Social thinning and psychiatric vulnerability after childhood maltreatment: A neurocognitive social transactional perspective

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Summary

Childhood maltreatment is associated with significant, enduring risk of psychiatric disorder. In this paper, we review how neurocognitive alterations following maltreatment may indirectly increase risk of psychiatric disorder via their impact on social functioning. We propose a *neurocognitive social transactional model*, within which the neurocognitive sequalae of maltreatment are postulated to affect how an individual's social architecture is constructed across development, including the quality and quantity of relationships in an individual's social network. We review extant evidence in two areas in relation to maltreatment: *stress generation* (a process by which individuals are more likely to experience interpersonal stressor events), and *social thinning* (an attenuation in the number and quality of relationships over time). We consider how neurocognitive alterations could contribute to these interactive and autocatalytic social processes, which gradually impoverish an individual's actual or potential social environment and ultimately increase psychiatric risk. We conclude by considering implications of this neurocognitive social transactional model for preventing psychiatric disorder following childhood maltreatment.

Search strategy and selection criteria

References for this review were identified using the search terms ("maltreatment" OR "abuse" OR "neglect") AND ("stress generation" OR "social network/s" OR "social support" OR "loneliness") in the title and abstract fields. Relevant articles published up to and including 30 September 2021 were identified through searches in Google Scholar, PubMed and ScienceDirect. Articles resulting from these searches and relevant references cited in those articles were reviewed. Only articles published in English were included. Articles were included if they focused on at least one of the following: physical, sexual or emotional abuse or neglect. Articles were excluded if they focused on the social circumstances of parents, rather than children. The resulting literature included meta-analyses, systematic reviews, narrative reviews, and behavioural and neuroimaging empirical studies.

Introduction

Childhood maltreatment, a common form of developmental adversity, is robustly associated with significant and enduring risk of psychiatric disorder[1]. When disorders arise, they are more likely to follow a severe course, with earlier onset, greater comorbidity and poorer responsiveness to traditional interventions[2,3]. In recent years, there has been systematic investigation of the putative neurocognitive mechanisms that increase psychiatric risk, with evidence implicating systems that process threat, reward and autobiographical memory, among others[4].

Childhood maltreatment is also associated with significant difficulties in social relationships[5]. In a recent study of over 150,000 participants, self-reported experience of maltreatment was associated with greater social isolation and loneliness in adulthood[6]. Maltreatment has been associated with a higher incidence of later stressful social experiences, such as peer victimisation[7] and violence in romantic relationships[8], and with reduced levels of social support in adulthood[9]. Individuals with a history of maltreatment also typically have a smaller social network (defined as fewer social relationships and less frequent social contact)[10] and increased loneliness[6]. These social difficulties are all inextricably entwined with mental health[11,12].

Collectively, these findings illustrate a clear relationship between maltreatment experience and psychiatric disorder, between maltreatment experience and later suboptimal social environments, and between suboptimal social environments and psychiatric disorder. However, there has been little theoretical or empirical work to comprehensively draw together these disparate strands of research. Instead, extant neuroimaging research has predominantly focused on how brain alterations following maltreatment contribute to an individual's latent vulnerability to psychiatric disorder – for example, by linking altered threat processing with

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risk of anxiety disorder[4,13]. Others have proposed that severe and repeated stress experienced can lead to chronic activation of domain-general processes, including the nervous, endocrine and immune systems [14]. Chronic activation of these systems is thought to lead to progressive wear and tear, compromising the body's capacity to engage in allostasis (maintaining physiological stability). The resulting *allostatic load*, or its extreme form *allostatic overload,* is postulated to have long-term negative effects on biological aging and physical and mental health[14].

Both accounts contend that it is the neurobiological changes that arise *within* the individual following maltreatment that elevates psychiatric risk[15,16]. However, such accounts say remarkably little about how neurobiological changes impact social determinants of mental health. We refer to these social determinants collectively as an individual's *social architecture*, given that these features of the social world are transactionally constructed across development[17]. Social architecture here comprises at least three distinct domains: (i) social status – one's position within a hierarchy, indexing access to resources; (ii) social integration – one's ability to maintain affiliative or supportive relationships; and (iii) social stress – one's experience of interpersonal stressful or adverse events. These aspects of social capital are strongly associated both with physical and mental health outcomes[17]. In this review, we suggest that altered neurocognitive functioning following maltreatment experience influences how individuals construct their social architecture, and that this in turn profoundly shapes future brain development and mental health outcomes across the lifespan (Figures 1 and 2)[5]. Specifically, we consider a *neurocognitive social transactional model* of mental health vulnerability following maltreatment, reviewing the evidence for two social processes that have been particularly well researched. The first, *stress generation* after maltreatment, refers to the process by which affected individuals actively contribute to interpersonal stress in their social environment; the second, *social thinning* after maltreatment, refers to the process by which

neurocognitive alterations following maltreatment contribute to social and behavioural outcomes that constrain and diminish a child's network of affiliative or supportive relationships over time[18].

Throughout, we emphasise that the social environment develops over time through transactional processes: there is an interactive, iterative relationship between an individual and the people around them. In a seminal paper in 1997, Rutter and colleagues argued that we are not passive recipients of chance social environments, but rather active agents in how our social environment is created over time[19]. For example, a child who is maltreated at home might interact with their peers more cautiously, more aggressively or with less social sensitivity[20,21]. This may impact their ability to establish and maintain social relationships, increase risk of negative social experiences such as being bullied[22], and limit future opportunities for social learning and support throughout childhood, adolescence and adulthood. In a review of the broader social determinants of health, Hertzman and Boyce describe the social causation of disorder and disease as "*iterative and recursive, in the sense of involving repeated, self-amplifying exposures over time…[with]…autocatalytic, self-organizing feedback loops, in which one traumatic event follows from others, giving rise over time to intensely negative and stressful social contexts*"[23]. This observation eloquently captures the way in which the social architecture of an individual affected by maltreatment might be constructed over time, with significant implications for mental health.

In the current paper, we first review evidence for stress generation and social thinning in the context of maltreatment. We consider how maltreatment experiences overall (rather than individual maltreatment subtypes) can influence a child's social architecture in ways that generally elevate psychiatric risk. This is in line both with the limited evidence for specificity between individual maltreatment subtypes and individual psychiatric outcomes[24] and the fact

that maltreatment subtypes are significantly correlated in community samples[25]. We then consider how neurocognitive alterations following maltreatment may increase the risk of stress generation and social thinning, focusing on three exemplar systems: threat, reward and autobiographical memory. Again, we focus on maltreatment as a general developmental stressor. It remains far from clear whether different maltreatment subtypes in children and young people impact brain circuitry in specific ways. Most functional brain imaging studies have either not measured or statistically accounted for other maltreatment subtypes, increasing the likelihood of overestimating the effects attributed to individual forms of maltreatment[4]. Throughout, we outline how stress generation and social thinning as social transactional processes may be implicated in the emergence of psychiatric disorder following maltreatment, and end by discussing implications for prevention.

Review of stress generation and social thinning in individuals who have experienced maltreatment

Stress generation

Individuals with a history of maltreatment are more likely to subsequently experience other stressful social events and relationships. Longitudinal studies have found that children who have been maltreated are more likely to experience peer rejection across childhood and adolescence[7,26]. For example, Bolger and Patterson[7] found that 50% of children who had experienced protracted maltreatment (>5 years) were rejected by their peers at one or more of the study's annual time points, compared to only 27% of comparison children. Young adults who self-report a history of maltreatment have an increased frequency of both minor stresses (daily 'hassles', including those relating to partners, family members and work colleagues)[27], and more significant stressful life events[28].

Romantic relationships are also more stressful. Longitudinal studies have found that childhood maltreatment predicts reduced competence (e.g. shorter length, poorer relationship quality) and increased violence in romantic relationships in adulthood[8,29–31]; although note that not all studies have found this[32]. One study found that, after controlling for demographic characteristics, experiencing any form of maltreatment before the age of 17.5 years predicted lower levels of romantic competence (β = -.23) and higher levels of relational violence (β = .24) in adulthood. A number of studies have assessed potential mediators of these relationships. For example, a longitudinal study found that the associations between childhood maltreatment and conflict, criticism and antagonism in young adult relationships (both friendships and romantic relationships) were mediated by antisocial behaviour and relational aggression in childhood[33]. Other studies have found that the relationship between maltreatment history and stress in romantic relationships may be mediated by reduced levels of emotional competence[34].

Critically, individuals with a history of maltreatment are not passive recipients of interpersonal stress in their life, but may also contribute to its occurrence. This phenomenon is known as *stress generation* and was originally identified in individuals with depression[35,36], but multiple studies have now found that stress generation is also associated with childhood maltreatment[27,28,37,38]. One study of young adults found that self-reported childhood emotional abuse was associated with more *interpersonal dependent stressors*, i.e. stressful social events that are at least partly influenced by the individual's own characteristics, such as a relationship breakdown; there was no association between maltreatment and non-interpersonal dependent or independent stressors[39].

This indicates that individuals with a history of maltreatment experience a specific type of social stress that arises, at least in part, because of their own cognitive and behavioural characteristics. A number of such mediating characteristics have been proposed, including

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personality traits such as neuroticism and low agreeableness[40,41], interpersonal characteristics such as insecure attachment[42] and excessive reassurance seeking[43]; and certain cognitive styles such as negative inferential style and hopelessness[38,44]. The presence of a psychiatric disorder or elevated symptoms alone do not appear to account for the phenomenon of stress generation after maltreatment. Depressed individuals with a history of maltreatment experience more stressful events than depressed individuals without a history of maltreatment[37]. Moreover, in a prospective study of young adults with self-reported experiences of maltreatment, elevated levels of stressful life events were reported even after accounting for baseline levels of anxiety and depression symptoms[28]. Further empirical studies are required to establish the precise behavioural and cognitive characteristics that increase the risk of stress generation in individuals with a history of maltreatment.

Social thinning

We use the term 'social thinning' to refer to the way in which a child's network of affiliative or supportive relationships diminish over time or is limited by not capitalising on opportunities to forge such relationships in the first place. Studies have highlighted that individuals with a history of maltreatment experience both, during childhood and adolescence but also into adulthood[45]. A longitudinal study asked young people (9-13 years) with and without a history of maltreatment to name their social contacts (e.g. 'Who do you hang out with?', 'Who makes you feel better when you're upset?'), and found that, averaged across three time points, participants who had experienced maltreatment named fewer people in their network[10]. At the second time point only, they reported fewer same-age friends specifically[10]. Relatedly, a study of 8- to 12-year-olds found that those with a history of maltreatment reported a higher proportion of very young children (<6 years) as members of their network (5.3%) compared to controls (2.6%); they also report fewer classmates in their network (mean = 3.7)

compared to controls (mean = 5.3)[46]. Another study found that children aged 8-10 years who had experienced neglect or emotional abuse had fewer playmates that also considered them to be playmates in return, compared to children who had not experienced maltreatment[47].

Maltreatment experience can lead to impoverished social networks even many years later. For example, adults who report adverse childhood events, including maltreatment, experience less social support from both family and friends compared to those who report few or no adverse events[48]. Another study of over 150,000 adults found that those who self-reported one type of childhood maltreatment (either physical, sexual or emotional abuse, or neglect) were more likely to experience loneliness (OR: 1.38) and social isolation (OR: 1.17) than those who experienced no maltreatment[6]. These odds increased as more types of maltreatment were experienced; participants who experienced all four types were more than three times as likely to experience loneliness (OR: 3.16) and nearly 1.5 times more likely to experience social isolation (OR: 1.45). Finally, a prospective cohort study found that adults (mean age 39.5 years) who had a documented history of maltreatment reported lower levels of social support than controls, as measured by the perceived ability of others to provide practice and emotional advice or help[9]. A lack of social support can contribute to psychiatric risk: a number of studies have found that social support moderates or partly mediates the relationship between childhood maltreatment and later psychiatric disorder[15,49–57], in part, perhaps, because social support enables people to have more positive beliefs about themselves and the world[58] (however, this relationships not been found in all studies[59–62]). Together, these findings highlight that, in the aftermath of maltreatment, building and maintaining supportive relationships is key to promoting good mental health. Unfortunately, individuals with maltreatment experience (compared with their peers with no history of maltreatment) are at an increased risk of social thinning, both in terms of number of social contacts but also the quality and depth of relationships.

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The role of the neurocognitive sequalae of maltreatment in stress generation and social thinning

What remains underexplored is how the neurocognitive alterations that arise after maltreatment might put an individual at increased risk of experiencing stress generation and social thinning. In this section we consider how alterations in three exemplar systems – threat, reward and autobiographical memory – may contribute to an increased risk of stress generation and social thinning, influencing how an individual's social architecture is constructed across development and ultimately increasing risk of psychiatric disorder. It is important to note that these systems, while reviewed here in isolation, are highly integrated and form part of an extended neural circuitry underpinning social functioning and psychiatric disorder[63].

Moreover, it is important to note that alterations in one or more systems will jointly influence complex social behaviours in ways that may lead to poorly optimised functioning. This is in line with a developmental transdiagnostic approach which places emphasis on the dynamic interplay between brain circuits, rather than focusing on singular brain regions[64]. In addition to the three exemplars described here, several other neurocognitive domains are impacted by maltreatment experience (for example, emotional regulation, emotion learning and touch processing) and these domains are likely to also be relevant to understanding the link between maltreatment experience, neurocognitive alteration, social functioning and psychiatric outcome. They are, however, beyond the scope of this paper, and we direct interested readers to comprehensive reviews of neurocognitive functioning following maltreatment elsewhere[4,15].

Threat processing

A number of studies have shown that maltreatment is associated with disrupted threat processing, with evidence for both hypervigilance towards and avoidance of threat cues,

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depending on the experimental context. For example, heightened reactivity in response to angry faces has been observed in the amygdala and anterior insula, key regions that process threat, in both adults and children with a history of maltreatment[13,65,66]. Conversely, other studies show that maltreated individuals present with amygdala hypoactivation[67] and patterns of behavioural avoidance to social threat cues[68]. A bias towards or away from threat is likely to be adaptive when a child is being maltreated: in a dangerous environment, it might be useful to be highly alert to threat, or protective to disengage from it[69]. But over time, this increases risk – especially as heightened reactivity is typically associated with poorer emotion regulation and cognitive control[70]. Behavioural hypervigilance and neural hyperreactivity to threat have been particularly implicated in conduct disorder[71] and anxiety disorders[72], and similar patterns of neural response have been found in individuals with depression and PTSD[73,74], demonstrating the role of altered threat processing in vulnerability to psychopathology.

Disrupted threat processing may impair a person's ability to effectively negotiate interpersonal challenges, which in turn may contribute to stress generation and social thinning. Every child or adolescent at some time or other needs to deal with being teased, snubbed, pressured or provoked by peers, and many will also experience bullying or other forms of aggression[22]. With a neural system primed to detect and respond to threat, individuals with maltreatment experience may be more likely to react unhelpfully to these social challenges. First, a person might respond to an ambiguous (or genuine) social threat with reactive aggression, such as shouting at or physically attacking the perceived aggressor. Repeated displays of reactive aggression in adolescents are associated with lower levels of popularity[75], which could comprise their ability to cultivate and maintain friendships. If displays of aggression are frequent or risk the safety of other pupils, it can result in exclusion from school[76]. This could lead to a cascade of further social stress such as conflict with parents and increased contact with delinquent peers. Exclusion also increases the risk of social thinning:

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permanent exclusion from school can lead to reduced access to relationships across multiple domains, effectively amounting to exclusion from society as a whole[77].

Alternatively, a young person might overreact to potential social threat by becoming submissive (e.g. becoming tearful and upset) rather than aggressive. This is often seen in victims of bullying, where such a response can exacerbate the bully's behaviour[78]. Others may respond to perceived social threat by withdrawing and avoiding new social challenges[79]. These responses to social threat may contribute to and be compounded by altered functioning in other socially-relevant processes operating in parallel, such as hostile attribution bias, attentional bias, and difficulties with emotion recognition, emotion regulation and mentalising. Together, these may serve to generate social stress and reduce opportunities for young people to learn effective social skills that can help them build and maintain an adaptive social architecture.

Reward processing

Children and adolescents who have experienced maltreatment have been found to show neurocognitive alterations in reward processing[5] – the set of neurocognitive mechanisms that respond to desirable stimuli, largely underpinned by a mesocorticolimbic dopaminergic circuit[80]. This is likely because abusive and neglectful environments offer very limited and unpredictable rewards, which may constrain a child's opportunities to learn which behaviours lead to reward or discover what reward feels like[81]. Blunted responses to reward may be appropriate and adaptive in such a context, potentially reducing disappointment and effort where there is little likelihood of rewarding outcomes. However, this may have an impact on stress generation and social thinning and subsequent psychiatric risk. Disrupted reward processing has particularly been implicated in the development of depression[82], but it is also associated with a number of other disorders including attention deficit hyperactivity disorder, eating disorders and schizophrenia[83].

Below we focus, in particular, on the impact of disrupted *social* reward processing because, almost by definition, maltreated children are less likely to receive predictable social rewards such as praise and affection from their caregivers[84]. Atypical social reward processing is also relevant to our model because it is associated with altered social behaviour and is a transdiagnostic marker of psychopathology, including depression, bipolar disorder, eating disorders and schizophrenia[83,85].

If a child with a history of maltreatment is less able to learn which behaviours elicit rewarding responses from others (e.g. smiles, compliments), less motivated to obtain these rewards, or less able to experience hedonic pleasure when they are received, this will likely affect their social behaviour. For example, it might mean a reduced motivation to follow rules and social norms to gain approval from others, which in time might alienate and frustrate the peers and adults around them, leading to social thinning. Disrupted reward processing can also lead to stress generation. One study of adolescent girls with no history of depression found that a reduced neural response to reward predicted a greater number of dependent, but not independent, life stressors over the following eighteen months[82]; it is possible that disrupted reward processing may act in a similar fashion in those with maltreatment experience. Over time, if individuals with a history of maltreatment have a reduced ability to learn from or appropriately respond to rewarding social cues, then they may be less likely to initiate or effectively maintain the very relationships they need to support their mental health.

Autobiographical memory processing

Detailed memories of personally experienced events are central to our sense of self and guide our present experiences. In contrast, children with maltreatment experience tend to show a pattern of *overgeneral memory*, in which autobiographic memories are recalled with a relative lack of detail[86]. For example, when asked to recall a memory in response to cue words such as

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'smile' or 'clumsy', individuals with a history of maltreatment tend to provide a general response, such as focusing on a series of incidents (e.g. 'visiting my grandparents at Christmas') or an extended period of life (e.g. 'when I was at primary school'), whereas those without such a history are more likely to provide detail of an event that happened at a specific time and place[86]. Those with a history of maltreatment also show a distinct pattern of neural activity when describing autobiographical memories, including reduced activation in the hippocampus and increased activation in the parahippocampal gyrus (positive memories) and increased activation in the amygdala (negative memories)[87]. Overgeneral memory may have functional value, helping the individual avoid specific traumatic or aversive memories[88]. However, this may come at a cost: overgeneral memory (and associated patterns of altered neural functioning) is seen in a range of psychiatric disorders, particularly depression and PTSD[88,89], and can predict the onset of depression in adolescents at risk of the disorder[90]. This memory style is also associated with poor problem solving abilities and negative self-representations[86].

We argue that overgeneral memory and its consequences in maltreated individuals can also lead to stress generation and social thinning, and ultimately an increased risk of psychiatric disorder. Specifically, if an individual has an overgeneral memory style, they may be less able to generate effective solutions to problems, which often have an interpersonal component[91]. When an individual with a history of maltreatment is faced with a social challenge, such as bullying at school, an argument with a friend, or a romantic conflict, a pattern of overgeneral memory may limit the richness of autobiographical memories that they can draw upon to guide their current behaviour. They might struggle to remember what behaviour exacerbated previous similar challenges, and what led to a resolution. They might be less able to judge what nuances of other's behaviour – including their language and facial expressions – have meant in the past, and therefore what they mean now. These complex social tasks will inevitably implicate

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multiple other neurocognitive processes in addition to autobiographical memory, for example empathy, perceptual and attentional processes and mentalising. Possibly in concert with deficits in these other systems, an overgeneral autobiographical memory will mean that individuals with maltreatment experience are less able to simulate different adaptive solutions to interpersonal problems, which may in turn increase conflict and reduce the likelihood of prosocial behaviour, leading to difficulty maintaining relationships over time[92].

Model summary

In this Review, we present evidence that maltreatment alters functioning in three exemplar brain systems (threat, reward and autobiographical memory) in ways that are relevant to social functioning. The relationship between neurocognitive alterations and social architecture is transactional and bidirectional; an individual's maltreatment experience influences their brain development and this in turn can shape how their social world unfolds, and this altered social world over time can then affect future brain development, resulting in either negative or positive outcomes for a child's future mental health (Figures 1, 2). For either scenario, potentially maladaptive neurocognitive alterations can develop after maltreatment. In Figure 1, a relatively high number of risk factors and a paucity of protective influences lead to stress generation and social thinning. These processes influence ongoing canalisation within neurocognitive systems, such that over time, the systems are less able to optimally support individuals when they negotiate new social challenges. This in turn leads to a social world characterised by more stressful interpersonal interactions and fewer protective social relationships. By contrast, in Figure 2, the same initial neurocognitive adaptations following maltreatment arise in the context of more protective and fewer risk factors. In this pathway, a child is able to gradually build a more positive, supportive social architecture, which in turn contributes to recalibration or compensation of neurocognitive functioning. Over time, the risk

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of psychiatric disorder is lowered both as a function of more adaptive neurocognitive functioning and a more protective social architecture.

Importantly, we note that other neurocognitive systems and specific functions, such as trust processing[93], may be of equal (if not greater) relevance to those reviewed here. Additionally, although there is a paucity of extant research delineating specific alterations in brain function following individual forms of abuse, how we operationalise adverse experience, including capturing a child's own perception of events, is a critical area for future research[94]. The viability and utility of dimensional approaches to measurement in the context of adversity and brain mechanisms (e.g. by contrasting experiences of deprivation and threat) are being actively debated[95,96]. One avenue of future research would be to explore such dimensions in the context of neurocognitive and social functioning and their relationship to mental health vulnerability.

Implications for prevention

To reduce rates of psychiatric disorder and their associated economic costs, there is increasing recognition that a radical shift towards prevention is needed[4,97,98]. We believe this requires a social transactional approach informed by neuroscience research that moves away from an exclusively proximal, individual-specific and symptom-based approach: risk and vulnerability mechanisms are not simply located within the child. Below, we highlight three main implications for indicated prevention stemming from the model presented in this Review.

First, social care and educational systems should develop approaches that foster trusted, stable, and supportive relationships for children who experience maltreatment. Recent policy and practice recommendations have emphasised the key role of relationship stability and continuity after maltreatment, including the importance of cultivating and maintaining trust[99,100]. Truly embedding such an approach requires systems to prioritise and monitor a

child's relational needs during decision-making processes[100]. For example, when considering changes in school or foster care placements, a social impact assessment, alongside routine assessment of safeguarding, could assess how a child's current (and future) relationships will be affected.

Second, training is needed for social care, educational and other staff regarding how maltreatment can derail the construction of a child's adaptive social architecture, as are policies and procedures that avoid systems operating (often inadvertently) in ways that amplify stress generation and social thinning[101]. For example, policies could focus on minimising school exclusion, a compelling example of a system unwittingly exacerbating and compounding the social impact of complex trauma. A key part of any systems-level response is recognition that a child's behaviour can be experienced as challenging, leading adults to experience compassion fatigue and burnout[102]. As such, all carers and professionals working routinely with children who have experienced complex trauma themselves require support and (where appropriate) supervision[100].

Third, policies should also support a child's broader social experience (e.g. by promoting opportunities within sport, music and the arts) to enable them to develop agency, self-worth and a sense of self-competence – all of which are compromised following maltreatment. These learning opportunities (and not simply relationships themselves) are key if the child is to forge a new kind of meaning about who they are and what they can achieve in life, in ways that are protective for long-term mental health. In our view, such non-clinical social prescribing opportunities could be combined with neurocognitively-informed interventions to support and enhance prevention efficacy[103].

Finally, researchers and clinicians should develop mechanistically-informed models of how risk trajectories unfold over time. Within a social transactional framework, this means identifying which specific cognitive and social processes might be the most malleable or

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pragmatic targets for intervention following maltreatment. For example, there is a particular gap in using neuroimaging research to investigate individual subjective experience and appraisal of maltreatment[95]. In addition, longitudinal neurocognitive research can also help shed light on functional plasticity in the brain following intervention, to clarify whether behavioural outcomes are associated with recalibration within a given neurocognitive system or the development of compensatory processes and whether this is associated with a hypothesised reduction in stress generation and social thinning. Together, system-level prevention efforts should foster an adaptive and protective social architecture around the child to improve mental health outcomes in the long term.

Conclusion

We have presented a socially-mediated pathway to psychiatric risk after maltreatment. Specifically, we have argued that neurocognitive alterations within multiple brain systems can singly and collectively influence how an individual interacts with and shapes their social world. This can contribute to the construction of a social architecture characterised by increased stressful interactions (stress generation) and attenuated social support (social thinning), which contribute to increased latent vulnerability for psychiatric disorder. This socially mediated risk is distal, dynamic and autocatalytic, accruing over time, and can be understood to operate alongside the proximal, neurocognitive risk mechanisms within the child[4,15,16]. We have described how a child's interactions can be shaped (and derailed) by neurocognitive alterations that may have been adaptive in earlier adverse (and atypical) environments. This can lead to difficulty in initiating and maintaining meaningful relationships, reduced social capital, including fewer opportunities for learning, with enduring consequences for mental health and wellbeing.

We conclude that the social environment of the child must be central to any prevention effort. Systems around the child should place relational quality centre stage, developing approaches that foster trusted, stable and supportive relationships as well as providing training and support for carers and professionals. Neurocognitive research is well positioned to develop precise and mechanistically-informed developmental models of how risk trajectories unfold over time to guide these initiatives and identify specific and malleable prevention targets. This approach has the potential to promote healthy, adaptive neurocognitive functioning following adversity and contribute to a child's ability to build an enduring social architecture with long term protective benefits for their mental health.

Contributors

All authors conceptualised the manuscript. EM and LF conducted the literature search. All authors wrote the original draft and reviewed and edited subsequent drafts. All authors read and agreed to the final version.

Acknowledgements

Conflict of interest statement

The authors declare no conflict of interest.

Figure legends

Figure 1. A schematic illustration of the neurocognitive social transactional model. This pathway depicts a child who has experienced maltreatment (repeated exposure to abuse and/or neglect) and subsequently experiences further risk factors and a paucity of protective influences. In this context, increased stress generation and social thinning lead to an impoverished social architecture contributing ultimately to an increased risk of psychiatric disorder.

Figure 2. A second version of the neurocognitive social transactional model. This pathway depicts a child who has experienced maltreatment (repeated exposure to abuse and/or neglect) and subsequently experiences a range of protective influences that help build and maintain their social relationships, but relatively few risk factors. In this context, less stress generation and social thinning lead to a richer, more adaptive social architecture contributing ultimately to a decreased risk of psychiatric disorder.

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