Carrion et al., 2002; Cohen & Scheeringa, 2009). Another way to extend this research would be to explore symptom severity as well as the influence of the number and types of symptoms endorsed in their association with functional impairment using more comprehensive measures of functional impairment.

Fourth, given that this research pooled data from nine independent samples and multiple countries, systematic differences between the studies may have influenced these results (Hussong,

Curran, & Bauer, 2013). Even though between-study heterogeneity was minimised with regards to measurement and study design characteristics, I was unable to evaluate how differences in sampling, geographic location, or the time since index trauma may have influenced these findings. This would be a fruitful area for future investigation.

It is also essential to acknowledge limits to the generalisability of this study. The majority of the children in this sample experienced unintentional injury as the index trauma event. We cannot assume that children who experience other types of trauma such as interpersonal violence or disasters will manifest symptoms and functional impairment in the same manner. Consequently, additional research across a diverse range of traumas should be undertaken.

Furthermore, although this research has combined data from nine different studies across four different countries, the participants are all from Western nations. We also cannot assume that the relationship between PTSD symptoms and functional impairment or age-related differences will manifest in the same manner in non-Western cultures. For example, Kohrt et al. (2011) demonstrated that symptoms of effortful avoidance may not be a valid indicator of post-traumatic pathology among war-exposed youth in Nepal. Consequently, replication of this study in non-Western settings is important to further our understanding of how PTSD and functional impairment manifest in this age-group in diverse populations.

6.5. Summary and Conclusion

Whereas much of the child PTSD research has used questionnaires for the assessment of PTSD (Trickey, Siddaway, Meiser-Stedman, Serpell, & Field, 2012), this research was based on the use of "gold standard" diagnostic interviews for the assessment of PTSD and functional impairment. It has brought together a large sample of participants drawn from nine different studies, spanning four different countries. It is also one of the only studies that has examined symptom heterogeneity using a number of different methods across three developmental stages. To the authors' best knowledge, it is the largest prospective study to examine age-related differences in PTSD symptom presentation in children aged 7-14 years.

The results of the studies highlighted two distinct groups of trauma-exposed children aged 7-14 years who merit further attention and care. The first group was comprised of highly symptomatic children who were functionally impaired. The second group was comprised of children with a low number of PTSD symptoms who were also functionally impaired. Within the first group were many children who did not meet criteria for the PTSD diagnosis due to a lack of diagnostic sensitivity, but who may have warranted such a diagnosis. The second group was

comprised of children who did not warrant a PTSD diagnosis, but who did need further attention as due to PTSD symptoms which were functionally impairing.

Taken together, this research has demonstrated several different facets of PTSD symptom expression in children aged 7-14 years. The three different studies conducted build on one another to paint a more nuanced and complex picture of PTSD symptom expression than what is currently presented in the DSM-5 (American Psychiatric Association, 2013a). This research has made a number of substantive original contributions to the field. First, it has demonstrated that there are age-related differences in PTSD symptom expression in children aged 7-14 years. These findings demonstrating heterogeneity in the manner that children in different developmental stages manifest PTSD symptoms have challenged the problematic assumption on which the current DSM-5 PTSD diagnosis is based: That PTSD results from a single common pathway comprising the same symptom clusters for all those who experience it (American Psychiatric Association, 2013b; Andreasen, 2011). Second, it has provided evidence that the DSM-5 PTSD algorithm may not be sensitive for children aged 7-14 years, and in particular for children aged 7-11 years. Third, it has established that children with low levels of PTSD symptoms may have high rates of functional impairment, and therefore warrant clinical intervention. More broadly and perhaps most importantly, it has illustrated the necessity of looking beyond diagnostic algorithms in determining which trauma-exposed children need attention and care. As such, it has both broadened and deepened our knowledge of paediatric PTSD, a substantial public health problem.

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Appendix A: Overview of Included Studies for Scoping Review

Table A1 Overview of Included Studies for Scoping Review

	Authors	Title	Measures Used	Trauma Type	Ages	Sample Size	Country
1	(Adams et al., 2014)	Prevalence and predictors of PTSD and depression among adolescent victims of the spring 2011 tornado outbreak	Structured Interview	Tornado	12-17	2000	USA
2	(Boelen & Spuij, 2013)	Symptoms of post-traumatic stress disorder in bereaved children and adolescents: Factor structure and correlates	Child PTSD Symptom Scale (CPSS)	Bereavement	8-18	332	Netherlands
3	(Bruce, Gumley, Isham, Fearon, & Phipps, 2011)	Post-traumatic stress symptoms in childhood brain tumour survivors and their parents	Impact of Events Scale-8	Brain tumour survivors	8-16	52	UK
4	(Bulut, 2013)	Prediction of post-traumatic stress symptoms via comorbid disorders and other social and school problems in	Child PTSD Reaction Index (CPTSD-RI)	Earthquake	6th -8th grade	191	Turkey

	Authors	Title	Measures Used	Trauma Type	Ages	Sample Size	Country
		earthquake exposed Turkish adolescents					
5	(Chen, Zhang, Liu, Liu, & Dyregrov, 2012)	Structure of the Children's Revised Impact of Event Scale (CRIES) with children and adolescents exposed to debris flood	Children's Revised Impact of Events Scale–13 (CRIES-13)	Flood	8-18	268	China
6	(Chou, Su, Wu, & Chen, 2011)	Child physical abuse and the related PTSD in Taiwan: The role of Chinese cultural background and victims' subjective reactions	PTSD Reaction Index	Physical abuse	9-15	1966	Taiwan
7	(Contractor et al., 2013)	Do gender and age moderate the symptom structure of PTSD? Findings from a national clinical sample of children and adolescents	PTSD Reaction Index	Varied	7-18	6591	USA

	Authors	Title	Measures Used	Trauma Type	Ages	Sample Size	Country
8	(Danzi & La Greca, 2016)	DSM-IV, DSM-5, and ICD-11: identifying children with posttraumatic stress disorder after disasters	PTSD Reaction Index	Natural Disaster	7-11	S1: 327 S2: 383	USA
9	(de Haan et al., 2016)	Psychometric properties of the German version of the Child Post-Traumatic Cognitions Inventory (CPTCI-GER)	CAPS CA or UCLA PTSD Reaction Index	Varied	7-16	223	Germany
10	(Dogan, 2011)	Adolescents' posttraumatic stress reactions and behavior problems following Marmara earthquake	PTSD Reaction Index	Earthquake	12-17	695	Turkey
11	(Dow, Kenardy, Le Brocque, & Long, 2013)	The diagnosis of posttraumatic stress disorder in school-aged children and adolescents following pediatric intensive care unit admission	The Children's PTSD Inventory, diagnostic interview	PICU admission	6-16	59	Australia

	Authors	Title	Measures Used	Trauma Type	Ages	Sample Size	Country
12	(Dyb, Jensen, & Nygaard, 2011)	Children's and parents' posttraumatic stress reactions after the 2004 tsunami	The Child Stress Disorder Checklist	Tsunami	6-18	319	Norway
13	(Familiar et al., 2014)	Posttraumatic stress symptoms and structure among orphan and vulnerable children and adolescents in Zambia	PTSD Reaction Index	Varied	5-18	343	Zambia
14	(Feo et al., 2014)	Prevalence of psychiatric symptoms in children and adolescents one year after the 2009 L'Aquila earthquake	CBCL and YSR	Earthquake	11-14	452	Italy
15	(Hashemi et al., 2017)	Facilitating mental health screening of war-torn populations using mobile applications	Researcher's measure	War	6-18	405	Gaza
16	(Hébert &Daigneault, 2016)	The association between peer victimization, PTSD, and	Children's Impact of Traumatic	Sexual abuse	6-14	158	Canada

	Authors	Title	Measures Used	Trauma Type	Ages	Sample Size	Country
		dissociation in child victims of sexual abuse	Events Scale–II (CITES-II)				
17	(Hitchcock, et al., 2015)	The prospective role of cognitive appraisals and social support in predicting children's posttraumatic stress	CAPS CA	Single Incident Stressor	7-17	97	Australia
18	(Hunt, Martens, & Belcher, 2011)	Risky business: Trauma exposure and rate of posttraumatic stress disorder in African American children and adolescents	Trauma Symptom Checklist, PTSD Reaction Index	Varied	8-17	271	USA
19	(Iselin, Le Brocque, Kenardy, Anderson, & McKinlay, 2010)	Which method of posttraumatic stress disorder classification best predicts psychosocial function in children with traumatic brain injury?	CAPS CA	Traumatic brain injury	6-14	184	Australia

	Authors	Title	Measures Used	Trauma Type	Ages	Sample Size	Country
20	(Israel-Cohen & Kaplan, 2016)	Acute stress reaction and positive future orientation as predictors of PTSD among Israeli adolescents exposed to missile attacks	PTSD Symptoms Scale (PSS-SR)	War	7th - 11th grade	461	Israel
21	(Iwadare et al., 2014)	Posttraumatic symptoms in elementary and junior high school children after the 2011 Japan earthquake and tsunami: Symptom severity and recovery vary by age and sex	Post-Traumatic Stress Symptoms for Children – 15 survey (PTSSC-15)	Earthquake, tsunami	5-6th grade, 8-9th grade	5582	Japan
22	(Kaplan, Kaal, Bradley, & Alderfer, 2013)	Cancer-related traumatic stress reactions in siblings of children with cancer	Child PTSD symptom scale (CPSS) Child report	Sibling cancer	8-17	125	USA
23	(Kassam-Adams, Marsac, & Cirilli, 2010)	Posttraumatic stress disorder symptom structure in injured children: Functional impairment and depression	CAPS CA, CPSS	Single incident injury	8-17	683	USA

	Authors	Title	Measures Used	Trauma Type	Ages	Sample Size	Country
		symptoms in a confirmatory factor analysis					
24	(Kieffer-Kristensen, Teasdale, & Bilenberg, 2011)	Post-traumatic stress symptoms and psychological functioning in children of parents with acquired brain injury	CRIES and CBCL	Parental brain injury	7-14	55	Denmark
25	(Kira, Lewandowski, Somers, Yoon, & Chiodo, 2012)	The effects of trauma types, cumulative trauma, and PTSD on IQ in two highly traumatized adolescent groups	CAPS 2 and CTS	Varied	11-18	390	USA
26	(Kohrt et al., 2011)	Validation of cross-cultural child mental health and psychosocial research instruments: Adapting the Depression Self-Rating Scale and Child PTSD Symptom Scale in Nepal	Child PTSD Symptom Scale (CPSS)	War	11-15	162	Nepal
27	(Lau et al., 2010)	Psychological distress among adolescents in Chengdu,	Children's Revised	Earthquake	Junior High -	3324	China

	Authors	Title	Measures Used	Trauma Type	Ages	Sample Size	Country
		Sichuan at 1 month after the 2008 Sichuan Earthquake	Impact of Events Scale–13 (CRIES-13)		Senior High		
28	(Liu & Chen, 2015)	A community study on the relationship of posttraumatic cognitions to internalizing and externalizing psychopathology in Taiwanese children and adolescents	PTSD Reaction Index	Varied	9-17	351	Taiwan
29	(Ma et al., 2011)	Risk indicators for post-traumatic stress disorder in adolescents exposed to the 5.12 Wenchuan earthquake in China	CRIES-13, Structured interview	Earthquake	12-18	3208	China
30	(Mannert et al., 2014)	Quality of life in Ethiopia's street youth at a rehabilitation center and the association with trauma	Structured diagnostic interview	Varied	6-20	89	Ethiopia

	Authors	Title	Measures Used	Trauma Type	Ages	Sample Size	Country
31	(McDermott, Berry, & Cobham, 2012)	Social connectedness: a potential aetiological factor in the development of child post-traumatic stress disorder	PTSD Reaction Index	Cyclone	8-13	804	Australia
32	(McKinnon et al., 2016)	An update on the clinical utility of the children's post-traumatic cognitions inventory	CAPS-CA, Children's PTSD Inventory (CPTSD-I), or ADIS-C	Single Incident Stressor	7-17	492	UK, Australia
33	(Meissen, Barnhoorn, Didden, Korzilius, & De Jongh, 2014)	Clinical assessment of PTSD in children with mild to borderline intellectual disabilities: A pilot study	ADIS_C adapted	Varied	8-13	15	Netherlands
34	(Mikolajewski et al., 2017)	Evaluating Diagnostic and Statistical Manual of Mental Disorders, fifth edition posttraumatic stress disorder diagnostic criteria in older children and adolescents	DISC-IV	Varied	7-12	76	USA

	Authors	Title	Measures Used	Trauma Type	Ages	Sample Size	Country
35	(Murphy et al., 2014)	Predictors of treatment completion in a sample of youth who have experienced physical or sexual trauma	PTSD Reaction Index	Sexual or physical abuse	7-21	928	USA
36	(Nixon et al., 2013)	The Child PTSD Symptom Scale: An update and replication of its psychometric properties	CPSS, CAPS_CA or ADIS	Medical trauma, varied	6-17	S1 185 S2 68	Australia and UK
37	(Palosaari et al., 2016)	Negative social relationships predict posttraumatic stress symptoms among war-affected children via posttraumatic cognitions	Children's Revised Impact of Events Scale–13 (CRIES-13)	War	10-12	240	Gaza
38	(Palosaari, Punamäki, Diab, & Qouta, 2013)	Posttraumatic cognitions and posttraumatic stress symptoms among war-affected children: a cross-lagged analysis	Children's Revised Impact of Events Scale–13 (CRIES-13)	War	10-12	240	Palestine

	Authors	Title	Measures Used	Trauma Type	Ages	Sample Size	Country
39	(Peltonen et al., 2017)	Peritraumatic dissociation predicts posttraumatic stress disorder symptoms via dysfunctional trauma-related memory among war-affected children	Children's Revised Impact of Events Scale	War	10-12	197	Gaza
40	(Ponnamperuma & Nicolson, 2016)	Negative trauma appraisals and PTSD symptoms in Sri Lankan adolescents	PTSD Reaction Index	Varied	12-16	414	Sri Lanka
41	(Rollocks, Dass, Hutchinson, & Mohammed, 2013)	The associations observed between experiencing multiple traumatic events and mental health symptoms among adolescents in Trinidad	Trauma symptom checklist (TSCC)	Varied	10-15	420	Trinidad
42	(Ross & Kearney, 2015)	Identifying heightened risk for posttraumatic symptoms among maltreated youth	Children's PTSD Inventory (CPTSD-I)	Child abuse	9-18	360	USA

	Authors	Title	Measures Used	Trauma Type	Ages	Sample Size	Country
43	(Ross & Kearney, 2017)	Posttraumatic symptoms among maltreated youth using classification and regression tree analysis	Children's PTSD inventory (CPTSD-I)	Abuse & removal from home	7-18	400	USA
44	(Runyon, Deblinger, & Steer, 2014)	PTSD symptom cluster profiles of youth who have experienced sexual or physical abuse	K-SADS, CBCL, CDI, BDI	Physical or sexual abuse	6-17	749	USA
45	(Russell et al., 2017)	The network structure of posttraumatic stress symptoms in children and adolescents exposed to disasters	PTSD Reaction Index	Disaster	8-13	338	USA
46	(Sachser et al., 2017)	Comparing the dimensional structure and diagnostic algorithms between DSM-5 and ICD-11 PTSD in children and adolescents	Child and Adolescent Trauma Screen (CATS)	Varied	7-17	475	Germany and Norway
47	(Sachser et al., 2017)	Complex PTSD as proposed for ICD-11: Validation of a	CAPS CA	Varied	7-17	155	Germany

	Authors	Title	Measures Used	Trauma Type	Ages	Sample Size	Country
		new disorder in children and adolescents and their response to Trauma-Focused Cognitive Behavioral Therapy					
48	(Sharma-Patel et al., 2014)	Patterns in blame attributions in maltreated youth: Association with psychopathology and interpersonal functioning	Child PTSD Symptom Scale (CPSS)	Physical abuse, sexual abuse, or traumatic bereavement	6-17	128	USA
49	(Soysa, 2013)	War and tsunami PTSD responses in Sri Lankan children: Primacy of re-experiencing and arousal compared to avoidance-numbing	Harvard Trauma Questionnaire (HTQ)	S1: War S2: Tsunami	S1: 9-16 S2: 12-14	S1: 60 S2: 60	Sri Lanka
50	(Sprung & Harris, 2010)	Intrusive thoughts and young children's knowledge about thinking following a natural disaster	Clinical interview	Hurricane	5-9	165	USA

	Authors	Title	Measures Used	Trauma Type	Ages	Sample Size	Country
51	(Steinberg et al., 2013)	Psychometric properties of the UCLA PTSD Reaction Index: Part I	PTSD Reaction Index	Varied	7-18	6291	USA
52	(Sullivan et al., 2017)	Aggression in children and adolescents following a residential fire: The longitudinal impact of PTSD re-experiencing symptoms	Child Reaction to Traumatic Events Scale (CRTES), CBCL	Fire	8-18	135	USA
53	(Vásquez et al., 2012)	Peritraumatic dissociation and peritraumatic emotional predictors of PTSD in Latino youth: Results from the Hispanic family study	National woman's study PTSD module (modified)	Varied	8-17	204	USA
54	(Verduijn, Vincken, Meesters, & Engelhard, 2015)	Emotional reasoning in acutely traumatized children and adolescents: An exploratory study	Child PTSD Symptom Scale (CPSS)	Single incident stressor	7-18		Netherlands & Belgium
55	(Verlinden et al., 2013)	What makes a life event traumatic for a child?: the	Children's Revised	Varied	8-18	643	Netherlands

	Authors	Title	Measures Used	Trauma Type	Ages	Sample Size	Country
		predictive values of DSM-Criteria A1 and A2	Impact of Events Scale–13 (CRIES-13)				
56	(Verlinden et al., 2014)	A parental tool to screen for posttraumatic stress in children: first psychometric results	Children's Revised Impact of Events Scale–13 (CRIES-13)	Varied	8-18	59	Netherlands
57	(Wei et al., 2013)	Prevalence and predictors of posttraumatic stress disorder among Chinese youths after an earthquake	PTSD Reaction Index	Earthquake	9-18	753	Taiwan
58	(Wittmann, Zehnder, Schredl, Jenni, & Landolt, 2010)	Posttraumatic nightmares and psychopathology in children after road traffic accidents	CAPS-CA	Road traffic accident	7-15	32	Switzerland
59	(Yelland et al., 2010)	Bushfire impact on youth	PTSD Reaction Index	Wildfires	8-18	136	Australia

	Authors	Title	Measures Used	Trauma Type	Ages	Sample Size	Country
60	(Yen et al., 2011)	A multidimensional anxiety assessment of adolescents after Typhoon Morakot-associated mudslides	Impact of Events Scale - Revised	Typhoon related mudslides	Grades 7-9	271	Taiwan
61	(Ying, Wu, Lin, & Chen, 2013)	Prevalence and predictors of posttraumatic stress disorder and depressive symptoms among child survivors 1 year following the Wenchuan earthquake in China	Child PTSD Symptom Scale (CPSS)	Earthquake	8-19	3015	China
62	(Zhang, Zhu, Du, & Zhang, 2015)	Posttraumatic stress disorder and somatic symptoms among child and adolescent survivors following the Lushan earthquake in China: A six-month longitudinal study	Children's Revised Impact of Events Scale–13 (CRIES-13)	Earthquake	8-19	2299	China

Appendix B: PTSD Algorithms

Table B1 PTSD Algorithms

PTSD Symptoms	DSM-IV	PTSD-AA	DSM-5 PTSD for 6 Years and Younger	DSM-5 PTSD	DSM-5 MA	DSM-5 MA with Avoidance
	Minimum symptom threshold: 6 symptoms	Minimum symptom threshold: 4 symptoms	Minimum symptom threshold: 4 symptoms	Minimum symptom threshold: 6 symptoms	Minimum symptom threshold: 4 symptoms	Minimum symptom threshold: 4 symptoms
			Intrusion Symptoms			
Intrusive memories	x	x	x	x	x	x
Distressing dreams	x	x	x	x	x	x
Dissociative reactions	x	x	x	x	x	x
Psychological distress	x	x	x	x	x	x
Physiological reactivity	x	x	x	x	x	x
Required for diagnosis	1 of 5 intrusion symptoms	1 of 5 intrusion symptoms	1 of 5 intrusion symptoms	1 of 5 intrusion symptoms	1 of 5 intrusion symptoms	1 of 5 intrusion symptoms

PTSD Symptoms	DSM-IV	PTSD-AA	DSM-5 PTSD for 6 Years and Younger	DSM-5 PTSD	DSM-5 MA	DSM-5 MA with Avoidance
Effortful Avoidance Symptoms						
Avoidance of thoughts/feelings	x	x	x	x	x	x
Avoidance of activities	x	x	x	x	x	x
Required for diagnosis	See under numbing symptoms for symptom requirement	See under numbing symptoms for symptom requirement	See under cognitive/mood symptoms for symptom requirement	1 of 2 avoidance symptoms	See under numbing symptoms for symptom requirement	1 of 2 avoidance symptoms
Numbing Symptoms						
Inability to recall an important aspect of the trauma	x	x	No	x	x	x
Loss of interest	x	x	x	x	x	x
Detachment	x	No	No	x	x	x
Restricted range of affect	x	x	No	No	x	x
†Inability to experience positive emotions	No	No	x	x	No	No

PTSD Symptoms	DSM-IV	PTSD-AA	DSM-5 PTSD for 6 Years and Younger	DSM-5 PTSD	DSM-5 MA	DSM-5 MA with Avoidance
Foreshortened future	x	x	No	No	x	x
Socially withdrawn behaviour*	No	x	x	No	No	No
Required for diagnosis	3 of 7 avoidance and/or numbing symptoms	1 of 7 avoidance and/or numbing symptoms	See under cognitive/mood symptoms for symptom requirement	See under cognitive/mood symptoms for symptom requirement	2 of 7 avoidance and/or numbing symptoms	1 of 6 avoidance/and or numbing symptoms
Cognitive/Mood Symptoms						
†Negative beliefs or expectations	No	No	No	x	No	No
†*Negative emotional state	No	No	x	x	No	No
†Distorted cognitions	No	No	No	x	No	No
Required for diagnosis	These cognitive mood symptoms are not a part of this algorithm		1 of 6 avoidance and/or numbing and/or mood symptoms	2 of 7 cognitive/mood and/or numbing symptoms		

PTSD Symptoms	DSM-IV	PTSD-AA	DSM-5 PTSD for 6 Years and Younger	DSM-5 PTSD	DSM-5 MA	DSM-5 MA with Avoidance
			Arousal/Reactivity Symptoms			
Difficulty sleeping	x	x	x	x	x	x
Irritability	x	x	x	x	x	x
Difficulty concentrating	x	x	x	x	x	x
Hypervigilance	x	x	x	x	x	x
Exaggerated startle response	x	x	x	x	x	x
†Reckless or self-destructive behaviour	No	No	No	x	No	No
Required for diagnosis	2 of 5 arousal/reactivity symptoms	2 of 5 arousal/reactivity symptoms	2 of 5 arousal/reactivity symptoms	2 of 6 arousal/reactivity symptoms	2 of 5 arousal/reactivity symptoms	2 of 5 arousal/reactivity symptoms

*New or substantially reformulated for DSM-5 PTSD for 6 Years and Younger.
†New or substantially reformulated for DSM-5 PTSD.

Appendix C: Item Response Probabilities

Table C1 Total Group High Symptom Class

High Symptoms: Overall Group	Probability of Yes (Category 2)	95% CI	
		Lower CI	Upper CI
Intrusive memories	0.67	0.38	0.95
Distressing dreams	0.50	0.29	0.71
Dissociative reactions	0.54	0.14	0.94
Psych distress	0.75	0.43	1.08
Physio distress	0.56	0.14	0.98
Avoid thoughts	0.69	0.32	1.06
Avoid activities	0.69	0.47	0.92
Inability to recall	0.51	0.38	0.64
Loss of interest	0.21	0.08	0.34
Detachment	0.19	0.08	0.30
Restricted affect	0.32	0.16	0.48
Foreshortened future	0.35	0.14	0.56
Difficulty sleeping	0.55	0.39	0.72
Irritability	0.65	0.49	0.82
Difficulty concentrating	0.47	0.31	0.62
Hypervigilance	0.53	0.31	0.75
Exaggerated startle	0.51	0.13	0.89

Table C2 Young Group High Symptom Class

High Symptoms: Young Group	Probability of Yes (Category 2)	95% CI	
		Lower CI	Upper CI
Intrusive memories	0.74	0.54	0.93
Distressing dreams	0.66	0.38	0.93
Dissociative reactions	0.65	0.38	0.91
Psych distress	0.95	0.84	1.06
Physio distress	0.6	0.36	0.83
Avoid thoughts	0.84	0.64	1.03
Avoid activities	0.8	0.63	0.96
Inability to recall	0.47	0.28	0.66
Loss of interest	0.13	0	0.25
Detachment	0.16	0.01	0.3
Restricted affect	0.35	0.16	0.53
Foreshortened future	0.39	0.18	0.61
Difficulty sleeping	0.43	0.22	0.64
Irritability	0.58	0.32	0.84
Difficulty concentrating	0.44	0.22	0.66
Hypervigilance	0.53	0.33	0.73
Exaggerated startle	0.63	0.31	0.96

Table C3 Latency Group Diverse Symptoms Class

Diverse Symptoms: Latency Group	Probability of Yes (Category 2)	95% CI	
		Lower CI	Upper CI
Intrusive memories	0.48	0.33	0.62
Distressing dreams	0.25	0.12	0.37
Dissociative reactions	0.24	0.12	0.36
Psych distress	0.63	0.48	0.77
Physio distress	0.23	0.11	0.36
Avoid thoughts	0.54	0.39	0.69
Avoid activities	0.39	0.21	0.56
Inability to recall	0.49	0.34	0.63
Loss of interest	0.16	0.05	0.26
Detachment	0.12	0.02	0.21
Restricted affect	0.19	0.06	0.32
Foreshortened future	0.16	0.04	0.27
Difficulty sleeping	0.31	0.15	0.47
Irritability	0.59	0.38	0.8
Difficulty concentrating	0.42	0.27	0.57
Hypervigilance	0.41	0.26	0.57
Exaggerated startle	0.33	0.17	0.48

Table C4 Adolescent Group High Symptom Class

High Symptoms: Adolescent Group	Probability of Yes (Category 2)	95% CI	
		Lower CI	Upper CI
Intrusive memories	0.80	0.52	1.07
Distressing dreams	0.60	0.28	0.92
Dissociative reactions	0.66	0.31	1.01
Psych distress	0.48	0.09	0.87
Physio distress	0.67	0.23	1.10
Avoid thoughts	0.46	0.09	0.84
Avoid activities	0.56	0.16	0.97
Inability to recall	0.43	0.10	0.76
Loss of interest	0.79	0.50	1.07
Detachment	0.16	-0.25	0.57
Restricted affect	0.48	0.12	0.84
Foreshortened future	0.58	0.24	0.93
Difficulty sleeping	1.00	1.00	1.00
Irritability	1.00	1.00	1.00
Difficulty concentrating	0.38	0.04	0.72
Hypervigilance	0.72	0.42	1.03
Exaggerated startle	0.67	0.27	1.07

Table C5 Total Group Some Symptoms Class

Some Symptoms: Total Group	Probability of Yes (Category 2)	95% CI	
		Lower CI	Upper CI
Intrusive memories	0.20	-0.03	0.43
Distressing dreams	0.15	-0.03	0.32
Dissociative reactions	0.21	0.13	0.29
Psych distress	0.18	-0.05	0.40
Physio distress	0.06	-0.04	0.16
Avoid thoughts	0.25	0.08	0.41
Avoid activities	0.25	0.03	0.46
Inability to recall	0.47	0.39	0.54
Loss of interest	0.15	0.09	0.21
Detachment	0.13	0.02	0.25
Restricted affect	0.09	-0.04	0.21
Foreshortened future	0.06	-0.04	0.17
Difficulty sleeping	0.26	0.01	0.50
Irritability	0.50	0.30	0.69
Difficulty concentrating	0.25	0.11	0.39
Hypervigilance	0.23	0.08	0.38
Exaggerated startle	0.13	0.03	0.23

Table C6 Young Group Some Symptoms Class

Some Symptoms: Young Group	Probability of Yes (Category 2)	95% CI	
		Lower CI	Upper CI
Intrusive memories	0.27	0.08	0.45
Distressing dreams	0.20	0.07	0.32
Dissociative reactions	0.25	0.14	0.35
Psych distress	0.18	-0.02	0.38
Physio distress	0.10	0.01	0.19
Avoid thoughts	0.40	0.26	0.54
Avoid activities	0.36	0.16	0.55
Inability to recall	0.48	0.34	0.61
Loss of interest	0.11	0.04	0.18
Detachment	0.15	0.05	0.25
Restricted affect	0.13	0.03	0.23
Foreshortened future	0.06	-0.01	0.14
Difficulty sleeping	0.28	0.12	0.44
Irritability	0.56	0.40	0.72
Difficulty concentrating	0.26	0.11	0.41
Hypervigilance	0.30	0.18	0.43
Exaggerated startle	0.18	0.09	0.27

Table C7 Latency Group Some Symptoms Class

Some Symptoms: Latency Group	Probability of Yes (Category 2)	95% CI	
		Lower CI	Upper CI
Intrusive memories	0.00	0.00	0.00
Distressing dreams	0.09	0.01	0.18
Dissociative reactions	0.20	0.07	0.32
Psych distress	0.00	0.00	0.00
Physio distress	0.00	0.00	0.00
Avoid thoughts	0.00	0.00	0.00
Avoid activities	0.23	0.12	0.34
Inability to recall	0.40	0.25	0.56
Loss of interest	0.29	0.17	0.42
Detachment	0.05	-0.01	0.12
Restricted affect	0.00	0.00	0.00
Foreshortened future	0.02	-0.02	0.05
Difficulty sleeping	0.27	0.13	0.41
Irritability	0.54	0.38	0.69
Difficulty concentrating	0.29	0.15	0.43
Hypervigilance	0.11	0.00	0.21
Exaggerated startle	0.00	0.00	0.00

Table C8 Adolescent Group Some Symptoms Class

Some Symptoms: Adolescent Group	Probability of Yes (Category 2)	95% CI	
		Lower CI	Upper CI
Intrusive memories	0.27	0.13	0.4
Distressing dreams	0.19	0.08	0.29
Dissociative reactions	0.22	0.11	0.34
Psych distress	0.23	0.1	0.35
Physio distress	0.14	0.04	0.24
Avoid thoughts	0.24	0.1	0.38
Avoid activities	0.33	0.17	0.49
Inability to recall	0.47	0.33	0.61
Loss of interest	0.15	0.05	0.25
Detachment	0.26	0.11	0.4
Restricted affect	0.15	0.06	0.24
Foreshortened future	0.14	0.04	0.24
Difficulty sleeping	0.41	0.26	0.56
Irritability	0.52	0.38	0.67
Difficulty concentrating	0.24	0.12	0.36
Hypervigilance	0.19	0.06	0.33
Exaggerated startle	0.12	0.03	0.21

Table C9 Total Group Low Symptom Class

Low Symptoms: Total Group	Probability of Yes (Category 2)	95% CI	
		Lower CI	Upper CI
Intrusive memories	0.00	-0.01	0.02
Distressing dreams	0.02	0.00	0.04
Dissociative reactions	0.03	-0.03	0.09
Psych distress	0.02	0.00	0.04
Physio distress	0.01	0.00	0.03
Avoid thoughts	0.04	-0.01	0.09
Avoid activities	0.03	-0.02	0.08
Inability to recall	0.40	0.33	0.46
Loss of interest	0.04	0.00	0.08
Detachment	0.00	-0.01	0.02
Restricted affect	0.00	0.00	0.00
Foreshortened future	0.00	0.00	0.00
Difficulty sleeping	0.04	0.00	0.08
Irritability	0.06	-0.06	0.19
Difficulty concentrating	0.05	-0.01	0.12
Hypervigilance	0.04	-0.01	0.09
Exaggerated startle	0.03	0.00	0.05

Table C10 Young Group Low Symptom Class

Low Symptoms: Young Group	Probability of Yes (Category 2)	95% CI	
		Lower CI	Upper CI
Intrusive memories	0.01	-0.02	0.03
Distressing dreams	0.03	0.00	0.06
Dissociative reactions	0.05	-0.02	0.11
Psych distress	0.04	0.00	0.08
Physio distress	0.01	-0.01	0.04
Avoid thoughts	0.09	0.02	0.17
Avoid activities	0.06	0.00	0.11
Inability to recall	0.35	0.26	0.43
Loss of interest	0.06	0.02	0.10
Detachment	0.01	-0.01	0.03
Restricted affect	0.00	0.00	0.00
Foreshortened future	0.01	-0.02	0.03
Difficulty sleeping	0.02	-0.01	0.06
Irritability	0.07	-0.05	0.19
Difficulty concentrating	0.04	0.01	0.08
Hypervigilance	0.06	0.01	0.11
Exaggerated startle	0.01	-0.02	0.05

Table C11 Latency Group Low Symptom Class

Low Symptoms Latency Group	Probability of Yes (Category 2)	95% CI	
		Lower CI	Upper CI
Intrusive memories	0.03	-0.06	0.11
Distressing dreams	0.04	-0.01	0.09
Dissociative reactions	0.07	0.01	0.14
Psych distress	0.05	-0.04	0.15
Physio distress	0.04	0.00	0.09
Avoid thoughts	0.08	0.01	0.16
Avoid activities	0.00	0.00	0.00
Inability to recall	0.46	0.35	0.58
Loss of interest	0.00	0.00	0.00
Detachment	0.00	0.00	0.00
Restricted affect	0.00	0.00	0.00
Foreshortened future	0.00	0.00	0.00
Difficulty sleeping	0.04	-0.01	0.09
Irritability	0.00	0.00	0.00
Difficulty concentrating	0.07	0.00	0.13
Hypervigilance	0.07	0.01	0.13
Exaggerated startle	0.07	0.02	0.13

Table C12 Adolescent Group Low Symptom Class

Low Symptoms: Adolescent Group	Probability of Yes (Category 2)	95% CI	
		Lower CI	Upper CI
Intrusive memories	0.01	-0.01	0.02
Distressing dreams	0.01	-0.01	0.02
Dissociative reactions	0.03	0.00	0.06
Psych distress	0.00	0.00	0.00
Physio distress	0.00	-0.01	0.02
Avoid thoughts	0.01	-0.01	0.03
Avoid activities	0.02	-0.01	0.04
Inability to recall	0.44	0.36	0.52
Loss of interest	0.05	0.01	0.09
Detachment	0.01	-0.03	0.05
Restricted affect	0.00	0.00	0.00
Foreshortened future	0.00	0.00	0.00
Difficulty sleeping	0.07	0.02	0.12
Irritability	0.12	0.05	0.19
Difficulty concentrating	0.08	0.03	0.13
Hypervigilance	0.04	0.00	0.09
Exaggerated startle	0.03	0.00	0.06

Appendix D: Ethics Approval

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

School of Medicine

The University of Queensland
Mayne Medical School
Herston Road
Herston Qld 4006 Australia

School of Medicine Approval Form for Research Involving Humans Including Behavioural Research

for Honours, MPhil & PhD Students in the School of Medicine

Chief Investigator (student)	Viktoria Vibhakar
Project Title	The Manifestation of Post-Traumatic Stress in School-Aged Children and Young Persons and its Implication for the PTSD Diagnosis
Supervisor(s)	Dr. Robyne Le Brocque, Professor Justin Kenardy
Co-Investigator(s)	
Research Centre/Institute/School	School of Medicine
SOM Clearance Number	**2016-SOMILRE-0169**
Date of Issue	10 April 2016
Date of Expiry	10 April 2018

Comments:

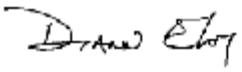
Low risk project with Gatekeeper permissions.
Full UQ application approved

UQ School of Medicine Low Risk Ethical Review Committee

This project complies with the provisions contained in the National Statement on Ethical Conduct in Human Research (complies with the regulations governing research involving humans) and UQ ethical paragraphs concerning low risk research.

UQ School of Medicine Low Risk Ethical Review Committee Representative

Associate Professor Diann Eley



Signed

10 April 2016

Date