



# Developmental and attachment-based perspectives on dissociation: beyond the effects of maltreatment

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## ABSTRACT

**Background:** Numerous years of theory and research have informed our understanding of the caregiving experiences that confer vulnerability for dissociation. This work has resulted in widespread agreement on the role of childhood maltreatment as an aetiological factor.

**Objective:** With clear integration of this perspective, the current paper draws attention to the spectrum of vulnerability that can exist over and above the trauma of maltreatment within early caregiving experiences.

**Method:** An integrative review of the developmental literature on dissociation is presented.

**Results:** We first review and integrate existing developmental theories of dissociation into a more unified perspective, highlighting a combination of defensive and intersubjective pathways towards dissociative outcomes. Next, we present empirical research demonstrating which specific caregiving experiences are associated with dissociation. Lastly, we review recent neurodevelopmental research demonstrating that (non-extreme) caregiving stressors during infancy impact the developing limbic structures in the brain. We conclude by offering directions for future research.

**Conclusion:** Findings make the case for approaching assessments of the caregiver-child relationship with discernment of factors beyond the presence/absence of maltreatment when conceptualizing risk pathways toward dissociation.

## Perspectivas basadas en apego y desarrollo sobre la disociación: más allá de los efectos del maltrato

**Antecedentes:** Varios años de teoría, investigación y avances clínicos sustentan nuestra comprensión de experiencias particulares en el cuidado temprano que confieren vulnerabilidad para la disociación. Este trabajo ha dado lugar a un acuerdo generalizado sobre el papel del maltrato infantil como un factor etiológico.

**Objetivo:** Con una clara integración de esta perspectiva, el presente artículo enfatiza el espectro de vulnerabilidad que puede existir más allá del trauma que constituye el maltrato dentro de las experiencias de cuidado tempranas.

**Método:** Se presenta una revisión integradora de la literatura del desarrollo sobre la disociación.

**Resultados:** Primero, revisamos e integramos las teorías del desarrollo existentes sobre la disociación en una perspectiva más unificada, resaltando una combinación de vías defensivas e intersubjetivas que resultan en disociación. Luego, presentamos una investigación empírica que demuestra qué experiencias específicas en el cuidado temprano están asociadas con la disociación. Finalmente, revisamos una investigación reciente en neurodesarrollo que demuestra que los estresores (no extremos) durante el cuidado en la infancia impactan el desarrollo de las estructuras límbicas del cerebro.

**Conclusión:** Los hallazgos justifican abordar las evaluaciones de la relación cuidador-niño con el discernimiento de factores más allá de la presencia/ausencia de maltrato al conceptualizar las vías de riesgo de disociación.

## 对于解离的发展和依恋的观点：虐待之外的影响

**背景:** 多年的理论、研究和临床进展提供了对导致解离易感性的照料经历的了解。这项工作已使得对于童年期虐待作为病因的作用达成广泛共识。

**目标:** 通过对这一观点的明确认识与整合，本文引发人们关注到：在早年照料经历中，除遭受虐待之外，还可能存在其它易感性的关注。

**方法:** 本文将呈现一项对解离发展理论的文献综述。

**结果:** 我们首先回顾并将现有解离发展理论简化成一个更加统一的视角，着重强调造成分离结果的防御和主体间路径的结合。接下来，我们有选择地回顾了哪些具体护理经历与解离有关的研究。最后，我们回顾了最近的神经发育研究，该研究表明，婴儿期（非极端的）护理应激源会影响大脑边缘结构的发育。最后，我们提供了未来研究的方向。

**结论:** 我们的研究发现，在概念化导致解离的风险途径时，有必要对照顾者-儿童关系进行评估，要找出除存在/不存在虐待之外的其它因素。

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## 关键词

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## HIGHLIGHTS:

- Dissociation develops from infancy in the context of stressors in the caregiver-child relationship.
- These stressors can occur with, but also without maltreatment.
- Changes in limbic brain regions may partly explain why such early stressors increase risk for dissociation.

Dissociation refers broadly to disruptions in the normal integration of memories, thoughts, identity, affects, sensations, perceptions, behaviour, or control over bodily movements (World Health Organization, 2018), resulting in experiences of being ‘detached from the environment, but also from the self’ (Allen, Console, & Lewis, 1999, p. 165). Numerous years of theory, research, and clinical advancements have informed our understanding of the caregiving experiences known to predispose individuals to dissociation, resulting in widespread recognition of the role of childhood trauma in the form of maltreatment (primarily abuse and neglect) as an aetiological factor (Bailey & Brand, 2017; Farina, Liotti, & Imperatori, 2019). The goal of the current paper is to present an integrative theoretical perspective on the development of dissociation, as it relates to caregiving experiences, but with additional emphasis on the spectrum of vulnerability that can exist over and above the experience of childhood trauma. We seek to first integrate and synthesize information from existing developmental theories into a more unified perspective. We then explicate the empirical basis of this theoretical perspective by reviewing the research that has contributed most critically to this developmental account, including recent neurodevelopmental research linking the quality of early caregiving experiences with structural alterations in limbic regions.

## 1. Developmental pathways to dissociation: an integration of theoretical perspectives

Children’s access to secure attachments with caregivers in the early years encode the enduring pathways through which they will learn to appraise, regulate, and make sense of their affective experiences as adults (Bowlby, 1980). The most significant departures from such caregiving experiences – those being individuals’ devastating experiences of maltreatment at the hands of caregivers in the early years – have long been understood to be the primary developmental precursor to dissociative outcomes (Bailey & Brand, 2017; Farina et al., 2019; Putnam, 1997; Schore, 2009). While maltreatment and dissociation are, without question, aetiologically and robustly linked (Vonderlin et al., 2018), individuals who display dissociative symptoms do not always report a history of such childhood trauma. Most notably, only a subset of trauma survivors ever develop dissociative symptoms (Briere, 2006). This apparent paradox has challenged researchers and clinicians’ understanding of dissociation as a developmental outcome, necessitating the consideration of a wider spectrum of caregiving experiences, beyond maltreatment,

that may account for additional variance in such outcomes.

Several theorists and researchers have stressed the importance of considering the role of ‘quieter’ disturbances in the caregiver-child relationship in the development of dissociation-like responses (Barach, 1991; Liotti, 2006, 2009; Lyons-Ruth, 2002; Main & Hesse, 1990). For instance, Main and Hesse (1990) described an affective context in which the caregiver’s stance is aggressive (‘frightening’; e.g. loud growling voice, angry/hostile expressions during play) and/or expresses fear and helplessness (‘frightened’). They theorized that this creates an irreconcilable paradox for the infant, in which the parent is equally a source of comfort as they are a source of disorder and fear. Lyons-Ruth, Bronfman, and Parsons (1999) further captured much of the essence of this parental stance in a construct they labelled ‘disturbed affective communication’. The term encapsulates behaviours such as withdrawal (e.g. interacting from a distance), affective errors (e.g. mixed cues such as sweet voice but negative message), role-confused responses (e.g. eliciting reassurance from the infant), disoriented responses (e.g. sudden changes in affect), and other important communication errors – all of which share the feature of the caregiver’s failure to organize the child’s affective experiences. One factor that commonly underpins these behaviours is the caregiver’s own unresolved traumas and dissociation, which can resurface in reaction to various traumatic reminders during interactions with the child (e.g. child distress) and interfere with affective engagement (Liotti, 2009; Putnam, 2016). Importantly, while these caregiving behaviours commonly co-occur with maltreatment, they can characterize a caregiver-child relationship in which there is no reportable abuse or neglect (Carlson, Yates, & Sroufe, 2009; Liotti, 2006, 2009; Lyons-Ruth, Dutra, Schuder, & Bianchi, 2006).

The potential impact of such disturbances on developmental outcomes can be understood in light of the caregiver’s role as an external regulator of the infant’s stress response (Bowlby, 1980; Schore, 2009; Schuder & Lyons-Ruth, 2004). As infants are not born with a mature capacity for regulation, caregiver inputs during infant distress, such as vocal tone, touch, eye-contact, and attention (Beebe et al., 2012) all play a crucial role in regulating the infant physiologically, allowing the child to internalize this capacity for self-regulation in later years. While the highly arousing threats of abuse and neglect represent the greatest and most obvious collapse in this developmental task, frightening-frightened behaviours and affective misattunement, when chronic and pervasive during the first year of life, can trigger stress dysregulation in the infant independently of

maltreatment – hence their conceptualization as ‘hidden traumas’ (Schuder & Lyons-Ruth, 2004).

While most would agree these types of disturbances in caregiving can compromise physiological and socioemotional development in a broad sense, theories have not converged on a unified perspective to explain how they may be linked to dissociation. Currently, the perspectives that feature most prominently in the literature and in clinical contexts have arisen from trauma models (Perry et al., 1995; Putnam, 1997; Schore, 2009; Van der Hart, Nijenhuis, & Steele, 2006). For instance, dissociation is commonly understood as a neurobiological defensive mechanism that develops in the context of overwhelming survival stress and fear (Lanius et al., 2018; Perry et al., 1995; Schore, 2009). Consistent with years of research on the neurobiological basis of post-traumatic stress (Lanius et al., 2018), this perspective has aptly situated dissociation along a hierarchy of defensive responses to threat, whereby the child’s parasympathetic nervous system overwrites the more evolutionarily dominant sympathetic response (‘fight/flight’ response) in response to chronic, insurmountable, and inescapable threat – such as maltreatment by a caregiver – as a near ‘last resort’ for self-protection. This accounts for some common manifestations of dissociation, such as the child’s awareness dampening, and shifting away from external threatening cues (Perry et al., 1995; Schore, 2009), and hyperaroused responses, such as anger, aggression, and fearful arousal, being downregulated for self-preservation (Lanius et al., 2018). Other theories have also emphasized defence systems as underlying the development of dissociation. For instance, Bowlby’s (1980) concept of ‘defensive exclusion’ posited that children have some capacity to keep relational traumas from conscious attention as a defence, thereby undermining integration across attention, affect, and behaviour during attachment stress. Likewise, the structural theory of dissociation (Van der Hart et al., 2006) posits that dissociation occurs when different action systems, which operate to either gear the child towards daily adaptive functions (e.g. attachment, pleasure-seeking) or defence against threat (e.g. flight/fight), fail to assimilate into one cohesive personality structure due to trauma. Poorly integrated defences may become dissociative parts of the personality in and of themselves (i.e. ‘Emotional Parts’), and account for a range of dissociative symptoms (e.g. traumatic flashbacks, out-of-control emotions experienced as disconnected from the self; Van der Hart et al., 2006). By and large, this understanding of dissociation as a defensive response, whereby one dissociates as a means to adapt to or protect oneself from threat, is also embraced by survivors of childhood trauma as being consistent with their subjective experience (Lanius, Bluhm, & Lanius, 2007).

A different theory is that of Liotti’s (2006, 2009), which supports an attachment-based model of dissociation that is ‘grounded in interpersonal, dialogic processes [...] rather than in intrapsychic defenses against mental pain’ (2006, p. 67). In keeping with Liotti’s (2006) view, which is echoed in that of key others (Carlson et al., 2009; Lyons-Ruth, 2002; Lyons-Ruth et al., 2006), dissociation does not function as an autonomic defensive response. Rather, it is believed to stem from the child’s fragmented model of self-with-others (or Internal Working Model; Bowlby, 1980) as a result of a lack of organizing and regulating attachment experiences. Liotti (2006, 2009) advances that when a child is repeatedly faced with incompatible relational experiences (e.g. experiencing caregivers as both sources of fear and rescuers; Main & Hesse, 1990) as well as a lack of organizing responses from the caregiving environment (e.g. fright without solution, caregiver withdrawal during distress), this child encodes this information into multiple and incompatible models of self-with-others (Liotti, 2006, 2009), leaving them with a lack of coherence about their internal experiences, their sense of self, and their expectations of others. Lyons-Ruth (2002) explains a similar idea, whereby ‘the parent’s incapacity to acknowledge particular aspects of the child’s existence and experience, in the dialogue with the child, is a primary contributor to the child’s inability to recognize and integrate those same aspects of experience’ (p. 901). Consequently, children are seen to struggle to coordinate their attention, consciousness, and behaviour under attachment stress (e.g. become unresponsive, freeze; Liotti, 2009). As also posited by Van der Hart et al. (2006), different self-states may eventually drive feelings, cognition, and behaviour discontinuously, particularly when the attachment system is activated, as observed in its most extreme form in Dissociative Identity Disorder (Liotti, 2009).

A primary contribution from this attachment perspective was to highlight disorganized attachment as a possible precursor to dissociation (Liotti, 2006, 2009; Main & Hesse, 1992). Main and Solomon (1990) were first to identify this subset of disorganized children who exhibited contradictory and disoriented attachment behaviours after being reunited with their parent in the Strange Situation Procedure (SSP; Ainsworth, Blehar, Waters, & Wall, 1978), which were contrasted by the relatively more *organized* attachment behaviours seen in other infants (i.e. secure, insecure-avoidant and insecure-ambivalent; Ainsworth et al., 1978). Such disoriented attachment behaviours are indicative of the child’s disintegrated model of self-with-others (Bowlby, 1980), making attachment disorganization a potential predisposing factor for long-term dissociation and, arguably, an embryonic dissociative

outcome in itself (Liotti, 2006, 2009). Indeed, as also observed by Main and Hesse (1990), the disorganized infant's dazed facial expressions, rapid changes in affect, and abruptly freezing movements in the presence of the caregiver could all be symptomatic of dissociating mental processes.

While at times presented as discordant (see Liotti, 2006, 2009), these theoretical perspectives may best be viewed in continuity rather than in contradiction. In congruence with an attachment trauma model proposed by Schuder and Lyons-Ruth (2004), this literature points to a dual developmental pathway to dissociation, with one pathway relating to the child's autonomic *defence systems*, and the second anchoring at the *intersubjective* level of the attachment relationship. In the former, sources of attachment-related stress activate the child's defensive responses, which could lead to a dissociative response in the context of severe and chronic disturbance (e.g. prolonged periods of infant distress without caregiver resolution; Perry et al., 1995; Schore, 2009), or otherwise predispose the child for dissociation in later years by altering the functioning of their stress systems (Schuder & Lyons-Ruth, 2004). Through the second pathway, attachment disruptions can further potentiate dissociative outcomes, shutting down the processing and integration of experience, should they leave the child without an organizing template from which they can learn to understand their internal and relational worlds (Carlson et al., 2009; Liotti, 2006, 2009; Lyons-Ruth, 2002; Lyons-Ruth et al., 2006; Van der Hart et al., 2006). Notwithstanding obvious parallels with the negative effects of maltreatment, as we exemplify below, this dual pathway is useful in helping capture sources of vulnerability in the caregiver-child relationship that are independent of – and *additive to* – the otherwise traumatizing experience of maltreatment. Importantly, the development of dissociation through these pathways is tied most saliently to the early formative years, during which the child's capacity for stress regulation (Schore, 2009; Schuder & Lyons-Ruth, 2004), understanding of self-with-others (Bowlby, 1980; Liotti, 2006, 2009), and personality structure (Van der Hart et al., 2006) are in their most immature and vulnerable stages, and depend heavily on the availability of a caregiver for development. The importance of the early years (i.e. infancy) for dissociation can also be explained in light of the influence of caregiving experiences on limbic region development in the brain, as the coming sections will help to demonstrate.

The pathways by which disturbances in the caregiver-child relationship can confer vulnerability for dissociation are useful to illustrate through an applied example, anchored in the familiar backdrop of childhood maltreatment. Consider the extent to which the following two caregiving contexts, both marked by

the trauma of abuse, may pose different levels of risk for a child to develop dissociative responses. In the first fictional scenario, abuse occurs in isolated contexts marked by the caregiver's poor anger control, rather than in the context of more pervasive emotional unavailability. The caregiver in this case expresses regret about their volatile behaviour and enacts attempts to repair the interaction with the child. This caregiver also maintains a sufficiently responsive moment-to-moment exchange with the child (e.g. initiating contact, attending to needs) beyond these instances of turbulence. By contrast, consider a second context in which the caregiver shows a pattern of shutting down opportunities for coregulation and basic integration of experience. This caregiver disengages from the interaction with the child in the aftermath of violence, withdrawing verbal communication, eye-contact, or any attention to the child's frightened state. The child's expression of distress usually provokes further distance from the caregiver in this case, or may otherwise be met with a distorted verbal account of the experience (e.g. caregiver downplaying abuse, justifying abuse, seeking reassurance from child around the incident). To a more profound degree than in the first, the child in this context would become locked into a fundamentally dysregulating state of survival stress given the absence of relational safety with an attachment figure. Compounding this, the caregiving environment in this case provides no organizing or coherent response for the child's internal experience, making it likely that this child would develop a disintegrated model of self-with-others and a disorganized attachment. While the devastating experience of abuse would conceivably augment the risk for dissociation in both scenarios, in the latter, the abuse occurs in the context of severe deprivation in caregiver regulation around the child's experience. This caregiving environment, which is both chronically dysregulating for the child's stress system and negating of the child's internal world, is particularly likely to be internalized as a fragmented caregiving experience, thereby forecasting a more profound disintegration of mental processes and contents.

The developmental perspective described herein has been shaped by key empirical investigations over the years, which are reviewed selectively in the following sections. We first briefly discuss recent meta-analytic research on maltreatment and dissociation, which we deem essential despite our narrowed focus. Subsequently, we focus on summarizing the contributions of two longitudinal investigations, namely the Minnesota Mother-Child Project by Egeland, Sroufe, and colleagues, and the Family Pathways Project (FPP) by Lyons-Ruth and colleagues, both of which tracked the impact of specific caregiving behaviours from infancy to adulthood.



Our justification for this focus is that while cross-sectional studies have contributed many noteworthy findings to dissociation research, the majority of caregiving behaviours that take place during infancy (e.g. affective cues, withdrawal), with the possible exception of abuse, are difficult for adults to recall retrospectively in a cross-sectional design. More comprehensive reviews of dissociation research are also already available elsewhere (see Bailey & Brand, 2017; Farina et al., 2019). Most recently, longitudinal work linking early caregiving experiences with limbic development has added a new preliminary dimension of evidence to this developmental account. Therefore, we review a subset of this neurodevelopmental research, with a focus on limbic structure development, in our final section.

## 2. Research on childhood maltreatment and dissociation

A review of research on the development of dissociation would be incomplete without clear acknowledgment of maltreatment as an aetiological factor. Compelling evidence supports the relationship between maltreatment and dissociation, as most recently meta-analysed by Vonderlin et al. (2018). The authors synthesized the findings of 65 cross-sectional studies ( $n = 7352$ ) that investigated links between maltreatment (abuse and neglect) and dissociation, as measured by self-report. Results showed that individuals with a history of abuse ( $d = .54$ ) and/or neglect ( $d = .36$ ) exhibited more dissociation than individuals without these experiences. Additionally, sexual and physical abuse (particularly when combined) were related to higher dissociation than emotional abuse and neglect overall. Younger age of onset, a longer duration of abuse, and a higher proportion of parental (vs. extrafamilial) abuse were also related to higher dissociation scores.

It is interesting to consider the finding that dissociation can emerge in the context of both abuse (i.e. threat-based trauma) and neglect (i.e. deprivation-based trauma), seeing as recent work has documented differences in neurodevelopment as a function of these distinct trauma types (i.e. deprivation affects pruning and proliferation, whereas threat exposure impacts fear-learning primarily through the amygdala, hippocampus, and medial prefrontal cortex; McLaughlin, Sheridan, & Lambert, 2014; McLaughlin, Weissman, & Bitrán, 2019). The co-occurrence of dissociation across abuse and neglect supports its conceptualization as a complex adaptation to attachment stress that likely occurs through more than one single developmental pathway. McLaughlin et al. (2014) model of neurodevelopment may provide useful guidance to sort out which risk pathway is *relatively* more salient in abuse versus

neglect. For instance, dissociation may operate primarily as a fear-based defensive mechanism in the context of physical and sexual abuse, which represent more active threats and directly trigger fear processing in the brain (McLaughlin et al., 2014). In comparison, dissociation may take hold more predominantly at an intersubjective level in contexts where attachment-related deprivation (e.g. loss, abandonment, neglect) is the primary source of traumatic stress. Indeed, as can be gathered from observational studies (Wilson, Rack, Shi, & Norris, 2008), neglect tends to be reflected in caregivers' 'subtle failures to display attentiveness and responsiveness' (p. 13), consistent with a scarcity in intersubjectivity, over and above a lack of attention to the child's basic needs (e.g. feeding, clothing). Albeit intuitively appealing, this idea necessitates investigation. It is also further complicated by the common co-occurrence of abuse and neglect, which conflates sources of vulnerability, and by its potentially limited relevance to infants, for whom threat and caregiver deprivation may be equally as fear-inducing and trigger similar levels of stress dysregulation.

Further adding to this complicated picture, research has found that the affective climate of the family environment (e.g. conflict, positive affect, hostility) moderates the impact of maltreatment on dissociation (e.g. see Narang & Contreras, 2005). This shifts the focus from solely the traumatic experience to more discreet aspects of the child's interactions with caregivers, as further exemplified below.

## 3. Prospective Research on Early Caregiving Relationships and Dissociation

Findings from the Minnesota Mother-Child Project provided the first tests of the long-term relationship between the caregiver-child relationship and dissociation. Ogawa, Sroufe, Weinfield, Carlson, and Egeland (1997) and Carlson's (1998) landmark longitudinal studies of over 150 high-risk dyads found that, among an array of endogenous and environmental predictors, clinically significant dissociative symptoms were best predicted by the quality of the mother-infant interaction. Specifically, they found that both avoidant (characterized by a lack of seeking contact with the caregiver when distressed; Ainsworth et al., 1978) and disorganized attachment in infancy were predictive of dissociative symptoms in adolescence (16–17 years). Attachment disorganization in infancy also predicted clinical levels of dissociation in early adulthood (age 19), accounting for 6% of the variance (Carlson, 1998; Ogawa et al., 1997). Most remarkably, Ogawa et al. (1997) found that mothers' psychological unavailability during infancy accounted for the most variance (19%) in dissociative outcomes at age 19, after accounting for

maternal risk factors, child temperament and cognitive ability, attachment classification, and abuse. Therefore, these findings were important in drawing attention to disorganized infants as displaying a pattern of vulnerability for dissociation, but were even more pivotal in highlighting the predominant influence of early caregiving behaviour in this developmental trajectory.

These findings were followed years later by those of the FPP, a 19-year longitudinal investigation of 56 at-risk mother-child dyads. As proxies of early caregiving behaviour, Dutra, Bureau, Holmes, Lyubchik, and Lyons-Ruth (2009) measured 1) mothers' positive affective involvement, hostility-intrusiveness, routine caretaking/comforting touch, and flatness of affect in the home; 2) disrupted maternal communication during the SSP (composite of communication errors, role confusion, negative-intrusive behaviour, fearful-disoriented behaviour, and withdrawal), and; 3) infant's attachment disorganization. The researchers investigated which of these variables were predictive of self-reported adult dissociative symptoms at age 19, while simultaneously considering the impact of various forms of trauma/maltreatment in later childhood. Findings showed that the quality of early care at 12 months had overwhelming primacy in the prediction of dissociative symptoms at 19 years, accounting for approximately half of the variability in dissociative outcomes. More specifically, the degree of disrupted communication in the laboratory, as well as mothers' lack of positive affective involvement and flatness of affect at home were most predictive of adult dissociation, after controlling for child gender, demographic risk, and childhood maltreatment. The only type of childhood maltreatment that added to the prediction of dissociative symptoms was the severity of verbal abuse. Taken together with Ogawa et al. (1997) findings, these results clearly demonstrate the significance of one particular risk factor for dissociation – this being caregivers (in this case mothers') lack of affective engagement and availability. Remarkably, the pathway from maternal behaviour to dissociation withstood a period of nearly 20 years in both investigations, lending results considerable significance.

By contrast, infant disorganization was observed to be a less consistent predictor of dissociation than caregiver behaviour, as it did not explain additional variance in dissociative symptoms in Dutra et al. (2009) study (contrary to Ogawa et al., 1997). This could be due to several factors. It may be that some confusion can arise when coding disorganization, particularly when the disorganized child displays approach behaviours that could be mistaken as evidence of secure attachment (i.e. 'D-secure' children; see David & Lyons-Ruth, 2005). The predictive power

of disorganized attachment for dissociation may be further dampened by some factors unrelated to the parent-child interaction that can account for variations in attachment (e.g. child genotype; Gervai, 2009), and by the massive developmental changes that occur from infancy to age 20. Caregiver behaviour may thus be a more stable predictor across time.

Nevertheless, there is evidence suggesting that disorganization in the caregiver-child relationship can carry forward into adolescence. Using data from the FPP, Obsuth, Hennighausen, Brumariu, and Lyons-Ruth (2014) found that adolescents with a history of disorganized attachment in infancy were predominantly those displaying disoriented patterns of communication with their mothers in adolescence. Results also showed that these adolescents displayed higher dissociation symptoms (concurrently), further underscoring the enduring impacts of early attachment disruptions on dissociation. Further evidence showing how early caregiving experiences influence the infant brain, as discussed below, provides further evidence for this proposition.

#### 4. Infant limbic region development and dissociation

While prospective data linking early caregiving behaviour and dissociative outcomes stands on its own merits, recent neurodevelopmental research may further substantiate these links. The neurobiological circuitry underlying dissociative processes – albeit not fully understood to this day (Krause-Utz, Frost, Winter, & Elzinga, 2017) – involves complex interactions between neural regions that regulate aspects of self-awareness (e.g. insula, precuneus), sensory processing (e.g. thalamus), pain and fear processing (e.g. periaqueductal grey) and cognitive regulation (e.g. medial prefrontal cortex; for reviews, see Krause-Utz et al., 2017; Lanius et al., 2018). The limbic regions of the brain, including the amygdala and hippocampus, mediate key aspects of stress regulation and have been shown to also be involved in dissociation through their functional interrelations with the abovementioned regions (Krause-Utz et al., 2017; Lanius et al., 2018).

The development of the amygdala and hippocampus is marked by rapid growth (Uematsu et al., 2012) and increased sensitivity to caregiver inputs (Schore, 2009) during the first 18 months of life (i.e. infancy). Accordingly, the neurodevelopmental effects of early caregiving experiences on the limbic regions could partially explain the long-lasting association observed between early care and dissociative outcomes. This explanation finds tentative support in an emerging body of neurodevelopmental research. In addition to showing concurrent (Rifkin-Graboi et al., 2015) and

prospective (Wang et al., 2019) links between early caregiving behaviour and differences in limbic network (i.e. functional) connectivity, this line of work has been remarkably prolific in documenting volumetric (i.e. structural) differences in limbic development following early caregiving stressors. Specifically, studies have shown that infants exposed to non-extreme stressors within their caregiving environments (e.g. maternal insensitivity, disturbed affective communication, depression) show increased hippocampal and/or amygdala volumetric growth concurrently during infancy (Rifkin-Graboi et al., 2015), and prospectively across childhood (Bernier et al., 2019; Lee et al., 2019; Lupien et al., 2011; Wen et al., 2017) and adulthood (Khoury, Pechtel, Andersen, Teicher, & Lyons-Ruth, 2019; Lyons-Ruth, Pechtel, Yoon, Anderson, & Teicher, 2016). Prospective studies have also found similar associations between insecure (Moutsiana et al., 2015) and disorganized (Hidalgo et al., 2019; Lyons-Ruth et al., 2016) attachment in the first 18 months and enlarged limbic structures years later (however, see conflicting data from Leblanc, Dégeilh, Daneault, Beauchamp, & Bernier, 2017). Two of these studies (Hidalgo et al., 2019; Lyons-Ruth et al., 2016) accounted for the effects of maltreatment. It is worth noting that some findings revealed volumetric differences in the amygdala, but not the hippocampus (Lupien et al., 2011; Lyons-Ruth et al., 2016; Moutsiana et al., 2015), which may be related to the timing of stress exposure and/or neuroimaging assessments (Lee et al., 2019). Likewise, some studies have found gender-dependent effects, albeit without a clear trend (e.g. see Wen et al., 2017 versus Lee et al., 2019), and differences in the laterality of limbic growth.

While more research will be necessary to reconcile these variations in results, the broad pattern in findings appears consistent with a ‘use-dependent’ model of neurodevelopment (Perry et al., 1995), which broadly posits that the brain develops based on experience. Importantly, findings seem to converge on two preliminary conclusions that support the results reviewed in earlier sections. First, caregiving/attachment stressors during infancy were (in most studies) associated with overdeveloped limbic areas, which are regions heavily involved in stress regulation (Schore, 2009) and dissociation specifically (Krause-Utz et al., 2017; Lanius et al., 2018). Second, these neurodevelopmental changes were observed to follow infant exposure to *non-extreme* stressors (though not all studies controlled for maltreatment), thereby exemplifying the heightened susceptibility of infancy as a developmental window. It should be noted that, among the aforementioned studies, Lyons-Ruth et al. (2016) was unique in its attempt to verify whether limbic growth mediated pathways from early caregiving to dissociation.

While the study found enlarged left amygdala volume to be concurrently associated with dissociative symptoms in adulthood, it did not mediate the relation between infant disorganized attachment and dissociation. However, the study was underpowered ( $n = 18$ ), which could have masked meaningful effects.

Structural overgrowth in the limbic regions could contribute to early vulnerability for dissociation in a number of ways, though all remain speculative. Enlarged limbic areas may contribute to heightened stress reactivity and a ‘sensitized’ reliance on defensive responses (Perry et al., 1995; Schore, 2009), and thus augment risk for attachment disorganization (see Rifkin-Graboi et al., 2019) and dissociative responses in the face of stress. Plausibly, in the context of chronic and severe attachment-related stressors, the immature infant brain could adapt to favour the dissociative defensive response over the hyperaroused response (fight/flight) because of individual coping style (Perry et al., 1995), but also because an unresponsive caregiver is a survival threat the infant can neither ‘fight’ nor ‘flee’. Likewise, enlarged limbic areas may alter functional connectivity with other regions (e.g. midbrain, prefrontal cortex; Lanius et al., 2018; Schore, 2009) and impede integration across emotion processing, pain processing, memory, attention, and other neurocognitive functions.

As a final point, we wish to situate these hypotheses within the complexities of the broader literature, as this pattern of *enlarged* limbic structures seems at odds with some evidence showing that dissociative adults may have atrophied (Krause-Utz et al., 2017) and underactive (Krause-Utz et al., 2017; Lanius et al., 2018) limbic structures. Among possible explanations, the severity of childhood stressors (Krause-Utz et al., 2017), the developmental timing of exposure to stressors (McLaughlin et al., 2019; Riem, Alink, Out, Van Ijzendoorn, & Bakermans-Kranenburg, 2015), and the severity of dissociative symptoms are potential factors that could account for differences in neurodevelopmental patterns. For instance, more severe stressors, such as maltreatment, may lead to cell damage (Krause-Utz et al., 2017) and thus volume *reductions* in limbic structures, particularly if exposure occurred in later childhood (McLaughlin et al., 2019; Riem et al., 2015). How these divergent and non-linear neurodevelopmental trajectories might impact the course, severity, and specific expression of dissociation remains an unsettled issue, and represents an important terrain of future inquiry for researchers.

## 5. Directions for future research

Future research would benefit from focusing on the following areas for growth. Much of the prospective research presented here focused on the role of the mother-child relationship in predicting dissociative outcomes, providing scarce information about the buffering

or additive effects of other attachments. The integrative attachment model recently proposed by Dagan and Sagi-Schwartz (2018) posits that child–mother and child–father attachment may predict developmental outcomes more strongly in combination, rather than in isolation from the other. Accordingly, a holistic family systems perspective needs to be applied to developmental research on dissociation to better address this hypothesis. Additionally, the remarkably diverse manifestations of dissociation (see Schimmenti & Sar, 2019) have yet to be clearly parsed out in relation to different types of early experiences, which further limits our understanding of the developmental aetiology of dissociation. It would be important to explore whether specific adverse experiences (e.g. characterized by deprivation vs. threat; McLaughlin et al., 2014) lead to different manifestations of dissociative symptoms (e.g. shifts in consciousness vs. identity fragmentation). Finally, research should continue to investigate neurodevelopment (including, but not limited to, the limbic regions) as a potential mediator of the link between early caregiving experiences and dissociative outcomes. Among methodological issues that merit attention, future studies should account for the presence of maltreatment/trauma so as to parse out the relative effects of different experiences. In addition, the timing of stressor exposure is a critical consideration to account for, as just mentioned, given its impact on neurological outcomes.

## 6. Conclusion

The current paper aimed to provide a theoretically integrative review of how dissociation develops from caregiving experiences, with emphasis on risk factors that exist beyond the otherwise well-understood negative impact of childhood maltreatment. By integrating existing theories, we show that dissociation likely develops through a combination of defensive and intersubjective developmental pathways. Collectively, the prospective findings presented herein demonstrate the enduring impact of early attachment-related stressors in the development of dissociative outcomes, which often co-occur with but can be independent of maltreatment. This is further supported by recent research demonstrating that even non-extreme caregiving disturbances during infancy impact the developing limbic structures in the brain. Taken together, findings make the case for approaching assessments of the caregiver-child relationship with discernment of factors beyond the presence/absence of maltreatment when conceptualizing children's risk profiles for dissociation.

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