

Is there a relationship between Adverse Childhood Experiences and Reading Comprehension Difficulties mediated by Executive Function?

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Research has shown that children affected by adverse childhood experiences (ACEs) are more likely to have difficulties with executive function. Research has also highlighted that reading comprehension is a complex process that is supported by executive functions including working memory, inhibition, shifting, planning and metacognition. In this essay I propose that ACE exposure may increase reading comprehension difficulties mediated by poorer executive functioning. ACE exposure is known to predict poorer academic outcomes, including reading ability but, at present, limited research has attempted to investigate specific factors underpinning this relationship.

In this essay, I outline research that has explored the relationship between executive function and ACEs and also executive function and reading comprehension. I will then bring these topics together to consider what the evidence is to directly support the essay question.

Overall, there is a lack of research in this area and this prevents firm conclusions from being drawn, at present. However, I argue that despite this, the current research suggests this is an important area for future research. I highlight a number of challenges within this topic including; the challenges with defining and measuring executive function, a lack of research within the topic of ACEs, as a whole, and variation in developmental outcomes depending on the ACE. These are important considerations for future research in this topic. In the final section, I highlight some potential implications for educational psychologists and teachers.

Adverse childhood experiences (ACEs) are highly stressful and potentially traumatic events or situations that occur during childhood or adolescence (YoungMinds, 2018, p. 22). ACEs include child maltreatment (abuse or neglect) and exposure to household dysfunction; domestic violence (DV), mental illness, caregiver death, substance misuse, divorce or imprisonment of a household member. ACEs are prevalent in England, with 23% of young people reported to have experienced at least one ACE and 9% exposed to four or more (YoungMinds, 2018). There is also a cumulative negative effect of ACEs; four or more ACEs, prior to age 18, are associated with a significantly increased risk of mental illness and premature death (Felitti et al., 1998). Research shows that long-term toxic stress impacts brain development which has

consequences for a child's cognitive, emotional and behavioural functioning (Lund et al., 2020). Specifically, impairments in the pre-frontal cortex (PFC) have been linked to ACE exposure (Lund et al., 2020; Pechtel & Pizzagalli, 2011). This area of the brain is integral for higher level cognitive processes including those connected to executive function (EF) (Lund et al., 2020; Pechtel & Pizzagalli, 2011; Zelazo et al., 2016).

EF has various definitions in the literature but there are a number of common threads. It is recognised to be an umbrella term that encompasses a range of higher order cognitive processes (Lund et al., 2020; Sesma et al., 2009) often activated during novel or complex tasks (Follmer, 2018; Lund et al., 2020) that support with the self-regulation of cognition, emotion and behaviour (Daly et al., 2017; Miyake &

Friedman, 2012; Segal & Collin-Vézina, 2019) to reach a specific goal (Follmer, 2018; Locascio et al., 2010; Segal & Collin-Vézina, 2019; Sesma et al., 2009). In the classroom, EFs support children to focus their attention, remember information, think flexibly (e.g. to consider another's perspective) and to plan and organise their work. Given their broad range of influence, it is unsurprising that better EF skills have been associated with higher academic achievement (Best et al., 2011), whereas, EF difficulties have been correlated with behavioural problems in school (Jacobson et al., 2011) and are a feature of a number of special educational needs (Zelazo et al., 2016).

Children affected by ACEs are more likely to have weaker EF (Pechtel & Pizzagalli, 2011; Roos et al., 2016). They are also reported to have poorer academic outcomes (Crozier & Barth, 2005; Delaney-Black et al., 2002; Duplechain et al., 2008) and difficulty with emotion and behavioural regulation (Lund et al., 2020; Tobin, 2016). It is plausible that EF could play a role in mediating these difficulties but, at present, limited research has directly studied this. As EF influences cognitive and emotional regulation, which both impact learning, this seems to be an area worthy of investigation. In this essay I will consider this question with a specific focus on reading comprehension (RC).

This focus has been chosen for two reasons. Early literacy skills (e.g., decoding and language comprehension) are known to be essential to RC (Cain et al., 2004). However, as the curriculum shifts towards the end of primary school from 'learning to read' to 'reading to learn', the interplay of other cognitive processes becomes more important (Sesma et al., 2009). Engaging in more complex RC involves making inferences based on prior knowledge and integrating ideas across sentences and paragraphs (Cain & Oakhill, 2006) and this involves processes controlled by EF (Cartwright et al., 2017; Daucourt et al., 2018; Sesma et al., 2009). This suggests it is worthwhile to consider whether EF difficulties in children affected by ACEs increase the risk of RC difficulties.

Secondly, RC skills are needed across all aspects of the curriculum and, therefore, play a role in overall school achievement. As school achievement is protective against later life

adversity (Dent & Cameron, 2003) it is useful to consider factors that contribute to this in order to support this group with a successful transition through school. This may have important implications for the practice of educational psychologists (EPs) and teachers.

To progress the understanding of this topic, I will begin with an overview of the construct of EF and consider some of the complexity within this field (Jurado & Rosselli, 2007; Miyake et al., 2000). I will then review research that has explored the relationship between EF and ACEs. This, on the whole, supports a relationship between ACEs and EF difficulties (Daly et al., 2017; Lund et al., 2020; Masson et al., 2015) although there is some variation. Some ACEs (e.g., neglect) are particularly predictive of EF difficulties (Lund et al., 2020) and other ACEs have received little research attention at present.

The next section of this essay will review research on EF and RC. The research reviewed predominantly supports the role of EF in RC (Cain et al., 2004; Cirino et al., 2019; Daucourt et al., 2018; Sesma et al., 2009). Again, there is some variation and methodological challenges in this research which will be discussed.

Following this, I will bring these topics together to consider the evidence for a relationship between ACEs and RC mediated by EF. A few studies have shown a correlation between higher ACE exposure and lower reading attainment (Crozier & Barth, 2005; Delaney-Black et al., 2002; Duplechain et al., 2008) but they do not explain the causes of this relationship. However, one recent study (Ferrara & Panlilio, 2020) looks at this more specifically in a study of ACEs, metacognition and RC.

Overall, I argue that it is not possible to draw firm conclusions in relation to the essay title at this point but that the evidence suggests this area warrants further attention. This essay will conclude with a discussion of some challenges that should be considered in future research, and implications for EPs and teachers.

Understanding and defining EF

It is important to address some of the challenges within the field of EF. As highlighted, the EF definition is broad and has even been described

as elusive to define (Jurado & Rosselli, 2007). The lack of an agreed definition reflects the complexity of EF. Challenges with isolating and operationalising different components of EF has contributed to the debate as to whether EF should be viewed as a unitary construct or made up of a number of co-functions (Jurado & Rosselli, 2007). Miyake (2000) argues the case of a unity and diversity model in that some processes overlap but that there are also independent components with their own distinct role. They support the distinct role of working memory (WM) (monitors information and updates WM contents), inhibition (deliberately stops automatic or dominant responses) and shifting (changing attentional focus between tasks or mental sets). In the subsequent sections of this essay, the role of these in relation to ACEs and RC will be considered. EF is also connected with the processes of planning, organising, monitoring and metacognition (Cirino et al., 2019; Locascio et al., 2010; Sesma et al., 2009). As these processes are relevant to the research on EF and RC they will be considered in addition to Miyake's three EF components.

Although metacognition has been considered independently in relation to RC (Swanson & Trahan, 1996) other research has grouped this under the umbrella of EF (Cirino et al., 2019). Metacognition is generally defined as thinking about thinking (Woolfolk, 2016) and, in practice, it has considerable overlap with EF. For example, both are described as higher order thinking processes (Woolfolk, 2016) that support cognitive self-regulation through planning, monitoring and evaluation (Roebbers, 2017). It has been suggested that EF facilitates metacognition (Roebbers, 2017) and this is partly reflected in the inclusion of metacognition within EF assessments such as the behaviour rating inventory of executive function (BRIEF). Based on these observations, metacognition will be considered to be a process influenced by EF.

The relationship between ACEs and EF

A number of studies have shown a relationship between ACEs and poor EF (Daly et al., 2017; Lund et al., 2020; Masson et al., 2015; Roos et al., 2016). In a study of university students, a self-reported history of maltreatment was

correlated with poorer performance on tasks assessing inhibition, switching and metacognition (Daly et al., 2017). Further, in a study of 694 children, aged 5, who were involved with child protection services, 43.5% of children performed worse than chance on a task that assessed inhibition and attention. WM deficits have also been associated with the experience of maltreatment in childhood (Masson et al., 2015).

Lund's (2020) systematic review is one of few that looked at a broader range of ACEs in relation to EF. However, half of the studies reviewed involved the more common research areas; child maltreatment (abuse or neglect) or exposure to DV. Not all studies reviewed supported a relationship between ACEs and EF but there was evidence to support a significant relationship between EF and ACEs in studies that looked at child maltreatment and poor maternal mental health. Child neglect was most significantly associated with poor EF; it was linked to deficits in inhibition, WM and attention. The authors explained this by the lack of social and cognitive inputs, which in addition to prolonged toxic stress, may have had a more pronounced impact on PFC development and associated EF. This also highlights a potential confounding variable in the form of early language development, which has been shown to be negatively affected by neglect (Hildyard & Wolfe, 2002; Segal & Collin-Vézina, 2019; Westby, 2018) and to be predictive of later RC (Cain & Oakhill, 2006; Cirino et al., 2019). The effect neglect has on RC may, therefore, be two-fold; further research would be required to isolate the specific impact of EF.

This study also raised a number of gaps in research. For instance, the authors found no studies linking parental imprisonment to EF. Additionally, half of the studies they reviewed did not consider the cumulative effect of ACE exposure; this may be a weakness when trying to consider the impact of ACEs overall, in light of research supporting the stronger detrimental effect to individuals when exposed to four or more ACEs (Felitti et al., 1998).

The role of EF in reading comprehension

There is also a growing body of research that supports a role of EF in RC. Within this, the WM

is the aspect of EF that has most consistently been connected with RC (Cain et al., 2004; Sesma et al., 2009; Swanson & Ashbaker, 2000). The WM is thought to support RC as it allow the reader to hold recently read text whilst simultaneously searching the long-term memory for relevant knowledge and engaging in other reading processes such as decoding words (Cain et al., 2004; Sesma et al., 2009). Limited WM capacity means that less information is stored whilst reading which affects integration and understanding of the text (Swanson & Ashbaker, 2000). Whilst word reading skills and prior knowledge do predict RC ability, they do not completely explain it (Cain et al., 2004; Sesma et al., 2009). Good word reading skills may support EF by allowing the reader to devote more cognitive resources to higher order thinking processes, instead of focusing on lower level processing such as decoding (Cain & Oakhill, 2006).

Research has also highlighted a role for shifting and inhibition in RC. Shifting has been linked to difficulties in switching between graphophonological processing and semantic processing, which prevented participants in the study from understanding the meaning of the text (Cartwright et al., 2017). Poor inhibition was associated with difficulty in preventing unnecessary information entering the WM during a reading task which overwhelmed cognitive processing (Daucourt et al., 2018).

Poor organising and planning have also been found to be predictive of children's RC difficulties (Locascio et al., 2010; Sesma et al., 2009). Planning supports readers to implement strategies for RC both prior to and during reading, to monitor their understanding and to evaluate whether they needed to change their strategy (Follmer, 2018). Planning and monitoring have also been recognised to be a feature of metacognition within RC research (Cain et al., 2004; Cirino et al., 2019)

Cirino et al. (2018) found that measures of EF (WM, planning, metacognition) uniquely predicted RC ability but there was also a lot of shared variance both within EF and other skills such as language. Their study suggested an important role for EF but they also highlighted that untangling the specific relationship between RC and EF is difficult. Both processes involve a

number of different skills which often overlap and can be challenging to measure independently. Supporting this, a recent meta-analysis (Follmer, 2018) found only a moderate positive effect in their review of studies of EF on RC. The most inconsistent results were shown for inhibition which also had the weakest effect size. They highlighted that a great variety of tests were used to measure inhibition which indicates that this concept may be particularly difficult to operationalise within the context of RC.

Task impurity is cited as a key methodological problem when assessing EF (Best & Miller, 2010; Miyake & Friedman, 2012). Complex performance tasks, which are necessary to assess EF, often call upon more than one EF making it challenging to assess their unique contributions. To illustrate this Miyake (2000) highlights that the Wisconsin card sorting task has been used by different researchers to assess shifting, inhibition and problem solving independently. Other research has used parental/teacher self-reports as behavioural measures of EF, for example the BRIEF (Cirino et al., 2019; Daucourt et al., 2018). Daucourt et al. (2018) suggests this approach is less prone to task impurity problems as behaviours are visible. However, further research has shown that behavioural measures of EF do not correlate highly with performance test measures (Toplak et al., 2013) suggesting they measure different underlying constructs. Toplak (2013) suggests that performance measures may more accurately measure efficiency of cognitive processing whereas behavioural measures assess EF under everyday conditions where an individual is pursuing self-directed goals. Measures such as the BRIEF are, therefore, considered to be more ecologically valid. However, Toplak argues that assessing EF with a performance measure could provide an indicator of EF potential, given the highly structured conditions are likely conducive to EF. Therefore, if a child performs better on a performance task compared to their behavioural ratings of EF it may give practitioners and parents an insight into what a child could do with structured support (Toplak et al., 2013).

Despite some mixed findings in the literature, a number of studies indicate a role for EF in RC. What seems less clear, is the specific contributions of different EF components in RC.

It is potentially problematic that a number of EF tasks also have a WM component (Best & Miller, 2005) as the role of the WM in RC tasks is well supported within the literature (Cain et al., 2004; Sesma et al., 2009). There is a need to understand whether other EF components are as important as WM to RC, but harder to measure. The BRIEF assessment may overcome some of these issues so could be included in future research.

ACEs, poor EF and reading comprehension difficulties

A number of studies have shown there is a correlation between the experience of ACEs and lower reading attainment (Crozier & Barth, 2005; Delaney-Black et al., 2002; Duplechain et al., 2008). One study also considered the cumulative effect of ACEs, showing that academic difficulties (including reading) increased in a linear fashion with ACE exposure (Blodgett & Lanigan, 2018). However, these studies are correlational and did not seek to directly explain the effect of EF on reading difficulties. However, a recent study did attempt to explore this more directly by looking at the role of metacognition in mediating the relationship between early adversity and poor RC (Ferrara & Panlilio, 2020).

Their study included 179 undergraduate students who were asked to self-report ACEs, current trauma symptoms, academic metacognition and maladaptive metacognition, alongside a RC test. The authors defined academic metacognition to involve regulation of cognition, planning, monitoring and evaluating, which overlaps with some of the EF processes reviewed above. Maladaptive metacognition was characterised by “lack of confidence in cognitions (i.e., not trusting one’s knowledge or memories), cognitive self-consciousness (i.e., the tendency to negatively monitor cognitions) and beliefs about the need to control thoughts” (Ferrara & Panlilio, 2020, p.3). Their results did not find a significant role for academic metacognition in RC. However, they did find that when students reported ACEs and current trauma symptoms, they showed higher levels of maladaptive metacognition. This was significantly associated with poorer RC

performance. The authors suggested that higher levels of maladaptive metacognition may have contributed to more negative appraisals of the RC task and to students believing their prior knowledge or skills were lacking. This may have led to lower self-esteem and more task avoidance.

Ferrara and Panlilio’s study is not easily generalisable as it was a sample of predominantly white, young adult women. Further, as this sample achieved the necessary academic levels to progress to higher education it could be inferred that they were not limited by poor EF skills. This may not be representative of all children affected by ACEs. However, the inclusion of maladaptive metacognition does add an interesting perspective of how ACEs may be connected to poorer RC. This finding could be interpreted as relating to more recent conceptualisations of EF as including ‘hot’ and ‘cold’ functions. Cold EFs refers to cognitive processes (e.g., WM, inhibition, shifting) that are emotionally neutral where as hot EFs refer to cognitive processes that are supported by emotional awareness and social perception (Zimmerman et al., 2016). Hot EF has been connected to deliberate emotion regulation such as attempts to reduce feelings of anxiety, sadness or anger (Zelazo et al., 2016). Ferrara and Panlilio’s findings suggest that emotionally motivated cognition (i.e., avoidance of perceived threat) may be significant for people affected by ACEs. This has relevance to the classroom as children who have experienced ACEs may choose to avoid tasks (such as reading) if they are concerned they lack the skills to complete it. Further, as emotion regulation difficulties are well reported in children affected by ACEs (Lund et al., 2020; Tobin, 2016) it makes sense to consider EF as incorporating both hot and cold aspects. Understanding how these independently and collectively influence learning in this group seems an important goal for research and for those interested in supporting vulnerable children.

Although there is some initial research seeking to clarify the relationship between ACEs and RC, at present, there is a lack of research in this area. This field is also inherently complicated by a number of methodological issues, such as defining and operationalising EF

on top of challenges with isolating the effect of its different components on RC. The complexity of these topics is also influenced by the fact that all three elements (ACEs, EF and RC) are influenced by other factors. For example, early language development influences later RC (Cain & Oakhill, 2006; Cirino et al., 2019) and children who have experienced ACEs are more likely to have language delays (Hildyard & Wolfe, 2002; Segal & Collin-Vézina, 2019). Further, children living in poverty are at increased risk of exposure to ACEs (Lewer et al., 2019; Sanders et al., 2020) and also to poorer early language (Foster et al., 2005). In Foster's study, home learning environment (e.g. less access to books or parents not reading with their child) mediated the relationship between socioeconomic status and poorer early language skills. This highlights that RC in disadvantaged children, who are also affected by ACEs, will likely be influenced by multiple factors and not just poor EF.

Another challenge comes with the heterogeneity inherent to ACEs. It is likely that different ACEs may have differential impacts on EF development. For example, experiencing neglect has been suggested to lead to less environmental stimulation which affects both language development and higher-level cognitive processing, whereas exposure to threat (e.g., physical/ sexual abuse) may bias the brain in the detection of threats, leading to more problems with emotion regulation and behaviour (Lund et al., 2020; Westby, 2018). Exposure to different ACEs may therefore lead to either hot or cold EF difficulties. Both will impact learning behaviours but with different antecedents.

In conclusion, it is apparent that a number of questions and challenges exist in relation to this topic. However, given the evidence reviewed, I argue that a relationship between ACEs and RC difficulties mediated by EF is plausible and that this is an area that warrants further attention. With this in mind, some potential implications have been highlighted below.

It may be beneficial for EPs and teachers to consider the role that EF plays in RC when assessing a child with reading difficulties. Language skills are important to an understanding of a child's RC level but where EF difficulties exist this may pose a significant

challenge to reading. The methodological challenges that have been highlighted are also relevant to assessment. EPs and teachers should be mindful that it can be difficult to isolate EF components. The work of Toplak (2013) suggests that utilising a combination of behavioural and performance test measures may provide a useful insight into how a child performs in different situations and what EF potential there might be. Gathering more information from a variety of settings will also contribute to a more holistic representation of a child's experience.

In terms of interventions to support with RC difficulties, a focus on 'cold' EF skills may be useful. Cirino (2018) suggested that decreasing the linguistic demands of the task and providing learning supports will support RC by placing less burden on the WM. For example, carefully considering text complexity or providing scaffolding. Ensuring children have the necessary vocabulary to complete comprehension tasks will also support WM by allowing more allocation of mental resources to complex elements of RC (Cain & Oakhill, 2006).

To support with the overall process of RC there is extensive evidence for the effectiveness of metacognitive strategies in RC (Education Endowment Foundation, 2017). This review found strategies such as encouraging children to make predictions about what will happen in the text increased attention and encouraged more active monitoring of comprehension. Supporting students to think about what they already knew about a topic was also helpful; this may have supported retrieval from the long-term memory and therefore reduced WM load. In general, the use of checklists can be helpful for children with poorer EF to support them to complete goals (Watson, 2016). Metacognitive strategies can act in this way by clarifying what the goal of the RC task is and what a child needs to focus on when reading. A similar concept is the use of mnemonics to support a child to remember key steps in the reading process for example thinking about the aim of the story or the character's intention (Woolfolk, 2016).

Lastly, through training EPs can raise awareness of the complexity of ACEs and the variety of ways they can impact child development including EF. For example, behaviours that may have been adaptive in terms

of surviving exposure to toxic stress (e.g., hyperarousal) are often interpreted as disruptive within a classroom (Segal & Collin-Vézina, 2019; Tobin, 2016). EPs can help schools to understand this and support the development of a trauma informed school. Making sure classrooms feel safe, have clear rules and systems and emphasise unconditional positive regard will support a child's emotion regulation and be more conducive to learning (Tobin, 2016). Further, Ferrara and Panlilio's study highlighted that motivation and self-esteem are also important to RC. EPs can encourage teachers to be mindful of this and understand that supporting children to be successful, through appropriate interventions, will likely promote future engagement in RC.

As highlighted at the start of this essay, school achievement can serve as a major protective factor against later life adversity for children affected by ACEs (Dent & Cameron, 2003). EPs, with their understanding of complex problem solving, should be seen to play a key role in developing the skills of school staff to prevent RC being a barrier to learning which may contribute to future risk for this group of children.

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