



Children, Young People and Families, Cognition

How adverse childhood experiences shape our brains

Gary Donohoe looks at the evidence for affective and cognitive pathways.

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Like many psychologists I am fascinated by how early childhood experiences shape our adult selves, and in particular how these developmental experiences affect cognitive and brain development. Uncovering the multiple pathways involved – and the challenges of establishing causal relationships between past events and current difficulties – may expand our understanding of childhood trauma and the therapeutic responses needed by those seeking help.

Almost all psychologically informed theories of mental health disorders rely on the core concept that early life adversity increases our risk of later psychological difficulties. Cognitive Behavioural Therapy (CBT), for example, teaches that our thinking can be biased by past experiences in a way that shapes our current expectations. Attentional and mnemonic processes, decision making and attributions are each affected. With time, this may come to shape how we think about ourselves (e.g. personalising negative events), others (e.g. expecting harsh judgement) and the future (e.g. catastrophising about events).

Sometimes these biases in thinking about ourselves and others are not subtle. For example, for us who work with individuals diagnosed with borderline personality disorder, or individuals whose thinking appears not just biased, but completely shut down during waves of distress. Psychologists who work with individuals diagnosed with major

depressive disorders, bipolar disorder or schizophrenia will also have encountered individuals whose cognitive function is not just biased, but challenged to the point of making it hard to take in and process information accurately.

In this piece, I describe some recent studies on correlates of early adversity, which suggest that there are multiple brain pathways influenced by early childhood effects. In addition to the well-established 'affective' pathway (associated with emotional dysregulation) that readers will be familiar with, I will highlight the evidence supporting a 'cognitive' pathway by which the effects of childhood trauma may be transmitted.

A focus on the limbic system

In recent decades, the cognitive neuroscience of mental health disorders has shed light on how the brain is shaped by adverse childhood events. In particular, we know much more about how components of the limbic system are altered by early adversity and stress. One of these component structures is the amygdala, the almond shape subcortical structure synonymous with threat appraisal.

Overactivation of the amygdala region in response to threat in those with experience of childhood adversity is the single most robust finding reported in the literature, whether in studies of children, healthy participants, or individuals with mental health difficulties (Mothersill & Donohoe, 2016). For these individuals, this is often subjectively experienced as feeling more easily threatened or 'triggered' in a range of situations, including even 'neutral' situations not generally considered threatening by others. This threat hyper-sensitivity has in turn been associated with a dampening of the frontal lobe's ability to modulate threat perception once the limbic system has become over-activated. It has also been associated with stress-related reductions in hippocampal volume, a region synonymous with consolidating and reconsolidating of memories, and which is exquisitely sensitive to stress. Reduction in hippocampal volume following childhood trauma is likely to further challenge our ability to bring to bear past memories so as to better distinguish between risky/threatening situations and 'false alarms' (Dannlowski et al., 2012).

Childhood adversity and social cognition

In addition to this canonical pathway by which psychologists have understood the effects of child trauma in adulthood, several research groups have in recent years been studying other pathways along which adverse childhood events might affect cognitive and social cognitive processes later in adulthood. The reason is this – as well as the emotionally 'triggering' effects of childhood trauma, many affected individuals show difference in cognitive processing even when not currently stressed or distressed. This has led researchers to hypothesise that stress exposure may increase risk for serious mental health disorders directly via a 'cognitive' pathway that is additional to the affective/threat pathway (e.g. Myin-Germeys & Os, 2007).

One of early findings have strongly influenced our recent work in this area. The first is evidence that early life adversity is strongly associated with cognitive and social cognitive

difficulties. Social cognition involves the ability to recognise and think about the emotions and intentions of others (e.g. emotion recognition, theory of mind), as well as thinking about our own intentions and reactions in social situations (emotional self-regulation).

A recent systematic review by our group found that accurate emotion recognition – usually measured in terms of facial emotion recognition – was negatively correlated with greater exposure to childhood adversity (Rokita et al., 2018). What was noteworthy here was that these cognitive challenges were found across both patient populations and healthy participants, and to roughly the same extent in clinical and non-clinical cohorts.

But what was even more surprising was the type of adversity most strongly associated with social cognition. Childhood adversity is measured in terms of exposure to a variety of experiences, including traumatic experiences involving emotional neglect and abuse, physical neglect and abuse, and sexual abuse (e.g. as measured by the Childhood Trauma Questionnaire, Bernstein et al., 1994). When we started this work, we reasoned (based on clinical experience) that exposure to emotional adversity would matter most to social cognition. For example, psychological treatment models for individuals with long terms relationship difficulties (e.g. Schema therapy, Young et al., 2003) consistently emphasise harsh and punitive parenting in formulating an understanding of the enduring relationship difficulties associated with borderline and other personality disorders. Having trained in these approaches, my money was firmly on emotional abuse and neglect as major predictors of cognitive difficulties.

It turns out this was wrong. Instead, exposure to physical neglect turned out to be the strongest predictor, an effect that was observed across multiple patient and healthy participant groups (Rokita et al., 2020). By way of explanation for this finding, a follow-up study found that much of the effect of childhood physical neglect on poorer emotion recognition was mediated by poorer maternal care. This seemed to suggest that having parents who struggle to meet even basic physical needs leads to developmental challenges from which it is difficult to emerge cognitively unscathed. Put in the language of attachment theory, having one's physical needs met is likely to represent a fundamental building block on which to build a secure base from which to explore the social world. Without it, young learners would struggle to amass the quality and quantity of childhood and adolescent experiences required in later adulthood to think about the social world. And in terms of social cognition, this does not simply result in cognitive 'biases' as CBT and other theories suggest, but more fundamental challenges to social cognition.

Recent advances in brain imaging

An important change in the field of cognitive neuroscience over the last ten years has been to move beyond seeing the brain in terms of 'blobs' of activity that 'light up' in individual brain regions during the performance of an MRI task. This has been replaced to a large extent by a more nuanced understanding the brain's activity in terms of distributed networks of activity that work in concert to support cognitive functions such as vigilant attention, and identifying salient versus non-salient information.

One of these networks is called the 'Default mode network' or DMN. What's interesting about this network is that it typically only becomes active when at rest – i.e. when we're not focused on a task, but rather thinking (daydreaming) about ourselves and what preoccupies us. At this time, large swathes of the parietal, posterior cingulate, and medial prefrontal cortex becomes active, like the low humming of car's engine when put in neutral gear.

Interestingly, this network is activated not just when thinking about ourselves, but also while musing about the other people in our lives. In terms of thinking about one's self, the DMN is involved when thinking about autobiographical memories (events and facts relating to one's self), self-referencing information (self-traits and descriptions) and reflecting about one's emotional state. When thinking about others, the DMN is involved in thinking about the mental states of others (Theory of mind), understanding their emotions, and evaluating others socially and morally. And just as the DMN is active when thinking about one's past, it's also active when imaging the future based on what we want and don't want. There is a strongly developmental aspect to the strength of connections within the DMN – a meta-analysis by Mak et al. (2017) found evidence of an inverse U-shape across the lifespan, with stronger connectivity in the DMN network in adults compared to either children or the elderly. Perhaps predictably, given its various functions, dysconnectivity of the DMN has been reported in a variety of developmental and degenerative disorders, including schizophrenia and Alzheimer's disease.

In our most recent studies, we sought to determine whether the association we previously observed between childhood adversity and social cognition was partly mediated via changes within this network. Why would this matter? Well, because it would suggest a more sophisticated model for understanding the effects of early childhood adversity. One that moved beyond thinking simply in terms of a cortical 'threat response' model, towards understanding a broader network of changes in brain activity. So doing might then provide a way to understand the cortical basis of difficulties in social information processing seen across populations. Importantly, doing so would expand on current cognitive models to include not just 'biases' but also subtle impairments in cognition.

In carrying out the study we included two groups – the first, a sample of healthy participants, to examine whether the cognitive effects of early life adversity are seen across diverse populations independent of diagnosis. The second was a patient sample of individuals with psychosis. This is a uniquely important group to study because they (a) report extremely high rates of childhood adversity (85 per cent in patients with schizophrenia compared to 30 per cent in the general population; Kessler et al., 2010; Larsson et al., 2013), and (b) show marked deficits in cognition, irrespective of exposure to adversity.

The findings across both groups were clear: those with greater exposure to childhood adversity showed reduced connectivity between multiple regions of the DMN. Two points are worth emphasising here. First, this 'dysconnectivity' was observed while participants lay with their eyes open and without having a cognitive task to complete. This is important because issues often associated with using cognitive measures in patient

samples functional MRI (e.g. tasks being too hard or too easy) do not arise. Second, this dysconnectivity didn't depend on diagnosis – the same pattern of dysconnectivity (within posterior regions of the brain, and between posterior and anterior regions) was observed for both patients and controls. To our knowledge this is the first study that has investigated the relationship between childhood adversity and brain connectivity within the default mode network in psychosis, showing that the dysconnectivity associated with greater exposure to childhood adversity is broadly the same as for healthy participants with similar.

Perhaps most importantly of all, in terms of understanding cognition, across all participants these connectivity changes were found to mediate the previously observed effects of early adversity on social cognition. Specifically, the association between greater exposure to childhood trauma and lower scores on an emotion recognition task were mediated via lower connectivity involving posterior regions of the DMN. As seen in our previous studies this finding was strongest for the association between physical neglect and emotion recognition – reduced DMN connectivity in posterior (i.e. parietal) brain regions mediated the association between higher exposure to physical neglect and poorer emotion recognition.

Some limitations

Anyone reading *The Psychologist* will recognise the important caveats to the kind of research described in this article, two of which are particularly noteworthy. The first is regarding the difficulty of making accurate causal inferences from cross-sectional data. Although a review of this length precludes a thorough review of the available research, both animal research and longitudinal research provides a broadly supportive basis for the inferences made here. For example, in a recently study based on the ALSPAC Longitudinal cohort of around 5,000 individuals followed from birth to 18 years, we found evidence that childhood adversity in the first couple of years of life was predictive of poorer cognitive function in middle childhood, even after the effects of maternal education was covaried for (Holland et al., 2020). Notwithstanding this evidence, the work reported here is cross-sectional and the inferences made are exactly that; causality has yet to be confirmed for the hypotheses presented.

The second is regarding the uncertain accuracy of retrospective accounts. While the childhood trauma questionnaire (CTQ) is widely used, the issues of recollection bias and subjectivity in retrospective measures of childhood trauma are widely acknowledged. Here again, however, recent studies comparing retrospective and prospective recall of childhood trauma found moderate correlations between these measures, with both explaining a similar amount of variation in negative life outcomes (Reuben et al., 2016). Furthermore, subjective reports of these experiences are noted to predict risk for later psychopathology more strongly than objective measures (e.g. court reports; Danese & Widom 2020).

Only part of the story

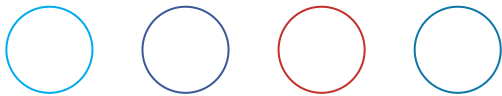
What do these studies mean for those of us working with individuals to have lived experience of mental health difficulties? No doubt we will each draw our own conclusions. Mine are relatively straightforward. The first is that the effects of trauma on the brain are

more broadly experienced than we first imagined. When we think about how the brain is shaped by adverse childhood experiences, we need to move beyond thinking that only isolated regions like the amygdala are affected, and instead consider the brain-wide effects of childhood trauma. In short, the story of a too easily triggered amygdala impacting on threat appraisal and emotional self-regulation in disorders of anxiety, mood and emotional dysregulation, is also only part of the full story. The second is that the widely held view among psychological therapists that early life experiences results in subtle cognitive 'biases', is only part of the picture. Instead, we need to understand that early childhood adversity may result cognitively in more fundamental challenges to accurately recognising and processing social relevant stimuli.

The final point is an important note of hope. In the same way that the genetic basis of cognition is predictive, but not deterministic, of academic and occupational outcome, so too the cognitive and social cognitive effects of early adversity are not the final word. The evidence from the studies above is that both affective (limbic) and cognitive (default mode network pathways) are affected to varying extent in adults whose childhoods involved exposure to adversity. Therapies that combine strategies for improving social thinking and regulating emotions by focusing on a wider range of cognitive skills are likely to be of enormous value in helping these individuals benefit from psychologically informed therapies.

Trauma-informed approaches to psychosis and other major mental health disorders are already recognised as an important therapeutic response to the needs of affected individuals. But there is also an abundance of evidence that interventions targeting cognitive and social cognitive deficits in major mental health disorders can, at least partially, restore cognitive function in those whose normal learning opportunities were disrupted by such trauma (Bowie, 2019). Providing cognitive training as a 'prequel' to traditional psychological interventions (CBT) may help increase the likelihood of success in those experiencing these challenges.

Gary Donohoe is Professor of Psychology at NUI Galway and an Irish Health Research Board Leader in youth mental health.



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