Attachment and Trauma

A Historical and Empirical Study of the Meaning of Unresolved Loss and Abuse in the Adult Attachment Interview

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Declaration

This thesis is the result of my own work and includes nothing which is the outcome of work done in collaboration except as declared in the Preface and specified in the text. I further state that no substantial part of my thesis has already been submitted, or, is being concurrently submitted for any such degree, diploma or other qualification at the University of Cambridge or any other University or similar institution except as declared in the Preface and specified in the text. It does not exceed the prescribed word limit for the relevant Degree Committee.

Attachment and Trauma: A Historical and Empirical Study of the Meaning of Unresolved Loss and Abuse in the Adult Attachment Interview

Lianne Bakkum

This thesis comprises three studies of the meaning of adults' unresolved states of mind with respect to attachment (U/d) in the Adult Attachment Interview.

The first study is a historical analysis of the conceptualisation of "trauma" in the unresolved state of mind classification, drawing on published and unpublished texts by Mary Main and colleagues. The paper traces the emergence of the construct of an unresolved state of mind, and places this in the context of wider contemporary discourses of trauma, in particular posttraumatic stress disorder and discourses about child abuse.

In the second study, individual participant data were used from 1,009 parent-child dyads across 13 studies. Interviewees with or without unresolved loss/abuse were differentiated by subsets of commonly occurring indicators of unresolved loss/abuse. Predictive models suggested a psychometric model of unresolved states of mind consisting of a combination of these common indicators, which was weakly predictive of infant disorganised attachment. There was no significant association between unresolved "other trauma" and infant disorganised attachment. The findings provide directions for further articulation and optimisation of the unresolved state of mind construct.

In the third study, first-time pregnant women (N = 235) participated in the Adult Attachment Interview while indicators of autonomic nervous system reactivity were recorded. Unresolved speech about loss was associated with increased heart rate. Participants classified as unresolved showed a decrease in pre-ejection period and blunted skin conductance level throughout the interview. Unresolved states of mind may be associated with physiological dysregulation, but questions remain about the psychological mechanisms involved.

This thesis contributes towards further clarification of the unresolved state of mind construct by examining its historical context, psychometric characteristics, and psychophysiological mechanisms. Further exploratory and theoretical work should focus on improving the definition and validity of the unresolved state of mind construct, to gain a better understanding of how attachment-related experiences of loss and trauma are processed and how this might affect parenting behaviour.

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Publications

** Papers with an asterisk are included in this thesis*

Papers published in academic journals

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Papers in progress

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1

Introduction

According to attachment theory (Bowlby, 1969), infants are predisposed to seek out familiar caregivers when experiencing alarm. Bowlby theorised that infants initially construct an interrelated set of expectations of the environment, themselves, and their caregivers based on their interactions with caregivers over time. These expectations remain open to new information throughout childhood, adolescence, and adulthood, and are used by individuals to predict how others may respond to their bids for comfort or support. Main, Kaplan, and Cassidy (1985) proposed that these expectations may be revealed in speech, especially when discussing attachment-related topics. Adults' narratives about experiences with their caregivers, including loss and childhood abuse, can be elicited through a semi-structured interview referred to as the Adult Attachment Interview (George et al., 1984, 1985, 1996). These narratives are thought to reveal adults' states of mind with respect to attachment.

Drawing on Bowlby's work on trauma and loss (1980), Main and colleagues found that some adults' narratives about loss or childhood abuse were disrupted by marked lapses in reasoning or discourse. They classified these adults with an unresolved (disorganised/disoriented) (U/d) state of mind with respect to attachment (Main & Hesse, 1990). The U/d category was developed semi-inductively based on the narratives of parents whose infants were classified with disorganised attachment in the Strange Situation procedure. These infants showed contradictory or anomalous behaviours in the presence of their parent, which were postulated to reflect the infant's internal conflict of whether to approach or avoid the parent (Main & Solomon, 1990). Interestingly, the presence of loss and childhood abuse experiences in adults' narratives were less predictive of infant disorganisation than how these events were spoken about.

Main and colleagues' work has been described as one of the five key landmarks of achievement in attachment research (Rutter et al., 2009), and has been influential for three decades of research in developmental science. A large body of attachment studies has investigated associations between adults' unresolved states of mind and infant disorganised attachment (Van IJzendoorn, 1995; Verhage et al., 2016), potential mechanisms that may account for these associations (Madigan et al., 2006; Schuengel et al., 1999), and relations of unresolved states of mind with mental health conditions (Bakermans-Kranenburg & Van IJzendoorn, 2009).

Yet there have been some long-standing questions about the meaning of an unresolved state of mind. The unresolved state of mind construct has been hypothesised to represent a form of unresolved trauma (Main & Hesse, 1990). But little is known about how the unresolved state of mind construct has been conceptualised, and how this measure of unresolved trauma relates to wider discourses of trauma. The conceptual meaning of an unresolved state of mind has been relatively understudied as compared to the concept of infant disorganised attachment (e.g., Duschinsky, 2015; Solomon et al., 2017). Insight into the meaning of unresolved loss and trauma is essential to address questions about the psychometric characteristics of the unresolved state of mind classification. Lapses in reasoning and discourse about loss and childhood abuse were combined by Main and her colleagues into a single rating category of the Adult Attachment Interview. However, at the time of developing the measure, Main and colleagues did not have the sample size nor the methodological equipment to investigate the validity of individual lapses in reasoning or discourse. Lastly, the psychological mechanisms underlying unresolved states of mind are not well understood. Main and colleagues have suggested that unresolved states of mind may result from abnormal processing of fear-related memories about loss or trauma (e.g., Main & Hesse, 1992) but empirical evidence for these ideas is lacking. These gaps in knowledge may hinder the formulation of specific hypotheses about the impact of loss and other attachment-related trauma on adults' mental health and the effects of these experiences on parent-child attachment relationships.

Study aims

This doctoral study combined historical analysis of Main and colleagues' work and statistical analysis of secondary data to reappraise the construct of an unresolved state of mind with respect to attachment. This thesis is comprised of three studies, oriented by the following aims:

1) To trace the emergence of the unresolved state of mind classification and examine assumptions about trauma in the construct;
2) To explore the linguistic patterns that are used to assess unresolved states of mind;
3) To investigate emotional regulation as an underlying mechanism of unresolved states of mind.

Outline of thesis

The studies in this thesis are described in separate chapters. Chapter 2 describes a historical study of the conceptualisation of "trauma" in the unresolved state of mind classification. The paper traces how the construct of an unresolved state of mind was developed, drawing on unpublished manuscripts from Main and Hesse's personal archive and on Main-Bowlby correspondence from the John Bowlby archive at the Wellcome Trust in London. The study describes three assumptions about trauma in the construct of an unresolved state of mind, which were proximally influenced by

the work of Bowlby. Attention is also paid to the context of wider contemporary discourses of trauma, in particular posttraumatic stress disorder and discourses about child abuse. The paper shows how the unresolved state of mind classification was shaped as an authoritative construct representing trauma and became rather isolated from wider scientific study of trauma.

Chapter 3 describes a study on the psychometric characteristics of the unresolved state of mind classification, using individual participant data from 1,009 parent-child dyads across 13 studies. In this study, we aimed to search for a psychometric model that may underlie the unresolved state of mind construct, investigated the relation of this model to infant disorganised attachment, and explored the relation between unresolved "other trauma" and infant disorganisation. The findings suggest that the current system for coding unresolved states of mind may have been overfitted to its development sample, and provide directions for further articulation and optimisation of the unresolved state of mind construct.

In Chapter 4, a study is described on emotional regulation as an underlying mechanism of unresolved states of mind. $N = 235$ first-time pregnant women participated in the Adult Attachment Interview while indicators of autonomic nervous system reactivity were measured. Autonomic nervous system responses were investigated in relation to interview questions about loss and trauma, unresolved discourse, and classifications of unresolved states of mind. The findings indicate that unresolved states of mind may be associated with physiological dysregulation, but questions remain about the psychological processes involved.

Finally, in Chapter 5, a summary of the key findings is presented, highlighting contributions to knowledge, methodological limitations, and directions for future research.

2

The Conceptualisation of Trauma in the Unresolved State of Mind Classification

Abstract

This paper examines how "trauma" has been conceptualised in the unresolved state of mind (U/d) classification in the Adult Attachment Interview, introduced by Main and Hesse in 1990. The unresolved state of mind construct has been influential for three decades of research in developmental psychology. However, not much is known about how this measure of unresolved trauma was developed, and how it relates to other conceptualisations of trauma. We draw on previously unavailable manuscripts from Main and Hesse's personal archive, including various editions of unpublished coding manuals, and on Main-Bowlby correspondence from the John Bowlby Archive at the Wellcome Trust in London. This paper traces the emergence of the U/d classification, and examines the assumptions about trauma embedded in the construct. These assumptions are situated both in the immediate context of the work of Main and Hesse and in terms of wider discourses about trauma in the period. Our analysis considers how a particular form of trauma discourse entered into attachment research, and in doing so partly lost contact with wider disciplinary study of trauma.

This chapter is based on:

Bakkum, L., Schuengel., C., Foster, S. L., Oosterman, M., Fearon, R. M., P., & Duschinsky, R. (2021). *Conceptualising and coding trauma and loss in the Adult Attachment Interview: Situating the unresolved state of mind classification in disciplinary and social context*. Manuscript in preparation.

Introduction

Trauma has been conceptualised in different ways across time and context, including variously as discrete distressing events and as the consequences of such events. Modern conceptualisations of trauma include traumatic hysteria (Freud, 1896), war neurosis (Rivers, 1918), and posttraumatic stress disorder (American Psychiatric Association, 1980). Trauma discourses change over time, and these changes may provide a lens on wider issues in the conceptualisation of the human mind, including memory and consciousness (Fassin & Rechtman, 2009; Hacking, 1994; Trembinski, 2011; Zajko, 1996).

One influential articulation of trauma discourse lies within the field of attachment research. In the late 1980s, the American psychologist Mary Main and her colleagues introduced the concept of an unresolved state of mind with respect to attachment as a category of the Adult Attachment Interview. The unresolved state of mind category was derived semi-inductively from confused or disrupted speech about loss or childhood abuse in adults' autobiographical narratives. Main and colleagues proposed that adults with an unresolved state of mind had not adequately processed past loss or abuse and that these adults were still traumatised by memories of these experiences (e.g., Main & Hesse, 1990). The coding system for unresolved states of mind (Main et al., 1991/1994) has been used for decades by researchers and clinicians.

Main and colleagues' use of linguistics to investigate patterns of attachment has been described as a "revolutionary shift" in attachment research (Van IJzendoorn & Bakermans-Kranenburg, 1997) and as the start of attachment research "Phase 2" (Holmes, 2009). Their work has been influential for decades of research in developmental psychology and psychopathology (Bakermans-Kranenburg & Van IJzendoorn, 2009; Verhage et al., 2016), and has informed psychotherapeutic practice, parenting interventions (e.g., Steele & Steele, 2008), and health policy (e.g., National Institute of Health and Care Excellence [NICE], 2015). However, there has yet to be any sustained examination of how "trauma" has been conceptualised in the Adult Attachment Interview.

The only historical analysis of the unresolved state of mind construct, or indeed Main's work in general, has been by Duschinsky (2020). However, Duschinsky's account of the unresolved state of mind construct is brief and serves primarily to highlight the category as a pivotal concept for the history of attachment theory. The historiography of attachment theory has mostly focused on the life and work of an earlier generation of scholars before Main: John Bowlby (e.g., Van der Horst & Van der Veer, 2010; Van der Horst et al., 2020) and Mary Ainsworth (e.g., Van Rosmalen et al., 2015, 2016), the founders of attachment theory. This paper contributes to historical research on the evolution of attachment theory after Ainsworth, by looking at the contributions of Main and her colleagues and placing these in a wider disciplinary and social context.

In their published writings, Main and colleagues have elaborated little on what they consider the meaning of an unresolved state of mind. A key obstacle to discussion of unresolved states of mind by other psychologists and historians of developmental science has been that the Adult Attachment Interview coding system has never been published; various editions have circulated in manuscript form only to attendees of accredited training institutes. In this paper, we trace the emergence of the unresolved state of mind classification and examine assumptions about trauma embedded in the construct. This is facilitated by access to previously unavailable manuscripts from Main and Hesse's personal archive, including various editions of unpublished Adult Attachment Interview coding manuals. We also draw on Main-Bowlby correspondence from the John Bowlby Archive at the Wellcome Trust in London.

Our work also seeks to contribute to the history of conceptualisations of trauma. Frequently this literature has treated trauma discourses as if they circulate readily and isomorphically between domains. The case of the unresolved state of mind construct is of interest as an instance where a particular form of trauma discourse entered a relatively insular area of scientific practice; and as a result partly lost contact with wider trauma discourse and scientific study of trauma, whilst also having influence on health policy and professional practice.

This study identifies three notable, and historically contingent, assumptions about trauma in the work of Main and colleagues in introducing the unresolved state of mind classification. These assumptions were influenced by Bowlby's work on trauma and loss. However, we also consider the context of wider contemporary trauma discourses, such as posttraumatic stress disorder and discourses about child abuse. Finally, we discuss the way that the unresolved state of mind construct became sequestered from wider disciplines of trauma research.

Histories of attachment research

Attachment theory was founded by the British psychiatrist John Bowlby. Bowlby (1973) proposed that children's early experiences with their caregivers could shape cognition, emotion, and behaviour in later relationships. He suggested that separation experiences, including loss, could have detrimental effects on the mental health of children and adults. Historians of attachment theory have focused on the development of Bowlby's thinking, describing how experiences from Bowlby's early life (Van Dijken, 1998) and his studies and clinical work (Van der Horst & Van der Veer, 2009; Van Dijken et al., 1998) may have influenced his ideas.

The American-Canadian psychologist Mary Ainsworth started working with Bowlby in the 1950s, and elaborated on his ideas by empirical work. Historians have regarded Ainsworth as the cofounder of attachment theory (Van Rosmalen et al., 2015, 2016). Ainsworth's major contribution to attachment theory has been the Strange Situation procedure, a brief laboratory procedure that

allows for observation of children's attachment behaviour during brief episodes of separation and reunion with the caregiver (Ainsworth et al., 1978). Three patterns of attachment behaviour were proposed: a group of infants who were visibly upset by the separation but adapted when the caregiver returned (group B, "securely attached"), a group of infants showing little distress upon separation from their caregiver (group A, "insecure-avoidant"), and a group of infants who were highly distressed throughout the procedure and were not easily soothed upon reunion with their caregiver (group C, "insecure-ambivalent"). The origins of the Strange Situation procedure have been documented by Van Rosmalen et al. (2015).

With the aim to replicate and extend Ainsworth's findings, Mary Main started her own lab at the University of California in Berkeley in the early 1970s. Main completed her doctoral thesis under supervision of Ainsworth and was a close colleague of hers. Main and her colleagues at Berkeley recruited a sample of 189 parents from middle- and upper-middle class backgrounds: the Berkeley Social Development Study. Observations of children's Strange Situation video recordings from the this cohort and high-risk samples from other research labs led Main and Solomon (1986, 1990) to introduce the infant *disorganized/disoriented (*D) classification. Infants classified with disorganised attachment were earlier found unclassifiable with Ainsworth's A/B/C system. The emergence of the infant disorganised attachment classification has been traced by Duschinsky and colleagues, who described how this category has been shaped by contemporary conceptualisations of madness and "breakdown of behaviour" (Duschinsky, 2015; Reijman et al., 2018).

The Adult Attachment Interview

The Adult Attachment Interview was developed in the early 1980s, as part of Main and colleagues' Berkeley Social Development Study. The families in this study participated in the Strange Situation when the children were 12 months old (with mother) and 18 months old (with father). A subset of these families were invited back to the laboratory for additional assessments when the children were 6 years old, in 1982. One of these assessments involved the parents taking part in an interview about their early attachment-related experiences: the Adult Attachment Interview. This semi-structured interview was developed by Main and her graduate students Carol George and Nancy Kaplan as part of their thesis projects.[1] In the first question of the interview, participants were asked to describe the relationship with their parents as a young child and to choose five adjectives to describe the relationship with each parent. Other key questions addressed early separations from parents, experiences of rejection, and why participants thought their parents behaved as they did. Participants were also asked about experiences of loss of important persons such as parents in

[1] Main, M. (1999) Disorganized attachment in infancy, childhood, and adulthood: An introduction to the phenomena. Unpublished manuscript, Mary Main & Erik Hesse personal archive.

childhood and adulthood.[2] Later versions of the interview protocol included questions about threatening behaviour by parents, experiences of abuse within the family, and potentially traumatic experiences other than loss and abuse (George et al., 1996).

The coding system for the Adult Attachment Interview was developed based on a "guess and uncover" method. This approach was described by Main and Cassidy (1988) and explained in more detail by Duschinsky (2020). Ruth Goldwyn, a research assistant in Main's lab, was given the task to study parents' Adult Attachment Interview transcripts and try to guess the probable infant Strange Situation classifications:

> "Developing the system involved moving (blind) through each transcript in the development sample, and in each instance using feedback ("correct" or "incorrect") with respect to the infant's attachment classification to that adult) to refine and to further develop the rule system. This is a slow-moving but highly profitable method of rule development, and it was used in the creation of every succeeding system".[3]

Through this inductive process, distinct patterns of adult discourse were identified.

Main and colleagues theorised that patterns of behaviour by children in the Strange Situation and by adults in presenting their autobiographical accounts in the Adult Attachment Interview could both be conceptualised as ways of organising attention in relation to attachment-related information. Later, Main would refer to differences in adults' organisation of attention in relation to attachment-relevant information as "states of mind with respect to attachment" (e.g., Main & Hesse, 1990). Main and colleagues (1985) emphasised that "simply asking adults to verbalize their concepts of relationships" (p. 78) would not work, because the actual "state of mind" toward attachment could be different than what the adult might express in the interview in terms of content. Rather, coders of the Adult Attachment Interview examine the entire narrative for inconsistencies and contradictions, in order to explore the allocation and coherence of attention to attachment-relevant information (p. 90).

A first group of parents identified by Main and Goldwyn were categorised as "autonomous/secure" (F). These parents discussed attachment relationships with relative objectivity and ease, seemed to value attachment relationships, and were able to reflect on the influence of early attachments on their adult personality, regardless of whether past experiences were positive or

[2] George, C., Kaplan, N., Goldwyn, R., & Main, M. (1982-83). Attachment interview for parents. John Bowlby Archive, Wellcome Trust, London, PP/Bow/B.3/35-6.

[3] Main, M. (1986). Behaviour and the development of representational models of attachment: Five methods of assessment. Unpublished manuscript, Mary Main & Erik Hesse personal archive.

negative. These parents frequently had infants who displayed secure attachment behaviour in the Strange Situation, five years earlier. One group of "insecure" parents dismissed difficulties in early attachment relationships and regarded these as having little value or influence on their life (later termed "dismissing" or "Ds"). According to Main and Goldwyn, dismissing speakers directed their attention away from (unfavourable) childhood memories; a pattern analogous to the behaviour of infants classified as insecure-avoidant in the Strange Situation. These infants showed little distress upon separation from the parent and actively directed their attention away from the parent on reunion. Another group of insecure parents seemed "preoccupied with dependency" on their parents and "still actively struggled to please them" (Main et al., 1985, p. 91; later termed "preoccupied" or "E"). Preoccupied speakers were identified to correspond to infants classified as insecure-ambivalent in the Strange Situation. These infants seemed highly distressed and sometimes fearful throughout the procedure, constantly directing their attention toward the parent and unable to focus on the environment (Main et al., 1985).

Unresolved loss

Main and Goldwyn observed that some interview transcripts of parents who had lost an attachment figure (a parent or other familiar caregiver) before adulthood showed incoherent and disrupted discourse across the interview. These individuals were frequently the parents of infants who were earlier found unclassifiable in the Strange Situation procedure. The unclassifiable infants would later be referred to as "disorganized/disoriented" (D; Main & Solomon, 1986, 1990). Main and Goldwyn discovered that the presence of loss experiences were less predictive of infant disorganised attachment than how these events were narrated.

These observations laid the basis of an additional Adult Attachment Interview classification. Main, together with her husband and collaborator Hesse and a research assistant Anitra DeMoss, developed a scale for identifying lack of resolution of mourning of attachment figures lost through death.[4] The scale was based on the assumption that "cognitive disorientation and disorganisation" were primary signs of lack of resolution of mourning, and that "irrationality of thought process with respect to a lost figure can be observed in speech". A prominent example of lack of resolution of mourning was indications of disbelief that the person is dead. Other examples were irrational feelings of having caused the death of a loved one, discussion of the loss with an unusual attention to detail, and indications of confusion between the dead person and the self. In addition, Main described

[4] Main, M. (1987). Lack of Resolution of Mourning. John Bowlby Archive, Wellcome Trust, London, PP/Bow/B.3/35-6. In this scale, the use of "attachment figures" was not limited to parents or family members. Main and colleagues noted that "Loss of any family member is significant, as is loss of anyone with whom the subject lived in childhood (or who lived in the family home). Some persons were very fond of and lost a non family-member. Note whether these persons seemed to serve as attachment figures for the subject."

examples of extreme behavioural responses to loss in the past, such as a suicide attempt. Though these reports were considered rare, they were nonetheless included in the scale as indices of lack of resolution.[5]

Ratings on a 1-9 scale for lack of resolution of mourning were assigned based upon careful examination of the interview transcript, focusing on the speaker's description of the relationship with the lost figure, discussion of events surrounding the loss (such as the funeral), and reflection on how the loss may have affected the speaker. Ratings of 1 were assigned to speakers showing no signs of "disorganization or disorientation" and ratings of 9 would apply to speakers who showed "definite disorganization, disorientation or evidence of irrational thought processes regarding a loss". The description of the highest end of the scale includes mention of "traumatic loss", which appears to be the first reference to trauma in the Adult Attachment Interview coding system.[6]

Main and colleagues came to refer to indices of lack of resolution of mourning as "lapses" in the monitoring of reasoning, discourse, or behaviour. The term "lapse" was first mentioned in a 1987 draft of the lack of resolution of mourning scale and was frequently used in later versions of the scale. Main's use of the language of "lapse" to characterise indices of lack of resolution is interesting. Lack of resolution of mourning was intended to predict and correspond to the infant disorganised attachment classification. However, infant disorganisation was characterised by Main in the 1980s as an "interruption" or "conflict" of attachment pattern. By contrast, lack of resolution was characterised as a "lapse" in state of mind regarding attachment. The term "lapse" implies much more a falling away from a given state, whereas interruption or conflict imply the disruption of a state by internal or external forces. This difference in terminology suggests an initial lack of clarity about whether an identical, similar, or merely analogous psychological process was taking place for infants in the Strange Situation and adults in the Adult Attachment Interview. It was not clear to Main how this question might be tested empirically. However, her personal suspicion was that it was an identical process in lack of resolution and in disorganised attachment: both unresolved states of mind and infant disorganised attachment were later conceptualised as "lapses in working memory" (Main & Hesse, 1992). On the basis of this supposition, from 1990, the lack of resolution of mourning scale was renamed into *unresolved/disorganized/disoriented states of mind with respect to experiences of loss*.

Main and Hesse (1990) reported on the relation between parents' unresolved loss and infant disorganised attachment in the Berkeley sample. The empirical association in this sample was strong: of the twelve mothers classified as unresolved, eleven had infants classified with disorganised

[5] Main, M. (1987). Lack of Resolution of Mourning. John Bowlby Archive, Wellcome Trust, London, PP/Bow/B.3/35-6.
[6] Ibid.

attachment (later studies did not nearly find equally strong effect size estimates; Verhage et al., 2016). Main and Hesse hypothesised that the link between parents' unresolved loss and infant disorganised attachment would be mediated by parents' frightening/frightened behaviour in the presence of their infant. Informal observations of frightening/frightened parental behaviour led Main and Hesse to suggest that parents with an unresolved state of mind were still frightened or traumatised by past loss or abuse. They proposed that these parents' frightening/frightened states were provoked by alarming memories of loss or abuse, leading to behaviours that could appear frightening to the infant, such as unusual vocal or movement patterns. However, the idea that (most) unresolved discourse was based on underlying frightening/frightened states involving alarming memories was not empirically tested. Main and Hesse (1990) acknowledged that they were "not able to examine this issue in a satisfactory way on the basis of our present sample" (p. 174) and stated that their informal observations of parental behaviour "tend to provide support for our hypothesis that the parent of the *D* infant may be frightening or frightened" (p. 175). This apparently deductive inference resulted in an encompassing theoretical model of the association between parents' unresolved states of mind and infant disorganised attachment, supported by concrete examples of frightening/frightened parental behaviour. Still missing, however, was a clear set of proposals about what unresolved discourse actually meant, as well as direct evidence of its inferred underlying mechanisms.

The assumption that unresolved states of mind and disorganised attachment would be underpinned by similar mechanisms of fear may have contributed to the appeal of the language of "transmission" by attachment researchers when investigating empirical associations between the Adult Attachment Interview and Strange Situation (Van IJzendoorn, 1992, 1995). The assumption of intergenerational transmission of unresolved states of mind, with activated alarm as a potential underlying mechanism, has been influential for subsequent decades of research in the attachment field (Madigan et al., 2006; Verhage et al., 2016).

Unresolved abuse

In the late 1980s, Main and colleagues became interested in unresolved abuse after seeing new interview transcripts collected by clinicians participating in training institutes for coding the Adult Attachment Interview (Duschinsky, 2020, p. 303). Main and colleagues discovered that lapses in the monitoring of reasoning and discourse also appeared surrounding discussions about childhood physical and sexual abuse by attachment figures, and that the presence of these indices was associated with infant disorganised attachment.[7]

[7] Main, M. (1987). Lack of Resolution of Mourning. John Bowlby Archive, Wellcome Trust, London, PP/Bow/B.3/35-6.

Initially, coders were instructed to use the indices from the unresolved loss scale to mark unresolved abuse by attachment figures.[8] Main finished a discrete version of a scale for coding unresolved abuse in 1991.[9] As with unresolved loss, unresolved abuse was coded based on disrupted speech about abuse, and not on the basis of the abuse experience itself. However, the first step in coding unresolved abuse was to establish that any abuse experience described by the interviewee was "traumatic" according to the standards of the Adult Attachment Interview coding system. According to the scale, when the speaker does not directly discuss a specific, potentially abusive experience, unresolved abuse may not be coded. Experiences that qualified as abuse were those that Main considered "overwhelmingly frightening" to the child, such as hitting that leaves marks, being in pain after being badly hit, being locked in a closet as punishment, and experiences of sexual abuse. Other experiences that qualified as frightening parental behaviour were threats to harm or kill the child and suicide attempts in the presence of the child. Excluded were parental behaviours that were perceived by the coder as distressing but not overwhelmingly frightening. Main noted that there may be cultural influences on what would be considered overwhelmingly frightened abuse: "in some sub-cultures spanking with the belt or a switch is expected in most families in the neighborhood, is seen by children as a natural form of discipline or punishment, and may therefore *not* be overwhelmingly frightening" (Main et al., 2003, p. 149).

The exemplary indicator of unresolved abuse was "unsuccessful denial of the occurrence, nature, or intensity of the abusive experience", which paralleled the "indications of disbelief that the person is dead" lapse from the unresolved loss scale. Other indices of unresolved abuse were feelings of having caused one's own abuse, psychologically confused statements about abuse, disoriented speech, and fears of being possessed by the abusive figure. In addition, and indicative of Main and colleagues' view that unresolved loss and abuse are functionally similar, coders were instructed to use indices from the unresolved loss scale to mark any unresolved abuse, and vice versa. From their perspective, what loss and abuse had in common were experiences of attachment figures that may make thinking about them alarming and overwhelming, causing both the aversion and the intensification of attention. Similar to unresolved loss, overall ratings of unresolved traumatic abuse were given on a 1-9 rating scale. When coding an Adult Attachment Interview, Main and colleagues advised that the scales for unresolved loss and unresolved abuse should be combined into one classification of unresolved/disorganized/disoriented state of mind. In the current version of the

[8] Main, M. (1987). Lack of Resolution of Mourning. John Bowlby Archive, Wellcome Trust, London, PP/Bow/B.3/35-6.

[9] A discrete version of the unresolved abuse coding scale was finished in 1991. The latest version of the Adult Attachment Interview coding system (version 7.2, 2003) still contains the 1991 version.

coding manual, the unresolved state of mind classification is assigned based on a rating of 5 or more on either the unresolved loss or the unresolved abuse scale, or both (Main et al., 2003).

In amongst the technical detail of the unresolved state of mind coding system are three important underpinning assumptions:

1) Bereavement is functionally identical to abuse as a kind of trauma when not psychologically reconciled;
2) Traumatic abuse experiences are restricted to child physical and sexual abuse by attachment figures;
3) Lapses in adult discourse about unresolved bereavement or abuse experiences are underpinned by the same process as disruptions of attachment behaviour shown by young children.

Main did not appear to regard these as remarkable stances or even consider whether or how they might be testable. No argument is presented for them: they are taken for granted in her writing, and likewise have been accepted as hypotheses by Main's contemporaries and subsequent generations of attachment researchers. Yet all three assumptions can be regarded as contingent, shaped by the historical context of the formation of the unresolved state of mind construct.

The influence of Bowlby: Segregated systems and defensive exclusion

A fundamental proximal influence on these assumptions was John Bowlby. Bowlby had originally wanted to focus his research on childhood physical and sexual abuse, having seen the influence of these experiences in his clinical work with children and families. However, he concluded that the topics were too controversial and that available scientific methods for assessing physical and sexual abuse were underdeveloped. Therefore, he decided to focus on loss rather than abuse.[10] Shortly before Main and colleagues began their work on the Adult Attachment Interview, Bowlby published the book *Loss* (1980), bringing together his decades of research on the topic.

Drawing on cognitive information processing theory, Bowlby (1980) suggested a framework of "principal systems" that exist within individuals. Examples include systems for organising behaviour for sex, friendly affiliation, eating, aggression, dominance, learning – and, of special interest to him, systems for careseeking and caregiving. According to Bowlby, principal systems contain perceptual information, such as thoughts, feelings, and memories. In most individuals, these systems are unified and communicate freely with one another. However in some people, these systems are not unified, but segregated: one system may have access to one source or interpretation of information, and another system may have access to other information, and there would be restricted communication

[10] Bowlby, J. (1985) Letter to Tirril Harris, 17th September 1985. John Bowlby Archive, Wellcome Trust, London, PP/Bow/J.9/94.

between the systems. These systems would then "differ in regard to what each perceived and how each interpreted and appraised events" (Bowlby, 1980, pp. 63-64). According to Bowlby, segregation of systems is a defensive process that can be evoked by loss. He illustrated this with an example of pathological mourning in adults: "One system is oriented towards the lost object, longs for it, strives to recover it, and reproaches it for its desertion; the other system recognises its loss and organises behaviour on that basis."[11]

Bowlby used the term *selective exclusion* to refer to attentional processes that filter incoming information from being further processed in consciousness. He referred to selective exclusion as an "integral and ubiquitous part of the action of the CNS [central nervous system]", which is "proceeding every minute of our lives".[12] Bowlby believed that in most cases, selective exclusion was useful and adaptive. For instance it is helpful to be able to filter unwelcome stimuli or memories when concentrating on a task. But selective exclusion may become maladaptive when it is long-term or persistent. This is what Bowlby called *defensive exclusion*. In the context of responses following loss, defensive exclusion could lead to pathological mourning:

> Consider, for example, the processes that direct attention and activity away from painful thoughts and reminders and towards neutral or pleasant ones. When such processes take control only episodically they are likely to be fully compatible with health. When, by contrast, they become rigidly established they lead to a prolonged inhibition of all the usual responses to loss (Bowlby, 1980, pp. 139-140).

Bowlby anticipated that segregated systems and defensive exclusion could both disrupt the capacity of an individual to orient towards loved ones - in reality or in thought - and to achieve support and comfort. He termed this the "disorganisation" and "disorientation" of thoughts and feelings, and characterised clinical cases in which such disruptions could be seen in patients' behaviour or their narratives in therapy. In his view, one of the central functions of therapy with such patients was to help reduce defensive exclusion of phenomena in the world, and reduce the segregation of mental systems. He anticipated this process would help the patient achieve reorganisation and reorientation to their life and enrich its possibilities.

In Bowlby's account, loss and abuse could both cause segregated systems and defensive exclusion. These processes could just as readily occur in children as in adults. Indeed, Bowlby's account of segregated systems and defensive exclusion was first developed as an attempt to provide

[11] Bowlby, J. (1962). Defences that follow loss: Causation and function. John Bowlby Archive, Wellcome Trust, London, PP/Bow/D.3/78.
[12] Ibid.

an alternative to the ideas of Melanie Klein, whilst fully maintaining her assumption that grieving processes in infants were fundamentally the same as those in adults.[13]

Main was deeply immersed in Bowlby's writings on loss, and travelled to London to discuss them with him in 1978.[14] Yet Bowlby's influence on her thinking about lack of resolution of mourning appears to have been tacit. One reason may have been that the account of segregated systems and defensive exclusion is exceptionally compressed in *Loss*. Only a few attachment researchers have ever subsequently discussed these concepts, primarily Inge Bretherton (Bretherton, 2005) and Carol George (Solomon & George, 2011). It is telling that their treatments differ vastly from one another, and that Bretherton expresses hesitancy as to whether she fully grasped Bowlby's meaning. Only a very close reading of *Loss* would make the concepts salient. In 1986, with the lack of resolution of mourning scale already developed, Main would write to Bowlby that:

> I have been re-reading your work on loss with the amazement I always experience in re-reading your work... In developing the scale for lack of resolution of mourning we worked and re-worked our development cases, trying to determine the overriding feature. Disorganisation and disorientation of thought-processes or in apparent feeling seemed the best descriptor for what we were scaling. I then found myself amazed to read your description of recovery from loss in terms of re-organisation and re-orientation.[15]

As Main acknowledged, this was clearly an important influence and appears in tacit form across the coding manual, even if she did not use the terms segregated systems or defensive exclusion. For instance "indications of disbelief that a person is dead" is characterised by Main as a disconnect between two experiences of reality, one in which a loved one has died, and another, deactivated system storing the memory that the person is still alive. When asked about the loss in the Adult Attachment Interview, the deactivated system may be activated briefly, resulting in a slip of the tongue to the present tense, without the speaker's awareness. Another instance is "lapses in monitoring of discourse" which is characterised by Main as a loss of perceptual attention to the current environment when faced by a potentially distressing topic, leading to inappropriate statements. Again Bowlby's technical term is not used by Main, but this is a recognisable instance of what Bowlby termed defensive exclusion.

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[13] Bowlby, J. (1962). Defences that follow loss: Causation and function. John Bowlby Archive, Wellcome Trust, London, PP/Bow/D.3/78.

[14] Bowlby, J. (1978.) Notes following discussion with Mary Main in March 1978 about the draft of Vol. 3 Loss. John Bowlby Archive, Wellcome Trust, London, PP/Bow/H.78

[15] Main, M. (1986). Letter to Bowlby, 12th September 1986. John Bowlby Archive, Wellcome Trust, London, PP/BOW/B.3/35.

The influence of Bowlby may have contributed to Main's usage of the terms "traumatic" and "unresolved" to refer to experiences of loss. In his book *Loss*, Bowlby characterised loss as a form of trauma. Indeed, the name of the first chapter is "The trauma of loss". *Loss* contains a few other appearances of trauma discourse. For example, Bowlby (1980) spoke of "traumatic loss" when discussing cases of mothers whose children died from choking or leukaemia (p. 163) and used the term "traumatic circumstances" when referring to the death of a parent due to suicide (p. 380). Bowlby did not use the term "unresolved" in *Loss*, but it did appear several times in his early paper "Pathological mourning and childhood mourning" (1963). In this article, Bowlby extensively discussed the work of the psychoanalyst Helene Deutsch, who used the term of "unresolved grief" in the context of absent mourning and "unresolved experiences" when referring to parental divorce (Deutsch, 1937).

Yet Bowlby was not the only influence on the conceptualisation of unresolved states of mind. From Main's perspective, the development of the unresolved state of mind category was inductive (M. Main, personal communication, May 15, 2021). However, this induction can be considered historically in context of ideas circulating in her academic and cultural context. In the next section, we characterise how the assumptions about trauma in the development of the unresolved state of mind construct in the early 1980s can be placed in the context of contemporary discourses of trauma, in particular: the introduction of posttraumatic stress disorder in the DSM-III in 1980 and discourses about child abuse in the US in the 1960s-80s.

Contemporary discourses of trauma

Posttraumatic stress disorder in the DSM-III (1980)

One background influence on Main's attention to trauma may well have been the introduction of posttraumatic stress disorder (PTSD) in the Diagnostic and Statistical Manual of Mental Disorders (3rd ed.; DSM-III; American Psychiatric Association, 1980) in 1980. The introduction of PTSD marked a shift in attitude towards trauma in psychology and psychiatry. Previous conceptualisations of trauma assumed that some individuals had inherent weaknesses or biological predispositions causing traumatic symptoms. In contrast, PTSD acknowledged that any person who had experienced an extremely distressing event could develop psychological and physiological symptoms, such as flashbacks, nightmares, and physiological arousal (Bracken, 2001; Fassin & Rechtman, 2009).

A general conceptual influence of PTSD on the unresolved state of mind construct may be the use of the term "trauma" to refer to experiences that are associated with lapses in reasoning and discourse in the Adult Attachment Interview. An early version of the lack of resolution of mourning scale included one reference to trauma: individuals with a high rating on the scale were believed to

have experienced a "traumatic" loss.[16] The term trauma was more frequently mentioned in later editions of the coding system, for example, to refer to "traumatic events", "traumatic experiences", and "unresolved trauma other than loss" (Main & Goldwyn, 1991). Main and Hesse also referred to the DSM when introducing the unresolved state of mind classification in 1990: "the term 'trauma' traditionally refers to experiences of intense fear, terror, or helplessness (see DSM-III-R) … which threaten an individual with psychological or behavioural disorganization" (p. 162).

As with PTSD, the construct of an unresolved state of mind acknowledged a direct relation between a traumatic event and its manifestations: a distressing event would cause a certain behavioural response. However, events that were regarded as traumatic differed between the two psychological constructs. In PTSD, traumatic events were defined as "unusual human experiences (...) [that] would be markedly stressing to almost anyone", with a wide range of examples such as military combat, rape, and natural disasters, but also serious threat or harm to loved ones, such as relatives and friends (American Psychiatric Association, 1980). According to this definition of trauma, experiences of childhood physical or sexual abuse by attachment figures would count as traumatic events. The way traumatic events were conceptualised in PTSD may have influenced Main and colleagues' decision to set qualifying thresholds for traumatic abuse in the unresolved state of mind classification, based on standardised definitions of which experiences would be considered overwhelmingly terrifying. A difference here, however, is that abuse could only be coded as unresolved if the perpetrator was an attachment figure, such as a parent. It may be possible that this focus on abuse by attachment figures would make Main and colleagues' theorising more easily accepted by the attachment field as relevant to attachment, as methods for assessing abuse were underdeveloped at the time.

Main did acknowledge that other events than physical and sexual by attachment figures could be potentially traumatic, such as sexual abuse by strangers or being witness to "extreme events", such as a suicide attempt by a parent (Main, 1991). These events could be considered traumatic according to the PTSD definition, but did not count towards a rating on the unresolved state of mind scale. A possible reason for not including these in the coding scale may have been that these experiences were not found in the interview transcripts of the development sample. But it may also be possible that Main and colleagues were unsure as to whether such experiences were relevant to attachment.

A "simple bereavement" was not listed as a traumatic event in PTSD, as it was considered a common experience (American Psychiatric Association, 1980). This is different from the way loss experiences were treated in the unresolved state of mind classification: there was no qualifying

[16] Main, M. (1987). Lack of Resolution of Mourning. John Bowlby Archive, Wellcome Trust, London, PP/Bow/B.3/35-6.

requirement that the loss of an important person, or the circumstances surrounding it, had to meet a certain threshold of "traumatic" to be marked as unresolved. On the other hand, Main and Hesse (1990) did not consider all losses to be traumatic. This depended on individual perceptions and on conditions surrounding the loss, although Main and Hesse did not make explicit what such conditions could be. It may well be possible that conditions around loss were viewed as relatively unimportant by Main and colleagues, because the focus of the Adult Attachment Interview was not on the facts of the past but on how these were narrated. Indeed, Hesse has mentioned that: "We do not try to establish whether the loss was in fact traumatic (we have no way to prove that). But rather, we assume that there is a high probability that it was traumatic, because these lapses [in reasoning or discourse] are associated with a psychodynamic propensity to enter into states that produce frightening/frightened behaviour and hence disorganised attachment in offspring" (E. Hesse, personal communication, May 13, 2021). It may also be possible that, through the influence of Bowlby's work (1980), loss had already been established as a potentially traumatic experience having relevance to attachment, and Main and colleagues might not have felt a need to justify this in the Adult Attachment Interview coding system.

Another influence of PTSD on unresolved states of mind may have to do with the phenomenon of intrusions. A prominent symptom of PTSD was "sudden acting or feeling as if the traumatic event were recurring" in which the individual may feel as if they are reliving the experience. The term "intrusive recollections" was used to refer to these kinds of experiences (American Psychiatric Association, 1980). In the unresolved state of mind classification, a direct reference to intrusions can be found in the lapse that refers to visual-sensory intrusions, such as the following example in the unresolved abuse scale: "And then he became after me, and I'm running up the stairs, count 'em – one, two, three, four, bang! Duck around the door just it hit the wall near my head" (Main et al., 2003, p. 153). However, the PTSD symptom of intrusions may have influenced the conceptualisation of an unresolved state of mind more broadly than this lapse. In later writings, Main used the term "intrusion" in attempts to explain possible underlying psychological mechanisms of the lapses in reasoning or discourse. For example, Main and Hesse (1992) proposed that the incoherent speech of adults classified as unresolved may be due to "partial intrusion of frightening, normally dissociated memories" (p. 187). A major difference here, however, is that PTSD symptoms are mentioned by a patient or observed by a clinician, whereas in the Adult Attachment Interview, manifestations of such dissociative intrusions are inferred from "lapses" in speech. Main and colleagues offered no evidence as to whether these lapses are intrusions or other psychopathological symptoms. This question has not been examined by subsequent attachment researchers, who

appeared to have taken the matter for granted on Main's authority, in the context of coding the Adult Attachment Interview.

Thus, the conceptualisation of unresolved states of mind as a form of trauma should be placed in the context of the introduction of PTSD in the DSM-III. But the unresolved state of mind construct clearly differs from PTSD in terms of the experiences that are regarded as traumatic, and how the psychological consequences of these events are inferred and assessed. A possible reason why Main diverged from the PTSD framework of trauma may be that her account of trauma was influenced by both PTSD and psychodynamic theory, which was an important framework for both Bowlby and her graduate advisor Ainsworth (Main, 1999). Though not explicit in her published texts of the period, a possible influence on Main's conceptualisation of unresolved states of mind may have been the idea from psychodynamic theory of pathological mourning as a response to loss. The concept has been frequently discussed by Bowlby (e.g., 1963, 1980), referencing psychoanalysts such as Freud and Klein. According to psychodynamic theory, pathological mourning could be manifested as defensive processes such as splitting, repression, and dissociation. These processes, often occurring outside awareness, could be elicited in psychotherapy. Main might especially have drawn on the concept of splitting, which referred to the idea that a person's internal state could be divided in two parts: one part acknowledging the death of a loved one, and another part wishing that the loved one would still be alive (Freud, 1927, as cited in Bowlby, 1980). Main's interest in psychodynamic theory was only nascent in the 1980s during the formulation of the unresolved state of mind classification, but would be developed in two publications for the *Journal of the American Psychoanalytic Association* (Main, 2000; Hesse & Main, 2000), speculating on the psychodynamic basis of unresolved/disorganised states.

The problematisation of child abuse in the United States (1960s-80s)

Main and colleagues' definition of child abuse in the Adult Attachment Interview was relatively narrow: only frightening experiences of physical or sexual abuse by an attachment figure could be marked as abuse. The coding manual listed three other experiences of qualifying abuse by attachment figures, which were suicide attempts in the presence of the child, threats to harm or kill the child, and expressions of bizarre and frightening behaviour in front of the child. Experiences that were merely distressing or upsetting, such as undeserved spankings that did not leave markings, were not coded as abusive. Coders of the Adult Attachment Interview were instructed to "probably plan to err on the side of exclusion", "whatever the speaker's opinion" (Main et al., 2003, p. 147). This narrow definition of abuse has been criticised by subsequent attachment researchers, especially those with clinical training (George & Solomon, 1996; Levinson & Fonagy, 2004; Lyons-Ruth et al., 2003).

However, Main and colleagues' attention to only these kinds of child abuse can be placed in a wider social context.

The problematisation of child physical and sexual abuse in the US in the 1960s-80s may have been a cultural discourse of trauma that influenced the conceptualisation of unresolved states of mind (Jenkins, 2004). Child abuse became recognised as a social problem in the United States from the early 1960s.[17] Paediatricians used the term "battered child syndrome" to refer to physical violence to children, usually by a family member, which was made visible through x-rays (e.g., broken bones). This was widely picked up by the media, and child abuse rapidly gained attention by the public, politicians, teachers, and social welfare professionals. From the early 1970s, there was also growing attention to the problem of child sexual abuse, raised by calls from feminist and humanitarian activist groups. These developments may have influenced Main and colleagues' focus on experiences of physical and sexual abuse.

Interestingly, neglect was regarded as a form of child abuse in American psychological discourse and wider culture already from the 1960s. Yet neglect was not considered a potentially traumatic event by Main and colleagues in their unresolved abuse scale. Rather, neglect received its own coding scale in the Adult Attachment Interview manual, referring to parents who were physically available but uninvolved or psychologically inaccessible, but this scale did not contribute to assignment of the unresolved state of mind classification (Main et al., 2003, p. 35). A possible reason for Main to not consider neglect as a form of abuse may be that these experiences were not reported by parents with disorganised infants in the development sample (Main & Hesse 1990), and thus neglect did not become part of the theoretical framework of unresolved states of mind. Another factor may be that neglect is an omission of care rather than a locatable event, whereas unresolved states of mind are coded on the basis of discrete events. In addition, it may be possible that Main did not regard neglect as a frightening experience. In the "Neglecting: Inaccessible when physically available" coding scale, Main and colleagues defined neglect as "absence of interaction when potentially readily available to be present in the household". Although Main and colleagues acknowledged that at high levels of parental neglect there could be a lack of connection between the parent and child, they considered that even children with highly psychologically or physically inaccessible parents "may feel more unnoticed than disliked, avoided and rejected" (Main et al., 2003, p. 35). Main has subsequently been criticised on this point by clinically-trained attachment researchers, who have argued that the range of frightening parental behaviour should be expanded to include experiences of neglect (e.g., Lyons-Ruth & Block, 1996). Main and colleagues have not adapted the scale in response to these proposals.

[17] This refers to the modern construct and exact term of "child abuse". Before the 1960s, similar experiences were referred to as "cruelty to children". Differences between the two concepts are described by Hacking, I. (1998). Child Abuse. In *Rewriting the soul: Multiple personality and the sciences of memory* (pp. 55–68). https://doi.org/10.2307/1318797

Similarly, the unresolved abuse scale did not include emotional abuse (or psychological abuse, the terms are used interchangeably in the literature) as a potentially traumatic experience, despite this being a recognised form of maltreatment by the 1980s. Indeed Bowlby had been advocating for acknowledgement of emotional abuse and neglect as social problems already by the early 1970s[18]. Nonetheless, one reason that Main and colleagues may have excluded emotional abuse was that in the early 1980s, a clear definition and theoretical framework of emotional abuse was lacking, causing practitioners as well as researchers to "stumble around in the dark" (Garbarino, 1978).

Since the 1980s, continuing theoretical and empirical attempts by developmental researchers have led towards improved operational definitions of emotional abuse as well as a growing body of evidence on the effects of emotional abuse and neglect on the development and well-being of children (e.g., Glaser, 2002; Thompson & Kaplan, 1996; see also Norman et al., 2012). Despite these developments, the definition of abuse in the unresolved abuse scale has not changed: it is still mainly focused on experiences of physical and sexual abuse.

Obstacles to the integration of U/d with trauma research

Developments within the attachment field may have further contributed to the unresolved state of mind classification appearing as an authoritative construct representing trauma. An important factor may have been the strong theoretical connection between unresolved states of mind and infant disorganised attachment. In the late 1980s, child maltreatment was seen as the primary precursor of disorganised attachment in high-risk samples (e.g., Carlson et al., 1989). However, in general population samples, the prevalence of maltreatment was assumed to be lower than the rates of disorganised attachment (Main & Hesse, 1990). Main and colleagues introduced the unresolved state of mind category as another potential pathway leading to infant disorganisation, which served to explain the proportion of infant disorganised attachment in general population samples: "We underscore here that the infant's *D* Strange-Situation response in low-risk samples such as ours is not normally an indication of maltreatment. Indeed, we will argue here for a quite different, although related, mechanism." (Main & Hesse, 1990, p. 165). Main and Hesse hypothesised that parents showing unresolved discourse in the interview were still frightened by memories of traumatic experiences such as loss. These parents would sometimes show frightened/frightening behaviours in the presence of their infant, such as unusual speech or movement patterns, which could lead to infant disorganised attachment behaviour. The idea that unresolved states of mind were associated with infant disorganised attachment, mediated by frightened/frightening parental behaviour, thus built on the underlying assumption that an unresolved state of mind was a construct related to fear

[18] Bowlby, J. (1971). Evidence presented on 6/4/1971 to the Committee on the Adoption of Children, Home Office and Department of Health and Social Security. The National Archives, Kew, BN 29/2340.

and trauma. Indeed, Main and Hesse (1990) themselves assumed that parents with unresolved states of mind were "still-traumatised" (p. 163).

The theoretical link between unresolved states of mind and infant disorganised attachment was formulated alongside with early findings from the Berkeley sample: out of the twelve mothers identified with unresolved loss, eleven had infants classified as disorganised in the Strange Situation (Main & Hesse, 1990). This association was also found by subsequent studies, with the first few studies showing extremely high effect sizes (Ainsworth & Eichberg, 1991; Ward & Carlson, 1995). The link between unresolved states of mind and disorganised attachment has been less strong in later studies. However, the findings from the early studies may have led to the premature assumption among attachment researchers that unresolved states of mind represented trauma, and that this was "transmitted" to the next generation (Verhage et al. 2016). In addition, later studies provided empirical evidence for the association of unresolved states of mind with frightened/frightening parental behaviour and infant disorganisation (Schuengel et al., 1999; Madigan et al., 2006), further adding to the theoretical meaning of the unresolved state of mind construct.

It seems that attachment researchers generally have taken for granted that an unresolved state of mind exists in the real world and that it represents a form of unresolved trauma.[19] This may have hindered empirical inquiry into the relationship between the unresolved state of mind construct and scientific research on trauma, also by non-attachment researchers. In part, perhaps, due to this lack of inquiry, the unresolved state of mind construct has not changed since its introduction, despite advances in knowledge about trauma from the wider field of developmental psychopathology research. As Stovall-McClough and Cloitre (2006), two developmental psychologists, have observed: "trauma theory and attachment theory have developed along relatively independent lines" (p. 219). Most strikingly, it is still unknown how the unresolved state of mind construct relates to standardised measures of trauma. A few researchers, mostly from the attachment field, have explored how unresolved states of mind may be related to PTSD (e.g., Harari et al., 2009; Nye et al., 2008; Turton et al., 2004). But studies so far have only focused on the unresolved state of mind classification as a whole, not considering potential associations between discrete manifestations of unresolved states of mind and trauma indicators from standardised measures.

One reason for the lack of interplay between the unresolved state of mind construct and wider trauma discourses may have been confusion about what it is that an unresolved state of mind actually

[19] An exception is the empirical work by Roisman and colleagues. Based on taxometric findings, they have suggested that "there may be no empirical distinction between indicators of preoccupation and unresolved discourse", in Haltigan, J. D., Roisman, G. I., & Haydon, K. C. (2014). The latent structure of the Adult Attachment Interview: Exploratory and confirmatory evidence. *Monographs of the Society for Research in Child Development*, *79*(3), 15–35 (p. 33). See also: Roisman, G. I., Fraley, R. C., & Belsky, J. (2007). A taxometric study of the Adult Attachment Interview. *Developmental Psychology*, *43*(3), 675–686.

measures, both to those inside and outside of the attachment field. Main and colleagues' explanations of the psychological mechanisms behind unresolved discourse have been somewhat ambiguous. Over the years, the lapses in reasoning or discourse have been suggested to indicate "continual mental disorganization and disorientation" (Main & Hesse, 1990, p. 168), "partial intrusion of frightening, normally dissociated memories" (Main & Hesse, 1992, p. 187), "lapses in working memory" (Main & Hesse, 1992, p. 196), and "micro-dissociative states" (Main & Morgan, 1996, p. 25). Main and Hesse did not pursue to develop these proposals into testable hypotheses and left the task to others to integrate these ideas with other scientific studies of trauma phenomena. Subsequent researchers have attempted to address some of these questions, for example, by examining the role of dissociative experiences (e.g., Schuengel et al., 1999) and differences in stress-sensitive brain regions (e.g., Van Hoof et al., 2019) in adults classified with an unresolved state of mind.

The lack of dynamic interplay between the unresolved state of mind construct and other areas of knowledge about trauma may be conceptualised as an effect of the relative autonomy of the attachment field (Bourdieu, 1975). As Duschinsky (2020) has observed, the field of attachment research is somewhat insular: it is a part of developmental science, but also in a way detached from it. Another reason for the lack of interplay of the unresolved state of mind classification with other disciplines may be that Main and her colleagues did not put the Adult Attachment Interview coding system into wider circulation. In 1986, Main had completed a book in which she described various measures developed for the Berkeley Social Development Study, including descriptions of the Adult Attachment Interview coding system. However, this book remained unpublished.[20] The coding manual was, and is still, provided to and only to be used by participants of intensive two-week training institutes. Learning to code the Adult Attachment Interview is an expensive and laborious process. Besides taking part in the training institutes, there is no other way of gaining detailed knowledge about unresolved states of mind. In this context, we are grateful that Main and colleagues have given us copies of these manuals for use in our historical research. Main and colleagues have sought to control the circulation of knowledge of how the Adult Attachment Interview is coded in order to reduce the potential risks of unlicensed applications by untrained researchers and of demand characteristics for participants. Yet from a historical perspective we would observe that publication of the 1986 book and/or the Adult Attachment Interview coding manual might have helped bring her ideas on measurement into greater dialogue with the wider field of developmental science.

[20] Main, M. (1986). Behaviour and the development of representational models of attachment: Five methods of assessment. Unpublished manuscript, Mary Main & Erik Hesse personal archive.

Conclusions

This paper traced the emergence of the unresolved state of mind classification, placing Main's conceptualisation of an unresolved state of mind in wider disciplinary and social context. We observed that there are multiple assumptions of trauma embedded in the construct of an unresolved state of mind: (1) bereavement is functionally identical to abuse as a kind of trauma when not psychologically reconciled; (2) traumatic abuse experiences are restricted to child physical and sexual abuse by attachment figures; and (3) lapses in adult discourse about unresolved bereavement or abuse experiences are underpinned by the same process as disruptions of attachment behaviour shown by young children. A proximal influence on all three assumptions was Bowlby, who had made bereavement and trauma his central focus in *Loss* (1980) and conceptualised segregated systems and defensive exclusion following loss as mechanisms that could disrupt the coherence of behaviour and speech in children and adults. Further, we related the development of the unresolved state of mind construct to broader contemporary trauma discourses, in particular the introduction of PTSD in the DSM-III in 1980 and discourses about child abuse in the US in the 1960s-80s. We have seen that, despite advances in knowledge from wider disciplines of trauma, the construct of an unresolved state of mind has remained unchanged. For example, the definition of child abuse in the unresolved state of mind classification is still focused on mainly child physical and sexual abuse, and is therefore relatively narrow compared to contemporary definitions of child abuse that include neglect and emotional abuse.

While attachment researchers have generally taken for granted that an unresolved state of mind represents a form of unresolved trauma, there has been a lack of interaction between the unresolved state of mind construct and other areas of knowledge about trauma. The unresolved state of mind classification was developed within the context of wider scientific and social debates about trauma but has also remained detached from it. This may be an effect of the relative autonomy of the attachment field, as well as confusion – both to those within and those outside the attachment field – about what it is that the construct of an unresolved state of mind actually represents. The decision by Main and colleagues to limit circulation of the Adult Attachment Interview coding manual to those who attend the two-week training course may have contributed to the lack of interplay of unresolved states of mind with wider trauma disciplines.

Our paper contributes to the history of attachment research by documenting the development of Main and colleagues' measure of unresolved loss and abuse. We have shown that Bowlby's work on trauma and loss was a fundamental influence on the conceptualisation of unresolved states of mind, and investigated broader disciplinary influences that may have helped shape the construct. This paper also contributes to the historiography of conceptualisations of trauma, by describing a

psychological measure characterised by an intriguing amalgamation of loss with trauma, which became a construct representing unresolved trauma and gained status within the relatively isolated area of attachment research.

3

Exploring the Meaning of Unresolved Loss and Trauma in 1,000 Adult Attachment Interviews

Abstract

Unresolved states of mind with respect to attachment (U/d) are identified through lapses in reasoning, discourse, and behaviour surrounding loss and abuse in response to the Adult Attachment Interview. Although the coding system for U/d has been widely used for decades, the individual indicators of unresolved loss and abuse have not been validated independently of Main and colleagues' (1985) initial sample. This study examined the psychometric validity of U/d, using individual participant data from 1,009 parent-child dyads across 13 studies. A latent class analysis showed that subsets of commonly occurring U/d indicators could differentiate interviewees with or without unresolved loss/abuse. Predictive models suggested a psychometric model of U/d consisting of a combination of these common indicators, with disbelief and psychologically confused statements about loss being especially important indicators of U/d. This model weakly predicted infant disorganised attachment. Multilevel regression analysis showed no significant association between ratings of unresolved other trauma and infant disorganised attachment, over and above ratings of unresolved loss/abuse. Altogether, these findings suggest that the coding system of U/d may have been overfitted to the initial development sample. Directions for further articulation and optimisation of U/d are provided.

This chapter is based on:

Bakkum, L., Verhage, M. L., Schuengel, C., Duschinsky, R., Cornelisz, I., Van Klaveren, C., Van IJzendoorn, M. H., Raby, K. L., Roisman, G. I., Bakermans-Kranenburg, M. J., Oosterman, M., Madigan, S., Fearon, R. M. P., Behrens, K., & The Collaboration on Attachment Transmission Synthesis. (2021). *Exploring the meaning of unresolved loss and trauma in more than 1,000 Adult Attachment Interviews*. Manuscript submitted for publication.

Introduction

Unresolved (disorganized/disoriented) attachment (U/d) is a classification of the Adult Attachment Interview (AAI; George et al., 1984, 1985, 1996; Main et al., 2003). Adults with an unresolved state of mind are believed to not have adequately processed experiences of loss and abuse, leading to incoherent speech surrounding discussion of these events in response to the AAI (Main & Hesse, 1990). Despite widespread use of the AAI coding system over decades (Van IJzendoorn et al., 1995; Verhage et al., 2016), the specific indicators used to classify unresolved states of mind have not been validated in study samples other than the original one studied by Main et al. (1985) in the Berkeley Social Development Study. This raises the question of whether attachment researchers have been measuring the same construct across the various studies. In addition, the indicators of unresolved states of mind may have partially captured discourse idiosyncratic to interviews in the Berkeley study, and might not generalise in other samples (i.e., "overfitted" to the initial data). Unresolved states of mind have been found to predict parenting behaviour and disorganised attachment relationships in the next generation (Van IJzendoorn, 1995; Verhage et al., 2016). This suggests that the coding scale contains valid indicators of unresolved states of mind, but it is not known which indicators are valid, or how much heterogeneity there might be.

As argued by Scheel et al. (2020), sufficiently defined concepts and valid measurements are needed before testing novel, theoretically-derived hypotheses. To strengthen these elements of the "hypothesis derivation chain", non-confirmatory research such as descriptive and psychometric work is required. To this end, the current investigation explored how the construct of adults' unresolved states of mind about experiences of loss and abuse has been shaped by the specific indicators described by Main et al. (2003), using multiple analytic approaches and by addressing both the construct and predictive validity of unresolved states of mind.

Unresolved states of mind about loss and abuse

When studying relations between parents' narratives about their childhood experiences and the attachment relationships with their infants, Main and Hesse (1990) discovered that some parents who had lost a parent before adulthood showed signs of "lack of resolution of mourning." This was indicated by unusual speech during the discussion of loss, akin to dissociative responses to trauma in the clinical domain. Based on the AAIs of 44 sets of parents (Duschinsky, 2020), Main and colleagues (1991/1994) developed a scale for rating individuals' unresolved states of mind with regard to experiences of loss. Main (1991) also theorised that experiences of abuse perpetrated by attachment figures may have disorganising effects on the attachment behavioural system. She therefore developed a scale for rating unresolved states of mind regarding childhood abuse that

mirrored the unresolved loss scale. These two rating scales are used by coders to classify adults with an unresolved attachment state of mind based on their AAI discourse.

The predictive validity of the unresolved classification has been shown in many subsequent studies. The first and most fundamental source of support for the classification was its association with children's behaviour during the Strange Situation, the classic laboratory-based procedure for assessing parent-child attachment (Ainsworth et al., 1978). Main and Hesse (1990) theorised that parents with an unresolved state of mind would show forms of frightened, frightening, or dissociated behaviour, which alarm their infants. These types of unpredictable experiences of fear in the context of the parent-child attachment relationship were theorised to lead to children's disorganised attachment behaviour in the Strange Situation. Specifically, behaviours such as freezing, stilling, or expressions of apprehension in the presence of the attachment figure were postulated to reflect the infant's internal conflict of whether to approach or avoid the parent (Main & Solomon, 1990). Meta-analytic findings have supported these predictions, with effect sizes ranging from .21 to .34 for the associations between parents' unresolved states of mind, parents' frightening behaviour, and children's disorganised attachment (Madigan et al., 2006; Schuengel et al., 1999).

The AAI coding system distinguishes three kinds of linguistic indicators of unresolved states of mind: i) lapses in the monitoring of reasoning, such as irrational beliefs that a loved one who died long ago is still alive or denial of the occurrence or consequences of childhood abuse; ii) lapses in the monitoring of discourse, such as a sudden inability to finish sentences or changing to an odd style of speech during discussion of loss or abuse; and iii) lapses in the monitoring of behaviour, indicating past or ongoing extreme behavioural responses to loss or abuse, such as a suicide attempt. AAI coders consider the severity and frequency of these indicators to assign ratings on two 9-point scales: *unresolved loss* and *unresolved abuse*. Coders are instructed to use the indicators of these scales interchangeably – indicators from the unresolved loss scale can be used to code unresolved abuse, and vice versa (Main et al., 2003, p. 131).

If an interview receives a high unresolved score (≥ 5) on either the unresolved loss or the unresolved abuse scale (or both), the unresolved classification is assigned. In low-risk community samples, around 20% of interviews are classified as unresolved (Verhage et al., 2016). In clinical samples and samples considered at-risk (e.g., those with a low socioeconomic status background), the numbers of unresolved classifications are higher (around 32% of at-risk samples and 43% of clinical samples; Bakermans-Kranenburg & Van IJzendoorn, 2009).

The coding system for assessing unresolved states of mind (Main et al., 2003) has not changed since the early 1990s and is still widely used by attachment researchers today. However, some assumptions underlying the construct of an unresolved state of mind have not been examined

empirically. Theoretical considerations, rather than psychometric evidence, have guided the construction of the unresolved loss and abuse coding scales and the rules for coding unresolved states of mind, including the selection and interpretation of indicators of unresolved loss and abuse. Some lapses in the monitoring of reasoning, such as feelings of being causal in a death where no material cause was present, are generally believed to be a stronger indicator of an unresolved state of mind than lapses in the monitoring of discourse, such as sudden moves away from discussing experiences of loss or abuse (Main et al., 2003). Using the examples presented in the coding manual as guidelines, it is up to the coder to determine the relative strength of individual indicators when assigning a score on the unresolved loss and abuse scales. The coding manual presents examples of indicators that are thought to suggest immediate placement in the unresolved category, with relative weighting suggestions of 6 to 9 on the 9-point scales. Thus, coders may decide to classify an interview as unresolved, based on the presence of a single indicator. If the coder assigns a rating of 5 on either or both of the unresolved loss/abuse scales, based on the presence and relative strength of one or multiple indicators, it is up to the coder to determine if this leads to placement in the U/d category (Main et al., 2003).

The extent to which coding practices using the AAI manual can be adequately described using psychometric models remains unknown. Given that most later studies on the intergenerational transmission of attachment patterns had used even smaller sample sizes than the original study (Verhage et al., 2016), attachment researchers have not been able to examine the occurrence and the relative strength of the individual indicators of unresolved loss and abuse. However, with sufficiently large datasets, it is possible to explore whether some indicators are stronger than others in contributing to the unresolved classification, in ways suggested by the coding system. In addition, large datasets make it possible to explore potential patterns of indicators underlying the coding scales, for example, whether there are certain combinations of indicators that often co-occur in interviews. Such findings would contribute to theoretical parsimony of the concept of unresolved states of mind and aid in efforts to produce a scalable version of the AAI (Caron et al., 2018). Like other attachment measures such as the Strange Situation, coding the AAI is labour-intensive and requires extensive training and practice. Limiting the number of indicators of unresolved loss and abuse would decrease coders' time investment and improve feasibility of coding and possibly also interrater reliability. As such, the first aim of this study was to investigate which patterns of indicators differentiate interviewees with and without unresolved loss/abuse. The second aim was to search for a psychometric model that may underlie the unresolved state of mind construct, by investigating the unique contribution of each indicator to overall ratings and classifications of unresolved states of mind.

Predictive validity of unresolved states of mind for infant disorganised attachment

A broader approach to exploring the meaning of unresolved loss/abuse entails considering the degree to which adults' unresolved states of mind predict infant disorganised attachment. This intergenerational association is especially important from a predictive validity standpoint because this was how the unresolved classification was originally developed. Main and Hesse's (1990) model of the transmission of unresolved states of mind to infant disorganised attachment has been generally supported by a large body of research (Van IJzendoorn, 1995; Verhage et al., 2016). This research has established that the unresolved category as a whole is associated with infant disorganised attachment. However, as previously noted, the unresolved state of mind classification can be based on anomalous reasoning, discourse, or behaviour with regard to experiences of loss or experiences of childhood abuse (Main et al., 2003), and the structure of this rich set of indicators has not yet been explored. This gap exists despite calls, including from Main and Hesse themselves, to examine the implications of such different manifestations of unresolved loss/abuse in parents' narratives (Hesse & Main, 2006). For example, Lyons-Ruth and colleagues (2005) have suggested that the principles for coding unresolved states of mind may be "more sensitive to processes involved in integrating loss and less sensitive to processes involved in integrating abuse" (p. 18), based on the fact that the guidelines for coding unresolved states of mind were initially developed based on parents' narratives about experiences of loss. Disaggregating lapses in the monitoring of reasoning, discourse, and behaviour may reveal additional clues regarding how parents' unresolved loss/abuse contribute to infant disorganisation and may suggest alternative ways in which such lapses may be usefully aggregated. In addition to the aim of searching for a psychometric model underlying adults' classification of unresolved, the third aim of this study was to examine the predictive validity of this model by examining its association with infant disorganised attachment.

Other kinds of unresolved trauma

Adverse experiences that do not directly involve individuals' childhood attachment figures, such as sexual abuse by non-caregivers, witnessing violence, or surviving a car accident, may also have significant implications for psychological functioning and parenting behaviour. For example, two studies have shown associations between unresolved states of mind about miscarriage and stillbirth and infant disorganised attachment (Bakermans-Kranenburg et al., 1999; Hughes et al., 2001). These experiences might be considered as potential traumas for the parent. However, beyond these studies, research has not yet addressed the question of whether traumatic experiences not directly involving attachment figures are related to infant disorganised attachment. Madigan et al. (2012) found that the majority of high-risk, pregnant adolescents who reported experiences of sexual abuse in the AAI were classified as having an unresolved state of mind, and that the majority of perpetrators were

non-attachment figures. The authors therefore emphasised the importance of exploring the impact of individuals' discourse regarding abuse perpetrated by attachment figures versus non-attachment figures for states of mind regarding attachment.

Since the early editions of the AAI coding manual (e.g., Main & Goldwyn, 1991), coders are instructed to record the nature of traumatic events perpetrated by non-attachment figures and apply the principles of the unresolved loss and abuse scales to identify any unresolved/disorganised responses. Yet, in the current version of the manual (Main et al., 2003), ratings of "other trauma" are not taken into account when determining placement into the unresolved category. As a first step in exploring the predictive significance of adults' discourse regarding other potentially traumatic experiences and parent-child attachment, the fourth aim of this study was to examine whether coders' ratings of unresolved other trauma were associated with infant disorganised attachment, over and above ratings of unresolved loss and unresolved abuse.

This study

In summary, the following research questions were addressed in this study:

1) Which patterns of indicators differentiate interviewees with or without unresolved loss/abuse?
2) What psychometric model based on the indicators of unresolved loss/abuse may underlie the construct of an unresolved state of mind?
3) What is the relation of this model to infant disorganised attachment?
4) What is the association between ratings of unresolved "other trauma" and infant disorganised attachment, over and above ratings of unresolved loss/abuse?

The research questions and study protocol were pre-registered on Open Science Framework (https://osf.io/bu5cx).

Method

Study identification and selection

This study was conducted using data gathered by the Collaboration on Attachment Transmission Synthesis (CATS) and built on the first individual participant data (IPD) meta-analysis on intergenerational transmission of attachment by Verhage et al. (2018). For the first IPD meta-analysis, principal investigators from 88 studies on attachment transmission were invited to participate in CATS by sharing individual participant data.[21] These studies had used the AAI to assess adults' attachment states of mind and included observational measures of parent-child attachment. In total, the CATS dataset contains AAI data (coded using Main and colleagues' system) and parent-

[21] The list of CATS consortium members can be found on Open Science Framework: https://osf.io/56ugw/

child attachment data from 4,521 dyads from 61 studies. For an overview of the study identification and selection process, see Verhage et al. (2018).

Data items

In the original CATS dataset (Verhage et al., 2018), information about unresolved loss/abuse in the AAI was limited to the unresolved classification and scores on the unresolved loss and unresolved abuse rating scales. For this study, we requested additional information about the specific indicators of unresolved loss and abuse. Principal investigators in CATS were invited to share the following information per applicable loss and abuse experience reported in the AAI: relationship with the deceased, type of abuse (e.g., physical, sexual), relationship with the abuse perpetrator, highest unresolved score for the event, and the indicators of unresolved loss/abuse that were marked for the event. This study included all 16 possible indicators of unresolved loss and all 16 possible indicators of unresolved abuse listed in the AAI coding system (Main et al., 2003). The requested data were shared by either providing AAI scoring forms or marked interview transcripts or by entering the information into an Excel spreadsheet, Word document, or SPSS template created for this study. All obtained data were checked for anomalies. In cases where data input errors were suspected, the principal investigators of the original studies were contacted for clarification.

Indicators of unresolved loss and abuse were dichotomised according to their presence in the interview (0 = lapse not present, 1 = lapse present) as the availability of coder ratings of the individual indicators was inconsistent. Participants who did not have an applicable loss or abuse experience were assigned scores of 0 for all the specific indicators of unresolved loss or abuse. In addition, the current study used the following data from the original CATS dataset: scale scores for unresolved loss, unresolved abuse, and unresolved other trauma (continuous; range 1-9); unresolved classification (dichotomous; 0 = not unresolved, 1 = unresolved); reported applicable loss (dichotomous; 0 = no loss reported, 1 = loss reported); reported applicable abuse (dichotomous; 0 = no abuse reported, 1 = abuse reported); infant disorganised attachment rating as measured in the Strange Situation (continuous; range 1-9); infant disorganised attachment classification (dichotomous; 0 = not disorganised, 1 = disorganised); and risk background of the sample (dichotomous; 0 = normative, 1 = at-risk). Consistent with previous research, participants without applicable loss, abuse, or other trauma experiences were given a score of 1 on the corresponding coding scales (Haltigan et al., 2014; Raby et al., 2017; Roisman et al., 2007).

We requested information about unresolved loss/abuse from 58 studies in CATS. This information was available from 1,009 parent-child dyads from 13 samples. From these samples, 11 had used the Strange Situation to assess the quality of the parent-child attachment relationship and Main and Solomon's (1990) coding system to measure infant disorganised attachment (n = 930

parent-child dyads). Interrater reliability of the four-way AAI classifications ranged from $\varkappa = 0.57$ to $\varkappa = 0.90$, and interrater reliability of the four-way Strange Situation classifications ranged from $\varkappa = 0.63$ to $\varkappa = 0.87$. An overview of the included studies, sample sizes, measures, interrater reliability, and distributions of classifications is reported in Appendix A. Interrater reliability scores of the unresolved loss and abuse scales were available from three and two studies, respectively. None of the studies reported reliability information for the specific indicators marked for unresolved loss/abuse.

Most of the studies in the original CATS dataset from which the requested information about indicators of unresolved/loss abuse was not available no longer had access to the data ($k = 27$). Other reasons for not participating were that authors did not respond ($k = 10$), experienced time constraints ($k = 3$), or did not wish to share unpublished data ($k = 2$). For two studies, AAIs were coded in a language not feasible to translate.

Participants

All parents in the current study were female ($N = 1{,}009$) and 517 of the children were female (51%). Parents were on average 29.79 years old ($SD = 6.76$) at the time of the AAI, and the average age of the children at the time of the Strange Situation procedure was 13.69 months ($SD = 1.99$). Forty percent of AAIs were conducted prenatally. Of the parent-child dyads from which the AAI was conducted after birth, children were on average 22.63 months old ($SD = 22.52$) when the interview was conducted. In the majority of studies using the Strange Situation procedure ($k = 6$; 64% of dyads), the AAI was conducted before the Strange Situation, in three studies (25% of dyads), participants were concurrently administered the AAI and the Strange Situation, and in two studies (11% of dyads) Strange Situation data were collected before the AAI. In total, 15% of participants were single, 18% had finished primary education or less, and 62% of the parent-child dyads were considered at-risk due to characteristics such as teenage motherhood, preterm birth, adoptive families, or substance abuse (see Verhage et al., 2018). The 13 studies included in this project were published between 1999 and 2016, and originated from seven countries (Canada, Denmark, Germany, Italy, Japan, the Netherlands, and the United States).

Statistical procedure

The statistical analysis for Research Question 1 was conducted using Mplus (version 7.4; Muthén & Muthén, 2015) and the analyses for Research Questions 2, 3, and 4 were performed in R (version 3.6.1; R Core Team, 2019) and Stata (version 16.1; StataCorp, 2019).

Research Question 1. Latent class analysis was used to investigate which patterns of indicators differentiate interviewees with or without unresolved loss/abuse. Separate latent class models were fitted for indicators of unresolved loss and unresolved abuse. Latent classes were estimated using maximum likelihood estimation with robust standard errors. The number of latent

classes was decided based on the Bayesian Information Criterion (BIC) value and the interpretability of the classes (Nylund et al., 2007). As a follow-up, we investigated the association between participants' at-risk background and the latent classes resulting from the best-fitting models.

Research Question 2. We aimed to define a psychometric model that may underlie the construct of an unresolved state of mind by investigating the contribution of each indicator to overall ratings and classifications of unresolved states of mind. To do this, we used predictive modelling (i.e., statistical learning). To our knowledge, these techniques are rarely used in the field of developmental psychopathology research. Therefore, these methods will be explained in more detail than what would normally be reported in a primary research article.

Aims of predictive modelling. As described by Yarkoni and Westfall (2017), most research in psychology has focused on identifying and explaining mechanisms of human behaviour, mostly using statistical inference (explanatory) techniques. However, more methodological tools have now become available to test predictive models. For some research questions in psychology, predictive models have the advantage over explanatory models to test how well a set of independent variables predicts a given outcome, with the aim of achieving good prediction accuracy. In the case of searching for a psychometric model that may underlie the construct of an unresolved state of mind, predictive models may thus help us to find a set of indicators of unresolved loss and abuse that do best in predicting unresolved scores and classifications.

When using predictive modelling, it is common practice to fit a model on one part of the dataset (the "training" data) and to evaluate its predictive performance on another part of the dataset (the "testing" or "out-of-sample" data). This approach makes it possible to test how well a predictive model generalises to new data. In our study, we used 70% of the dataset as training data and 30% as testing data. Further, it is important to consider the trade-off between model complexity and prediction accuracy. Using more complex models can lead to better prediction accuracy, but these models may be more difficult to interpret. In addition, more complex models could lead to overfitting. Overfitting refers to situations in which a predictive model fits well on the data on which it is trained, but does not generalise to new data. It is therefore important to find a model that is flexible enough to identify patterns in the data, but to constrain model complexity so that the model achieves good predictive performance on the out-of-sample data. One way to address overfitting in predictive modelling is to use regularisation techniques, such as ridge regression and lasso regression. These techniques add penalty terms to the model that shrink or force the coefficients of variables that explain little variance in the outcome variable to zero (James et al., 2013; Kuhn & Johnson, 2013).

Developing the predictive models. The outcome of the predictive models was participants' unresolved score (range 1-9). The following variables were used as predictors: indicators of unresolved loss/abuse, at-risk background, reported loss, reported abuse (all dichotomously coded), and study sample (12 dummy variables). Using the training data (70% of the dataset), we fitted nine predictive models: linear regression (ordinary least squares), lasso regression, ridge regression, multivariate adaptive regression splines (MARS), logic regression, random forest, and support vector machines with a linear, polynomial, and radial kernel. These models are commonly used supervised learning models for continuous outcome variables (i.e., regression models). Supervised learning models are used to address questions about the association between predictors (in this case: indicators of U/d) and a given outcome (in this case: unresolved scores). These models use predictors and labeled outcome values to train the algorithm, attempting to optimise the mean squared error: the extent to which predicted values are close to the actual, observed values.

Some of the models used in this study are linear regression models or cousins of linear regression (linear, lasso, and ridge regression) and some are non-linear regression models (MARS, logic regression, random forest, and support vector machines). These models vary in complexity, ranging from simpler models (e.g., linear, lasso, or ridge regression) to more complex models (e.g., random forest). We used a variety of predictive models in this study, because we attempted to find a model that would do best in predicting unresolved scores and classifications. In case that a simpler and a complex model would do equally well in predicting the outcome, we would choose the simpler model over the complex one as the final model, because complex models may be more difficult to interpret (James et al., 2013).

After fitting the models on the training data, the outcomes were predicted on the testing data (30% of the dataset). The models' predictive performance for unresolved classifications was evaluated according to two steps, after which a final model was chosen.

Evaluating model performance: Two steps. First, we used the *precision* and *sensitivity* for unresolved classifications as indicators of model performance. The predicted unresolved scores (based on the indicators of unresolved loss/abuse) were used to calculate the precision and sensitivity for the *actual* unresolved classifications according to the human coders. Precision refers to the proportion of predicted unresolved classifications that were actually classified as unresolved, and was calculated by dividing the number of true positives by the sum of true positives and false positives. Sensitivity refers to the proportion of actual unresolved classifications that were correctly predicted as unresolved, and was calculated by dividing the number of true positives by the sum of true positives and false negatives. Higher precision and higher sensitivity indicate better predictive performance. Another important indicator of model performance is *specificity*, which refers to the proportion of

actual not-unresolved classifications that were correctly predicted as not-unresolved, and was calculated by dividing the number of true negatives by the sum of true negatives and false positives. Table 1 presents an overview of these model performance measures.

Table 1

Measures for Evaluating Predictive Model Performance

Measure	Description	Calculation
Precision	The proportion of predicted U/d classifications that were actually classified as U/d	$\frac{true\ positives}{true\ positives + false\ positives}$
Sensitivity	The proportion of actual U/d classifications that were correctly predicted as U/d	$\frac{true\ positives}{true\ positives + false\ negatives}$
Specificity	The proportion of actual not-U/d classifications that were correctly predicted as not-U/d	$\frac{true\ negatives}{true\ negatives + false\ positives}$

Note. The examples in the "Description" column refer to Research Question 2 (*Defininig a psychometric model underlying classifications of U/d*). The same model performance measures were used for Research Question 3 (read "infant D" instead of "U/d").

A more informative way to evaluate the models' predictive performance was to explore how performance varies if different rules for assigning the unresolved classification would be used. Therefore, in the second step of evaluating the models' predictive performance, we examined the trade-off between sensitivity (proportion of correctly predicted cases) and specificity (proportion of correctly predicted non-cases) of unresolved scores predicting unresolved classifications by different threshold scores for classification. In other words, we varied the *threshold predicted unresolved score* at which the models labeled participants as unresolved versus not-unresolved. Using this approach, we aimed to identify as many persons as possible who would likely receive an unresolved classification, without wrongly identifying those without a classification as being a likely candidate. The results were plotted as to examine which threshold gave the best sensitivity and specificity trade-off for unresolved classification. Of particular interest is the level of sensitivity and specificity at around a threshold predicted unresolved score of ≥ 5, because this is the AAI coding manual's threshold for assigning the unresolved classification.

Lastly, to explore how model performance varies if fewer indicators of unresolved loss/abuse were used to predict unresolved scores, we re-tested the final model (i.e., the model with favourable predictive performance resulting from the previous step) using only the top seven, five, and three

most important predictors. Obtaining relatively high out-of-sample predictive performance for unresolved scores using fewer indicators may have implications for theoretical parsimony of the unresolved state of mind construct as well as scalability of the measure.

Research Question 3. The aim was to investigate how the psychometric model of unresolved states of mind resulting from Research Question 2 would relate to infant disorganised attachment. To test this, the same nine predictive models as in Research Question 2 were developed using the smaller sample of parent-child dyads who participated in the Strange Situation (n = 930). The predictive models were trained on 70% of the data. The outcome of the predictive models was participants' unresolved score (range 1-9). Predictors were: indicators of unresolved loss/abuse, at-risk background, reported loss, reported abuse (all dichotomously coded), and study sample (12 dummy variables).

The predictive validity of these models for infant disorganised attachment was assessed in two steps, using the testing data (30% of the dataset). First, the models were compared by the precision and sensitivity for identifying infant disorganised attachment classifications. Second, the trade-off between sensitivity and specificity for infant disorganised attachment was plotted by different threshold predicted unresolved scores (Table 1 presents an overview of the model performance measures).

Research Question 4. The aim was to investigate the association between unresolved "other trauma" and infant disorganised attachment. Using multilevel modelling to account for the nested data, we investigated the association between ratings of unresolved other trauma and infant disorganised attachment, over and above ratings of unresolved loss/abuse. The analysis was performed first with infant disorganised attachment *ratings* as the outcome, and then with infant disorganised attachment *classifications* as the outcome.

Handling missing data

Nearly five percent of the parent-child dyads (n = 45) had missing data on infant disorganised attachment. The way in which missing data were handled depended on the type of analysis. For the predictive models used to address Research Question 3, missing disorganised attachment scores were imputed by the sample mean because these models could not be estimated when the variables contained missing values. The multilevel regression analyses (Research Questions 1 and 4) used full maximum likelihood estimation to deal with these missing data.

Results

Descriptive statistics

The total sample consisted of 1,009 participants clustered in 13 study samples. Ninety-three percent of participants reported at least one applicable loss, 23% reported at least one applicable abuse experience, and 21% reported both loss and abuse in the AAI. Of the participants reporting loss, 78% reported no abuse, and 9% of participants who reported abuse did not report any loss.

Descriptive statistics of unresolved loss and abuse and infant disorganised attachment are shown in Table 2. The correlation between unresolved loss and unresolved trauma scores was statistically significant ($r = .20$, $p = < .001$). The correlation between the highest unresolved scores and infant disorganised attachment scores was also statistically significant ($r = .13$, $p = < .001$). The raw frequencies of the indicators of unresolved loss and abuse and the correlation matrices are reported in Appendix B.

Table 2
Descriptive Statistics of the Study Variables

	M	*SD*	Min-max
Continuous variables			
Unresolved loss score	3.04	1.88	1-9
Unresolved abuse score	1.54	1.34	1-8
Unresolved other trauma score	1.28	0.89	1-9
Unresolved score	3.23	1.94	1-9
Infant disorganised attachment score	3.44	2.08	1-9
	n	%	
Dichotomous variables			
Unresolved versus not-unresolved	233	23%	
Disorganised versus not-disorganised (infants)	230	23%	
At-risk background	407	40%	

Note. Unresolved score was determined by the highest score from the unresolved loss and abuse scales. Participants without applicable loss, abuse, or other trauma were given a score of 1 on the corresponding rating scales.

Research Question 1: Patterns of indicators that differentiate interviewees with or without unresolved loss/abuse

Latent class analysis was used to investigate patterns of indicators that differentiate interviewees with and without unresolved loss/abuse. Separate latent class models were fitted for indicators of unresolved loss and unresolved abuse. Table 3 presents the model fit parameters of the estimated models. For both unresolved loss and abuse, the 2-class models were chosen as the best-fitting models. The 2-class models of unresolved loss and abuse were chosen on the basis of the lowest BIC

values, theoretical plausibility, and clear differentiation of interviewees with and without unresolved loss/abuse.

Table 3

Results From the Latent Class Analysis of Indicators of Unresolved Loss and Abuse

	1 class	2 classes	3 classes	4 classes	5 classes
Indicators of unresolved loss					
Number of free parameters	16	33	50	67	84
Log-likelihood	-4038	-3826	-3797	-3776	-3759
BIC	8188	7880	7940	8015	8099
Entropy		0.61	0.61	0.60	0.68
Indicators of unresolved abuse					
Number of free parameters	16	33	50	67	
Log-likelihood	-1328	-1152	-1124	-1111	
BIC	2766	2532	2594	2685	
Entropy		0.85	0.93	0.90	

Note. BIC = Bayesian Information Criterion. The models with > 5 classes for unresolved loss and > 4 classes for unresolved abuse resulted in model-non-identification and are therefore not reported.

As seen in the profile plots in Figure 1, the two latent classes of unresolved loss (A) were distinguished based on the probability of showing disbelief, disoriented speech, unusual attention to detail, disorientation with regard to time, and extreme behavioural reactions. The two latent classes of unresolved abuse (B) were distinguished based on the probability of showing disoriented speech and unsuccessful denial of abuse. As seen in the Figure, the order of indicators discriminating the latent classes closely follows the frequency of occurrence: the indicators providing the most information for discriminating the classes were the ones most frequently identified in the interviews (see Appendix B for raw frequencies). The profiles characterised by high probabilities of showing the frequently occurring indicators were designated as "high-lapsing" classes, and the profiles characterised by low-to-zero probabilities of showing these indicators were designated as "low-lapsing" classes. Forty percent of the participants with loss experiences belonged to the high-lapsing unresolved loss class and 62% of the participants who reported abuse experiences belonged to the high-lapsing unresolved abuse class. The bivariate residuals and the associations between the latent classes, unresolved scores, unresolved classifications, and infant disorganised attachment scores are reported in Appendix C.

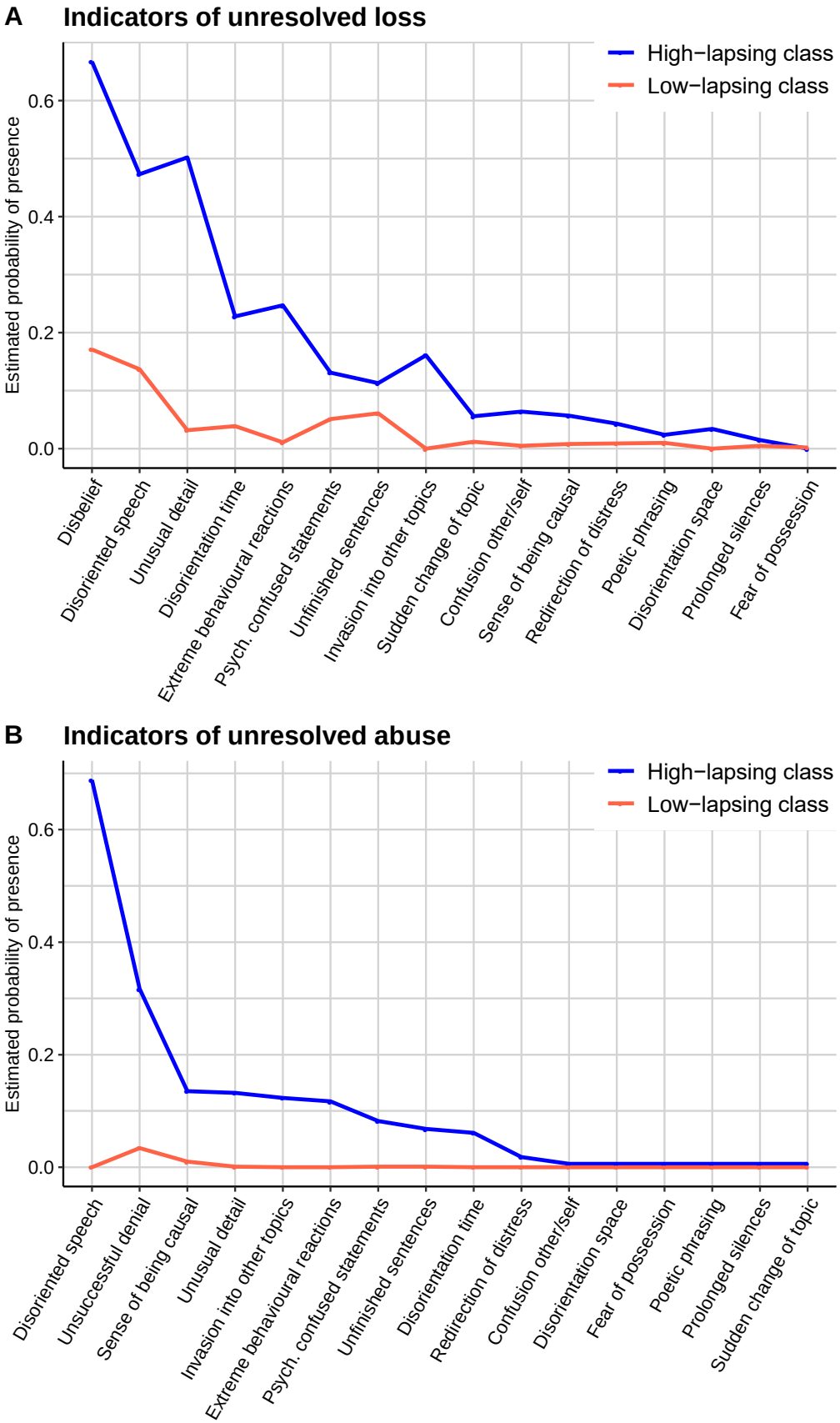

Figure 1. Profile plots from the latent class analysis for indicators of unresolved loss (A) and unresolved abuse (B). The lines represent the latent classes from the best-fitting models. The indicators on the x-axis are arranged in descending order of frequency of occurrence.

Associations between the latent classes and at-risk background. Multinomial logistic regression analysis showed that at-risk background was significantly associated with belonging to the high-lapsing unresolved loss class ($B = 2.17$, $SE = 0.26$, $p < .001$) and the high-lapsing unresolved abuse class ($B = 2.36$, $SE = 0.41$, $p < .001$). Participant-child dyads considered at-risk had a predicted probability of 0.58 of falling into the high-lapsing unresolved loss class, and a predicted probability of 0.25 of falling into the high-lapsing unresolved abuse class. Dyads considered not at-risk had a predicted probability of 0.14 of falling into the high-lapsing unresolved loss class, and a predicted probability of 0.03 of falling into the high-lapsing unresolved abuse class.

Research Question 2: Defining a psychometric model underlying classifications of unresolved states of mind

We aimed to define a psychometric model that may underlie the construct of an unresolved state of mind. Using predictive modelling, we examined the extent to which indicators of unresolved loss/abuse are uniquely associated with scores and classifications of unresolved states of mind.

Developing the predictive models. First, we identified indicators with zero or near-zero variance and removed these from the dataset. Variables were identified as having near-zero variance if the following two conditions were met: the ratio of frequencies of the most common value over the second most common value was above a cut-off of 95/5, and the percentage of unique values out of the total number of data points was below 10% (Kuhn, 2008). Of the 16 indicators of unresolved loss, the following eight had sufficient variance to be included in the models: disbelief that the person is dead, disoriented speech, unusual attention to detail, disorientation with regard to time, extreme behavioural reactions, psychologically confused statements, unfinished sentences, and invasion of the loss into other topics. Only two of the 16 indicators of unresolved abuse could be included: disoriented speech and unsuccessful denial of abuse. In addition to the indicators of unresolved loss/abuse, the following predictors were included: at-risk background (because at-risk background was significantly associated with the high- and low-lapsing unresolved loss/abuse latent classes in Research Question 1), reported loss, reported abuse, and 12 dummy variables of the study samples, to control for the nested data. All variables were dichotomously coded.

The dataset ($N = 1{,}009$) was randomly split into a 70% training dataset and 30% testing dataset. Both datasets contained no missing values. We fitted nine predictive models on the training data: linear regression (ordinary least squares), lasso regression, ridge regression, MARS, logic regression, random forest, and support vector machines with linear, polynomial, and radial kernels. The outcome of the predictive models was participants' unresolved score (range 1-9).[22] After fitting the

[22] The root mean squared errors (RMSE) are reported in Appendix D.

predictive models on the training data, we evaluated their predictive performance on the testing (out-of-sample) data by the following two steps. Based on these findings, we decided on a final model.

Step 1: Evaluating model performance by precision and sensitivity for unresolved classifications. First, we examined whether the predicted unresolved scores from the predictive models could be used to identify participants' *actual* unresolved classifications according to the human coders. The precision for unresolved classifications ranged from 70% (random forest) to 88% (lasso). In other words, 88% of the unresolved classifications predicted by the lasso regression model were actually given unresolved classifications. The sensitivity for unresolved classifications ranged from 38% (ridge regression) to 50% (support vector machine with a polynomial kernel). In other words, half of the participants classified as unresolved by the support vector machine were correctly predicted by the model. The precision and sensitivity levels from all the models and for different threshold unresolved scores are reported in Appendix D.

Step 2: Evaluating model performance by examining the trade-off between sensitivity and specificity for unresolved classifications. We then examined the trade-off between sensitivity and specificity for unresolved classifications by different *threshold predicted unresolved scores*. In other words, we investigated whether the use of different classification thresholds would lead to a better prediction of unresolved states of mind. The following procedure was carried out. For each participant in the sample, the sensitivity and specificity for the unresolved classification was calculated, with a classification threshold equal to the participant's predicted unresolved score. To illustrate: if participant 1 had a predicted unresolved score of 2, score ≥ 2 would be taken as a threshold for classification. In this example, each participant with a predicted unresolved score of ≥ 2 would be given a predicted unresolved classification, and each participant with a predicted unresolved score < 2 would be given a predicted not-unresolved classification. These predicted classifications were then compared with the actual unresolved classifications (according to the human coders) across the entire sample, yielding a number of true positives, true negatives, false positives, and false negatives. This process was repeated for all participants in the sample. The sensitivity and specificity values were then plotted, showing the trade-off between the values. This approach was followed for each of the nine predictive models.

The plots showed that the lasso regression model (Figure 2) had a favourable performance, and was therefore chosen as the final model. Lasso is a penalised regression model. This means that it uses a penalty term that forces the coefficients of predictors with a low contribution to the outcome variable to be exactly zero. Lasso is therefore a useful method for variable selection (Kuhn & Johnson, 2013). At a threshold predicted unresolved score of ≥ 5 (the AAI coding manual's threshold score for assigning the classification), the sensitivity of unresolved scores predicting

unresolved classifications reached .41. Thus, the lasso regression model correctly predicted 41% of participants with an actual unresolved classification, meaning that 59% of unresolved cases were missed. The specificity was 98%, meaning that the model correctly predicted nearly all not-unresolved cases. A more favourable sensitivity and specificity trade-off was observed if the threshold for unresolved classifications was shifted towards unresolved score ≥ 4. At this threshold, around 80% of the actual unresolved cases were correctly predicted, while still achieving a high specificity level (85%).

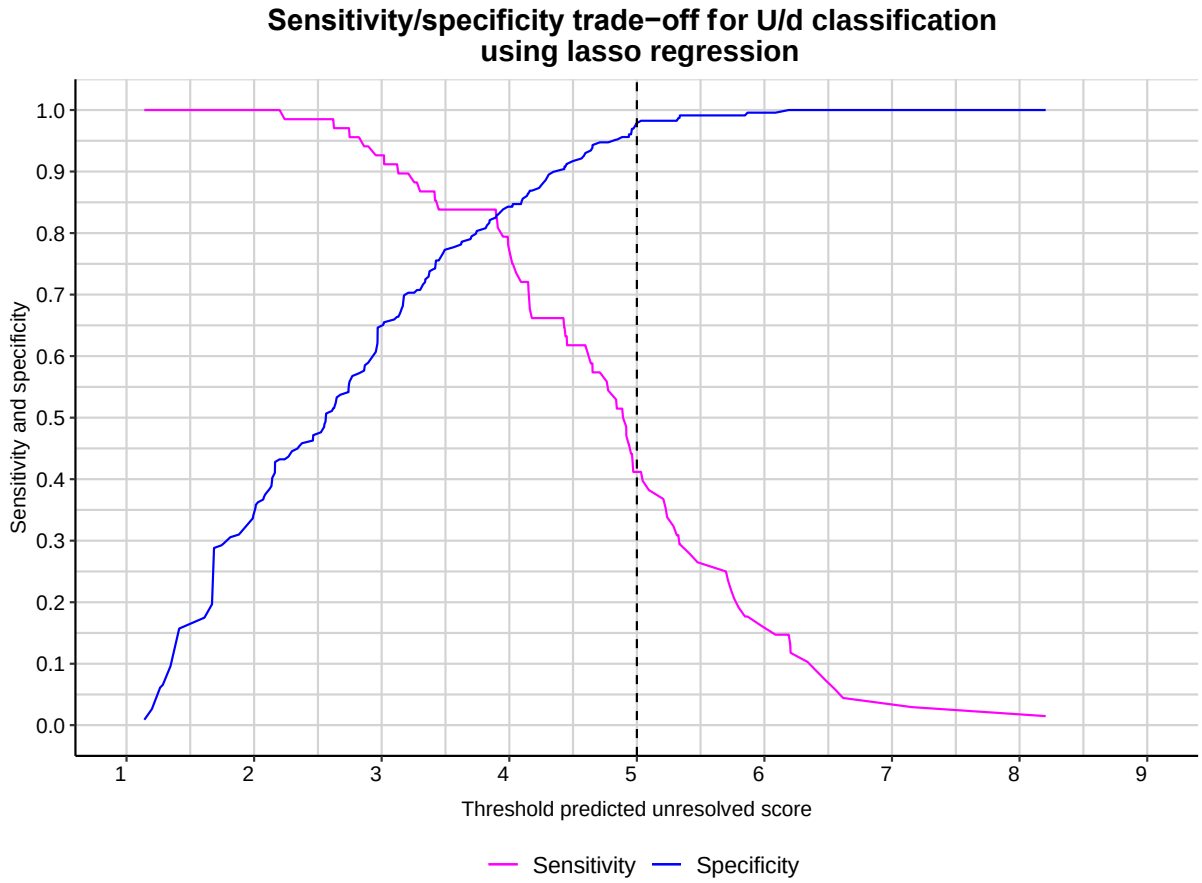

Figure 2. The trade-off between sensitivity and specificity for unresolved (U/d) classification, based on thresholds equal to participants' predicted unresolved score (lasso regression model; tested out-of-sample). The vertical line indicates the AAI coding manual's threshold score for unresolved classification (≥ 5).

Regression coefficients of the final model. The estimated regression coefficients of the lasso regression model are presented in Table 4. As seen in the Table, the lasso regression model forced the coefficient of the at-risk background variable to be zero, meaning that at-risk background did not contribute to predicting unresolved scores. The other predictors were retained in the model, meaning that these contributed to predicting unresolved scores.

Table 4

Coefficients of the Lasso Regression Model Predicting Unresolved Score

Predictors	Coefficients
Unresolved loss: Disbelief	1.28
Unresolved loss: Psychologically confused statements	1.13
Abuse reported in the interview	0.87
Unresolved loss: Extreme behavioural reactions	0.85
Unresolved loss: Disorientation with regard to time	0.72
Unresolved loss: Unusual attention to detail	0.68
Unresolved loss: Unfinished sentences	0.53
Unresolved abuse: Unsuccessful denial	0.47
Loss reported in the interview	0.46
Unresolved loss: Disoriented speech	0.39
Unresolved abuse: Disoriented speech	0.25
Unresolved loss: Invasion of loss into other topics	0.23
At-risk background	0.00
Random variable	0.00

Note. The coefficients are arranged in decreasing order of size. The 12 dummy variables representing the study samples were included in the lasso model, but are not reported in this Table.

Predicting unresolved states of mind using fewer indicators. With the aim to explore the possibility of using fewer indicators to classify interviews as unresolved, we re-tested the lasso regression model using *only* the top seven, five, and three predictors. The top indicators were based on the regression coefficients presented in Table 4. The results from each model were again plotted as to examine which threshold gave the best sensitivity and specificity trade-off for unresolved classification. As shown in Figure 3, we were able to obtain good predictive performance: sensitivity and specificity levels were high (≈ 75%) when the seven, five, and three most important predictors were used.

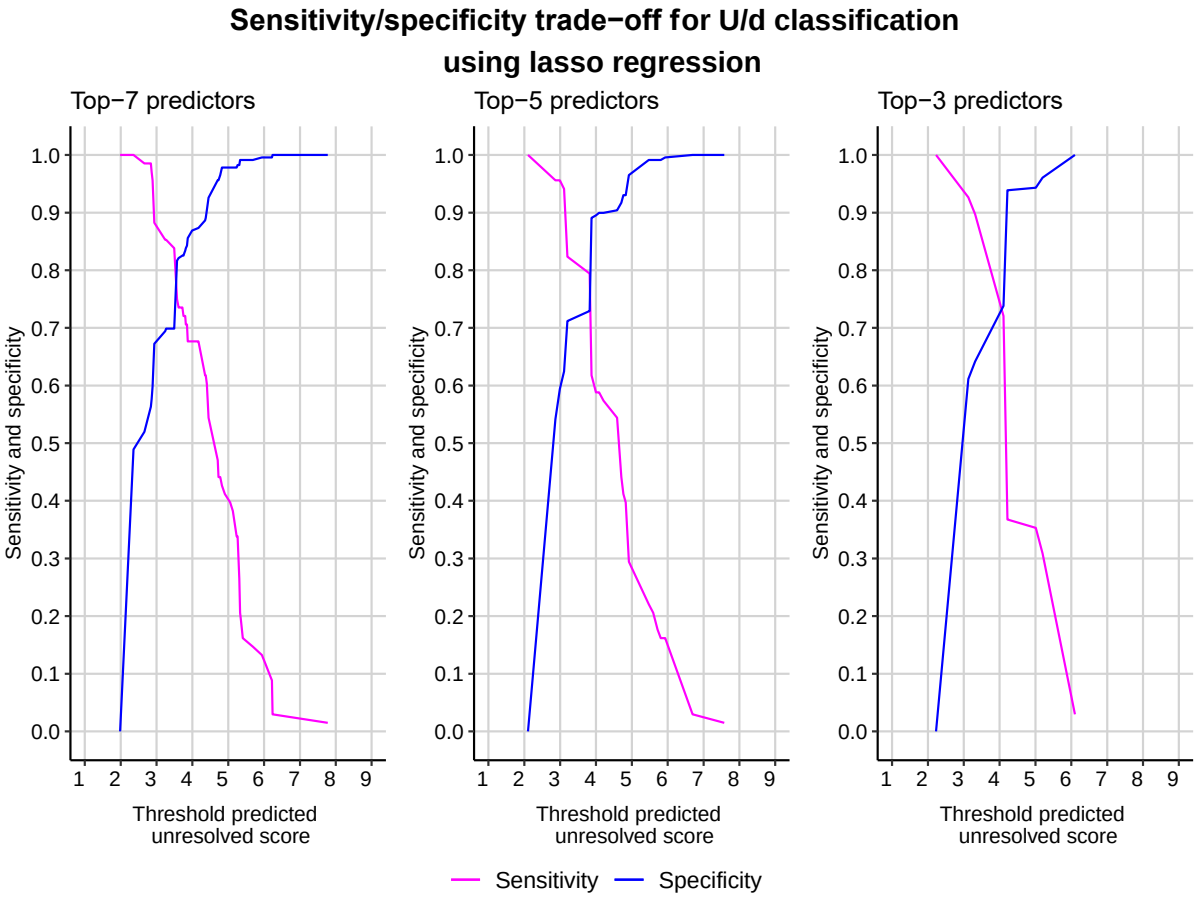

Figure 3. The trade-off between sensitivity and specificity for unresolved (U/d) classification, based on thresholds equal to the predicted unresolved score (lasso regression model; tested out-of-sample). The seven, five, and three most important predictors from the lasso regression model in Table 4 were included.

Summary of findings. The aim of this Research Question was to search for a psychometric model that may underlie the unresolved state of mind construct. We tested nine predictive models with unresolved scores as the outcome, using the indicators of unresolved loss/abuse as predictors. The models' predictive performance was then evaluated out-of-sample, according to the precision, sensitivity, and specificity of unresolved scores predicting unresolved classifications. Based on the trade-off between sensitivity and specificity for unresolved classifications, the lasso regression model was considered as the final model. At a threshold predicted unresolved score of ≥ 4, the lasso regression model correctly predicted 80% of the actual unresolved classifications (sensitivity). Around 85% of not-unresolved cases were correctly predicted by the model (specificity). Then, the lasso regression model was re-tested using only the three, five, and seven most important predictors, all showing good predictive performance for unresolved classifications (sensitivity and specificity levels around 75%). The findings suggest that the following variables take up the lion's share of the prediction: disbelief and psychologically confused statements about loss, and reported abuse.

Research Question 3: Investigating the predictive significance of the psychometric model of unresolved states of mind for infant disorganised attachment

As a follow-up to Research Question 2, we tested the predictive significance of the psychometric model underlying unresolved states of mind for infant disorganised attachment. For these analyses, only the samples with infant disorganised attachment classifications were used (n = 930). The data were randomly split into a 70% training dataset and 30% testing dataset. Both datasets contained no missing values. Similar to Research Question 2, nine predictive models were trained on the training data with unresolved score as the outcome variable, using the same set of predictors (see Results: Research Question 2 for more information about the predictor variables). Two steps were followed to evaluate the models' predictive validity for infant disorganised attachment, using the testing (out-of-sample) data.

Step 1: Using predicted unresolved scores to calculate the precision and sensitivity for infant disorganised attachment. Our aim was to investigate whether the predicted unresolved scores, based on the indicators of unresolved loss/abuse, could be used to predict infant disorganised attachment. As a first step in testing this, we used the predicted unresolved scores to calculate the precision and sensitivity for the *actual* infant disorganised attachment classifications (according to the human coders). Precision and sensitivity give a first indication of the predictive validity of indicators of unresolved loss/abuse for infant disorganised attachment. The precision for infant disorganised attachment classification at threshold score 5 (the AAI coding manual's threshold for unresolved classification) ranged from 0.27 (support vector machine with a radial kernel) to 0.36 (logic regression). In other words, of the disorganised classifications predicted by the logic regression model, 36% were actually given disorganised classifications. The sensitivity for infant disorganisation ranged from 0.15 (support vector machine with a radial kernel) to 0.27 (random forest). In other words, 27% of infants classified as disorganised were correctly predicted by the random forest model. The precision and sensitivity levels from all the models and for different threshold unresolved scores are reported in Appendix D.

Step 2. Using predicted unresolved scores to examine the trade-off between sensitivity and specificity for infant disorganised attachment. Next, we examined the trade-off between sensitivity and specificity for infant disorganised attachment classification by different threshold predicted unresolved scores. This way, using adults' predicted unresolved scores, we aimed to identify as many children as possible who would likely be classified with disorganised attachment, without wrongly identifying those without an actual classification as being a likely candidate. The sensitivity and specificity plots of the predictive models showed similar predictive performance. The lasso regression model (shown in Figure 4) was considered as the final model, because of our preference of choosing a simpler, more convenient model (lasso is a regression model) over a more

complex model when models show comparable performance. In addition, lasso regression has the benefit of using regularisation techniques that force the coefficients of low-contributing variables to zero, yielding more parsimonious models (Kuhn & Johnson, 2013).

At a threshold predicted unresolved score of ≥ 5 (the AAI coding manual's threshold for the unresolved classification), the lasso regression model correctly predicted 20% of actual disorganised attachment classifications, and 85% of non-disorganised attachment cases were correctly predicted. If the threshold for classification was shifted towards a predicted unresolved score of ≥ 3, sensitivity for classification would increase up until 60%, meaning that around 60% of actual disorganised attachment classifications would be correctly predicted by the model. However, less specificity would be achieved (60%).

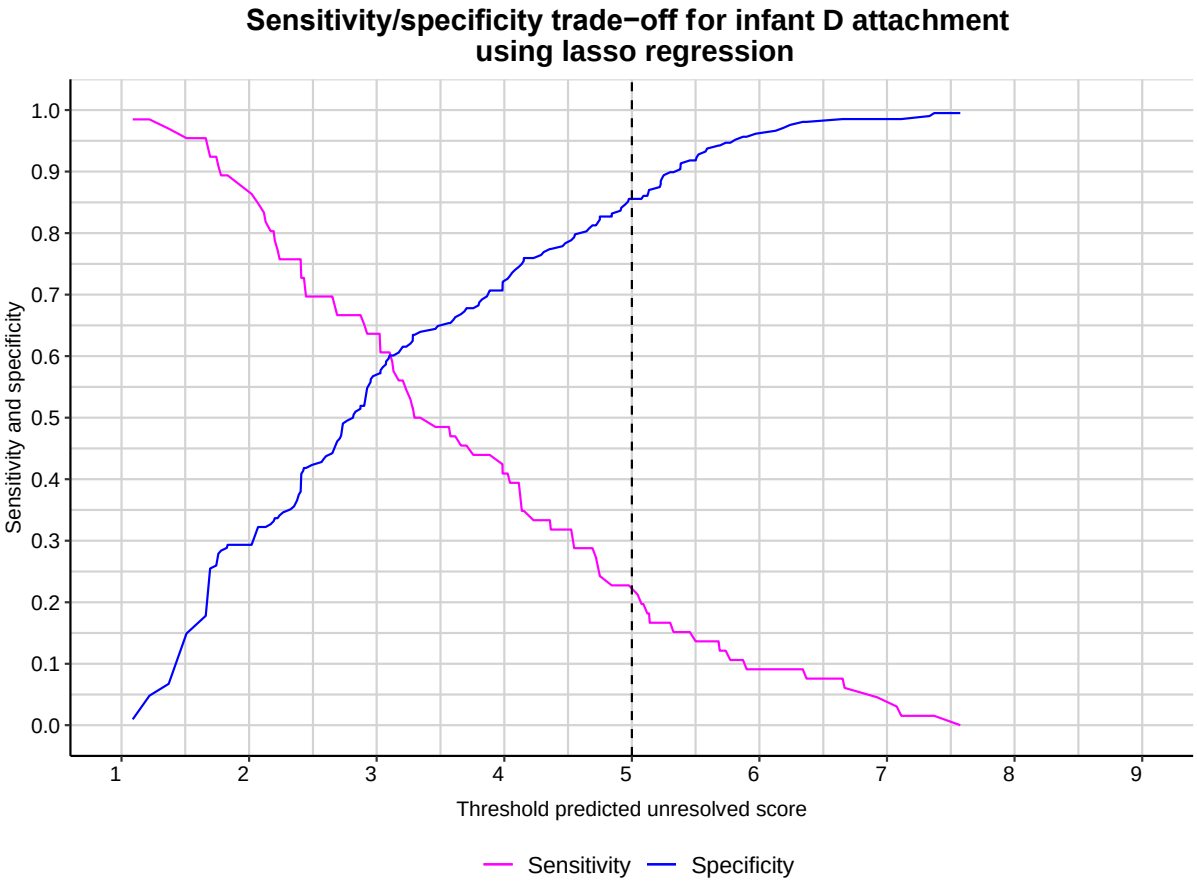

Figure 4. The trade-off between sensitivity and specificity for infant disorganised (D) attachment classification, based on thresholds equal to adults' predicted unresolved score (lasso regression model; tested out-of-sample).The vertical line indicates the AAI coding manual's threshold score for unresolved classification (≥ 5).

Summary of findings. The aim of this Research Question was to test the predictive validity of the psychometric model underlying U/d (resulting from Research Question 2) for infant disorganised attachment classifications. The sensitivity and specificity of adults' predicted unresolved scores for infant disorganised attachment were explored using sensitivity and specificity trade-off

plots. The lasso regression model was considered the final model. At a threshold predicted unresolved score of $\geq \approx 3$, the lasso regression model correctly predicted 60% of actual infant disorganised attachment classifications and 60% of not-disorganised cases. Considering the relatively weak predictive performance, we may conclude that the psychometric model of U/d – based on the indicators of unresolved loss/abuse – is weakly related to infant disorganised attachment.

Research Question 4: The association between unresolved "other trauma" and infant disorganised attachment

The final Research Question addressed the association between ratings of unresolved "other trauma" and infant disorganised attachment. Multilevel modelling was used to account for the nested data.

Preliminary analysis. As a preliminary analysis, we investigated whether unresolved loss and abuse scores were uniquely associated with infant disorganised attachment scores. First, an unconditional means (intercept-only) model was estimated with the 9-point infant disorganised attachment scores as the dependent variable. When unresolved loss scores were included as an independent variable, the model fit did not significantly improve ($\chi^2(1) = 3.38$, $p = 0.066$). This means that the regression model with unresolved loss scores was not a better fit to the data than the model without unresolved loss scores. Unresolved loss was also not significantly associated with infant disorganised attachment ($B = 0.07$, $SE = 0.04$, $p = 0.066$). Unresolved abuse scores were then added to the model as an additional independent variable, which did not significantly improve the model fit ($\chi^2(1) = 0.83$, $p = 0.363$). There was no unique significant association between unresolved abuse and infant disorganisation scores ($B = 0.05$, $SE = 0.05$, $p = 0.360$), controlling for unresolved loss. The association between unresolved abuse and infant disorganised attachment remained non-significant in this model ($B = 0.06$, $SE = 0.04$, $p = 0.106$). Because unresolved loss and unresolved abuse were not uniquely associated with infant disorganised attachment, we used the overall unresolved scores (i.e., the highest score from the unresolved loss and abuse scales) for subsequent analyses.

Main analysis. Then, we tested the association between unresolved other trauma scores and infant disorganised attachment scores, over and above unresolved scores. Adding unresolved other trauma to the unconditional means model with infant disorganised attachment scores as the outcome did not significantly improve the model fit ($\chi^2(1) = 1.50$, $p = 0.221$). Thus, the regression model with unresolved other trauma as an independent variable was not a better fit to the data than the model without unresolved other trauma. Unresolved other trauma was also not significantly associated with infant disorganised attachment scores ($B = 0.10$, $SE = 0.08$, $p = 0.222$). When unresolved scores (i.e., the highest score of the unresolved loss/abuse scales) were added to the model as an independent

variable, the model fit significantly improved ($\chi^2(1) = 4.30$, $p = 0.038$). This means that the model with unresolved scores and unresolved other trauma as independent variables was a better fit to the data than the model with only unresolved other trauma. Higher unresolved scores were significantly associated with higher infant disorganisation scores ($B = 0.08$, $SE = 0.04$, $p = 0.038$), over and above unresolved other trauma. The association between unresolved other trauma and infant disorganised attachment scores remained non-significant ($B = 0.06$, $SE = 0.08$, $p = 0.427$).

As a follow-up, multilevel logistic regression analysis was used to test the association between unresolved other trauma scores and infant disorganised attachment *classifications* (instead of scores). An unconditional means model was estimated with infant disorganised attachment classification as the outcome variable. The model fit did not significantly improve when unresolved other trauma scores were included as an independent variable ($\chi^2(1) = 0.23$, $p = 0.634$), and unresolved other trauma was not significantly associated with infant disorganised attachment ($B = 0.04$, $SE = 0.09$, $p = 0.631$). In contrast, the model fit significantly improved when unresolved scores were added ($\chi^2(1) = 5.63$, $p = 0.018$). Unresolved scores were significantly associated with infant disorganised attachment classifications ($B = 0.10$, $SE = 0.04$, $p = 0.017$) and unresolved other trauma remained a non-significant predictor of infant disorganised attachment.

Taken together, these findings suggest that there is no significant association between unresolved other trauma and infant disorganised attachment, over and above unresolved loss/abuse.

Discussion

In the late 1980s, Main and colleagues used a semi-inductive methodology to develop a detailed coding system for assessing adults' unresolved states of mind regarding attachment, based on a variety of linguistic indicators identified in the interviews with 44 sets of parents in the Berkeley Social Development Study (Main et al., 1985; Duschinsky, 2020). The AAI coding manual provides coders with a large set of indicators for classifying interviews as unresolved. However, it is not yet known which indicators are valid and which may account for most of the discriminating validity of unresolved classifications. Researchers have not yet had the methodology or large samples to evaluate the relative contributions of individual indicators of unresolved loss/abuse. In this paper, we took a novel approach to examine key criteria used to assign the unresolved states of mind classification, using a large sample of AAI and parent-child attachment data gathered by the Collaboration on Attachment Transmission Synthesis (CATS).

Indicators of unresolved loss and abuse: Separating the wheat from the chaff

Unresolved states of mind are coded based on marked lapses in reasoning, discourse, or behaviour surrounding loss or abuse. Coders are instructed to rate the presence of these indicators and their relative strength on two 9-point scales: unresolved loss and unresolved abuse. Our first aim

was to investigate which patterns of indicators may differentiate interviewees with and without unresolved loss/abuse. The findings from the latent class analysis suggested a group of participants with a high likelihood of displaying indicators from a subset of commonly occurring indicators (disbelief, disoriented speech, unusual attention to detail, disorientation with regard to time, extreme behavioural reactions, psychologically confused statements, unfinished sentences, and invasion of loss into other topics about loss; and disoriented speech and unsuccessful denial about abuse) and a group of participants with a near-zero likelihood of showing any indicators.

Eight of 16 indicators of unresolved loss and 14 of 16 indicators of unresolved abuse showed low occurrence (i.e., present in between 0.1% and 3% of interviews). Of these rare indicators, seven were identified not more than once across the full set of 1,009 interviews. For unresolved loss, this was fear of possession, and for unresolved abuse, these were confusion between the abusive person and the self, disorientation with regard to space, fear of possession, poetic phrasing, prolonged silences, and sudden changes of topic/moving away from the topic of abuse. The low occurrence of these indicators suggest that these are not part of the unresolved state of mind classifications that are actually observed in practice. The AAI coding manual states that both the unresolved loss and abuse scales may be used to assess all potentially traumatic events (Main et al., 2003, p. 131) and that the scales will be combined in future editions of the manual (p. 142). Apart from fear of possession by the abusive figure, the five indicators of unresolved abuse that did not occur more than once in our study are originally listed under the unresolved loss scale. Therefore, we found no empirical basis for using these indicators of unresolved loss for coding unresolved abuse. Similarly, we found no empirical basis for using fear of possession – originally listed under the unresolved abuse scale – for coding unresolved loss.

Searching for a psychometric model of unresolved states of mind

Next, we aimed to define a psychometric model that may underlie the construct of an unresolved state of mind (Research Question 2). Predictive modelling was used to explore associations between the indicators of unresolved loss/abuse and participants' overall unresolved scores and classifications. Except at-risk background, all included variables[23] contributed to the prediction of unresolved scores in the final model (lasso regression). These findings suggest a psychometric model of unresolved states of mind consisting of a linear combination of the following indicators of unresolved loss and abuse, in decreasing order of coefficient size: disbelief and psychologically confused statements about loss; reported abuse; extreme behavioural reactions, disorientation with regard to time, unusual attention to detail, and unfinished sentences about loss;

[23] Predictors of interest were: indicators of unresolved loss/abuse, at-risk background, reported loss, reported abuse (all dichotomously coded). Study sample was included as a covariate to account for the nested data (12 dummy variables).

unsuccessful denial of abuse; reported loss; disoriented speech about loss; disoriented speech about abuse; and invasion of loss into other topics.

In the final predictive model, the indicators of unresolved loss and abuse correctly predicted nearly all not-unresolved classifications by the human coders but only less than half of the actual unresolved cases when predicted unresolved scores ≥ 5 were used as the threshold for classification. When predicted unresolved scores ≥ 4 were used as the threshold for classification, the model correctly predicted the majority of actual not-resolved and unresolved cases (around 80%). This finding contradicts the coding manual's instruction that interviews with a score below 5 should not receive the unresolved classification. A prior study from CATS (Raby et al., 2020) suggested that individual differences in unresolved states of mind may be dimensionally rather than categorically distributed. Along with these findings, our results might suggest that the traditional assumption of using scores of 5 as a cut-off for classification is reconsidered.

These findings might partially be due to unreliability of the coding of indicators of unresolved loss and abuse. Measurement error in predictor variables may affect the predictive performance of statistical learning models (Jacobucci & Grimm, 2020). But the findings might also suggest that the mere presence or absence of indicators provide insufficient information for constructing a model for the way in which unresolved loss and abuse are coded. We could not include the relative strength of individual indicators in the predictive models, because these ratings were not consistently reported in the coders' notes. Notably, these ratings can come with coder subjectivity, which may be challenging to capture in psychometric models. The coding manual provides examples of indicators of unresolved loss and abuse and their relative strength to help coders with identifying these in interviews. Coders have to "generalize in looking for a fit to their own transcripts" (Main et al., 2003, p. 132) as lapses can present in a variety of ways. The interpretation and scoring of lapses also depends on the context of the narrative. Such variation may be difficult to operationalise, not least because this would require a more detailed differentiation of indicators than currently described in the coding manual (e.g., different categories of disbelief lapses). This might be undesirable for coders given that the coding system is already detailed and requires extensive training.

An alternative explanation for the findings that threshold unresolved scores of ≥ 4 lead to better prediction of unresolved classifications than scores of ≥ 5 may be that coders draw on information not captured by the unresolved loss/abuse coding scales to assign scores and classifications of unresolved states of mind. For example, coders may – intentionally or unintentionally – use indices related to other AAI state of mind categories to determine placement into the unresolved category, such as those from the preoccupied state of mind classification. Interviewees classified as having a preoccupied state of mind may show angry preoccupation and/or

vague or passive discourse when discussing memories of experiences with caregivers. Factor analytic studies of the latent structure of the AAI have suggested that preoccupied and unresolved state of mind scale scores may load on a common factor (e.g., Haltigan et al., 2014; Raby et al., 2017; Roisman et al., 2007), including a recent study from CATS (Raby et al., 2020). As speculated by Raby et al. (2017), this may indicate that some linguistic characteristics of preoccupied and unresolved states of mind reflect similar psychological phenomena. Indices from other coding scales were not included in the statistical analyses of the current study. This is a natural direction for future investigations.

In the final predictive model, the indicators of disbelief and psychologically confused statements about loss had the largest contribution in the prediction of unresolved scores. Both of these indicators are lapses in the monitoring of reasoning – the first one indicating disbelief that the deceased person is dead, and the second one indicating attempts to psychologically "erase" past or ongoing experiences (as described by Main et al., 2003, p. 136). The third most important predictor of unresolved scores was reported abuse, meaning that unresolved scores were predicted by reported abuse independent of the presence of indicators of unresolved abuse. When the final predictive model was retested with only these three predictor variables, the model predicted around 75% of not-unresolved and unresolved classifications by the human coders. This finding underscores that disbelief and psychologically confused statements about loss and reported abuse may be especially important for the construct of an unresolved state of mind.

The predictive value of reported abuse irrespective of lapses in the monitoring of reasoning or discourse about abuse raises the possibility that discussion of abuse may lead to speech acts not currently part of the coding system that are marked as "unresolved." Alternatively, the presence of abuse in an interview may contribute to other aspects of coder judgement in assigning unresolved scores that are not based on the indicators of unresolved loss/abuse. This finding also raises the concern that has repeatedly been discussed in the literature about potential variation in the degree to which interviewers probe for abuse experiences (e.g., Bailey et al., 2007; Madigan et al., 2012). When asked for experiences of abuse in the interview, speakers may refuse to talk about these experiences or display so much distress so that the interviewer does not probe further, resulting in fewer opportunities to record indicators of unresolved abuse, while subsequent probing of loss experiences may still elicit indicators of unresolved loss. Another possible explanation for the findings may be that the presence of abuse in combination with loss leads to linguistic disorganisation in thinking and reasoning about loss, resulting in elevated unresolved scores for loss, but without the presence of indicators of unresolved abuse, due to limited probing.

Predicting infant disorganised attachment using the indicators of unresolved loss and abuse

To explore the predictive significance of the psychometric model of unresolved states of mind, we examined its relation to infant disorganised attachment (Research Question 3), the variable through which the system for coding unresolved states of mind was originally semi-inductively created (Duschinsky, 2020). Similar to Research Question 2, we first used the indicators of unresolved loss and abuse to predict unresolved scores assigned by the human coders. The predicted unresolved scores were then used to calculate the specificity and sensitivity for infant disorganised attachment classifications. Using predicted unresolved scores of 3 or higher as a threshold for infant disorganised attachment classifications, we were able to correctly identify 60% of infants with a disorganised attachment classification and 60% of infants without a classification.

It is important to note that the unresolved states of mind category, and the AAI more broadly, is developed for group-level research and is not a diagnostic system for assessing infant disorganised attachment on the individual level (see Forslund et al., 2021, for a discussion). Therefore, the outcomes of this analysis should not be interpreted as such. Instead, the current exercise should be viewed as an exploratory approach to examine associations between individual indicators of unresolved loss/abuse and infant disorganised attachment in the context of psychometric validity of the unresolved state of mind construct. In addition, the limitations of our approach should be considered, such as the reliability of the input data and the insufficient information about relative strengths of the indicators of unresolved loss/abuse. Nevertheless, the current findings provide no evidence that some indicators of unresolved loss/abuse are potentially more predictive of infant disorganised attachment than other indicators. Our findings indicate that unresolved states of mind are predictive of infant disorganised attachment but that this association is not accounted for by the presence or absence of individual indicators. The behavioural indicators of infant disorganised attachment are rather heterogeneous, with potentially different functions and underlying processes (Solomon et al., 2017). Hesse and Main (2006) have predicted that specific manifestations of caregivers' unresolved loss and abuse will be linked to different parenting behaviours, leading to varying forms of disorganised attachment behaviour in the Strange Situation. Future research might follow up Hesse and Main's proposal to explore associations between individual indicators of unresolved states of mind, parenting behaviour, and indices of infant disorganised attachment.

Significance of unresolved "other trauma" for infant disorganised attachment

Research Question 4 addressed the association between unresolved "other trauma" and infant disorganised attachment. We found no significant association between ratings on the unresolved other trauma scale and infant disorganised attachment, controlling for ratings of unresolved

loss/abuse. There was also no significant bivariate association between unresolved other trauma and infant disorganised attachment in this sample. These findings appear to contradict previous arguments, especially from clinician-researchers, that the construct of an unresolved state of mind should be expanded to include other experiences than loss and abuse by attachment figures, and that doing so would improve prediction to infant attachment disorganisation (George & Solomon, 1996; Levinson & Fonagy, 2004; Lyons-Ruth et al., 2005). To some extent, this finding may be an artefact of the protocol for delivering the AAI, rather than solely reflecting the weaker relationship between "other trauma" and unresolved states of mind. The unresolved other trauma score is a reflection of a variety of potentially traumatic events that the participant may bring up in response to questions asking them whether they have had experiences that they would regard as potentially traumatic, other than any difficult experiences already described. Such a broad prompt will lead to a variety of answers, including but not limited to experiences that fall within the domain of trauma, weakening the signal of potential causal relationships. Furthermore, there appears to be marked variation in the extent to which other potentially traumatic experiences are probed by interviewers. The interview guide explicitly states that "many researchers may elect to treat this question [about potential traumatic events] lightly, since the interview is coming to a close and it is not desirable to leave the participant reviewing too many difficult experiences just prior to leave-taking" (George et al., 1996, p. 56). Some of the "other traumatic" events reported in the interview may profoundly affect the parent-child attachment relationship, while others may have no implications whatsoever. In addition, it is possible that some unresolved other trauma may be associated with other relevant outcomes, such as frightening or anomalous parenting. More descriptive work is needed on the experiences marked as unresolved other trauma, and the extent to which these experiences may be associated with parent-child attachment and parenting behaviour.

Conceptualisation of unresolved states of mind

The findings from Research Question 2 (*Defining a psychometric model that may underlie the construct of an unresolved state of mind*) raise important questions regarding the conceptualisation of unresolved states of mind. A first question is whether current theory about unresolved states of mind is sufficient for understanding the meaning of these indicators. As described by Duschinsky (2020), the concept of a "state of mind with respect to attachment" has remained underspecified in the literature, prompting discussion among attachment researchers about what it is that the AAI measures. A similar question may be asked about the concept of an unresolved state of mind. The theoretical definition of an unresolved state of mind has remained unclear, both due to the fact that Main and colleagues have given different explanations about the psychological mechanisms behind the indicators (such as fear and dissociation, e.g., Main & Hesse, 1990; Main & Morgan, 1996), and

the relative lack of empirical scrutiny of these proposed mechanisms. So far, the concept of an unresolved state of mind can therefore only be defined by the presence of the indicators described in the coding manual, because these are the only directly observable expressions of an unresolved state of mind. As of yet, there are no other, external indicators that can be used to define an unresolved state of mind, or sufficient theory to predict what such indicators might be. Our findings go some way towards specifying the core indices for the construct of an unresolved state of mind at least as operationalised in current coding systems, which in turn might be the basis for renewed and refined theoretical work. Specifically, our findings may suggest that disbelief and psychologically confused statements about loss are core features of the unresolved state of mind construct, and that the indicators that were extremely rare in our sample are not relevant for the construct and may have been coincidental findings in Main and colleagues' development sample.

Another question raised by our findings is the nature of the relation between the indicators and the construct of an unresolved state of mind. An important consideration here is whether the measurement model underlying U/d should be regarded as reflective or formative. Following the framework suggested by Coltman et al. (2008), a *reflective* model would consider the construct of an unresolved state of mind to exist independent of the indicators, with the process defined by the construct causing the indicators to manifest themselves (i.e., an unresolved state of mind causes a person to show lapses in the monitoring of reasoning or discourse). A *formative* model would consider that the construct of an unresolved state of mind is formed by the lapses, with the presence of the lapses bringing the construct into being. It could also be that neither of these measurement models are appropriate, as reflective and formative models may not be categorically distinctive (VanderWeele, 2020). Current theory about unresolved states of mind does not provide clues about whether a reflective or formative measurement model may underlie the unresolved state of mind construct. Some argue that it might be important to start with clear, precise definitions of a construct before proposing indicators that measure the construct and conducting empirical analyses to test these associations (VanderWeele, 2020). However, the construct of U/d was developed semi-inductively by Main and colleagues: features of interviews of parents of children classified as disorganised in the Strange Situation were identified inductively and then were elaborated deductively (Duschinsky, 2020). The resulting group of indicators was then interpreted as a group named "unresolved state of mind." This initial work was then enriched with valuable theoretical reflections, both by Main and colleagues (e.g., U/d may indicate dissociative states; Main & Morgan, 1996) and other developmental researchers (e.g., U/d has similarities to posttraumatic stress disorder; Fearon & Mansell, 2001). However, the conceptualisation process based on mechanistic empirical work has stagnated for some decades, leaving the theory about unresolved states of mind still highly

underspecified regarding: i) how attachment-related memories about loss and trauma are processed, and ii) how these psychological processes affect parenting behaviour. Future work in this area may be advised to focus on improving the theoretical definition of an unresolved state of mind, by collecting observational and experimental data to test proposed mechanisms of unresolved states of mind and clarifying underspecified aspects of the theory. In addition, further research is needed to assess whether a more parsimonious model of an unresolved state of mind (i.e., consisting of fewer indicators) is predictive of relevant outcomes beyond infant disorganised attachment, such as parenting behaviour.[24]

Strengths and limitations

A unique strength of the current study is the large sample of individual participant data with international diversity. However, dyads who were considered at-risk were overrepresented in this study (62% of the total sample). As shown by previous studies using the AAI (Bakermans-Kranenburg & Van IJzendoorn, 2009), unresolved classifications are overrepresented in high-risk samples (e.g., participants with lower socioeconomic backgrounds) and in clinical samples. In addition, intergenerational transmission of attachment is weaker in at-risk samples (Verhage et al., 2018). In the current analyses, we did not differentiate between normative and at-risk dyads. However, we controlled for at-risk background by adding it as a covariate in the analyses. At-risk background was significantly associated with the high-lapsing unresolved loss and abuse classes resulting from the latent class analysis (as expected, following the findings by Bakermans-Kranenburg and Van IJzendoorn, 2009), but was not found to contribute to predicting unresolved scores in the predictive models. Therefore, we cautiously suggest that our preliminary psychometric model of unresolved state of mind scores and classifications can be generalised to both normative and at-risk samples. In addition, the out-of-sample prediction of unresolved scores (i.e., testing of predictive models on previously unseen data) demonstrates the robustness of the findings.

This study has a few limitations. A first and salient limitation of this study, and the AAI literature more broadly (but see Booth-LaForce & Roisman, 2014), is the lack of interrater reliability of the indicators marked for unresolved loss and abuse. Because previous studies using the AAI have primarily focused on the attachment state of mind categories, interrater reliability is usually calculated and reported on the level of classifications, but not for the scale scores and individual indicators. The official training to code the AAI does not focus on the level of indicators. Therefore, interrater reliability of individual indicators may have varied across the included study samples, violating measurement invariance. As described by Jacobucci and Grimm (2020), measurement error in

[24] This study did not test whether the smaller set of indicators of unresolved loss/abuse predict infant disorganised attachment, because the predictive performance of the full set of indicators for disorganised attachment was already relatively low; using a smaller set of indicators would not have led to better predictions.

independent variables in predictive models can result in biased coefficient estimates and poor model performance. A possibility to overcome this limitation in our study could have been to recode the indicators of unresolved loss/abuse and calculate the interrater reliability figures ourselves, using the uncoded interview transcripts. However, we only had access to the interview transcripts of one study sample. Instead, we attempted to reduce the influence of measurement error on the results by operationalising the indicators of unresolved loss and abuse as present or not present in the interview – in other words, we used the largest common denominator.

Another limitation and potential source of measurement error may be the reliability of interviewers. As indicated in the AAI protocol (George et al., 1996), training of interviewers is crucial for conducting valid interviews. However, whether interviewers perform similarly and according to the protocol has – to the best of our knowledge – not yet been tested empirically. For example, failure to adhere to the set probes for experiences of loss could result in less opportunity to mark indices of unresolved loss. Assessment of interviewer reliability would be another essential step toward reliable data.

A third potential limitation may be the overlap between reported loss and abuse in the interviews – nearly all participants in this study who reported experiences of abuse also reported loss. Differentiating the analyses for unique loss versus abuse would have resulted in insufficient statistical power for unique abuse, because only 9% of the participants reported abuse without loss. Therefore, it was not possible to explore different psychometric models for unresolved loss and unresolved abuse. However, this limitation does not suggest a plausible alternative explanation for our results.

Conclusions and implications for further research

The construct of an unresolved state of mind has been proposed to account for a set of directly observable expressions. This has invited theory (e.g., Main & Hesse, 1990; Main & Morgan, 1996) and empirical research (e.g., Bakkum et al., 2020; Bahm et al., 2017) to articulate and to probe their (1) adaptive function, (2) phylogenetic history, (3) physiological mechanisms, and (4) ontogenetic or developmental history (Tinbergen's four questions; Tinbergen, 1963). The current findings provide some clues to assist in this endeavour, such that disbelief and psychologically confused statements about loss may be important features of the construct of an unresolved state of mind, and a group of indicators that were extremely rare in our sample are potentially irrelevant. Taken together, our findings raise the possibility that the construct of an unresolved state of mind might be further articulated and optimised. We hope our findings will prompt renewed theoretical discussion and empirical work of more specific hypotheses about how loss and trauma relevant to attachment are processed. Findings may also suggest directions for future methodological innovation to improve scalability, aiding previous efforts to create more concise versions of the AAI (Caron et al., 2018).

However, further tests are needed to confirm whether the presence of indicators that contributed to predicting unresolved states of mind in our study and their relative strength do indeed lead to higher unresolved ratings and classifications, and whether they predict expected correlates such as parenting behaviour and infant disorganised attachment. Exploring links between the indicators of unresolved loss and abuse and measures of anomalous parenting behaviour (e.g., Bronfman et al., 2004; Schuengel et al., 1999; Madigan et al., 2006) may be helpful for further definition of the construct of an unresolved state of mind.

As recently pointed out by Van IJzendoorn and Bakermans-Kranenburg (2021), the pioneering studies on attachment theory, including those by Main and colleagues, "were not equipped to validate the measures or test substantive hypotheses at the same time [as developing the measures]". Now that the equipment (i.e., advanced statistical techniques) and data are available, our study attempted to strengthen elements of the hypothesis derivation chain stemming from Main and colleagues' important and influential discoveries. Taken together, our findings suggest that the current coding system of unresolved states of mind, as developed by Main and colleagues using the Berkeley sample, might not generalise well to other samples. We hope that our findings will spur further work to scrutinise and articulate the category of unresolved states of mind and will contribute to efforts to make Main and colleagues' unresolved and disorganised attachment measures more scalable and psychometrically valid.

4

Psychophysiological Responses Underlying Unresolved Loss and Trauma

Abstract

Unresolved loss/trauma in the context of the Adult Attachment Interview (AAI) has been theorised to result from dissociative processing of fear-related memories and ideas. To examine the plausibility of this model, this study tested hypothesised associations between unresolved loss/trauma and indicators of autonomic nervous system (ANS) reactivity. First-time pregnant women (N = 235) participated in the AAI while heart rate (interbeat interval; IBI) and indicators of parasympathetic reactivity (respiratory sinus arrhythmia; RSA) and sympathetic reactivity (pre-ejection period; PEP, skin conductance level; SCL) were recorded. Using multilevel modelling, ANS reactivity was examined in relation to topic (loss/trauma versus other questions); discussion of actual loss/trauma; classification of unresolved/disorganised; and unresolved responses during the interview. Responses to loss/trauma questions and discussion of loss were associated with respectively larger and smaller IBIs. There was no moderation by unresolved/disorganised status. Unresolved responses about loss were associated with smaller IBIs. Participants classified as unresolved/disorganised showed decreasing PEP and blunted SCL throughout the whole interview. The findings suggest that unresolved speech about loss co-occurs with physiological arousal, although the inconclusive findings regarding parasympathetic and sympathetic nervous system responses fail to clearly support the role of fear.

This chapter is based on:

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Introduction

Since its introduction by Bowlby (1969), attachment theory has given insight into how early social experiences, including loss and trauma, may affect human behaviour and mental processes. According to Bowlby (1973), children form expectations of the world, themselves, and their attachment figures. Attachment figures are preferred persons, such as parents, to whom children turn when anxious or alarmed. Children's expectations of their attachment figures, developing throughout childhood and adolescence, help them to be effective in eliciting support and protection when needed. Loss and other events that disrupt the accessibility of attachment figures as sources of comfort may therefore be cause for alarm. After the loss of an attachment figure, attached persons usually go through a process of mourning. Bowlby (1980) proposed several components of mourning. Following the first shock of loss, persons may initially continue to search for and yearn for contact with the deceased. Usually, the complex set of emotions gives way to reorganisation of their expectations of the world – one in which they can no longer turn to their loved one in times of distress. For some persons, such reorganisation continues to be a challenge, and as a result these persons may enter a chronic state of unresolved mourning. Bowlby's (1980) framework can also be applied to understand other unresolved trauma involving attachment figures, such as physical or sexual abuse. For instance, persons who experienced parental abuse in childhood may continue struggling with the idea of a world wherein their parent has not always been protective. Additionally, reorganisation of abuse experiences may be elicited when they later recognise that other parents can be sensitive and protective. In such cases, unresolved trauma may entail efforts to distance oneself from the abuse or its potential psychological effects.

Drawing on Bowlby's (1980) ideas, Main and colleagues developed a linguistic framework for assessing adults' disorganised state of mind about loss or trauma, as expressed through their narrative about childhood memories (Main & Hesse, 1990). The Adult Attachment Interview (AAI; George et al., 1984, 1985, 1996) was introduced as an interview about early family relationships and includes opportunities for participants to discuss experiences of loss, abuse, and other potential trauma. Interviewees are asked to bring to mind and discuss attachment-related experiences, all the while maintaining a coherent narrative for the interviewer to follow (Hesse, 1996). Main and her colleagues concluded that an "unresolved (disorganised/disoriented)" (U/d) state of mind regarding loss or trauma is expressed through lapses in the monitoring of reasoning or discourse (unresolved discourse) in the interviewee's narrative about these experiences (Main et al., 1991/1994; Main et al., 2003). These lapses may indicate disrupted or irrational ideas about loss or abuse (e.g., by expressing beliefs that a loved one who died long ago is still alive) or losing track of the interview context (e.g., by changing to a eulogistic style of speech). Unresolved states of mind are overrepresented in clinical

populations (Bakermans-Kranenburg & Van IJzendoorn, 2009) and have been associated with frightening, frightened, and dissociated parenting behaviours (Madigan et al., 2006).

Questions remain about the generative mechanisms underlying these phenomena. Main and Hesse (1992) theorised that unresolved loss/trauma reflects memories containing perceptions that were partially processed or dissociated due to their overwhelmingly distressing or frightening nature. When the AAI directs attention to these memories, the speaker may experience frightening intrusions of the loss or trauma, flooded working memory, and reduced ability to produce coherent reasoning or speech. Additionally, Hesse (2016) suggested that individual differences in coherent discourse in the AAI may reflect "differences in what are presumed to be deeply internalized strategies for regulating emotion and attention" (p. 557). Based on these explanations, emotional dysregulation is likely to go along with unresolved discourse about loss or trauma. However, this hypothesis requires further specification and empirical testing.

Indicators of emotional arousal, such as activity of the autonomic nervous system (ANS; Kreibig, 2010), may provide insight into the regulatory mechanisms involved in unresolved states of mind. Previous studies suggest that adults' recall of childhood loss or trauma is associated with dysregulated ANS reactivity (Bernstein et al., 2013; Dale et al., 2018; Koopman et al., 2004; Luecken, 2008). Thus far, only one study investigated the relation between unresolved states of mind and ANS reactivity during the AAI, using a sample of adolescents (Beijersbergen et al., 2008). These authors connected ANS reactivity to the questions in the AAI and found a significant relation between responses to the loss question and higher interbeat interval reactivity, compared to the baseline, during which the participants completed a questionnaire. However, this relation was not moderated by being classified as unresolved/disorganised. The current study aimed to contribute to understanding of unresolved states of mind by examining relations between unresolved loss/trauma in the AAI and indicators of ANS reactivity.

Autonomic nervous system reactivity, emotional arousal, and social behaviour

Emotional arousal can be measured by activity of the ANS (Balzarotti et al., 2017; Kreibig, 2010; Levenson et al., 2016). The two branches of the ANS, the parasympathetic and the sympathetic nervous system, regulate vital functions of the body including the cardiovascular system, and contribute to controlling bodily arousal (Berntson et al., 1994; Cacioppo et al., 1994). According to polyvagal theory (Porges, 2003, 2007), the ANS responds to environmental threats through a process called neuroception and supports cognitive and behavioural responses for coping. Porges (2003) proposed that perceptions of safety and threat affect the extent to which individuals can engage in social behaviour. The parasympathetic nervous system is responsible for maintaining homeostasis when there is no environmental risk. During states of relaxation, the influence of the

parasympathetic tone on the heart is high, which slows down the heart rate, supports restoration of the body's organs, and facilitates social engagement. When neuroception evaluates the environment as threatening, the parasympathetic nervous system withdraws, allowing for an increase of sympathetic nervous system activity, which speeds up the heart rate and helps prepare the body for a fight-or-flight response. This internal state is expected to hinder the fluent expression of social engagement behaviours (Porges, 2003). Thus, to understand the mechanisms involved in unresolved states of mind, it may be informative to study indicators of parasympathetic and sympathetic reactivity and their linkages with discourse about loss or trauma.

In psychophysiological research, heart rate is the most commonly used indicator of physiological reactivity in relation to emotion (Levenson et al., 2016). Heart rate is regulated by both the parasympathetic and sympathetic nervous system (Berntson et al., 1994). Therefore, it provides limited insight into the specific involvement of these systems. In research on mental health and ANS functioning, parasympathetic nervous system response is often indicated by the high-frequency component of heart rate variability (HF-HRV). Another widely-used indicator of parasympathetic reactivity is respiratory sinus arrhythmia (RSA), which is a naturally occurring variation in heart rate synchronised with the respiratory cycle (Berntson et al., 1993). Sympathetic nervous system response is frequently indicated by electrodermal activity such as skin conductance level (SCL) (Levenson et al., 2016), and by pre-ejection period (PEP), an index of contractility of the heart (Sherwood et al., 1990). The current study included these measures of parasympathetic and sympathetic response. These measures and their associations with states of deactivation (rest) and activation (stress/arousal) are presented in Table 1.

Table 1

Indicators of ANS Response and Relations With States of Deactivation and Activation

Branch of ANS	ANS response indicator	Deactivation (rest)	Activation (stress)
PNS/SNS	IBI ↑	↑	↓
	IBI ↓	↓	↑
PNS	RSA ↑	↑	—
	RSA ↓	↓	—
SNS	PEP ↑	—	↓
	PEP ↓	—	↑
	SCL ↑	—	↑
	SCL ↓	—	↓

Note. PNS = parasympathetic nervous system. SNS = sympathetic nervous system. IBI = interbeat interval, an indicator of heart rate. Arrows indicate increased (↑) or decreased (↓) values (indicators of ANS response) or states (deactivation/activation). Based on Berntson et al. (1994), Levenson et al. (2016), and Porges (2007).

Loss, trauma, and autonomic nervous system reactivity

To date, few researchers have examined ANS reactivity during the AAI (Beijersbergen et al., 2008; Dozier & Kobak, 1992; Roisman et al., 2004). Both Dozier and Kobak (1992) and Roisman et al. (2004) used the Adult Attachment Interview Q-Set (Kobak, 1989; 1993) to code the interviews, which does not include a scale for assessing unresolved loss or trauma. Beijersbergen and colleagues (2008) did not find that responses to the loss and trauma questions in the AAI were associated with the interview being classified as unresolved/disorganised (U/d). However, their analysis did not control for differences between the groups in type of unresolved experience discussed (i.e., loss, abuse, or other potential trauma). Furthermore, as Beijersbergen et al. (2008) mentioned in the discussion, this study only focused on the specific interview questions that probe for loss and trauma. Because speakers can bring up loss and trauma anywhere in the interview, linking ANS reactivity to discussion of these experiences across the entire AAI may provide more insight. Moreover, the direct association between individual instances of unresolved discourse and ANS response on a micro-level was not addressed.

Findings outside the realm of attachment theory suggest that recall of trauma may be linked to aberrant ANS reactivity. Studies in which participants were asked to recall traumatic memories have linked PTSD and trauma-related dissociation to blunted ANS response (Griffin et al., 1997; Koopman et al., 2004; Sack et al., 2012). In the study by Griffin et al. (1997), which involved female victims of rape, participants with high dissociation showed blunted skin conductance responses and

decreasing heart rate when discussing their trauma. During a similar task, Sack et al. (2012) found a relation between dissociation and decreasing heart rate, as well as diminished RSA reactivity. A study involving female undergraduates with a history of trauma showed that participants with high dissociation had larger decreases in RSA and shorter PEP when recalling traumatic memories, indicating withdrawal of the parasympathetic nervous system and increased fight-or-flight responses (Sledjeski & Delahanty, 2012).

Similarly, studies among persons with PTSD found decreasing parasympathetic reactivity during trauma recall tasks (Keary et al., 2009; Sack et al., 2004). For example, Sack et al. (2004) found a pattern of decreasing RSA accompanied by increased heart rate, suggesting involvement of both the parasympathetic and sympathetic nervous system. In contrast, Chou and colleagues (2018) found that persons with PTSD showed increased parasympathetic reactivity (indicated by HF-HRV) when asked to recall their traumatic experience, which is inconsistent with other findings (e.g., Keary et al., 2009). According to the authors, their choice of a neutral recall baseline as compared to resting baseline in other studies may have partially contributed to this inconsistency, because both speaking and recalling memories may affect measures of cardiovascular activity (Chou et al., 2018). Taken together, PTSD and trauma-related dissociation are linked to dysregulated ANS responses, although not consistently. Following the theoretical propositions about unresolved states of mind (e.g., Main & Hesse, 1990) this indirect evidence points to the possibility that dysregulated ANS reactivity may be underlying unresolved discourse. However, as available work in attachment theory does not provide clarity about the psychological processes of unresolved discourse and unresolved states of mind, the expected nature of this relation (e.g., heightened or diminished ANS reactivity) is uncertain.

This study

In the current study, we tested ANS responses as indices of emotional arousal involved in unresolved/disorganised (U/d) states of mind about loss/trauma. First-time pregnant women participated in the AAI while ANS response was recorded, allowing assessment of parasympathetic and sympathetic nervous system response. We examined associations between ANS reactivity and i) responses to questions about loss, abuse, and other trauma; ii) discussion of experiences of loss/trauma anywhere in the interview; iii) the interview being classified as unresolved/disorganised (U/d); and iv) instances of unresolved discourse about loss/trauma. The following hypotheses were tested in this study:

1) It was hypothesised that responses to questions about loss/trauma would be associated with changes in ANS reactivity, and that this association would be moderated by unresolved status

2) It was hypothesised that discussion of loss/trauma anywhere in the interview would be associated with changes in ANS reactivity, and that this association would be moderated by unresolved status
3) It was hypothesised that unresolved discourse in response to questions about loss/trauma would be associated with changes in ANS reactivity
4) It was hypothesised that unresolved discourse anywhere in the interview would be associated with changes in ANS reactivity

The study design, hypotheses, and data analytical procedures were pre-registered on Open Science Framework (https://osf.io/tp3kd).

Method

Participants

Data were used from the ongoing Generations[2] longitudinal study on parenthood and the development of the parent-child relationship. First-time pregnant women (*N* ~2,000) in the larger cohort were recruited through midwifery practices, pregnancy fairs, and the project's website. The current study used data from a focus sample of women who were invited to participate in intensive measurements including the AAI (*N* = 254). This focus sample consists of first-time pregnant women from normative and high-risk groups. Women in the normative group (*n* = 135) were invited for participation after their first prenatal questionnaires were received (around 12 weeks of pregnancy). The high-risk group (*n* = 119) included 56 women who reported visiting a psychologist or psychiatrist or being in youth care before the age of 18, and 5 women who reported heightened scores on prenatal assessments of depression and anxiety. Fifty-eight women in the high-risk group were recruited from youth care organisations or institutions, or from prenatal parenting programs for at-risk women. Women were excluded for participation in the study if they reported a prenatal diagnosis for a congenital abnormality of the foetus.

Only women who reported any loss or trauma experiences in the AAI were selected for this study (*N* = 235), of whom 51% were from the normative group and 49% from the high-risk group. For the purposes of the current study and because the same measures were used, women from both groups were combined into one group. When the AAI was administered, during second or third trimester of pregnancy, women's ages ranged from 15 to 41 years (*M* = 27.88, *SD* = 6.02). The majority of women had parents who were born in the Netherlands (88%). Most women (54%) were highly educated with a bachelor's or master's degree, 22% had completed further vocational education, 16% had completed secondary school, and 4% had completed up to eight groups of primary education. Regarding marital status, 85% percent of women had a partner, of whom 50% were cohabiting and 41% were married. Fifteen percent of women were single.

This study used data collected during the second or third trimester of pregnancy, depending on the time of recruitment. The data were collected between 2009 and 2013. Before the start of the study, all women signed informed consent, and if younger than 18 years, also their legal guardians. Women were home-visited by a trained interviewer to conduct the AAI, during which signals of electrocardiography (ECG), impedance cardiography (ICG), and skin conductance were recorded. Women from the normative group received a 60-euro gift card after the first year of measurements was completed, and women from the at-risk group received financial compensation after each measurement, with a total of 100 euro. This study has been approved by the Medical Ethical committee of the Vrije Universiteit Medical centre (NL24319.029.08).

Measures

Unresolved loss and trauma. Participants' unresolved states of mind about loss or trauma were assessed using the Dutch version of the Adult Attachment Interview (AAI; George et al., 1996). The AAI is a semi-structured interview consisting of 20 questions with follow-up probes and covers one's early relationship experiences with their caregivers, including reflections on how these experiences have affected their development into adulthood. The interviews were transcribed verbatim. Trained coders of the AAI, who established reliability on the Berkeley reliability set, rated the interview transcripts for unresolved discourse about loss or trauma (i.e., lapses in the monitoring of reasoning or discourse) using the coding system by Main and colleagues (1994-2004). Unresolved responses were rated on two separate rating scales, one for unresolved loss and one for unresolved trauma (range 1-9). Interviews were classified into the unresolved/disorganised (U/d) category if they contained significant unresolved responses to loss or trauma, usually on the basis of a score of 6 or higher on either of the unresolved rating scales. The average kappa score between three AAI coders for the U/d classification was 0.72 (range 0.58-1.00; based on 15 interview transcripts).

Of the 254 participants from which our subsample was drawn, 20% (n = 51) were classified as U/d. This proportion did not differ from the proportion of U/d classifications in non-clinical samples (Bakermans-Kranenburg & Van IJzendoorn, 2009), $\chi^2(1, N = 254) = 0.40$, $p = .525$. Classification into the U/d category was an independent variable in this study and was dichotomously coded (0 = not classified as U/d, 1 = classified as U/d).

This study included behaviourally-focused sub-questions on trauma. These questions were already included in the AAI protocol that was used, as recommended by Bailey et al. (2007) and Madigan et al. (2012), and were more deliberately probed by the interviewers in this study: (a) "Were you ever hit as a child?"; if confirmed: "Could you tell me more about what happened?", "Could you describe the circumstances?", "How old were you at the time?", "How often did it happen?". If the circumstances were still unclear: "Could you think of a specific time that it happened?", "Was there

an object used?", "Where on your body were you hit?", "Did it ever leave marks?"; (b) "Some people have had negative sexual experiences in their childhood. Did anything like that ever happen to you or someone in your family?". If confirmed: "Could you tell me more about what happened?", "How old were you at the time?", "How often did it happen?". If the circumstances were still unclear: "What did he/she try to do to you?", "Did he/she use physical coercion to threaten or hurt you?"; (c) "Some people have memories of threatening experiences, maltreatment, or abuse by people outside their family, during childhood. Did anything like that ever happen to you or someone in your family?"; and (d) "Do you have memories of threatening experiences, maltreatment, or abuse by people outside of your family, after you were 12 years old? Or did anything like that happen to someone in your family?". After each discussed experience, the speaker was asked about how they felt the experience still affected them as an adult.

To be able to connect discussions of loss/trauma to recordings of ANS reactivity, these experiences were extracted from the AAI scoring sheets and marked interview transcripts and were then linked to the time points in the interview audio recordings. The data were prepared through the following steps: 1) a team of 11 undergraduates listened to the interview audio recordings while reading the marked transcripts and AAI scoring sheets; 2) in a separate Excel file, the undergraduates took notes of the time points at which interviewees discussed loss/trauma; 3) the first author (who received training in coding the AAI by Main and Hesse on 12-23 June 2017, Berkeley) went back to the original marked transcripts and AAI scoring sheets to check the students' notations of trauma and corrected them where necessary; 4) the first author used the original marked interview transcripts to identify instances of unresolved discourse about loss/trauma. Marked indices of unresolved discourse were identified in responses to the loss/trauma questions as well as in responses to the other interview questions (see Appendix F for an overview). For the purposes of this study, discussions of abuse (physical and sexual abuse by attachment figures) and other potential trauma (e.g., abuse by non-attachment figures, car accidents) were both marked as "trauma".

Participants' response to the interview questions was a within-subject independent variable with 21 categories, representing each of the interview questions. The first interview question (asking for an overview of the speaker's early family situation) was used as the baseline. Interview question 8 was divided into two categories, each representing a separate part of the question: one about experiences of rejection by caregivers, and one about feelings of worry or fright. This decision was made because of the possibility that speakers would bring up loss/abuse when asked about the latter.

Per interview question, it was indicated whether participants discussed any loss/trauma, and whether they showed any indications of unresolved discourse. Discussion of loss/trauma and unresolved discourse about loss/trauma were within-subject independent variables. These were

dichotomously coded (0 = no loss/trauma discussed, 1 = loss/trauma discussed; 0 = no unresolved discourse, 1 = unresolved discourse). Figure 1 presents an overview of the within-subject independent variables.

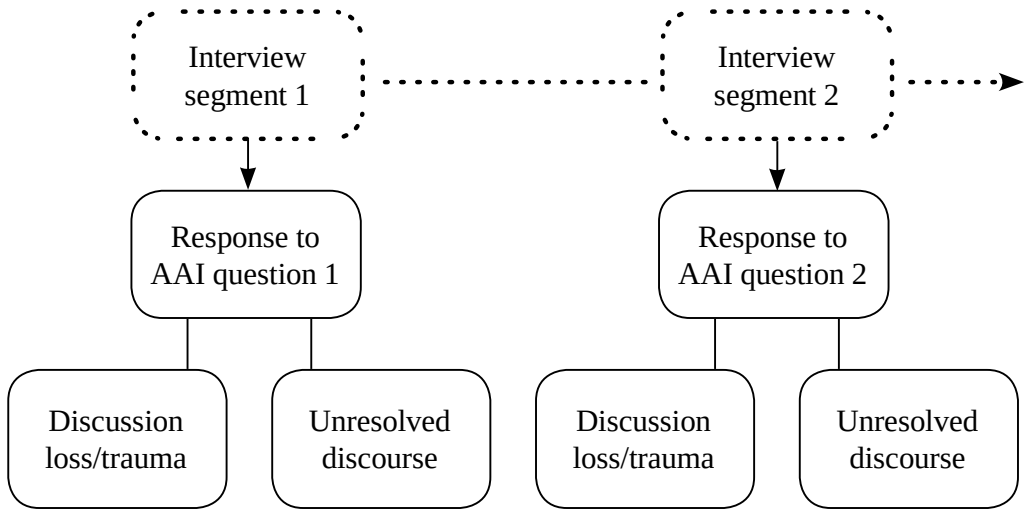

Figure 1. Within-subject independent variables. The first two interview segments are presented here, corresponding to participants' responses to the first two AAI questions.

Autonomic nervous system reactivity. During administration of the AAI, signals of ECG, ICG, and skin conductance were recorded using the Vrije Universiteit Ambulatory Monitoring System (VU-AMS; De Geus et al., 1995; Willemsen et al.,1996). A lead wire connector and seven disposable gelled ECG electrodes were used for recording the ECG and ICG. The electrodes were positioned on the participants' bodies according to standard procedures described for the VU-AMS, while participants were sitting at a table (De Geus et al., 1995; Willemsen et al., 1996). The ICG signal (dZ/dt) was derived from the change in thoracic impedance (dZ) due to pulsatile variation. For skin conductance, a separate wire connector was used with an electrode holder filled with gel for the index and middle or ring finger.

The VU-DAMS software (version 4.0; Pelt & Viswanathan, 2015) was used to divide the physiological data into labelled segments indicating participants' responses to the interview questions. Each interview segment also indicated whether loss or trauma was discussed and/or if the segment contained indices of unresolved discourse. The physiological data were labelled by the first author and the undergraduate students involved in this project. Data labelled by the undergraduate students were corrected by the first author if necessary. This study included indicators of heart rate (interbeat interval; IBI), sympathetic reactivity (PEP and skin conductance) and parasympathetic reactivity (RSA), which were averaged across the interview questions. IBI is defined as the time (ms) between two consecutive R-peaks in the ECG signal and was automatically scored by the software. Ensemble

averaged ICG (dZ/dt) waveforms were computed across the interview questions and were automatically scored for the specific locations of the upstroke (B-point), dZ/dt_{min} (C-point), and incisura (X-point). From these points, PEP was acquired, defined as the time (ms) from the Q-wave onset in the ECG complex to the B-point in the ICG waveform (Riese et al., 2004). The ICG waveforms were visually inspected, and morphologically inconsistent B-points were manually corrected following the guidelines by Sherwood et al. (1990). To ensure reliability, a set of 14 subjects (n = 577 ICG waveforms) were double-coded by the first and second author, which yielded excellent interrater reliability (ICC = .99; single measures, absolute agreement).

The tonic component of skin conductance was used in this study (also referred to as skin conductance level; SCL). The frequency of the skin conductance signal (μS) was 10 samples per second (10 Hz; signal range 0-95 Hz). Clipping levels were automatically detected and removed from further analysis. To estimate RSA, the VU-DAMS software utilises the peak-to-valley method (Grossman et al., 1990; De Geus et al., 1995) which combines heart period (IBI) and respiratory data. The respiration signal was acquired from the filtered (0.1-0.4 Hz) dZ signal. For each respiratory cycle, RSA (ms) was computed by subtracting the shortest IBI during the inhalation interval from the longest IBI during the exhalation interval. Respiratory cycles were scored automatically by the software algorithm. RSA values were positively skewed (skewness = 1.47). Therefore, RSA was transformed to its natural logarithm (skewness = -0.36).

Per interview segment, outliers were defined using standardised values (z-scores < -3.29 | > 3.29) following Tabachnick and Fidell (2013). Outlying values were winsorised: the outliers were replaced by the next-most extreme non-outlying values. One outlying IBI value, 26 RSA values, 6 PEP values, and 2 SCL values were winsorised. Additionally, we found 30 zero-values of SCL, which were set to missing. Overall, less than 0.1% of data were missing for IBI, 2% were missing for RSA, 3% were missing for PEP, and 1% were missing for SCL.

Statistical procedure

R version 3.5.2 (R Core Team, 2018) was used for the analyses. First, descriptives of the study variables were calculated, which included distributions of the outcome variables (IBI, RSA, PEP, SCL), and frequencies of the independent variables (participants' discussion of loss/trauma, and indices of unresolved discourse). Secondly, as age may affect cardiovascular measures of psychophysiology (Berntson et al., 2007), we examined whether age should be included as a covariate in the analyses. Logistic regression was used to test the association between age and the interview being classified as U/d.

The study hypotheses were tested using multilevel modelling (linear mixed models). Multilevel modelling is commonly used in psychophysiological studies, because it considers the hierarchical

structure of the data and handles non-independent observations by including the possibility to fit random intercepts and random slopes for the independent variables (Page-Gould, 2016; Ruwaard et al., 2018). We used a two-level design with repeated measures (level 1) nested within the study participants (level 2).

The outcome variables were indicators of ANS response (IBI, RSA, PEP, and SCL), which were averaged across the interview segments. These were within-subject variables (level 1). The following independent variables were entered in the models: i) within-subject (level 1) categorical variables representing each of the 21 interview questions (dummy-coded), accounting for change in ANS reactivity compared to the baseline (i.e., the first interview question, which was the reference category in the analyses); ii) within-subject (level 1) categorical variables indicating whether an interview segment contained discussion of loss or trauma (dichotomously coded); iii) a within-subject (level 1) categorical variable indicating whether an interview segment contained indices of unresolved discourse (dichotomously coded); and iv) a between-subject (level 2) variable indicating participants' classification of U/d (dichotomously coded) (see also Figure 1). An autocorrelated covariance structure was used, which is considered appropriate for repeated measures designs in which the order of the observations is important (Page-Gould, 2016). Maximum likelihood estimation was used to estimate the model parameters. Likelihood ratio tests were performed to compare the goodness of fit between two subsequent models. Pairwise comparisons (estimated marginal means) were calculated to follow-up on significant findings.

Each hypothesis was tested with different unconditional and conditional growth models, of which the specific variables are presented in Table 2. For all hypotheses, an unconditional means model (Model 1) was first estimated. This model included only a random intercept, which was used to assess the degree of non-independency in ANS responses across the interview segments (within-subject observations). Intraclass correlation coefficients (ICC) were computed to examine how much of the variance in ANS reactivity (on the within-subject level) would be accounted for by differences between participants. ICCs close to zero would imply statistical independence of the within-subjects observations (Hayes, 2006). In the next step, for all hypotheses, an unconditional growth model with a random intercept would be estimated (Model 2), in which the dummy variables representing the 21 interview questions were added as predictors. These variables accounted for change in the indicators of ANS reactivity across the interview questions, with the baseline (i.e., the first interview question) as the reference category. Next, we would include a random slope for the interview questions, which would allow participants to vary in ANS reactivity during the interview segments. If adding a random slope model did not improve the model fit, we dropped the random slope and continued with an intercept-only model. The same approach was used regarding participants' discussion of loss/trauma.

As seen in Table 2, subsequent models (i.e., Model 3, 4, and 5) were different for each hypothesis. In Model 3, participants' U/d classification (level 2), discussion of loss/trauma (level 1), and/or unresolved discourse (level 1) were added as predictors, to investigate whether these variables would be associated with change in the outcome variables, over and above the effect of the interview questions. In Model 4 and Model 5, interactions terms were added involving various combinations of the level 1 and level 2 variables. Effect sizes were determined by calculating f^2, which compares the explained variance (R^2) by the model of interest versus the unconditional means model (Lorah, 2018; see also Cohen, 1992; Snijders & Bosker, 2012).

Table 2

Growth Models and Variables per Study Hypothesis

	Hypothesis 1	Hypothesis 2	Hypothesis 3	Hypothesis 4
Model 1	Intercept	Intercept	Intercept	Intercept
Model 2	Intercept	Intercept	Intercept	Intercept
	Interview questions about loss/trauma	All interview questions	Interview questions about loss/trauma	All interview questions
Model 3	Intercept	Intercept	Intercept	Intercept
	Interview questions about loss/trauma	All interview questions	Interview questions about loss/trauma	All interview questions
	U/d status	Loss/trauma discussion	U/d discourse	Loss/trauma discussion
				U/d discourse
Model 4	Intercept	Intercept	Intercept	Intercept
	Interview questions about loss/trauma	All interview questions	Interview questions about loss/trauma	All interview questions
	U/d status	Loss/trauma discussion	U/d discourse	Loss/trauma discussion
	Interview questions about loss/trauma × U/d status	U/d status	Interview questions about loss/trauma × U/d discourse	U/d discourse
				Loss/trauma discussion × U/d discourse
Model 5	–	Intercept	–	–
	–	All interview questions	–	–
	–	Loss/trauma discussion	–	–
	–	U/d status	–	–
	–	Loss/trauma discussion × U/d status	–	–

Results

Descriptive statistics

Table 3 shows the means and standard deviations of the outcome variables during the baseline and the interview questions about loss, abuse, and other trauma. Frequencies of the within-subject independent variables are presented in Appendix F.

Table 3

Descriptives of the Outcome Variables per Interview Question

	IBI		RSA		PEP		SCL	
Question	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
1. Orientation (baseline)	676.17	79.78	4.11	.48	91.63	20.73	5.48	2.66
9. Abuse	718.76	83.34	4.19	.47	91.84	20.00	5.86	2.76
13. Loss	722.59	88.80	4.23	.60	92.24	19.45	5.53	2.69
14. Other trauma	728.48	91.21	4.20	.62	92.52	19.46	5.56	2.73

Note. IBI = interbeat interval, an indicator of heart rate; PEP = pre-ejection period; RSA = respiratory sinus arrhythmia; SCL = skin conductance level.

Preliminary analyses

A binary logistic regression was used to examine the association between age and the likelihood of being classified as U/d in the AAI. The logistic regression model with age as a predictor was not significantly different from the null model (χ^2 (1) = 0.665, p = .42). Therefore, age was not included as a covariate in subsequent analyses. In a preliminary analysis for Hypothesis 1, we tested both models with separate interview responses (~5,004 within-subject observations) and combined interview questions and responses (~10,190 within-subject observations). The likelihood ratio estimates of these models were not directly comparable due to differing numbers of observations. Reported analyses included only the responses to the interview questions, because participants could only discuss experiences of loss/trauma and show unresolved discourse when responding to a question. Analyses with the less-parsimonious models are reported in Appendix F.

Hypothesis 1: The effects of responding to questions about loss/trauma on ANS reactivity, and moderation by unresolved status

It was hypothesised that responding to questions about loss/trauma would be associated with changes in ANS reactivity, and that this effect would be moderated by unresolved status. The results of these analyses are reported in Table 4. Including a random slope for the interview questions resulted in non-convergence of the models, even when the maximum number of iterations was increased and when the random intercept/slope covariance parameter was removed. To obtain

convergence, the models reported in Table 4 are random intercept models allowing the intercept, but not the slope, to vary across participants.

The ICCs from the unconditional means models revealed that a large proportion of the variance in ANS reactivity was accounted for by differences between participants (IBI = 84%, RSA = 70%, PEP = 93%, SCL = 82%), which indicates a high dependency of the within-subject observations, confirming that multilevel modelling is appropriate in this study (Hayes, 2006).

Responses to questions about loss/trauma. Including the interview questions as a predictor to the unconditional means model (Model 2) resulted in an improved model fit for all indicators of ANS reactivity (*p*s < .001). Larger IBIs and higher RSA were significantly associated with responses to questions about loss (*p*s < .001), abuse (resp. $p < .001$ and $p = .002$), and other trauma (resp. $p < .001$ and $p = .002$). For PEP, no significant associations were found (*p*s > .112). Higher SCL was associated with the abuse question ($p < .001$), but not with the loss and other trauma questions (*p*s > .555). The model for IBI explained 4% in variance ($f^2 = 0.04$), compared to the variance unexplained by the model. Explained model variance was only 1% ($f^2 = 0.01$) for RSA and 0.05% ($f^2 = 0.005$) for SCL. Pairwise comparisons showed that IBIs were significantly larger during responses to questions about loss ($M = 722.02$, $SE = 5.60$, $p < .001$), abuse ($M = 718.57$, $SE = 5.60$, $p < .001$), and other trauma ($M = 729.19$, $SE = 5.60$, $p < .001$) compared to baseline ($M = 675.86$, $SE = 5.60$).

Moderation by unresolved status. For all indicators of ANS reactivity, the model fit did not improve when unresolved status was included as predictor (Model 3) (*p*s > .214). Including the interaction term between questions about loss/trauma and unresolved status (Model 4) did not result in an improved model fit for IBI and RSA (*p*s > .149). Including the interaction term resulted in an improved model fit for PEP and SCL (resp. $p = .002$ and $p = .035$). For PEP, there was a significant interaction effect between unresolved status and responses to the question about other trauma ($p = .020$), but not for the questions about loss and abuse (*p*s > .203). For SCL, the interaction effect between unresolved status and responses to questions about loss, abuse, and other trauma on SCL was significant (resp. $p = .006$, $p = .003$, and $p = .032$). Explained model variance was a mere 0.2% for PEP ($f^2 = 0.002$) and 1% for SCL ($f^2 = 0.01$).

Table 4

Hypothesis 1: The Effects of Responding to Questions About Loss and Trauma on ANS Reactivity, and Moderation by Unresolved/Disorganised Status

	IBI (ms)		lnRSA (ms)		PEP (ms)		SCL (µS)	
Fixed effects	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS
Model 1								
Intercept	714.37 (5.31)***		4.19 (.03)***		92.43 (1.27)***		5.55 (.17)***	
Model 2		369***		104***		25***		79***
Intercept	675.68 (5.60)***		4.11 (0.03)***		91.64 (1.31)***		5.48 (.18)***	
Loss question	46.16 (2.54)***		0.12 (0.03)***		0.79 (0.50)		.06 (.10)	
Abuse question	42.71 (2.54)***		0.08 (0.03)**		0.03(0.50)		.35 (.09)**	
Other trauma question	53.33 (2.55)***		0.08 (0.03)**		0.78 (0.50)		.05 (.10)	
Model 3		0		0		0		1
Intercept	673.99 (6.26)***		4.09 (0.04)***		91.52 (1.47)***		5.57 (.20)***	
Loss question	46.16 (2.54)***		0.12 (00.03)***		0.79 (0.50)		.06 (0.10)	
Abuse question	42.71 (2.54)***		0.08 (.03)**		0.03 (0.50)		0.35 (0.09)**	
Other trauma question	53.33 (2.55)***		0.08 (0.03)**		0.78 (0.50)		0.05 (0.10)	
U/d status	8.65 (12.94)		0.09 (0.07)		0.59 (3.08)		-0.46 (0.42)	
Model 4		8		14		21**		16*
Intercept	675.02 (6.34)***		4.10 (0.04)***		91.122 (1.49)***		5.48 (0.20)**	
Loss question	46.17 (2.87)***		00.10 (0.03)**		1.13 (0.56)*		0.19 (0.11)	
Abuse question	41.97 (2.87)***		.06 (0.03)*		0.33 (0.56)		0.48 (0.10)***	
Other trauma question	52.03 (2.89)***		0.06 (0.03)*		1.40 (0.57)*		0.18 (0.11)	
U/d status	3.95 (13.59)		0.03 (0.08)		2.35 (3.19)		-0.01 (0.44)	
Loss question × U/d status	-0.15 (6.14)		0.07 (0.06)		-1.52 (1.20)		-0.64 (0.23)**	
Abuse question × U/d status	3.33 (6.15)		0.08 (0.06)		-1.31 (1.20)		-0.65 (0.22)**	
Other trauma question × U/d status	5.84 (6.15)		0.12 (0.06)		-2.81 (1.21)*		-0.51 (0.23)*	

Note. ΔDS = decrease in deviance statistic (Log-likelihood). U/d = classification of unresolved/disorganised. Responses to all interview questions were included in the analyses (5004 within-subject observations), but only the questions about loss/trauma are reported in this Table. Responses were coded as dummy variables with the first question as reference. * $p < .05$ ** $p < .01$ *** $p < .001$

Hypothesis 2: The association between discussion of loss/trauma anywhere in the interview and ANS reactivity, and moderation by unresolved status

It was hypothesised that discussion of actual loss/trauma anywhere in the interview would be associated with changes in ANS reactivity, and that this association would be moderated by unresolved status. The results of these analyses are reported in Table 5. The full models and analyses with separate variables indicating discussion about loss *or* trauma are reported in Appendix F.

Discussion of loss/trauma anywhere in the interview. Including the interview questions as predictors to the unconditional means model (Model 2) resulted in an improved model fit for all indicators of ANS reactivity (*p*s < .001). Including discussion of loss/trauma as predictor to the model with the interview questions (Model 3) resulted in an improved model fit for IBI and RSA (resp. $p = .033$ and $p = .035$) but not for PEP and SCL (resp. $p = .511$ and $p = .112$). For all indicators of ANS reactivity, the model fit improved when random slopes were added (*p*s < .001), which indicated that participants varied in their ANS reactivity when discussing experiences of loss or trauma. Smaller IBIs (higher heart rate) and higher RSA (more parasympathetic reactivity) were significantly associated with discussion of loss/trauma (resp. $p = .034$ and $p = .018$). For PEP and SCL, no significant associations were found (*p*s > .356). Explained model variance was 13% for IBI ($f^2 = 0.13$) and 41% for RSA ($f^2 = .41$). Pairwise comparisons revealed that IBIs were smaller during discussion of loss/trauma ($M = 712.68$, $SE = 5.40$, $p = .034$), compared to when these experiences were not discussed ($M = 716.14$, $SE = 5.38$). RSA was higher during discussion of loss/trauma ($M = 4.23$, $SE = 0.03$, $p = .018$), compared to when these experiences were not discussed ($M = 4.19$, $SE = 0.03$).

Additional pre-registered analyses with separate variables indicating loss *or* trauma showed that smaller IBIs were significantly associated with discussion of loss but not trauma (resp. $p = .005$ and $p = .691$). There was no significant relation between RSA and discussion of loss or trauma (resp. $p = .080$ and $p = .106$).

Moderation by unresolved status. For all indicators of ANS reactivity, including unresolved status as predictor (Model 4) did not improve the model fit (*p*s > .227). Nor did the model fits improve when the interaction between discussion of loss/trauma and unresolved status was included (Model 5) (*p*s > .231).

Table 5

Hypothesis 2: The Association Between Discussion of Actual Loss/Trauma and ANS Reactivity, and Moderation by Unresolved/Disorganised Status

	IBI (ms)		lnRSA (ms)		PEP (ms)		SCL (µS)	
Fixed effects	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS
Model 1								
Intercept	714.37 (5.31)***		4.19 (0.03)***		92.43 (1.27)***		5.55 (0.17)***	
Model 2		369***		104***		25***		79***
Intercept	675.86 (5.60)***		4.11 (0.03)***		91.64 (1.31)***		5.48 (0.18)***	
Interview questions[a]								
Model 3		415***		16***		202***		1798***
Intercept	678.11 (5.70)***		4.09 (0.04)***		91.76 (1.33)***		5.42 (0.18)***	
Interview questions[a]								
Loss/trauma discussion	-3.46 (1.63)*		0.04 (0.02)*		-0.23 (0.31)		0.05 (0.05)	
Model 4		0		1		0		1
Intercept	676.61 (6.33)***		4.09 (0.04)***		91.63 (1.48)***		5.52 (0.20)***	
Interview questions[a]								
Loss/trauma discussion	-3.49 (1.63)*		0.04 (0.02)*		-0.22 (0.31)		0.05 (0.05)	
U/d status	6.94 (12.84)		0.08 (0.07)		0.62 (3.08)		-0.51 (0.42)	
Model 5		1		1		0		1
Intercept	675.87 (6.36)***		4.07 (0.04)***		91.65 (1.48)***		5.54 (0.20)***	
Interview questions[a]								
Loss/trauma discussion	-2.40 (1.87)		0.05 (0.02)*		-0.32 (0.36)		0.01 (0.06)	
U/d status	9.63 (13.04)		0.09 (0.07)		0.57 (3.08)		-0.57 (0.43)	
Loss/trauma discussion × U/d status	-3.22 (2.70)		-0.02 (0.03)		0.25 (0.50)		0.10 (0.08)	

Note. ΔDS = decrease in deviance statistic (Log-likelihood). U/d = classification of unresolved/disorganised. [a] Responses to all interview questions were included in the analyses (5004 within-subject observations), but are not reported in this Table. Responses were coded as dummy variables with the first question as reference.
* $p < .05$ ** $p < .01$ *** $p < .001$

Hypothesis 3: The association between unresolved discourse in response to the loss/trauma questions and ANS reactivity

It was hypothesised that unresolved discourse in response to questions about loss/trauma would be associated with ANS reactivity. The results of these analyses are reported in Table 6. No unresolved discourse was found in response to questions 16-20, which were therefore excluded from analysis.

Including the interview questions as predictors to the unconditional means model (Model 2) resulted in an improved model fit for all indicators of ANS reactivity (ps < .001). Including unresolved discourse as a predictor to the model with the interview questions (Model 3) resulted in an improved model fit for IBI (p < .001) but not for RSA, PEP, and SCL (ps > .138). Smaller IBIs (higher heart rate) were associated with unresolved discourse (p = .017). Explained model variance was 3% (f^2 = 0.03). Pairwise comparisons revealed that IBIs were smaller during responses with unresolved discourse (M = 706.45, SE = 5.56, p = .017), compared to responses without unresolved discourse (M = 710.70, SE = 5.31).

Additional pre-registered analyses with separate variables indicating unresolved discourse about loss *or* trauma showed that smaller IBIs were associated with unresolved discourse about loss but not trauma (resp. p = 0.018 and p = 0.313; complete results are reported in Appendix F). The model fits did not improve when the interaction term between the interview questions and unresolved discourse was included (Model 4) (ps > .078).

Table 6

Hypothesis 3: The Association Between Unresolved Discourse in Response to Questions About Loss/Trauma and ANS Reactivity

	IBI (ms)		lnRSA (ms)		PEP (ms)		SCL (µS)	
Fixed effects	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS
Model 1								
Intercept	708.23 (5.29)***		4.17 (0.03)***		92.42 (1.27)***		5.54 (0.17)***	
Model 2		259***		52***		20***		70***
Intercept	675.89 (5.56)		4.11 (0.03)***		91.64 (1.32)***		5.46 (0.18)***	
Loss question	46.14 (2.51)***		0.12 (0.02)***		0.80 (0.50)		0.03 (0.10)	
Abuse question	42.73 (2.51)***		0.08 (0.02)**		0.03 (0.50)		0.32 (0.09)**	
Other trauma question	53.27 (2.52)***		0.08 (0.03)**		0.79 (0.50)		0.02 (0.11)	
Model 3		2.87*		1		0		1
Intercept	676.06 (5.56)***		4.11 (0.03)***		91.65 (1.32)***		5.46 (0.18)***	
Loss question	48.57 (2.70)***		0.10 (0.03)***		0.90 (0.55)		-0.001 (0.11)	
Abuse question	43.60 (2.54)***		0.07 (0.03)**		0.07 (0.50)		0.31 (0.10)**	
Other trauma question	53.29 (2.52)***		0.08 (0.03)**		0.79 (0.50)		0.02 (0.11)	
U/d discourse	-4.25 (1.78)*		0.03 (0.02)		-0.17 (0.39)		0.05 (0.04)	
Model 4		5.32		8		4		12
Intercept	676.68 (5.58)***		4.12 (0.03)***		91.50 (1.32)***		5.45 (0.18)***	
Loss question	48.55 (3.11)***		0.07 (0.03)*		0.81 (0.64)		0.07 (0.11)	
Abuse question	42.97 (2.67)***		0.06 (0.03)*		0.41 (0.54)		0.32 (0.10)**	
Other trauma question	52.42 (2.56)***		0.07 (0.03)**		0.93 (0.51)		0.04 (0.11)	
U/d discourse	-19.27 (7.99)*		-0.16 (0.09)		3.19 (1.68)		0.47 (0.18)*	
Loss question × U/d discourse	14.05 (8.52)		0.22 (0.10)*		-2.98 (1.81)		-0.50 (0.19)**	
Abuse question × U/d discourse	15.06 (8.67)		0.21 (0.10)*		-4.18 (1.84)*		-0.37 (0.20)	
Other trauma question × U/d discourse	20.80 (10.79)		0.23 (0.13)		-3.51 (2.38)		-0.43 (0.23)	

Note. ΔDS = decrease in deviance statistic (Log-likelihood). U/d discourse = unresolved/disorganised responses about loss/trauma. Responses to the first 15 interview questions were included in the analyses (3829 within-subject observations), but only the questions about loss/trauma are reported in this Table. Responses were coded as dummy variables with the first question as reference. * $p < .05$ ** $p < .01$ *** $p < .001$

Hypothesis 4: The association between unresolved discourse about loss/trauma and ANS reactivity

It was hypothesised that unresolved discourse anywhere in the interview would be associated with ANS reactivity. The results of these analyses are reported in Table 7. These models included a random slope for discussion of loss/trauma.

Including the interview questions as predictors to the unconditional means model (Model 2) resulted in an improved model fit for all indicators of ANS reactivity (ps < .001). For all indicators of ANS reactivity, the model fit improved when discussion of loss/trauma and unresolved discourse were included as predictors to the model with the interview questions (Model 3; ps < .001 for IBI, PEP, and SCL, p = .002 for RSA). There was no significant association between unresolved discourse and IBI (p = .073). However, additional pre-registered analyses with separate variables indicating loss *or* trauma showed that smaller IBI was associated with unresolved discourse about loss (p = 0.047), over and above the effect of discussion of loss (p = .049). Explained model variance was 13% (f^2 = 0.13).

For RSA, PEP, and SCL, no significant associations were found (ps > .381), also not when examining separate variables indicating unresolved discourse about loss *or* trauma (complete results are reported in Appendix F). The model fit indices did not improve further when the interaction term between discussion of loss/trauma and unresolved discourse was included (Model 4) (ps > .294).

Table 7

Hypothesis 4: The Association Between Unresolved Discourse About Loss/Trauma and ANS Reactivity

	IBI (ms)		lnRSA (ms)		PEP (ms)		SCL (µS)	
Fixed effects	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS
Model 1								
Intercept	708.23 (5.29)***		4.16 (0.03)***		92.42 (1.27)***		5.54 (0.17)***	
Model 2		259***		52***		20***		70***
Intercept	675.89 (5.56)***		4.11 (0.03)***		91.64 (1.32)***		5.46 (0.18)***	
Interview questions[a]								
Model 3		301***		7**		131***		1378***
Intercept	677.46 (5.65)***		4.09 (0.04)***		91.77 (1.33)***		5.40 (0.19)***	
Interview questions[a]								
Loss/trauma discussion	-1.99 (1.72)		0.03 (0.02)		-0.25 (0.34)		0.03 (0.05)	
U/d discourse	-4.05 (2.26)		0.02 (0.02)		-0.10 (0.46)		0.02 (0.07)	
Model 4		0		0		0		1
Intercept	677.45 (5.66)***		4.09 (0.04)***		91.78 (1.33)***		5.40 (0.19)***	
Interview questions[a]								
Loss/trauma discussion	-1.95 (1.74)		0.03 (0.02)		-0.27 (0.35)		0.02 (0.05)	
U/d discourse	-3.06 (6.82)		0.01 (0.07)		-0.49 (1.37)		-0.19 (0.21)	
Loss/trauma discussion × U/d discourse	-1.11 (7.16)		0.02 (0.07)		0.44 (1.44)		0.23 (0.22)	

Note. ΔDS = decrease in deviance statistic (Log-likelihood). U/d discourse = unresolved/disorganised responses about loss/trauma. [a] Responses to the first 15 interview questions were included in the analyses (3829 within-subject observations), but are not reported in this Table. Responses were coded as dummy variables with the first question as reference. * $p < .05$ ** $p < .01$ *** $p < .001$

Exploratory analyses

Exploratory analyses were performed to follow up on some of the hypothesis testing results. These analyses were not pre-registered, hence their exploratory nature.

Unresolved discourse during the interview baseline. We discovered that 10 participants showed unresolved responses during the baseline (the first question in the AAI, see also Table S1). As this might have affected the neutrality of the baseline, we examined whether participants with unresolved discourse during baseline had different ANS activity, compared to participants without unresolved discourse. T-tests demonstrated no significant difference in IBI ($t(11.98) = 1.28$, $p = 0.23$), RSA ($t(10.03) = -0.68$, $p = 0.51$), PEP ($t(9.62) = -0.91$, $p = 0.39$), and SCL ($t(9.94) = -1.77$, $p = 0.11$) during baseline. Further, t-tests revealed that baselines were not significantly different for participants with and without a U/d classification; IBI ($t(87.01) = -0.26$, $p = .79$), RSA ($t(91.72) = -0.51$, $p = .61$), PEP ($t(78.26) = -0.63$, $p = .53$), and SCL ($t(72.63) = -0.17$, $p = .77$).

Trajectories of ANS reactivity throughout the entire interview. A visual inspection of the moderating effects of unresolved status in Hypothesis 1 suggested that there may be important time-trends in physiological response across the interview as a whole, which the prior analyses focused on comparisons of specific interview segments, had not addressed. Therefore, we estimated the trajectories of ANS response across the entire interview, moderated by unresolved status. First, a continuous "time" variable was created representing the questions and responses in the AAI (~43 observations per subject, 10,190 within-subject observations in total). Unresolved status was dichotomously coded (0 = not classified as U/d, 1 = classified as U/d). We used multilevel modelling. In the first step, an unconditional means model was estimated (Model 1). Secondly, the interaction between time and unresolved status was included as a linear effect (Model 2). In the next steps, we included polynomial transformations of time (quadratic, cubic, quartic) and their interactions with unresolved status as predictors. Likelihood ratio tests were used to compare the goodness of fit between two subsequent models. Due to space limitations, the full models are reported in Appendix F. The best-fitting models are presented in Figure 2.

IBI. The best fitting model for IBI was the cubic model, which had a better fit than the quadratic model ($p < .001$). The cubic effect of time on IBI was significant ($p < .001$), but the interaction between time and unresolved status was not ($p = .74$). For that reason, another cubic model was estimated including only the main effects of time. The linear, quadratic, and cubic effects of time on IBI were significant (ps $< .001$). IBI increased over the course of the interview, suggesting decreasing heart rate.

RSA. The best-fitting model for RSA was the quartic model, which had a better fit than the cubic model ($p < .001$). The quartic effect of time on RSA was significant ($p < .001$), but the

interaction between time and unresolved status was not (p = 0.59). Therefore, another quartic model including only the main effects of time was estimated. The linear, quadratic, cubic, and quartic effects of time on RSA were significant (ps < .001).

PEP. The best-fitting model for PEP was the quadratic model, which had a better fit than the linear model (p < .001). The quadratic and linear effects of time on PEP were significant, as were the interaction effects between time and unresolved status (ps < .001). PEP decreased for participants classified as U/d, suggesting an increase in sympathetic reactivity; whereas PEP increased for those not classified as U/d. However, as seen in Figure 2, standard errors were large, suggesting that these results should be interpreted with caution.

SCL. The best-fitting model for SCL was the cubic model, which had a better fit than the quadratic model (p < .001). The cubic, quadratic, and linear effects of time on SCL were significant, as were the interaction effects between time and unresolved status (ps < .001). Participants classified as U/d showed diminished skin conductance levels, compared to those not classified as U/d.

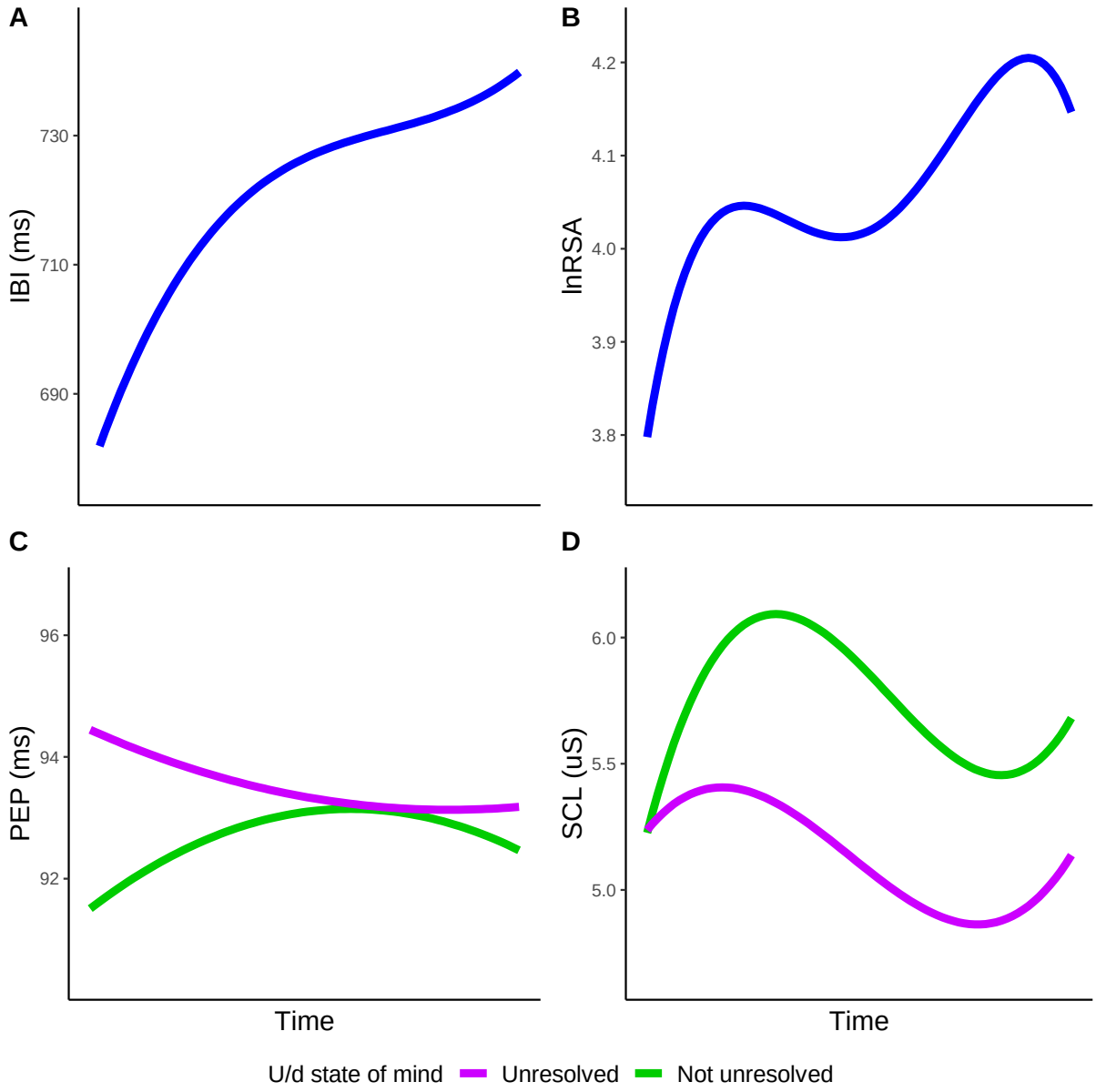

Figure 2. Estimated trajectories of IBI (A; cubic model), RSA (B; quartic model), PEP (C; quadratic model), and SCL (D; cubic model) across the Adult Attachment Interview. Significant moderation effects of unresolved status were found for PEP and SCL. Error bounds represent standard errors.

Discussion

This study tested ANS responses as indices of emotional arousal involved in unresolved/disorganised (U/d) states of mind about loss/trauma. Relations were tested between ANS reactivity and i) responses to questions about loss, abuse, and other trauma; ii) discussion of experiences of loss/trauma anywhere in the interview; iii) the interview being classified as unresolved/disorganised (U/d); and iv) instances of unresolved discourse about loss/trauma (i.e., lapses in the monitoring of reasoning or discourse). The first question in the AAI was used as the baseline.

First, we hypothesised that responses to questions about loss/trauma (Hypothesis 1) and discussion of loss/trauma anywhere in the interview (Hypothesis 2) would be associated with changes in ANS reactivity, and that these relations would be moderated by participants' unresolved status (U/d). Responses to questions about loss and trauma were weakly associated with larger interbeat intervals (IBI), indicating lower heart rate (Hypothesis 1). Discussing actual loss anywhere in the interview was moderately associated with smaller IBIs (Hypothesis 2). However, against our expectations, these relations were not materially moderated by unresolved status. No main nor interaction effects were found for respiratory sinus arrhythmia (RSA), pre-ejection period (PEP), and skin conductance level (SCL). Secondly, we hypothesised that unresolved discourse about loss/trauma would be associated with changes in ANS reactivity (Hypotheses 3 and 4), over and above the effect of discussion of loss/trauma. Interview questions with unresolved discourse about loss were associated with smaller IBIs, indicating heightened physiological arousal (Hypothesis 3 and 4). This finding provides preliminary support for the theory that unresolved loss/trauma reflects potentially dissociated attention to distressing experiences. No associations were found between unresolved discourse and RSA, PEP, and SCL.

The exploratory finding of increasing IBI across the interview as a whole may account for why responses to questions about loss and trauma were associated with larger IBIs (Hypothesis 1), because these questions usually appear in the second half of the AAI. Responses to questions about loss, abuse, and other trauma (which would often involve reporting the absence of such experiences) were not associated with indicators of parasympathetic (RSA) and sympathetic reactivity (PEP and SCL) (Hypothesis 1). The absence of moderation by unresolved status is consistent with previous findings by Beijersbergen et al. (2008), and would appear to run counter to Main and Hesse's (1990, 1992) theorising. This implies either that i) the physiological measures do not adequately index emotional dysregulation or the effects of unresolved states of mind regarding attachment; or ii) responding to questions about loss/trauma in the AAI does not or very weakly prompt emotional dysregulation or the effects of unresolved states of mind. One possibility is that the loss and trauma

probes in the AAI may not be challenging enough to evoke states of fear or threat strong enough to trigger specific parasympathetic or sympathetic nervous system responses. One reason to consider this is that other researchers have alleged that the AAI interview protocol does not adequately probe for trauma (Bailey et al., 2007; Crowell et al., 2002). Bailey and colleagues (2007) noted that the way the abuse question is phrased "calls for the respondent to evaluate whether an experience was abusive" (p. 143), which may lead to underreported abuse. However, the interviewers in this study specifically pursued the AAI protocol's follow-up questions about trauma.

Discussion of actual loss anywhere in the interview was associated with smaller IBIs (Hypothesis 2). Increased heart rate has been associated with negative emotions such as sadness, anxiety, or fear (Kreibig, 2010). This finding therefore indicates that bringing up memories of loss may trigger such emotions, which is in line with our expectations. Again, there was no moderation by unresolved status. To the degree that ANS response is an index of emotional arousal, such findings suggest that unresolved states of mind do not have an additional effect during recall of loss/trauma, over and above the impact of these experiences in themselves. To the degree that unresolved loss/trauma would be expected according to current theory to be reflected in emotional arousal, the current results call for further specification of this theory.

This study made a first attempt to connect ANS reactivity to parts of the interview with occurrences of unresolved discourse about loss or trauma (i.e., lapses in the monitoring of reasoning or discourse). Unresolved discourse about loss was associated with smaller IBIs (increased heart rate), over and above the effect of discussing any loss (Hypothesis 3 and 4). This finding suggests that some emotional arousal may occur when interviewees show lapses in the monitoring of reasoning or discourse about loss. However, it is unclear whether these responses are triggered by frightening intrusions (fear) as theorised by Main and Hesse (1990, 1992) or whether these merely indicate sadness or anxiety about the loss (Kreibig, 2010). This study failed to show an effect of unresolved discourse on specific parasympathetic and sympathetic responses (RSA, PEP, and SCL). However this might be due to the way that occurrences of unresolved discourse were operationalised. Per interview question, we indicated whether participants' interview questions included lapses in the monitoring of reasoning or discourse. These momentary lapses can appear anywhere during an interview response, which can sometimes be quite long. Future research might timestamp the exact moment identified as an occurrence of unresolved discourse to detect changes in parasympathetic and sympathetic reactivity, for example, by measuring non-specific skin conductance responses.

In an exploratory analysis, we investigated participants' trajectories of ANS reactivity throughout the entire interview. IBI and RSA increased during the interview, but these trajectories

did not differ according to participants' classification of U/d. These findings can be explained using Porges' polyvagal theory (2007). Activity of the parasympathetic nervous system supports individuals' abilities to engage in social behaviour, which is needed to cope with the task of participating in the AAI. The exploratory findings for PEP indicated different trajectories of PEP according to participants' classification of unresolved/disorganised (U/d). Participants classified as U/d showed decreasing PEP across the interview, indicating increasing sympathetic reactivity. This might suggest that these participants experienced an increase in stress over the course of the interview, whereas for participants not classified as U/d, PEP increased. These participants might have felt nervous at the start of the interview, not knowing what to expect, and became increasingly comfortable over the course the interview. However, the findings on PEP should be interpreted with caution, because the standard errors were large.

Further, exploratory findings showed that participants classified as U/d had blunted skin conductance levels (SCL) over the course of the interview. A similar finding has been reported by Reijman et al. (2017), who showed that women classified as U/d had decreased SCLs when watching a video in which two animated ellipses, "parent" and "child", appeared to be separated from one another (Johnson et al., 2007). The authors cautiously suggested that the decreased SCLs of women classified as U/d might reflect passive emotional coping (sadness without crying; Kreibig, 2010), and also pointed to the potentially dissociative character of unresolved states of mind, as theorised by Main and Hesse (1992). Blunted SCLs have been found among persons with PTSD and dissociation and have been linked to early exposure to trauma and multiple types of trauma (D'Andrea et al., 2013). In line with Main and Hesse's (1992) thinking, responding to general questions about attachment relationships in the AAI may trigger attachment-related memories of frightening loss or abuse experiences, which may activate a dissociative state. However, this association has not been empirically tested, and the current study did not include measures of dissociation. There is some empirical evidence of the relation between unresolved states and dissociative symptomatology (Abrams et al., 2006; Riggs et al., 2007; Schuengel et al., 1999; Thomson & Jaque, 2004), but findings are not consistent (Madigan et al., 2012; Stovall-McClough & Cloitre, 2006). Further research is required to investigate the potential role of dissociation involved in unresolved states of mind. However, the principle of allostatic load (McEwen & Gianaros, 2010) may provide another explanation for the findings. Early experiences and environmental factors can influence the way in which individuals respond to stressful situations, in terms of behaviour as well as physiology. After prolonged or intense exposure to stress, allostatic systems – such as the ANS – may be unable to shut down or become exhausted, leading to wear and tear on the brain and body. This may result in either exaggerated or blunted physiological reactivity to stress (Lovallo, 2011). It could be that

discussing loss/trauma in the AAI is a stressful task and having an unresolved state of mind may create an additional challenge, leading to exhausted physical capacities to respond. In addition, there is evidence that cumulative risk factors (e.g., depressive symptoms and childhood poverty) could influence physiological stress reactivity and allostatic load (Evans & Kim, 2012; Sturge-Apple et al., 2013). Future research should focus on exploring these mechanisms.

The hypothesis-testing results showed no differences in parasympathetic (RSA) and sympathetic reactivity (SCL, PEP) in relation to participants' unresolved state of mind (U/d) and unresolved discourse. This is in contrast with previous studies outside of the field of attachment, in which participants with PTSD and/or dissociation showed aberrant sympathetic and parasympathetic nervous system responses when recalling traumatic memories (e.g., Chou et al., 2018; Sledjeski et al., 2012). This might be explained by differences in the study design. In trauma recall experiments, participants are often asked to close their eyes, bring to mind their most distressing traumatic experience, and describe the event vividly and in detail. In the AAI, interviewees are probed to discuss experiences of loss, and are briefly asked about potential abuse, but are not required to provide a rich description of events and may even choose to refrain from answering the questions. As mentioned previously, the loss/trauma questions in the AAI may therefore not have evoked specific parasympathetic or sympathetic responses or too weakly relative to the statistical power of the study. In 2014, Van IJzendoorn and Bakermans-Kranenburg wondered whether the unresolved classification on the AAI "shows sufficient incremental validity beyond established measures for posttraumatic stress symptomatology" (p. 165). This important question remains unanswered. In our study, expected correlates for PTSD (dysregulated parasympathetic and sympathetic nervous system reactivity) were not found in relation to unresolved states of mind in the AAI, offering some evidence that these are different constructs. One the other hand, it may still be possible that unresolved states and PTSD have similar characteristics, such as intrusions and behavioural avoidance (Harari et al., 2009; Nye et al., 2008; Stovall-McClough & Cloitre, 2006; see also Fearon & Mansell, 2001). Further research is required to establish the common and distinct phenomena of unresolved states and PTSD.

Strengths and limitations

This study used a comprehensive approach and a sample of considerable size to investigate the relation between unresolved loss and trauma and ANS reactivity. Although we employed robust statistical methods and pre-registered the analysis plan, we encountered some statistical constraints that did not allow us to model random slopes for the interview questions. This might explain why we were unable to demonstrate an interaction effect of responses to questions about loss/trauma and unresolved states of mind on indicators of parasympathetic and sympathetic reactivity. The small

effect sizes found for Hypothesis 1 and 3 should also be interpreted in the context of leaving out random slopes – including these would likely have explained more variance in ANS reactivity. Furthermore, the study baseline (asking for an orientation to the speaker's early family situation) was not ideal. This question might have already triggered some emotional response for participants with a history of adversity, and participants might have felt nervous during the first interview questions. Future studies should use a more neutral talking baseline.

Conclusions and implications

Overall, our findings suggest the need for further specification and clarification of theory. In line with Beijersbergen and colleagues' (2008) findings, this study found no effect of either unresolved states of mind and unresolved discourse on parasympathetic and sympathetic reactivity during recall of loss or trauma in the AAI. This might partially be explained by methodological limitations, but otherwise has significant implications for theory. Main and Hesse's explanations of unresolved loss and trauma (e.g., Main and Hesse, 1992) remain speculative, and at times there is a lack of specificity in the theory. This hindered us in knowing how to interpret the results of our study. If not attributed to methodological limitations, the results could represent a partial falsification of the theory. Or they could signal that the processes Main and colleagues are discussing are not relevant to specific parasympathetic and sympathetic nervous system responses.

Taken together, this study raised several questions regarding the current state of theory of unresolved states of mind. For example, Main and Hesse (1990) have explained unresolved states of mind as resulting from fear. However, our findings indicate that, during the AAI, persons with an unresolved state of mind may not experience fear as conceptualised by polyvagal theory (threat or danger; Porges, 2007). On the other hand, these persons might experience a kind of fear not being picked up by the physiological measures in our study. To further investigate the role of fear – both in unresolved states of mind and the caregiver-child attachment relationship – a next step could be to link caregivers' ANS responses to frightening/frightened parenting behaviours during interactions with their child (e.g., Main & Hesse, 1990; Lyons-Ruth et al., 1999). Another question raised by this study more broadly regards the psychological characteristics of unresolved states of mind. Some of the lapses in the monitoring of reasoning or discourse, as described by Main and colleagues (1991/1994; 2003), may not represent any fear or fright. Rather, these lapses might reflect the speaker's efforts to make sense of painful experiences during the interview, for example by manipulating their mind and diverting their attention away from difficult memories. Furthermore, there has been a lack of attention in the literature regarding the nature and psychological consequences of loss versus trauma in relation to U/d. To investigate assumptions about the "architecture" of unresolved states of mind, future studies would need sufficient statistical power

and/or detailed qualitative data. Another area of ambiguity is that over the years, Main and colleagues have given different interpretations of the term "dissociation" in relation to unresolved states of mind, sometimes referring to dissociated or segregated memory systems and in other instances referring to altered states of consciousness (Main & Hesse, 1992; Main & Morgan, 1996). Yet there is currently a lack of direct evidence to support these interesting ideas. Additionally, given the current state of knowledge it might even be possible that, for some persons, unresolved states of mind reflect other aspects of psychological functioning or childhood care (Lyons-Ruth et al., 2003).

In conclusion, this study was the first to link ANS responses directly to manifestations of unresolved loss and trauma in the AAI. Current findings indicate that persons with an unresolved state of mind may experience some physiological dysregulation throughout the entire interview, but questions remain about the psychological processes involved. Taken together, we argue that the theory of unresolved states of mind is still evolving, and more direct empirical evidence is needed to further articulate the psychological characteristics of unresolved states of mind.

5

Concluding Remarks

In a two-way dialogue between historical and empirical work, this thesis aimed to address some long-standing questions regarding the construct of an unresolved state of mind with respect to attachment. This thesis contributes towards further clarification of the unresolved state of mind construct by examining its historical context, psychometric characteristics, and psychophysiological mechanisms. This chapter presents an overview of the key findings and contributions, methodological limitations, and directions for further research.

The historical study described in Chapter 2 traced the emergence of the unresolved state of mind classification and examined assumptions about trauma in the construct. The paper shows that Bowlby's work on loss and trauma was a fundamental influence on the conceptualisation of unresolved states of mind. Yet the development of the unresolved state of mind construct should also be placed in the context of wider contemporary discourses of trauma, in particular posttraumatic stress disorder and discourses about child abuse. Further, the paper describes how the unresolved state of mind classification became a construct representing trauma in the relatively isolated field of attachment research, and by doing so, partly lost contact with wider disciplines of trauma research. This study contributes to the historiography of attachment theory as well as the history of conceptualisations of trauma.

The analysis of more than 1,000 Adult Attachment Interviews reported in Chapter 3 suggests that the current system for coding unresolved states of mind may not generalise well to other samples than the one originally studied by Main and colleagues (1985). The findings indicate a psychometric model of unresolved states of mind consisting of a combination of frequently occurring indicators of unresolved loss and abuse, with disbelief and psychologically confused statements about loss as core indices. Some indicators of unresolved loss and abuse were very rare in our sample. These indicators were fear of possession (unresolved loss), and confusion between the abusive person and the self, disorientation with regard to space, poetic phrasing, prolonged silences, and sudden changes of topic/moving away from the topic (unresolved abuse). We found no empirical basis for using these indicators for coding unresolved states of mind. This study contributes to research on the measurement properties of the Adult Attachment Interview (e.g., Bakermans-Kranenburg & Van IJzendoorn, 1993; Booth-LaForce &

Roisman, 2014; Raby et al., 2020; Roisman et al., 2007). The findings may also have implications for coding unresolved states of mind and aid previous efforts to make the Adult Attachment Interview more scalable (Caron et al., 2018).

Unresolved states of mind have been theorised to represent intrusions of fear-related memories or ideas about loss or abuse (e.g., Main & Hesse, 1992). The plausibility of this model was investigated in Chapter 4. N = 235 first-time pregnant women participated in the Adult Attachment Interview while indicators of autonomic nervous system reactivity were measured. Unresolved discourse about loss was associated with faster heart rate, which may indicate distress. However, the findings regarding parasympathetic and sympathetic nervous system reactivity in relation to unresolved discourse were differentiated. The equivocal findings may partially be due to methodological limitations, or they may provide a partial falsification of current theory of unresolved states of mind, such that unresolved discourse may not be associated with intrusions of fearful memories. Additional analyses indicated that participants with an unresolved state of mind showed anomalous sympathetic nervous system reactivity across the interview as a whole. This suggests that an unresolved state of mind may be conceptualised as a dysregulation in physiological arousal in the context of heightened attention to childhood memories. However, questions still remain about the psychological mechanisms involved. This study contribute to research on the psychophysiology of the Adult Attachment Interview (e.g., Beijersbergen et al., 2008; Dozier & Kobak, 1992; Roisman et al., 2004) as well as literature on psychophysiology and recall of trauma from the wider discipline of trauma research (e.g., Bernstein et al., 2013; Sack et al., 2004).

This thesis aimed to reappraise the construct of an unresolved state of mind by combining historical study and analysis of secondary empirical data. Taken together, the three studies contribute towards increased understanding of the meaning of the unresolved state of mind construct, both on a conceptual level and on the level of measurement. The combination of historical and empirical methods in this thesis has been essential for addressing questions regarding the conceptualisation and measurement of unresolved states of mind. For instance, it would not be possible to empirically investigate and interpret the linguistic patterns that are used to assess unresolved states of mind without understanding how the construct of an unresolved state of mind and its associated coding system were developed. Also, it would not be possible to explore psychological mechanisms underlying unresolved discourse without scrutiny of the meaning of unresolved discourse and how this has evolved over decades. In addition to providing clarification, this thesis also highlighted remaining questions about the current state of theory of unresolved states of mind, which may be addressed in future research.

Methodological limitations

A limitation of the historical study (Chapter 2) is that our access to sources has been limited. The study focused entirely on written records, and we did not have access to oral testimonies. Being able to draw on oral testimonies in addition to written material could have provided us with a more complete picture of how the unresolved state of mind construct was developed.

The empirical studies in Chapter 3 and 4 drew on secondary data. In Chapter 3, we analysed data that were originally recorded for other purposes than the current study. The use of secondary data has advantages, such as time efficiency and the availability of large samples. But there are also disadvantages of using existing data. In this context, a salient limitation is the lack of interrater reliability of the indicators marked for unresolved states of mind. In studies using the Adult Attachment Interview, interrater reliability is usually calculated and reported on the level of classifications. Interrater reliability of the scale scores is not commonly reported (but see Appendix A for exceptions) and no published studies so far have reported on the interrater reliability of individual indicators. The interrater reliability of individual indicators of unresolved loss/trauma may have varied across included study samples (in Chapter 3) and among coders (in Chapter 3 and 4), which may have increased measurement error. In both studies, we operationalised the study variables in ways that may have mitigated the influence of measurement error. Further, the discoveries from mining large existing datasets (Chapter 3) are not immediately suitable for prospective hypothesis testing research. Using existing data, we have gone some way towards exploring the psychometric characteristics of the unresolved state of mind construct. But new data may be needed to conduct a more detailed analysis of coding mechanisms and to provide more concrete suggestions for optimising the coding system of unresolved states of mind.

Directions for further research

This thesis contributed to further clarification of the nature and meaning of the unresolved state of mind construct, whilst also raising questions about the current state of theory of unresolved states of mind. As Scheel and colleagues (2021) proposed, exploratory research activities such as forming concepts and developing valid measures are important goals in themselves, and are necessary to make hypothesis testing work more informative. By sticking to the original conceptualisation and measurement of unresolved states of mind, the field has brought us to the point that we can more fully survey the phenomenon under study, bringing us to the brink of further theoretical and empirical development.

A natural direction for further research would be to articulate the psychological mechanisms of unresolved loss and abuse, and to improve understanding about how these experiences are

transmitted to the next generation. Future studies may focus on elucidating the theoretical links between unresolved states of mind and other constructs that describe psychological responses to intense and distressing experiences, for example, dissociative symptoms and memory disturbances such as in posttraumatic stress disorder. This may lead to more specific hypotheses about how loss and other attachment-related traumatic experiences are processed. Our study, which encompasses the work of the consortium members who collected the original data, may also inform future methodological innovations to create a more scalable and concise version of the coding system of unresolved states of mind. Future studies could test how a more concise coding system would relate to relevant outcomes, including frightening/frightened parental behaviour and infant disorganised attachment. A next step in historical work could be to explore how the unresolved state of mind construct is related to conceptualisations of dissociation in clinical and psychodynamic theory. Further historical research could also examine how Bowlby's work on bereavement processes in parents may have shaped Main and Hesse's conceptualisation of frightening/frightened parental behaviour.

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Appendix A: Studies Included in Individual Participant Data Meta-Analysis

This Appendix presents the original studies included in the individual participant data meta-analysis reported in Chapter 3 (*Exploring the Meaning of Unresolved Loss and Trauma in 1,000 Adult Attachment Interviews*). Descriptives of the included samples are reported in Table S1. Interrater reliability of the unresolved loss scale was available from Pace and Zavattini (2011) (ICC = 0.83), Raby et al. (2015) (ICC = 0.87), and Van Londen-Barentsen (2002) (ICC = 1.00). Interrater reliability of the unresolved abuse scale was available from Raby et al. (2015) (ICC = 0.94) and Pace and Zavattini (2015) (ICC = 0.63). Three studies had available interrater reliability data of infant disorganised attachment score: Bailey et al. (2017) (ICC = 0.85), Van Londen-Barentsen (2002) (ICC = 0.70), and Raby et al. (2015) (ICC = 0.99).

Table S1

Descriptives of Study Samples Included in Individual Participant Data Meta-Analysis

Study name	*N*	Measures	Interrater reliability of classifications		Distributions of classifications	
			AAI 4-way $\varkappa$	SSP 4-way $\varkappa$	Unresolved versus not-unresolved (%)	Disorganised versus not-disorganised (%)
Bailey et al. (2017), HC sample	48	AAI, SSP	0.78	0.78	31%	54%
Behrens et al. (2007)[a]	48	AAI, SRP	0.69	1.00	19%	–
Behrens et al. (2016)	64	AAI, SSP	0.90	0.74	11%	12%
Finger (2006)	148	AAI, SSP	–	–	45%	25%
Verhage (2013)	306	AAI, SSP	0.72	–	18%	18%
Gloger-Tippelt et al. (2002)	12	AAI, SSP	0.83	0.63	8%	17%
Van Londen-Barentsen (2002)	70	AAI, SSP	0.57	0.87	43%	24%
Klein Velderman et al. (2006), control group	26	AAI, SSP	0.66	0.82	27%	23%
Lionetti (2014)	29	AAI, SSP	0.82	0.77	14%	34%
Raby et al. (2015)	56	AAI, SSP	0.57	0.85	30%	29%
Pace & Zavattini (2011)[a]	31	AAI, SRP	0.72	–	6%	–
Schuengel et al. (1999)	81	AAI, SSP	0.73	–	22%	30%
Smith-Nielsen et al. (2015)	90	AAI, SSP	0.73	0.73	2%	2%

Note. AAI = Adult Attachment Interview (George et al., 1984, 1985, 1996); SSP = Strange Situation procedure (Ainsworth et al., 1978); SRP = Separation Reunion Procedure (Main & Cassidy, 1988). ICC = intraclass correlation coefficient.

[a] Studies not included in the analyses with infant disorganised attachment because the SRP was used to assess caregiver-child attachment.

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Appendix B: Frequencies and Correlations of Indicators of U/d

This Appendix contains supplementary descriptive data to the individual participant data meta-analysis reported in Chapter 3 (*Exploring the Meaning of Unresolved Loss and Trauma in 1,000 Adult Attachment Interviews*). Figure S1 presents the raw frequencies of the indicators of unresolved loss and abuse in the total sample (N = 1,009). Tables S1 and S2 show the correlation matrices of the indicators of unresolved loss and abuse.

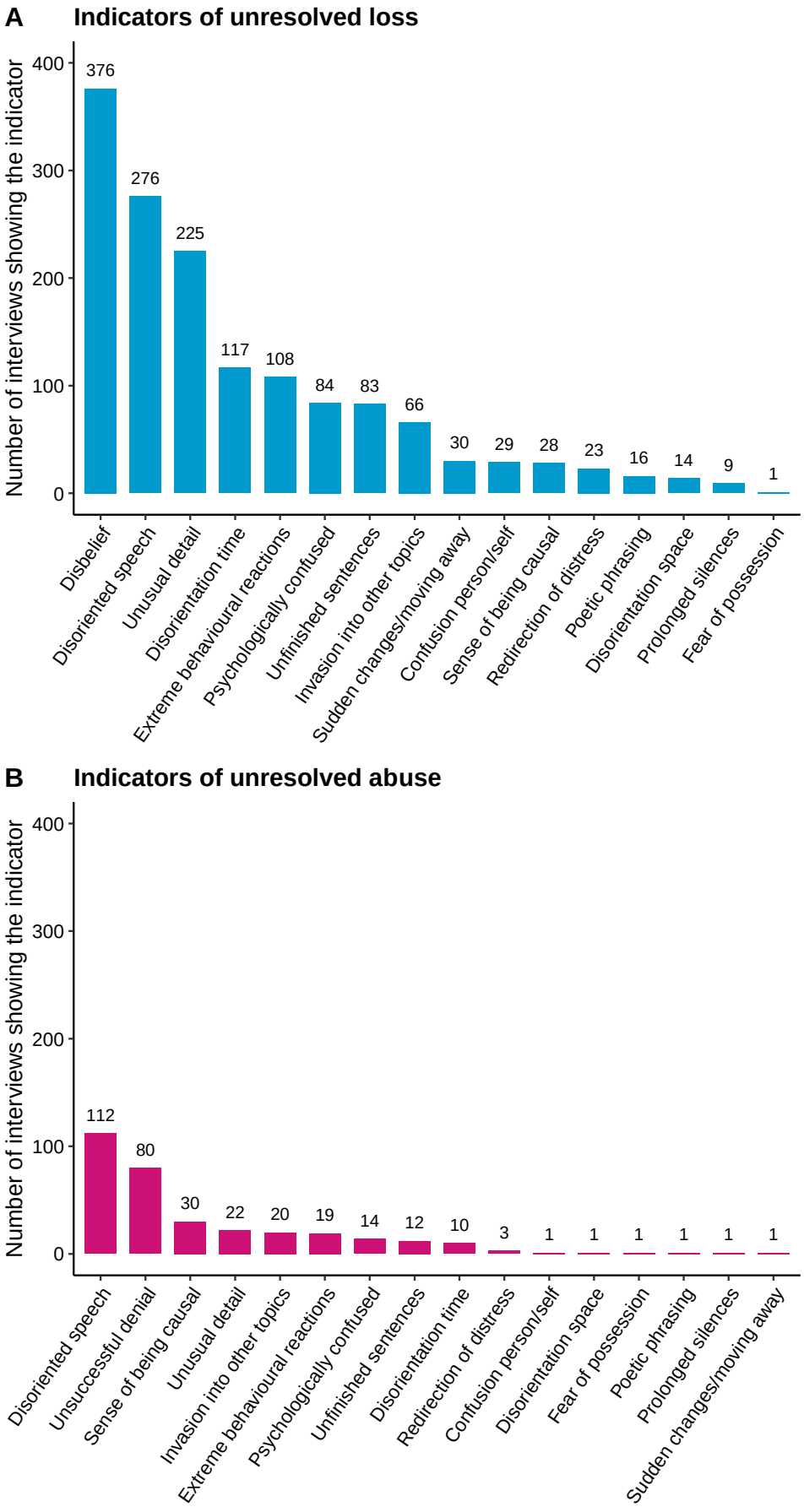

Figure S1. Raw frequency of occurrence of indicators of unresolved loss (A) and unresolved abuse (B).

Table S1

Correlation Matrix: Indicators of Unresolved Loss

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Disbelief															
2. Sense of being causal	0.180														
3. Confusion other/self	0.347	0.200													
4. Disorientation time	0.224	0.122	0.317												
5. Disorientation space	0.266	0.357	0.178	0.332											
6. Psych. confused statements	0.177	0.209	0.132	0.100	0.127										
7. Unusual attention to detail	0.501	0.256	0.316	0.271	0.299	0.127									
8. Poetic phrasing	0.067	0.159	0.015	0.290	0.142	-0.180	0.179								
9. Prolonged silences	0.171	0.272	0.266	0.163	0.240	0.061	0.001	0.218							
10. Unfinished sentences	0.119	0.145	-0.040	0.075	0.243	0.004	0.094	0.208	0.365						
11. Sudden change/moving away	0.143	0.387	0.029	0.212	0.172	-0.051	0.336	0.314	0.440	0.478					
12. Invasion into other topics	0.507	-0.122	0.112	0.365	0.294	0.025	0.497	-0.314	-0.030	-0.080	-0.136				
13. Redirection of distress	0.295	-0.043	0.081	-0.068	0.079	0.264	0.207	0.055	0.157	0.197	0.075	0.441			
14. Extreme behavioural reactions	0.420	0.256	0.421	0.202	-0.206	0.097	0.516	-0.113	-0.126	0.038	0.124	0.436	0.131		
15. Disoriented speech	0.304	0.103	0.089	0.376	0.093	0.000	0.368	0.179	0.064	0.205	0.192	0.365	-0.075	0.188	
16. Fear of possession	0.096	0.569	0.564	0.355	0.654	0.411	0.226	0.638	0.704	0.413	0.560	0.449	0.594	0.369	0.179

Table S2

Correlation Matrix: Indicators of Unresolved Abuse

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Unsuccessful denial															
2. Sense of being causal	0.680														
3. Psych. confused statements	0.251	0.172													
4. Fear of possession	0.419	0.560	0.654												
5. Disoriented speech	0.522	0.317	0.653	0.363											
6. Confusion other/self	0.419	0.560	0.654	0.923	0.363										
7. Disorientation time	-0.086	0.239	0.558	0.692	0.617	0.692									
8. Disorientation space	0.419	0.560	0.654	0.923	0.363	0.923	0.692								
9. Unusual attention to detail	0.135	0.083	0.087	0.599	0.737	0.599	0.295	0.599							
10. Poetic phrasing	0.419	0.560	0.654	0.923	0.363	0.923	0.692	0.923	0.599						
11. Prolonged silences	0.419	0.560	0.654	0.923	0.363	0.923	0.692	0.923	0.599	0.923					
12. Unfinished sentences	0.175	0.060	0.343	0.672	0.669	0.672	0.248	0.672	0.114	0.672	0.672				
13. Sudden change/moving away	0.419	0.560	0.654	0.923	0.363	0.923	0.692	0.923	0.599	0.923	0.923	0.672			
14. Invasion into other topics	0.159	0.266	0.423	0.611	0.711	0.611	0.493	0.611	0.718	0.611	0.611	0.277	0.611		
15. Redirection of distress	0.328	0.493	0.811	0.818	0.522	0.818	0.482	0.818	0.364	0.818	0.818	0.456	0.818	0.379	
16. Extreme behavioural reactions	0.258	0.277	0.710	0.617	0.778	0.617	0.322	0.617	0.341	0.617	0.617	0.464	0.617	0.050	0.563

Appendix C: Supplementary Data to Latent Class Analysis of Indicators of U/d

This Appendix contains supplementary data to the latent class analysis of indicators of unresolved loss and abuse as reported in Chapter 3 (*Exploring the Meaning of Unresolved Loss and Trauma in 1,000 Adult Attachment Interviews*). Latent class analysis was used to investigate patterns of indicators of unresolved loss/abuse that differentiate interviewees with and without unresolved loss/abuse. The analysis identified high-lapsing and low-lapsing unresolved loss and unresolved abuse classes. Table S1 and S2 show the bivariate residuals from the latent class analysis. Results from the multilevel analysis on associations between latent class probabilities with unresolved scores, unresolved classifications, and infant disorganised attachment are also reported.

Table S1

Latent Class Analysis: Bivariate Residuals of Indicators of Unresolved Loss

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Disbelief															
2. Sense of being causal	0.314														
3. Confusion other/self	0.612	0.166													
4. Disorientation time	1.151	0.066	1.843												
5. Disorientation space	0.038	1.954	0.013	1.360											
6. Psych. confused statements	0.056	1.033	0.061	0.017	0.018										
7. Unusual attention to detail	0.757	0.001	0.081	0.558	0.000	0.495									
8. Poetic phrasing	0.101	0.263	0.704	3.062	0.352	0.495	0.214								
9. Prolonged silences	0.063	1.088	0.897	0.179	0.221	0.002	0.716	0.184							
10. Unfinished sentences	0.033	0.449	0.481	0.000	1.454	0.131	0.135	1.715	5.792						
11. Sudden change/moving away	0.352	5.521	0.191	0.497	0.062	0.653	1.486	3.203	7.238	24.117					
12. Invasion into other topics	3.528	2.496	0.443	2.382	0.303	1.023	2.335	1.804	1.143	1.989	2.395				
13. Redirection of distress	1.006	1.137	0.021	1.471	0.642	2.665	0.000	0.503	0.305	1.395	0.003	7.336			
14. Extreme behavioural reactions	0.464	0.297	4.184	0.375	4.730	0.253	3.534	1.098	1.926	0.387	0.140	3.008	0.046		
15. Disoriented speech	0.004	0.451	1.132	6.535	0.768	2.456	0.112	0.630	0.050	2.997	0.185	1.515	3.063	2.039	
16. Fear of possession	0.207	131.237	0.005	0.041	0.000	0.053	0.034	0.010	0.005	0.065	0.012	0.000	0.009	0.011	0.159

Table S2

Latent Class Analysis: Bivariate Residuals of Indicators of Unresolved Abuse

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Unsuccessful denial															
2. Sense of being causal	18.864														
3. Psych. confused statements	0.550	0.431													
4. Fear of possession	2.158	6.454	0.090												
5. Disoriented speech	1.335	5.348	0.224	0.454											
6. Confusion other/self	0.466	0.156	0.090	0.006	0.454										
7. Disorientation time	4.780	0.106	1.969	0.066	0.008	15.382									
8. Disorientation space	0.466	0.156	0.090	0.006	0.454	0.006	0.066								
9. Unusual attention to detail	3.312	1.558	2.162	0.152	1.100	0.152	0.092	0.152							
10. Poetic phrasing	0.466	0.156	0.090	0.006	2.212	0.006	0.066	0.006	0.152						
11. Prolonged silences	0.466	0.156	0.090	0.006	0.454	0.006	0.066	0.006	0.152	0.006					
12. Unfinished sentences	0.977	1.789	0.012	0.073	0.726	0.073	0.768	13.814	1.760	0.073	0.073				
13. Sudden change/moving away	0.466	0.156	0.090	0.006	0.454	0.006	0.066	0.006	0.152	0.006	0.006	0.073			
14. Invasion into other topics	2.748	0.224	0.098	0.141	0.371	0.141	0.586	7.174	9.340	0.141	0.141	0.113	0.141		
15. Redirection of distress	0.004	1.029	13.872	0.019	0.007	0.019	0.200	0.019	0.462	53.553	0.019	0.222	0.019	0.427	
16. Extreme behavioural reactions	1.060	0.152	9.269	7.605	2.188	0.133	0.028	0.133	0.129	0.133	7.605	0.468	0.133	2.978	1.387

Associations between latent class probabilities with unresolved scores, unresolved classifications, and infant disorganised attachment

Multilevel linear regression analysis was used to test associations between the latent class probabilities with unresolved scores, unresolved classifications, and infant disorganised attachment scores.

Associations between latent classes and unresolved scores. The unconditional means (intercept-only) model with unresolved score as the dependent variable revealed that 18% of the variance in unresolved scores was accounted for by differences between studies. The predicted probability of belonging to the high-lapsing unresolved loss class significantly improved the model fit ($\chi^2(1) = 442.06, p < .001$) and was significantly associated with higher unresolved scores ($B = 3.05$, $SE = 0.13$, $p < .001$). The predicted probability of belonging to the high-lapsing unresolved abuse class also significantly improved the model fit compared to the unconditional means model ($\chi^2(1) = 134.13, p < .001$) and was significantly associated with higher unresolved scores ($B = 2.11$, $SE = 0.18$, $p < .001$).

Associations between latent classes and unresolved classifications. An unconditional means model was estimated with unresolved classification as the outcome variable. The predicted probability of belonging to the high-lapsing unresolved loss class significantly improved the model fit ($\chi^2(1) = 171, p < .001$) and was significantly associated with unresolved classifications ($B = 3.01$, $SE = 0.25$, $p < .001$). The predicted probability of the high-lapsing unresolved abuse class also significantly improved the model fit compared to the unconditional means model ($\chi^2(1) = 77.18, p < .001$) and was significantly associated with unresolved classifications ($B = 2.06$, $SE = 0.24$, $p < .001$).

Associations between latent classes and infant disorganised attachment scores. The unconditional means model with infant disorganised attachment score as the dependent variable revealed that 10% of the variance in infant disorganisation was accounted for by differences between studies. The predicted probability of belonging to the high-lapsing unresolved loss class did not improve the model fit ($\chi^2(1) = 2.56, p = .110$) and was not significantly associated with infant disorganised attachment score ($B = 0.32$, $SE = 0.20$, $p = 0.108$). The predicted probability of belonging to the high-lapsing unresolved abuse class did also not improve the model fit compared to the unconditional means model ($\chi^2(1) = 2.94, p = .086$) and was not significantly associated with infant disorganisation ($B = 0.39$, $SE = 0.23$, $p = 0.084$).

Appendix D: Out-of-Sample Performance of Predictive Models

This Appendix contains supplementary data to the predictive models that were used to define a psychometric model underlying classifications of U/d, as reported in Chapter 3 (*Exploring the Meaning of Unresolved Loss and Trauma in 1,000 Adult Attachment Interviews*).

As described in Chapter 3, we tested nine predictive models for continuous outcomes, using the indicators of unresolved loss/abuse as predictors and unresolved scores as the outcome. The models' predictive performance was first examined by comparing the root mean square errors (RMSE). As seen in Table S1, the support vector machine (SVM) with a polynomial kernel showed the best performance (lowest RMSE) for predicting unresolved score. However, as the RMSE only provides an overall indicator of model performance and does not distinguish between different dimensions of performance (e.g., precision and sensitivity), it is insufficient as an indicator of how well the models can differentiate interviews with and without an unresolved classification. Therefore, we did not use the RMSE to choose a final model.

Table S1

Out-of-Sample Performance of Predictive Models for Unresolved Score

Model	RMSE
Linear regression (ordinary least squares)	1.119
Lasso regression	1.121
Ridge regression	1.120
Multivariate adaptive regression splines	1.144
Logic regression	1.136
Random forest	1.133
Support vector machine: linear kernel	1.132
Support vector machine: polynomial kernel	1.072
Support vector machine: radial kernel	1.122

Note. RMSE = root mean squared error.

Precision and sensitivity of unresolved scores predicting U/d classifications

The models' predictive performance was then evaluated based on the sensitivity and specificity for unresolved classifications. Figure S1 shows the precision of unresolved scores predicting unresolved classifications at classification threshold scores of 3, 5, and 7. The highest precision at threshold score 5 (the AAI coding manual's threshold for unresolved classification) was shown by the lasso model: 88% of unresolved classifications predicted by the model were actually given unresolved classifications.

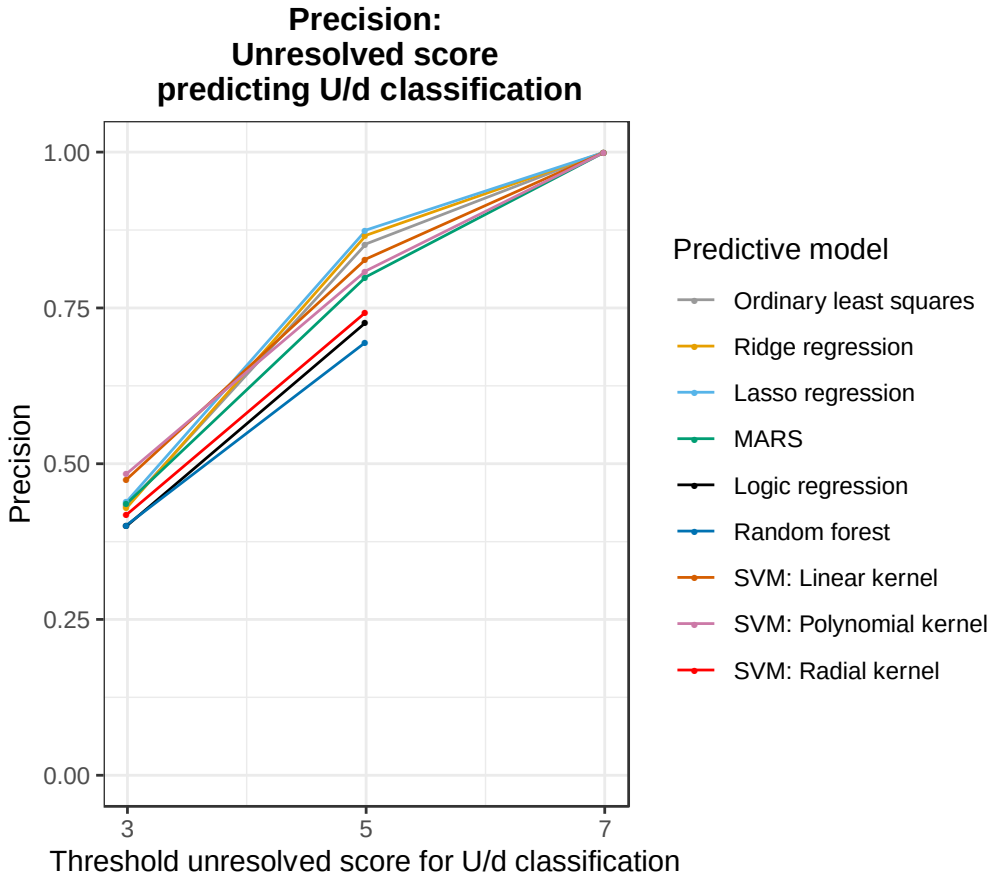

Figure S1. Precision for unresolved classification by threshold unresolved scores of 3, 5, and 7. Note: at threshold score 7, the SVM with a radial kernel, the logic regression model, and the random forest did not identify any unresolved classifications, hence the missing data points.

Figure S2 shows the sensitivity of unresolved scores predicting unresolved classifications at classification threshold scores of 3, 5, and 7. The highest sensitivity at threshold score 5 was achieved by the SVM with a polynomial kernel: 50% of participants classified as unresolved were correctly predicted by the model.

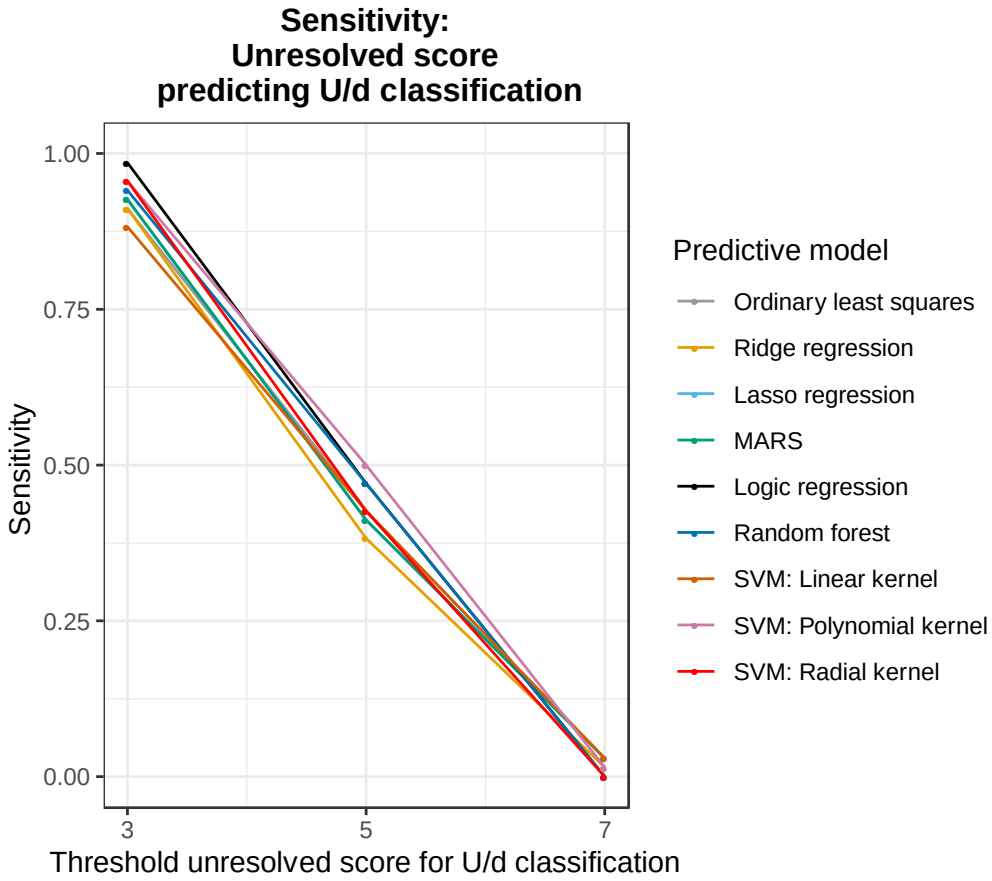

Figure S2. Sensitivity for unresolved classification by threshold unresolved scores of 3, 5, and 7.

Precision and sensitivity of unresolved scores predicting infant D attachment

We also evaluated the models' predictive performance based on the sensitivity and specificity for infant disorganised attachment classifications. Figure S3 shows the precision of unresolved scores predicting infant disorganised attachment at classification threshold scores of 3, 5, and 7. The highest precision at threshold score 5 (the AAI coding manual's threshold for unresolved classification) was achieved by the logic regression model: 36% of infant disorganised attachment classifications predicted by the model were true classifications.

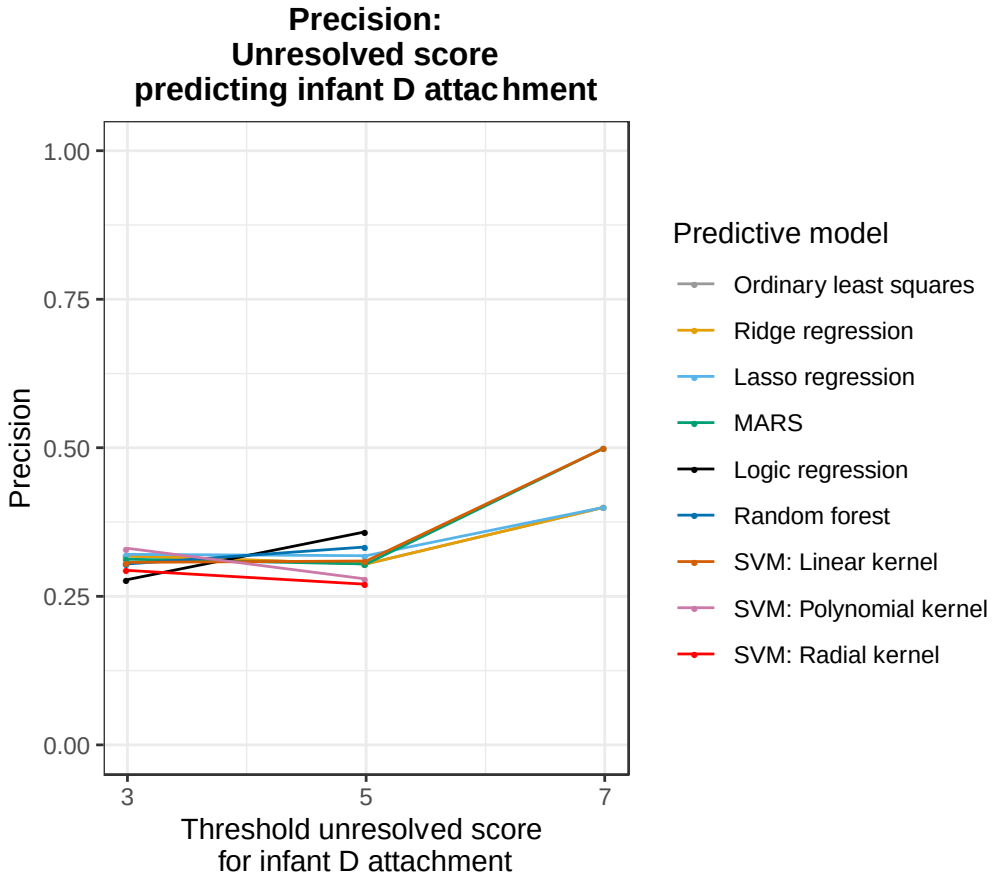

Figure S3. Precision for infant disorganised classification by threshold unresolved scores of 3, 5, and 7. Note: at threshold unresolved score 5, the logic regression model, random forest, SVM with a polynomial kernel, and the SVM with a radial kernel did not identify any infant disorganised attachment classifications, hence the missing data points.

Figure S4 shows the sensitivity of unresolved scores predicting infant disorganised attachment at classification threshold scores of 3, 5, and 7. The highest sensitivity at threshold score 5 was shown by the random forest: 27% of infants classified as disorganised were correctly predicted by the model.

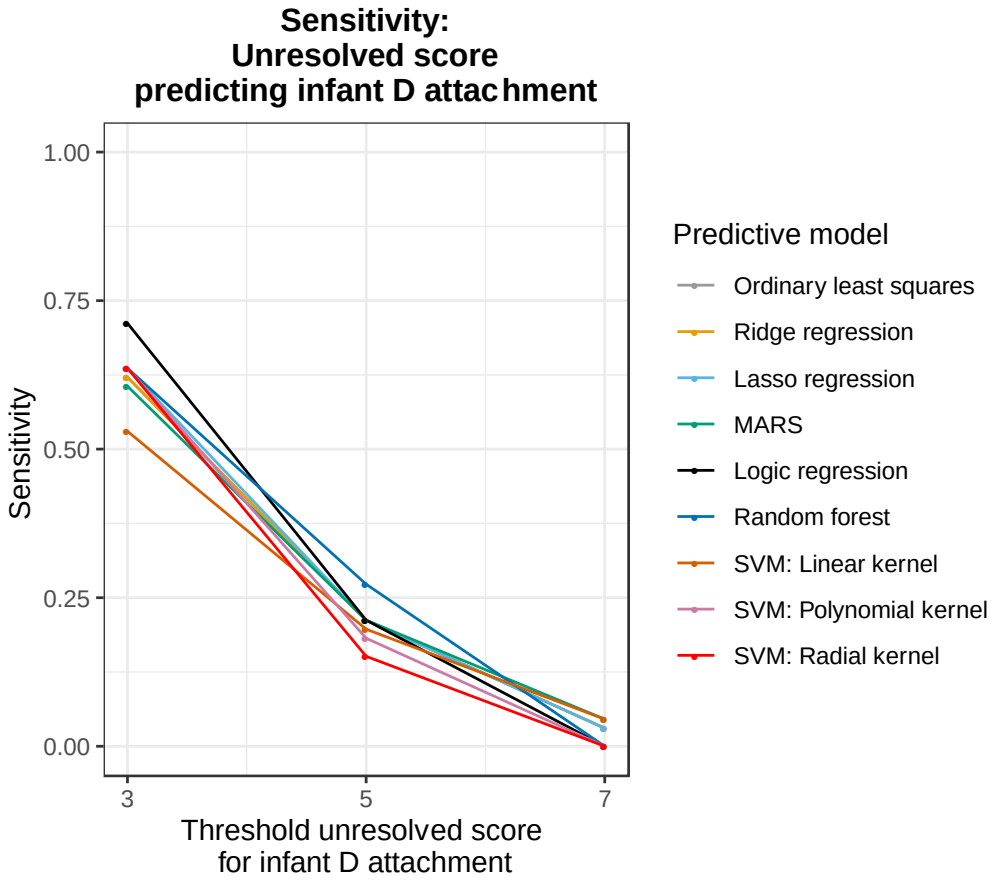

Figure S4. Sensitivity for infant disorganised classification by threshold unresolved scores of 3, 5, and 7.

Appendix E: Exploratory Factor Analysis of Indicators of U/d

This Appendix presents the findings of an exploratory factor analysis (EFA) of the indicators of unresolved loss. This analysis was conducted using the individual participant data on indicators of unresolved loss as described in Chapter 3 (*Exploring the Meaning of Unresolved Loss and Trauma in 1,000 Adult Attachment Interviews*). This analysis was not pre-registered.

The covariance structure of the indicators of unresolved loss was examined using EFA in Mplus version 7.4 (Muthén & Muthén, 2015) with oblique geomin rotation, which allows factors to be correlated. Separate analyses were attempted for indicators of unresolved loss and unresolved abuse (dichotomous; lapse not present/lapse present). To account for the clustering of participants within 13 study samples, the "type = complex" option was used, which adjusted the standard errors for non-independence of observations. This method is appropriate when the number of clusters is >20, therefore, the study samples were randomly split to obtain $n = 26$ clusters. Parameters were estimated using weighted least square mean and variance adjusted (WLSMV), which is an appropriate estimator for EFA with categorical variables (Muthén & Muthén, 2015). The number of extracted factors was determined by examination of the scree plot.

First, an EFA was conducted with all 16 indicators of unresolved loss. However, bivariate residuals involving the following indicators yielded empty cells, and these were therefore not included in the analysis: poetic phrasing with a memory quality, prolonged silences, invasion of loss into other topics, redirection of distress, extreme behavioural reactions, and fears of being possessed. Models with >2 factors could not be estimated due to non-convergence. Therefore, only the one and two-factor solutions were examined. The scree plot suggested that the two-factor solution was more optimal than the one-factor solution. The factor loadings are presented in Table S1. A chi-squared test of model fit indicated that the two-factor solution was a significantly better fit to the data than the one-factor solution ($\chi^2(9) = 20.92$, $p = .013$). The factors in the two-factor solution were not significantly correlated ($r = 0.30$, $p = 0.072$).

Table S1

Results From the Factor Analysis of Indicators of Unresolved Loss

	One-factor solution	Two-factor solution	
		Factor 1	Factor 2
Disbelief	0.646*	**0.685***	-0.015
Sense of being causal	0.356*	0.238	0.206
Confusion between dead person/self	0.397*	**0.548***	-0.203
Disorientation with regard to time	0.457*	**0.391***	0.142
Disorientation with regard to space	0.464*	**0.389**	0.153
Psychologically confused statements	0.187	**0.257***	-0.087
Unusual attention to detail	0.689*	**0.677***	0.124
Unfinished sentences	0.293*	-0.088	**0.564**
Sudden change of topic/moving away	0.543*	0.005	**0.876***
Disoriented speech	0.445*	**0.328***	0.258
Eigenvalue	2.932	1.434	

Note. * $p < .05$

When attempting to conduct an EFA with all 16 indicators of unresolved abuse, all bivariate residuals yielded empty cells. This was possibly due to the near-zero variance of most of the variables. Only two variables had sufficient variance to be included in the analysis. Because it is not useful to conduct a factor analysis with only two variables, we did not run this analysis.

Appendix F:
Supplementary Psychophysiological Data

This Appendix contains supplementary data to the psychophysiology study reported in Chapter 4 (*Psychophysiological Responses Underlying Loss and Trauma*). Table S1 shows the frequencies of discussions of loss, trauma, and unresolved discourse per interview question. Tables S2-S5 present supplementary data from the hypothesis testing analyses and exploratory analyses.

These data have been published as supplementary material for: Bakkum, L., Oosterman, M., Verhage, M. L., Kunseler, F. C., Fearon, R. M. P., Schuengel, C., & Duschinsky, R. (2020). Psychophysiological responses underlying unresolved loss and trauma in the Adult Attachment Interview. *Development and Psychopathology*, 1–16. https://doi.org/10.1017/S0954579420001492.

Table S1

Frequencies of Participants' Discussions of Loss and Trauma and Unresolved Discourse per Interview Question

Question	Loss discussed *n*	Trauma discussed *n*	Unresolved discourse *n*
1. Orientation (baseline)	134	2	10
2. Describe relationship	12	10	9
3. Adjectives mother	15	10	7
4. Adjectives father	15	16	10
5. Which parent closest	12	2	3
6. Upset/hurt/ill	15	10	5
7. Separation	7	2	2
8. Rejection	3	3	2
8a. Frightened/worried	5	5	5
9. Abuse	3	83	59
10. Effects	9	8	4
11. Why did parents behave	3	–	3
12. Other adults	21	1	2
13. Loss	232	–	150
14. Other trauma	4	20	10
15. Changes relationship	5	4	3
16. Current relationship	5	–	–
17. Separation own child	–	–	–
18. Wishes own child	–	–	–
19. Gains early experiences	2	–	–
20. Own child in 20 years	–	–	–

Note. Discussion of loss/trauma and unresolved discourse about loss/trauma were dichotomously coded. Unresolved responses were rated by the Main and Goldwyn (1994) coding system.

Supplementary data Hypothesis 1: The effects of responding to questions about loss/trauma on ANS reactivity, and moderation by unresolved status

Table S2 shows the models for Hypothesis 1 (*It was hypothesised that responses to questions about loss/trauma would be associated with changes in ANS reactivity, and that this association would be moderated by unresolved status*) but with the interview questions and responses combined in a variable (~10,190 within-subject observations).

Table S2

Hypothesis 1: The Effects of Responding to Questions About Loss and Trauma on ANS Reactivity, and Moderation by Unresolved/Disorganised Status

	IBI (ms)		lnRSA (ms)		PEP (ms)		SCL (μS)	
Fixed effects	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS
Model 1								
Intercept	719.78 (5.39)		4.06 (0.03)***		92.85 (1.26)***		5.79 (0.18)	
Model 2		947***		499***		62***		706***
Intercept	681.91 (5.56)***		3.82 (0.03)***		92.76 (1.28)***		5.61 (0.18)***	
Loss question	61.28 (2.64)***		0.08 (0.05)		1.58 (0.49)**		0.21 (0.03)***	
Loss response	40.01 (2.69)***		0.40 (0.04)***		-0.31 (0.50)		0.88 (0.07)***	
Abuse question	44.79 (2.63)***		-0.17 (0.05)***		0.99 (0.49)*		0.22 (0.03)***	
Abuse response	36.69 (2.70)***		0.36 (0.04)***		-1.11 (0.50)*		0.89 (0.08)***	
Other trauma question	60.74 (2.63)***		0.16 (0.04)***		-0.20 (0.49)		0.24 (0.03)***	
Other trauma response	47.11 (2.72)***		0.37 (0.04)***		-0.34 (0.50)		0.96 (0.07)***	
Model 3		0		1		0		0
Intercept	680.22 (6.25)***		3.80 (0.04)***		92.62 (1.44)***		5.69 (0.20)***	
Loss question	61.28 (2.64)***		0.08 (0.05)		1.58 (0.49)**		0.21 (0.03)***	
Loss response	40.01 (2.69)***		0.40 (0.04)***		-0.31 (0.50)		0.88 (0.07)***	
Abuse question	44.79 (2.63)***		-0.17 (0.05)***		0.99 (0.49)*		0.22 (0.03)***	
Abuse response	36.69 (2.70)***		0.36 (0.04)***		-1.11 (0.50)*		0.89 (0.08)***	
Other trauma question	60.74 (2.63)***		0.16 (0.04)***		-0.20 (0.49)		0.24 (0.03)***	
Other trauma response	47.11 (2.72)***		0.37 (0.04)***		-0.34 (0.50)		0.96 (0.07)***	
U/d status	7.79 (13.11)		0.09 (0.07)		0.64 (3.06)		-0.41 (0.43)	
Model 4		24		26		35**		30*
Intercept	681.26 (6.30)***		3.81 (0.04)		92.12 (1.45)***		5.65 (0.20)***	
Loss question	61.68 (2.99)***		0.07 (0.05)		1.88 (0.56)**		0.25 (0.04)***	
Loss response	39.88 (3.04)***		0.40 (0.04)***		0.15 (0.56)		0.98 (0.08)***	
Abuse question	45.18 (2.97)***		-0.16 (0.05)**		1.34 (0.55)*		0.26 (0.04)***	
Abuse response	35.78 (3.06)***		0.36 (0.04)***		-0.70 (0.56)		1.00 (0.08)***	

Table S2 Continued

Fixed effects	IBI (ms) *B (SE)*	lnRSA (ms) *B (SE)*	PEP (ms) *B (SE)*	SCL (μS) *B (SE)*
Model 4 Continued				
Other trauma question	62.53 (2.99)***	0.13 (0.05)**	0.68 (0.56)	0.26 (0.04)***
Other trauma response	45.70 (3.08)***	0.35 (0.04)***	0.40 (0.56)	1.02 (0.08)***
U/d status	3.18 (13.50)	0.08 (0.08)	2.86 (3.12)	-0.23 (0.44)
Loss question × U/d status	-2.06 (6.38)	0.05 (0.11)	-1.29 (1.20)	-0.16 (0.08)*
Loss response × U/d status	0.39 (6.50)	0.02 (0.09)	-2.02 (1.19)	-0.46 (0.18)*
Abuse question × U/d status	-1.80 (6.37)	-0.08 (0.14)	-1.49 (1.21)	-0.16 (0.08)*
Abuse response × U/d status	4.02 (6.54)	0.03 (0.09)	-1.80 (1.20)	-0.52 (0.18)**
Other trauma question × U/d status	-7.93 (6.31)	0.13 (0.09)	-3.88 (1.18)**	-0.12 (0.08)
Other trauma response × U/d status	6.27 (6.54)	0.07 (0.09)	-3.34 (1.21)**	-0.32 (0.18)

Note. ΔDS = decrease in deviance statistic (Log-likelihood). U/d = classification of unresolved/disorganised. All interview questions and responses were included in the analyses (10109 within-subject observations), but only the questions about loss/trauma are reported in this Table. The interview questions and responses were coded as dummy variables with the first question and response to the first question as references.
* $p < .05$ ** $p < .01$ *** $p < .001$

Supplementary data Hypothesis 2: The association between discussion of loss/trauma anywhere in the interview and ANS reactivity, and moderation by unresolved status

Table S3 shows the full models for Hypothesis 2 in Chapter 4 (*It was hypothesised that discussion of loss/trauma anywhere in the interview would be associated with changes in ANS reactivity, and that this association would be moderated by unresolved status*). For these analyses, we used a combined variable of discussion of loss/trauma (0 = no loss/trauma discussed, 1 = loss/trauma discussed).

In addition to the main analyses reported in Chapter 4, the analyses for Hypothesis 2 were performed with separate variables indicating discussion of loss *or* trauma. The results of these analyses are reported in the text below.

IBI. The model fit improved when discussions of loss/trauma were added to the model with the interview responses ($\chi^2(6) = 827.91$, $p < .001$). Discussion of loss was significantly associated with smaller IBIs, indicating higher heart rate ($B = -5.89$, $SE = 2.09$, $p = .005$). There was no signification relation between discussing trauma and IBI ($B = 0.95$, $SE = 2.39$, $p = .691$). In the next step, unresolved/disorganised status was added as predictor, but this did not improve the model fit ($\chi^2(1) = 0.362$, $p = .547$). Nor did the model fit improve when the interaction between discussion of loss/trauma and unresolved/disorganised status was added ($\chi^2(2) = 1.902$, $p = .386$).

RSA. The model fit improved when discussions of loss/trauma were added as predictors ($\chi^2(6) = 31.94$, $p < .001$). However, there was no significant relation between RSA and discussing loss ($B = 0.04$, $SE = 0.02$, $p = .080$) or discussion of trauma ($B = 0.04$, $SE = 0.03$, $p = .106$). The model fit did not improve when unresolved/disorganised status was added as predictor ($\chi^2(1) = 1.46$, $p = .227$). Nor did the model fit improve when the interaction term was added ($\chi^2(2) = 1.13$, $p = .567$).

PEP. The model fit improved when discussions of loss/trauma were added as predictors ($\chi^2(6) = 404.01$, $p < .001$). However, there was no significant relation between PEP and discussion of loss ($B = 0.05$, $SE = 0.41$, $p = 0.903$) or discussion of trauma ($B = -0.61$, $SE = 0.48$, $p = 0.203$). Including unresolved/disorganised status as predictor did not improve the model fit ($\chi^2(1) = 0.04$, $p = .840$). Nor did the model fit improve when the interaction term was added ($\chi^2(2) = 1.12$, $p = .570$).

SCL. The model fit improved when discussions of loss/trauma were added as predictors ($\chi^2(6) = 3580.80$, $p < .001$). Discussion of loss was associated with higher SCL ($B = 0.16$, $SE = 0.06$, $p = .011$), but there was no association between discussion of trauma and SCL ($B = -0.09$, $SE = 0.08$, $p = .257$). In the next step, unresolved/disorganised status was added as predictor,

but this did not improve the model fit ($\chi^2(1) = 1.491$, $p = .222$). Nor did the model fit improve when the interaction term was added ($\chi^2(2) = 1.37$, $p = .503$).

Table S3

Hypothesis 2: The Association Between Discussion of Actual Loss/Trauma and ANS Reactivity, and Moderation by Unresolved/Disorganised Status

	IBI (ms)		lnRSA (ms)		PEP (ms)		SCL (μS)	
Fixed effects	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS
Model 1								
Intercept	714.37 (5.31)***		4.19 (0.03)***		92.43 (1.27)***		5.55 (0.17)***	
Model 2		369***		104***		25***		79***
Intercept	675.86 (5.60)***		4.11 (0.03)***		91.64 (1.31)***		5.48 (0.18)***	
2. Describe relationship	1.38 (1.90)		0.03 (0.02)		-0.23 (0.41)		0.24 (0.04)***	
3. Adjectives mother	18.32 (2.27)***		-0.01 (0.03)		0.31 (0.47)		0.41 (0.05)***	
4. Adjectives father	18.32 (2.43)***		0.02 (0.03)		0.22 (0.49)		0.56 (0.06)***	
5. Which parent closest	32.85 (2.49)***		0.02 (0.03)		1.47 (0.50)**		0.54 (0.07)***	
6. Upset/hurt/ill	35.68 (2.52)***		0.09 (0.03)**		0.78 (0.50)		0.43 (0.08)***	
7. Separation	35.46 (2.54)***		0.05 (0.03)		1.02 (0.50)*		0.32 (0.08)***	
8. Rejection	40.89 (2.54)***		-0.01 (0.03)		1.89 (0.50)***		0.30 (0.08)***	
8a. Frightened/worried	38.43 (2.55)***		0.02 (0.03)		1.04 (0.50)*		0.25 (0.09)**	
9. Abuse	42.71 (2.54)***		0.08 (0.03)**		0.03 (0.50)		0.35 (0.09)***	
10. Effects	42.66 (2.54)***		0.12 (0.03)***		0.75 (0.50)		0.20 (0.09)*	
11. Why did parents behave	43.42 (2.55)***		0.09 (0.03)***		1.15 (0.50)*		0.09 (0.09)	
12. Other adults	49.52 (2.56)***		0.07 (0.03)*		1.26 (0.50)*		-0.004 (0.10)	
13. Loss	46.16 (2.54)***		0.12 (0.03)***		0.79 (0.50)		0.06 (0.10)	
14. Other trauma	53.33 (2.55)***		0.08 (0.03)**		0.78 (0.50)		0.05 (0.10)	
15. Changes relationship	45.67 (2.55)***		0.14 (0.03)***		1.30 (0.50)**		-0.08 (0.10)	
16. Current relationship	51.66 (2.55)***		0.15 (0.03)***		0.45 (0.50)		-0.15 (0.10)	

Table S3 Continued (1)

	IBI (ms)		lnRSA (ms)		PEP (ms)		SCL (µS)	
Fixed effects	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS
Model 2 Continued								
17. Separation own child	53.31 (2.55)***		0.21 (0.03)***		1.03 (0.50)*		-0.04 (0.10)	
18. Wishes own child	59.38 (2.55)***		0.16 (0.03)***		0.28 (0.50)		-0.007 (0.10)	
19. Gains early experiences	57.56 (2.55)***		0.15 (0.03)***		0.91 (0.50)		-0.12 (0.10)	
20. Own child in 20 years	62.66 (2.55)***		0.14 (0.03)***		1.34 (0.50)**		-0.14 (0.10)	
Model 3		415***		16***		202***		1798***
Intercept	678.11 (5.70)***		4.09 (0.04)***		91.76 (1.33)***		5.42 (0.18)***	
2. Describe relationship	-0.54 (2.55)		0.05 (0.03)		-0.31 (0.51)		0.25 (0.08)**	
3. Adjectives mother	16.40 (2.50)***		0.01 (0.03)		0.25 (0.50)		0.45 (0.08)***	
4. Adjectives father	24.30 (2.51)***		0.04 (0.03)		0.13 (0.50)		0.62 (0.08)***	
5. Which parent closest	30.33 (2.58)***		0.04 (0.03)		1.34 (0.52)		0.61 (0.08)***	
6. Upset/hurt/ill	33.68 (2.54)***		0.11 (0.03)***		0.70 (0.51)		0.52 (0.08)***	
7. Separation	33.35 (2.58)***		0.07 (0.03)**		0.92 (0.52)		0.38 (0.08)***	
8. Rejection	38.86 (2.58)***		0.01 (0.03)		1.77 (0.52)***		0.37 (0.08)***	
8a. Frightened/worried	36.13 (2.58)***		0.04 (0.03)		0.91 (0.52)		0.31 (0.08)***	
9. Abuse	41.31 (2.46)***		0.08 (0.03)**		-0.04 (0.49)		0.41 (0.08)***	
10. Effects	40.87 (2.54)***		0.14 (0.03)***		0.64 (0.51)		0.23 (0.08)***	
11. Why did parents behave	4.10 (2.59)***		0.11 (0.03)***		1.07 (0.52)*		0.16 (0.08)	
12. Other adults	47.80 (2.57)***		0.08 (0.03)**		1.15 (0.51)*		0.05 (0.08)	
13. Loss	47.15 (2.49)***		0.10 (0.03)***		0.90 (0.50)		0.07 (0.08)	

Table S3 Continued (2)

	IBI (ms)		lnRSA (ms)		PEP (ms)		SCL (µS)	
Fixed effects	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS
Model 3 Continued								
14. Other trauma	51.09 (2.55)***		0.10 (0.03)***		0.68 (0.51)		0.11 (0.08)	
15. Changes relationship	43.35 (2.57)***		0.16 (0.03)***		1.17 (0.51)*		-0.01 (0.08)	
16. Current relationship	49.64 (2.58)***		0.17 (0.03)***		0.37 (0.52)		-0.07 (0.08)	
17. Separation own child	50.90 (2.59)***		0.24 (0.03)***		0.95 (0.52)		0.03 (0.08)	
18. Wishes own child	57.26 (2.60)***		0.18 (0.03)***		0.16 (0.52)		0.07 (0.08)	
19. Gains early experiences	55.44 (2.59)***		0.17 (0.03)***		0.85 (0.52)		-0.04 (0.08)	
20. Own child in 20 years	60.31 (2.60)***		0.16 (0.03)***		1.23 (0.52)*		-0.06 (0.08)	
Loss/trauma discussed	-3.46 (1.63)*		0.04 (0.02)*		-0.23 (0.31)		0.05 (0.05)	
Model 5		1		1		0		1
Intercept	675.87 (6.36)***		4.07 (0.04)***		91.65 (1.48)***		5.54 (0.20)***	
2. Describe relationship	-0.35 (2.56)		0.05 (0.03)		-0.33 (0.51)		0.24 (0.08)**	
3. Adjectives mother	16.56 (2.51)***		0.01 (0.03)		0.24 (0.50)		0.44 (0.08)***	
4. Adjectives father	24.50 (2.52)***		0.04 (0.03)		0.11 (0.50)		0.61 (0.08)***	
5. Which parent closest	30.47 (2.58)***		0.04 (0.03)		1.33 (0.52)*		0.61 (0.08)***	
6. Upset/hurt/ill	33.83 (2.54)***		0.11 (0.03)***		0.68 (0.51)		0.51 (0.08)***	
7. Separation	33.51 (2.58)***		0.07 (0.03)**		0.90 (0.52)		0.38 (0.08)***	
8. Rejection	39.04 (2.58)***		0.01 (0.03)		1.75 (0.52)***		0.37 (0.08)***	
8a. Frightened/worried	36.32 (2.58)***		0.05 (0.03)		0.89 (0.52)		0.31 (0.08)***	

Table S3 Continued (3)

	IBI (ms)		lnRSA (ms)		PEP (ms)		SCL (µS)	
Fixed effects	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS
Model 5 Continued								
9. Abuse	41.43 (2.46)***		0.08 (0.03)*		-0.05 (0.49)		0.40 (0.08)***	
10. Effects	41.06 (2.55)***		0.14 (0.03)***		0.63 (0.51)		0.28 (0.08)***	
11. Why did parents behave	41.26 (2.60)***		0.11 (0.03)***		1.05 (0.52)*		0.15 (0.08)	
12. Other adults	47.97 (2.57)***		0.09 (0.03)**		1.15 (0.51)*		0.08 (0.08)	
13. Loss	46.97 (2.49)***		0.10 (0.03)***		0.92 (0.50)		0.08 (0.08)	
14. Other trauma	51.24 (2.55)***		0.10 (0.03)***		0.66 (0.51)		0.11 (0.08)	
15. Changes relationship	43.52 (2.58)***		0.16 (0.03)***		1.15 (0.52)*		-0.01 (0.08)	
16. Current relationship	49.79 (2.59)***		0.17 (0.03)***		0.35 (0.52)		-0.07 (0.08)	
17. Separation own child	51.05 (2.59)***		0.24 (0.03)***		0.93 (0.52)		0.03 (0.08)	
18. Wishes own child	57.41 (2.60)***		0.18 (0.03)***		0.15 (0.52)		0.07 (0.08)	
19. Gains early experiences	55.58 (2.60)***		0.17 (0.03)***		0.84 (0.52)		-0.05 (0.08)	
20. Own child in 20 years	60.46 (2.60)***		0.16 (0.03)***		1.22 (0.52)*		-0.07 (0.08)	
Loss/trauma discussed	-2.40 (1.87)		0.05 (0.02)*		-0.32 (0.36)		0.01 (0.06)	
U/d status	9.63 (13.04)		0.09 (0.07)		0.57 (3.08)		-0.57 (0.43)	
Loss/trauma discussed × U/d status	-3.22 (2.70)		-0.02 (0.03)		0.25 (0.50)		0.10 (0.08)	

Note. ΔDS = decrease in deviance statistic (Log-likelihood). U/d = classification of unresolved/disorganised. Responses to all interview questions were included in the analyses (5004 within-subject observations). Responses to the interview questions were coded as dummy variables with the first question as reference. Model 4 is not reported in this Table (main effect of U/d status).
* $p < .05$ ** $p < .01$ *** $p < .001$

Supplementary data Hypothesis 3: The association between unresolved discourse in response to the loss/trauma questions and ANS reactivity

In addition to the main analyses reported in Chapter 4, the analyses for Hypothesis 3 (*It was hypothesised that unresolved discourse in response to questions about loss/trauma would be associated with changes in ANS reactivity*) were also performed with separate variables indicating unresolved discourse about loss or trauma. The results of these analyses are reported in the text below.

IBI. The model fit improved when unresolved discourse was added to the model with the interview responses ($\chi^2(2) = 6.48$, $p < .05$). Unresolved discourse about loss was associated with smaller IBI ($B = -5.58$, $SE = 2.36$, $p = 0.018$). There was no significant relation between unresolved discourse about trauma and IBI ($B = -2.62$, $SE = 2.60$, $p = 0.313$). Including the interaction between the interview responses and unresolved discourse led to nonconvergence.

RSA. There was no model fit improvement when unresolved discourse was added as predictor ($\chi^2(2) = 2.66$, $p = .265$). Including the interaction term led to nonconvergence.

PEP. There was no model fit improvement when unresolved discourse was added as predictor ($\chi^2(2) = 3.00$, $p = .224$). Including the interaction term led to nonconvergence.

SCL. There was no model fit improvement when unresolved discourse was added as predictor ($\chi^2(2) = 2.74$, $p = .254$). Including the interaction term led to nonconvergence.

Supplementary data Hypothesis 4: The association between unresolved discourse about loss/trauma and ANS reactivity

Table S4 shows the full models for Hypothesis 4 in Chapter 4 (*It was hypothesised that unresolved discourse anywhere in the interview would be associated with changes in ANS reactivity*). For these analyses, we used combined variables of loss/trauma discussed (0 = no loss/trauma discussed, 1 = loss/trauma discussed) and unresolved discourse (0 = no unresolved discourse, 1 = unresolved discourse).

In addition to the main analyses reported in Chapter 4, the analyses for Hypothesis 4 were performed with separate variables indicating discussions of loss *or* trauma and unresolved discourse about loss *or* trauma. The results of these analyses are reported in the text below.

IBI. The model fit improved when discussions of loss/trauma and unresolved discourse were added to the model with the interview responses ($\chi^2(8) = 600.02$, $p < .001$). Discussing loss ($B = -4.12$, $SE = 2.09$, $p = .049$) and unresolved discourse about loss ($B = -5.59$, $SE = 2.91$, $p = 0.047$) were associated with smaller IBI, indicating higher heart rate. Neither discussing trauma ($B = 1.23$, $SE = 3.02$, $p = .681$) nor unresolved discourse about trauma ($B = 3.51$, $SE = 3.93$, $p = .372$) were significantly associated with IBI. Including the interaction between discussions of loss/trauma and unresolved discourse led to nonconvergence.

RSA. There was no improved model fit when discussions of loss/trauma and unresolved discourse were added as predictors ($\chi^2(8) = 14.46$, $p = 0.071$). Including the interaction term led to nonconvergence.

PEP. The model fit improved when discussions of loss/trauma and unresolved discourse were added as predictors ($\chi^2(8) = 261.48$, $p < .001$). However, there was no significant association between PEP and discussing loss ($B = -0.09$, $SE = 0.43$, $p = .835$), discussing trauma ($B = -0.26$, $SE = 0.61$, $p = .667$), unresolved discourse about loss ($B = 0.34$, $SE = 0.57$, $p = .548$), and unresolved discourse about trauma ($B = -0.72$, $SE = 0.80$, $p = .370$). Including the interaction term led to nonconvergence.

SCL. The model fit improved when discussions of loss/trauma and unresolved discourse were added as predictors ($\chi^2(8) = 2743.60$, $p < .001$). However, there was no significant association between SCL and discussing loss ($B = 0.12$, $SE = 0.07$, $p = .065$), discussing trauma ($B = -0.05$, $SE = 0.10$, $p = .613$), unresolved discourse about loss ($B = 0.14$, $SE = 0.09$, $p = .117$), and unresolved discourse about trauma ($B = -0.05$, $SE = 0.13$, $p = .717$). Including the interaction term led to nonconvergence.

Table S4

Hypothesis 4: The Association Between Unresolved Discourse About Loss/Trauma and ANS Reactivity

	IBI (ms)		lnRSA (ms)		PEP (ms)		SCL (μS)	
Fixed effects	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS
Model 1								
Intercept	708.23 (5.29)***		4.16 (0.03)***		92.42 (1.27)***		5.54 (0.17)***	
Model 2		259***		52***		20***		70***
Intercept	675.89 (5.56)***		4.11 (0.03)***		91.64 (1.32)***		5.46 (0.18)***	
2. Describe relationship	1.37 (1.87)		0.03 (0.02)		-0.22 (0.42)		0.24 (0.04)***	
3. Adjectives mother	18.27 (2.23)***		-0.008 (0.02)		0.32 (0.47)		0.51 (0.05)***	
4. Adjectives father	25.79 (2.39)***		0.02 (0.02)		0.25 (0.49)		0.55 (0.06)***	
5. Which parent closest	32.82 (2.46)***		0.02 (0.02)		1.48 (0.50)**		0.53 (0.07)***	
6. Upset/hurt/ill	35.68 (2.49)***		0.09 (0.02)***		0.79 (0.50)		0.42 (0.08)***	
7. Separation	35.45 (2.51)***		0.05 (0.02)*		1.02 (0.50)*		0.29 (0.08)***	
8. Rejection	40.90 (2.51)***		-0.01 (0.02)		1.89 (0.50)***		0.28 (0.09)**	
8a. Frightened/worried	38.45 (2.52)***		0.03 (0.03)		1.04 (0.50)*		0.21 (0.09)*	
9. Abuse	42.73 (2.51)***		0.08 (0.02)**		0.03 (0.50)		0.32 (0.09)***	
10. Effects	42.64 (2.51)***		0.12 (0.02)***		0.76 (0.50)		0.18 (0.10)	
11. Why did parents behave	43.40 (2.52)***		0.09 (0.02)***		1.15 (0.50)*		0.06 (0.10)	
12. Other adults	49.49 (2.53)***		0.06 (0.03)*		1.27 (0.50)*		-0.03 (0.10)	
13. Loss	46.14 (2.51)***		0.12 (0.02)***		0.80 (0.50)		0.03 (0.10)	
14. Other trauma	53.27 (2.52)***		0.08 (0.03)**		0.79 (0.50)		0.02 (0.11)	
15. Changes relationship	45.62 (2.51)***		0.14 (0.02)***		1.30 (0.50)**		-0.11 (0.11)	
Model 3		301***		7**		131***		1378***
Intercept	677.46 (5.65)***		4.09 (0.04)***		91.77 (1.33)***		5.40 (0.19)***	

Table S4 Continued (1)

	IBI (ms)		lnRSA (ms)		PEP (ms)		SCL (µS)	
Fixed effects	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS
Model 3 Continued								
2. Describe relationship	0.12 (2.51)		0.04 (0.03)		-0.31 (0.51)		0.24 (0.08)**	
3. Adjectives mother	16.93 (2.46)***		0.01 (0.03)		0.25 (0.50)		0.45 (0.08)***	
4. Adjectives father	24.89 (2.46)***		0.04 (0.03)		0.15 (0.50)		0.61 (0.08)***	
5. Which parent closest	31.02 (2.53)***		0.03 (0.03)		1.35 (0.52)**		0.61 (0.08)***	
6. Upset/hurt/ill	34.31 (2.49)***		0.11 (0.03)***		0.68 (0.51)		0.51 (0.08)***	
7. Separation	33.97 (2.53)***		0.07 (0.03)*		0.91 (0.51)		0.37 (0.08)***	
8. Rejection	39.54 (2.53)***		0.01 (0.03)		1.76 (0.51)***		0.37 (0.08)***	
8a. Frightened/worried	36.83 (2.53)***		0.04 (0.03)		0.90 (0.52)		0.30 (0.08)***	
9. Abuse	42.65 (2.46)***		0.08 (0.03)**		-0.01 (0.50)		0.39 (0.08)***	
10. Effects	41.46 (2.49)***		0.13 (0.03)***		0.65 (0.50)		0.27 (0.08)***	
11. Why did parents behave	41.79 (2.55)***		0.11 (0.03)***		1.05 (0.52)*		0.15 (0.08)	
12. Other adults	48.32 (2.52)***		0.08 (0.03)**		1.17 (0.51)*		0.05 (0.08)	
13. Loss	48.92 (2.65)***		0.09 (0.03)***		0.99 (0.54)		0.06 (0.08)	
14. Other trauma	51.72 (2.50)***		0.09 (0.03)***		0.67 (0.51)		0.11 (0.08)	
15. Changes relationship	44.01 (2.52)***		0.16 (0.03)***		1.17 (0.51)*		-0.01 (0.08)	
Loss/trauma discussed	-1.99 (1.72)		0.03 (0.02)		-0.25 (0.34)		0.03 (0.05)	
Unresolved discourse	-4.05 (2.26)		0.02 (0.02)		-0.10 (0.46)		0.02 (0.07)	
Model 4		0		0		0		1
Intercept	677.45 (5.66)***		4.09 (0.04)***		91.78 (1.33)***		5.40 (0.19)***	
2. Describe relationship	0.13 (2.51)		0.04 (0.03)		-0.31 (0.51)		0.23 (0.08)**	

Table S4 Continued (2)

	IBI (ms)		lnRSA (ms)		PEP (ms)		SCL (µS)	
Fixed effects	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS
Model 4 Continued								
3. Adjectives mother	16.94 (2.46)***		0.01 (0.03)		0.25 (0.50)		0.44 (0.08)***	
4. Adjectives father	24.88 (2.47)***		0.04 (0.03)		0.15 (0.50)		0.61 (0.08)***	
5. Which parent closest	31.03 (2.54)***		0.03 (0.03)		1.34 (0.52)**		0.60 (0.08)***	
6. Upset/hurt/ill	34.32 (2.49)***		0.11 (0.03)***		0.68 (0.51)		0.51 (0.08)***	
7. Separation	33.98 (2.53)***		0.07 (0.03)*		0.90 (0.52)		0.37 (0.08)***	
8. Rejection	39.55 (2.53)***		0.01 (0.03)		1.75 (0.52)***		0.36 (0.08)***	
8a. Frightened/worried	36.84 (2.53)***		0.04 (0.03)		0.89 (0.52)		0.30 (0.08)***	
9. Abuse	42.65 (2.46)***		0.08 (0.03)**		-0.02 (0.50)		0.39 (0.08)***	
10. Effects	41.47 (2.50)***		0.13 (0.03)***		0.64 (0.51)		0.27 (0.08)***	
11. Why did parents behave	41.79 (2.55)***		0.11 (0.03)***		1.05 (0.52)*		0.15 (0.08)	
12. Other adults	48.33 (2.52)***		0.08 (0.03)**		1.16 (0.51)*		0.05 (0.08)	
13. Loss	48.97 (2.66)***		0.09 (0.03)***		0.97 (0.54)		0.10 (0.08)	
14. Other trauma	51.74 (2.51)***		0.09 (0.03)***		0.67 (0.51)		0.10 (0.08)	
15. Changes relationship	44.02 (2.53)***		0.16 (0.03)***		1.16 (0.51)*		-0.02 (0.08)	
Loss/trauma discussed	-1.95 (1.74)		0.03 (0.02)		-0.27 (0.35)		0.02 (0.05)	
U/d discourse	-3.06 (6.82)		0.01 (0.07)		-0.49 (1.37)		-0.19 (0.21)	
Loss/trauma discussed × U/d discourse	-1.11 (7.16)		0.02 (0.07)		0.44 (1.44)		0.23 (0.22)	

Note. ΔDS = decrease in deviance statistic (Log-likelihood). U/d discourse = unresolved/disorganised responses about loss/trauma. Responses to the first 15 interview questions were included in the analyses (3829 within-subject observations). Responses to the interview questions were coded as dummy variables with the first question as reference.

* $p < .05$ ** $p < .01$ *** $p < .001$

Supplementary data: Exploratory analyses

Table S5 presents the results from the trajectories of ANS response throughout the AAI as a whole.

Table S5

Exploratory Analysis Results: Trajectories of ANS Response Throughout the Adult Attachment Interview, and Moderation by Unresolved/Disorganised Status

	IBI (ms)		lnRSA (ms)		PEP (ms)		SCL (μS)	
	B (SE)	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS
Fixed effects								
Model 1								
Intercept	720.14 (5.39)***		4.06 (0.03)***		92.86 (1.26)***		5.45 (0.17)***	
Model 2 (Linear)		488***		162***		42***		3481***
Intercept	693.98 (5.95)***		3.90 (0.04)***		92.29 (1.46)***		5.85 (0.21)***	
Time	1.18 (0.09)***		0.01 (0.001)***		0.02 (0.01)		-0.01 (0.003)	
U/d	3.31 (12.78)		0.06 (0.08)		1.94 (3.13)		-0.47 (0.45)	
Time*U/d	0.21 (0.19)		0.01 (0.001)		-0.06 (0.03)*		-0.01 (0.01)	
Model 3 (Quadratic)		130***		2		13***		205***
Intercept	658.53 (6.45)***		3.86 (0.05)***		89.98 (1.53)***		4.78 (0.22)***	
Time	2.87 (0.15)***		0.01 (0.002)***		0.13 (0.03)***		0.05 (0.004)***	
U/d	2.64 (13.83)		-0.05 (0.11)		5.34 (3.28)		0.64 (0.47)	
Time^2	-2182.20 (152.33)***		-2.10 (2.27)		-139.67 (28.27)***		-65.78 (3.21)***	
Time*U/d	0.24 (0.31)		0.01 (0.004)		-0.23 (0.05)***		-0.06 (0.01)***	
Time^2*U/d	-48.18 (325.47)		-6.04 (4.89)		206.56 (60.88)**		68.53 (6.92)***	
Model 4 (Cubic)		25***		9***		2		272***
Intercept	620.67 (8.72)***		3.46 (0.11)***		87.83 (1.89)***		2.02 (0.25)***	
Time	4.68 (0.32)***		0.03 (0.005)***		0.23 (0.06)***		0.18 (0.01)***	
U/d	6.85 (18.66)		0.20 (0.23)		6.78 (4.06)		2.01 (0.53)***	
Time^2	-8008.69 (917.04)***		-60.48 (13.87)***		-464.11 (170.75)**		-490.80 (18.86)***	
Time^3	3692.92 (573.20)***		36.99 (8.68)***		205.49 (106.65)		269.36 (11.79)***	
Time*U/d	0.04 (0.68)		-0.01 (0.01)		-0.29 (0.13)*		-0.12 (0.02)***	
Time^2*U/d	594.10 (1956.11)		30.68 (29.56)		422.212 (366.40)		278.17 (40.53)***	
Time^3*U/d	-404.75 (1223.30)		-23.26 (18.48)		-136.32 (229.54)		-132.76 (25.34)***	

Table S5 Continued

	IBI (ms)		lnRSA (ms)		PEP (ms)		SCL (μS)	
Fixed effects	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS	*B (SE)*	ΔDS
Model 5 (Quartic)		1		24***		3*		122***
Intercept	638.45 (14.33)***		2.32 (0.21)***		91.61 (2.87)***		-1.34 (0.34)***	
Time	3.83 (0.63)***		0.08 (0.01)***		0.05 (0.12)		0.34 (0.01)***	
U/d	-15.47 (30.56)		0.42 (0.44)		10.87 (6.13)		2.71 (0.73)***	
Time^2	-3114.45 (3262.79)		-363.02 (49.07)***		557.76 (607.04)		-1412.97 (66.28)***	
Time^3	-3522.91 (4652.05)		484.36 (70.16)***		-1300.94 (865.38)		1628.72 (94.48)***	
Time^4	3388.52 (2167.94)		-210.51 (32.76)***		707.38 (403.26)		-638.27 (44.02)***	
Time*U/d	1.11 (1.34)		-0.02 (0.02)		-0.49 (0.25)		-0.16 (0.03)***	
Time^2*U/d	-5553.43 (6953.85)		86.73 (104.73)		1537.03 (1301.89)		469.10 (142.37)**	
Time^3*U/d	8660.93 (9922.65)		-104.93 (150.13)		-1789.40 (1860.32)		-412.99 (203.13)*	
Time^4*U/d	-4257.86 (4626.81)		38.04 (70.24)		779.62 (868.43)		131.21 (94.70)	

Note. ΔDS = decrease in deviance statistic (Log-likelihood). U/d = classification of unresolved/disorganised.
* $p < .05$ ** $p < .01$ *** $p < .001$