

***Doctorate in Professional Educational, Child
and Adolescent Psychology***



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Psychology**

Doctoral Thesis

**A psychologically-informed bouldering intervention for children
with differences associated with ADHD: a pilot study.**

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Date – 17/05/2024

Declaration

I, Sam Worth, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

In line with guidance, the word count includes any footnotes, endnotes, maps, diagrams, and tables, but excludes the appendices and list of references, as well as the title page, declaration, abstract, impact statement, acknowledgements, contents page, and lists of tables and figures.

Word count: 32,449

Abstract

Research indicates a well-established link between ADHD and negative educational outcomes (Barry et al., 2002; Fleming et al., 2017), mental health outcomes (Secnik et al. 2005) and imprisonment (Young et al., 2015). The clinical evidence for medication as a means of symptom-reduction is strong (Cortese et al., 2018) and the proportion of individuals with ADHD who have been prescribed medication quadrupled in boys and increased almost nine-fold in girls between 2000 and 2018 (McKechnie et al., 2023). NICE guidelines recommend that medication should not be used as a first-line treatment in children with mild to moderate ADHD (NICE, 2016), as there are a number of associated side effects (Cascade et al. 2010). The current study aimed to expand the range of nonpharmacological intervention approaches for children who experience difficulties related to ADHD, by exploring a novel psychologically-informed bouldering approach.

Twelve male participants (aged 11-13), with difficulties related to ADHD, took part in a six week psychologically-informed bouldering intervention. This convergent mixed-methods study collected pre- and post-intervention quantitative measures of attention, emotion regulation and cognitive regulation (using the TEA-CH2 and BRIEF-2). Quantitative data was analysed by comparing the means of scores pre- and post-intervention. Semi-structured interviews (post-intervention) were analysed using a reflexive thematic analysis and later integrated with quantitative findings to develop meta-inferences.

The study found strong evidence that levels of attention and cognitive regulation had improved, thus providing early support for the application of psychologically-informed bouldering to support CYP with symptoms associated with ADHD. Qualitative data indicated that emotion regulation had improved for some participants, but this was not captured in the quantitative data. The study provided a unique contribution to the literature and future research should consider expanding the research sample in terms of size and in terms of individual differences (e.g. gender presentation).

Impact statement

This research explored the application of a psychologically-informed bouldering intervention for children with symptoms associated with ADHD. It examined to what extent this novel approach to intervention could improve levels of attention, emotion regulation and cognitive regulation. The symptoms of ADHD, when unsupported, can have a profound impact on individual children and the community around them (e.g. family life, classroom, school and wider society). The discussion of Aetiology in ADHD is unclear and at times controversial, but nevertheless approaches to treatment rely heavily on a medical model (e.g. stimulant medication). Indeed, some Educational Psychologists (EPs) have been concerned that stimulant medication is often offered as a first response, before considering other non-pharmacological options (Hill & Turner, 2016). Although medical/biological understandings of ADHD are certainly one important piece of the puzzle, a multifactorial approach that gives due consideration to other social, environmental and psychological factors is needed.

The current study drew heavily on evidence from exercise/physiological interventions and from climbing as a manualised therapy for mental health in adults. It presented a new nonpharmacological approach to intervention that incorporated evidence-based psychological approaches. The findings of this study suggest that children and young people with the symptoms of ADHD are likely to benefit from similar interventions that incorporate psychology and climbing. Beyond individual children, the findings contribute to academic literature as well as the professional practice of Educational Psychologists, educators, policy makers and other professionals engaged in the mental health of young people. Implications include:

- **Supporting mental health:** rock climbing of all kinds offers a unique opportunity for the development of physical health, balance/coordination, concentration, self-regulation, mindfulness, problem-solving and social skills. This combination of benefits strongly indicates that climbing could be used as manualised treatment for other mental health challenges (as it has been in other European countries).

- **Future academic research:** the findings of the current study provide a valuable starting point for future researchers wishing to push the knowledge-base forward. It would be of most value for future research to explore this intervention approach on a larger scale and in a more diverse participant group. Additionally, researchers may wish to explore modifications that would better target emotion regulation (e.g. prioritising the therapeutic relationship and/or using other forms of climbing that are more likely to elicit a fear response).
- **Educational psychologists:** the current study hoped to expand the range of nonpharmacological responses to supporting children with the symptoms of ADHD. EPs are trained to understand and critique the evidence-base that supports any potential intervention and they are well-positioned to make recommendations that can positively impact the lives of young people. Given their unique skills, EPs could also be involved in the adaptation and delivery of new therapeutic climbing interventions in the future.

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1. Literature review

The NHS recently launched a long-term plan, which included a commitment to expand the range of evidence-based responses to the mental health and emotional wellbeing of children and young people (CYP; Department for Health, 2019). A recent government green paper placed an increased emphasis on UK schools to support the mental health and emotional wellbeing of their students (Department of Health and Social Care and Department for Education, 2017). Educational Psychologists (EPs) are well positioned to support schools with early identification and importantly, to advise on effective, evidence-based interventions. The present study piloted the use of a six-week psychologically-informed bouldering intervention for young people with identified needs relating to ADHD.

The following literature review will start by considering how issues with attention (or a diagnosis of Attention Deficit Hyperactivity Disorder) can impact on the educational and life outcomes of children and young people. There will be discussion of labelling/diagnostic practices in general and how this guided the inclusion criteria of the current study. Following this will be discussion of how ADHD is most commonly treated, with specific reference to stimulant drugs and nonpharmacological responses, including physical exercise/physiological interventions. There will be a brief introduction to bouldering as a form of physical exercise before consideration of how EPs can contribute to a wider range of evidence-based, non-pharmacological intervention approaches. Then, there will discussion of the current study's theoretical perspective, the study variables and approaches to measuring those variables.

1.1 The mental health and educational impact of ADHD

In the Diagnostic and Statistical Manual, Fifth Edition (DSM-5, 2013), ADHD is classified as a neurodevelopmental disorder and defined in terms of, "a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development." Inattention refers to a general difficulty with attention (i.e., the ability to selectively attend to certain relevant stimuli and

inhibit or reject irrelevant or distracting stimuli). Impulsivity refers to the tendency for reactive behaviours without appropriate consideration of consequences. Hyperactivity is often characterised by restless and fidgety behaviours. It makes intuitive sense that in certain environments a significant issue with one or more of these three areas could be limiting and impact on a young person's mental health and emotional wellbeing. This is heightened in a typical classroom learning environment, where success is underpinned by attention (L. E. Arnold, Hodgkins, Kahle, Madhoo & Kewley 2020; Kirk, Gray, Riby, Taffe & Cornish 2017). Research conducted by Barriga et al. (2002) suggested that the link between 'problem behaviours' (defined as withdrawal, social problems, delinquency and aggression) were moderated by attention problems (specifically inattention). In other words, the so-called 'problem behaviours' were associated with attentional problems, which in turn had a negative impact on academic achievement. More recently, C. Stevens and Bavelier (2012) argued that selective attention was amenable to training and implicated in domains important to academic performance (language processing, literacy and mathematics).

Research suggests that children and adults with a diagnosis of ADHD perform worse than their neurotypical counterparts on a range of educational and life outcomes, relating to mental health (Harpin, Mazzone, Raynaud, Kahle & Hodgkins 2016), including poorer self-esteem and social function. Academic success can have a positive impact on mental health and has long been associated with better outcomes in adulthood (Yu & Williams, 1999). A large population-based cohort study conducted in Scotland analysed data from 766,244 children who had attended primary, secondary and special school between 2009 and 2013 (Fleming et al., 2017). They found that school children who had received treatment for ADHD had fared worse than their peers in terms of academic attainment. The same group were also experiencing higher levels of unauthorised absence, exclusion and unemployment. Another study conducted by Barry, Lyman and Klinger (2002) found that severity of ADHD symptoms significantly predicted academic underachievement in reading, writing and maths. Children with ADHD are not only negatively affected in terms of their education, but also in terms of other life outcomes as they progress into adulthood.

Outside of education, ADHD has been shown to negatively impact mental health in other ways. Adults diagnosed with ADHD are significantly more likely to have issues with substance abuse and to have a comorbid diagnoses of various mental health issues, including anxiety, depression and bipolar disorder (Secnik, Swensen & Lage 2005). Additionally, a diagnosis of ADHD is associated with a higher likelihood of imprisonment. When compared with the general population, prevalence rates are five times higher in youth prison populations and ten times higher in adult prison populations (Young, Moss, Sedgwick, Fridman & Hodgkins 2015). Research shows a relationship between ADHD and the way that parents manage their own stress. In one study, parents showed more dysfunctional (avoidant-focused) coping mechanisms (Craig et al., 2020) when their child was diagnosed with ADHD. The lifetime cost to society of ADHD in childhood is estimated at £102,135 per person. This figure accounts for the cost of extra health care, extra educational provision and the reduction of future earnings (Khong, 2014).

1.2 Diagnosis of ADHD in practice and how this relates to the inclusion criteria of the current study

The present study focused on young people with difficulties in inattention, hyperactivity and/or impulsivity. As with any neurodevelopmental disorder, diagnosis is not always simple or clear (Morris-Rosendahl & Crocq, 2020). Individuals have varying levels of presentation across different context-specific domains and some internalising behaviours are more likely to go unnoticed. The diagnostic criteria in the DSM-V distinguishes between three presentations of ADHD: predominantly inattentive, predominantly hyperactive-impulsive and combined (American Psychiatric Association (APA), 2013). Field trials have previously shown that children belonging to the predominantly inattentive subtype were more likely to be diagnosed at a later age than those showing predominantly hyperactive-impulsive behaviours (Lahey et al., 1994). Inattentive symptoms are more subtle and likely to go unnoticed, in comparison to external displays of excessive gross motor activity (Adesman, 2001).

There is another issue with the level of subjectivity and how criteria are interpreted in different settings. The various behaviours or symptoms of ADHD are not always observed directly by the diagnosing professional. Diagnosis is often based on the subjective reports of *perceived* behaviour from the individual concerned, family members or other professionals. While there is a systematic approach to these data, there is a lack of objective, clearly defined markers (Gualtieri & Johnson, 2005). The symptoms of ADHD can be situational and environment-dependent (Purper-Ouakil, Wohl, Michel, Mouren & Gorwood 2004) and difficulties with sustained attention are only relevant in an environment where there is a demand for this skill, with the level of demand likely to vary from school-to-school and classroom-to-classroom. Therefore, the likelihood of an ADHD diagnosis may be skewed towards learning environments that hold more traditional expectations of behaviour.

A diagnosis of ADHD is often comorbid with other classifications of behaviour, particularly other neurodevelopmental conditions, such as Autism. Estimates vary but evidence from various studies suggests that the comorbidity of ADHD symptoms for Autistic young people ranges from 28.2 to 87% (Ames & White, 2011; Amr et al., 2012; Harkins, Handen & Mazurek 2022; T. Stevens, Peng & Barnard-Brak 2016). If the current study had used an inclusion criterion based on diagnosis, it could have potentially excluded those CYP who were diagnosed with ASD instead.

As discussed above, there are a number of limitations relating to the diagnosis of ADHD which would make diagnosis unsuitable as an inclusion criteria for the present study (e.g. professional subjectivity, bias towards more externalising presentations and the context-specific nature of symptom presentation). However, the primary reason for using an alternative inclusion criteria is due to wait times for children and young people to be assessed. While there is no national data on the waiting times and referrals for ADHD, a report conducted by The Nuffield Trust reported that NHS services have been unable to keep up with the rise in demand (Morris, 2024). In an attempt to alleviate the problem, NHS England announced a cross sector ADHD taskforce. NHS England's Chief

Executive said, “We have recognised that more needs to be done to ensure people can get a timely diagnosis and, importantly, that all their needs are addressed” (Lang, 2024).

The current author worked collaboratively with a Special Educational Needs Coordinator (SENCo) to select students who presented with difficulties relating to ADHD symptoms. This school SENCo had a number of years’ experience and is suitably-trained to understand and coordinate support for all students with Special Educational Needs and Disabilities (DfE, 2023). This selection process was not without flaws and did introduce a level of subjectivity, which is not dissimilar to diagnosing practices.

1.3 Pharmacological and nonpharmacological intervention approaches to ADHD

Interventions for (or treatment of) ADHD are heavily related to perceptions of aetiology, which is likely a complex interaction of genetic and environmental factors. The literature in this area implicates a profusion of various factors, ranging from consumption of saturated fats (Morandini et al., 2022), psychosocial adversity (Gómez-Cano, Zapata-Ospina, Arcos-Burgos & Palacio-Ortiz 2023) attachment concerns (Ladnier & Massarani, 2000) and gene mutations in the dopamine transporter gene (Ougrin, Chatterton & Banarsee 2010). In spite of this, the medical model of understanding seems to be dominant in ADHD. Current NHS information (2021) about the causes of ADHD is exclusively biological (genetics and brain function/structure). There is no mention of environmental factors that have been associated with the aetiology and maintenance of ADHD, e.g. the quality of the child's caregiving and social environment (Howe, 2010). It seems that in treating ADHD, common practices are also largely in line with this medical model as prescriptions of stimulant medication are high and increased dramatically between 1995 and 2015 (Renoux, Shin, Dell'Aniello, Fergusson & Suissa 2016). A more recent population-based cohort study demonstrated that this trend had continued, with the researchers finding evidence of increasing rates of new diagnoses and medical

prescriptions between 2000 and 2018 (McKechnie et al, O'Nions, Dunsmuir & Peterson, 2023) and the proportion of individuals prescribed medication had quadrupled in boys and increased almost nine-fold in girls. NICE guidelines recommend that medication should not be used as a first-line treatment in children with mild to moderate ADHD (NICE, 2016), but some EPs reported that stimulant medication is still often offered as a first response, before considering other non-pharmacological options (Hill & Turner, 2016).

The clinical evidence for medication as a means of reducing symptoms is strong. Results of a large scale meta-analysis conducted by Cortese et al. (2018), showed that all commonly prescribed ADHD medications (excluding modafinil) were more efficacious than placebo in the short-term treatment of ADHD. One large and rigorous study conducted by Spencer et al. (2005) found that in adults, there was a significant difference between therapeutic response to methylphenidate versus the placebo (76% vs. 19%). Stimulant medication, at the right dosage is a legitimate and effective treatment for ADHD, especially in the short-term, but there are a number of side effects associated that include loss of appetite (and weight loss), insomnia, stunted growth and mood disturbances (Cascade, Kalali & Wigal 2010). Psychostimulant medications were first used in children in the 1930s and since then there have been enormous advances in the understanding of ADHD. As this understanding continues to grow, there is more evidence suggesting that the current treatment approach should be adapted to expand beyond pharmacological responses (J. Posner, Polanczyk & Sonuga-Barke 2020).

The evidence for non-pharmacological responses to ADHD is promising but there are fewer studies in comparison to medical treatment options (J. Posner et al., 2020). In a recent review paper Shrestha, Lautenschleger & Soares (2020) discussed a wide range of nonpharmacological approaches that have an improving evidence-base, including behaviour management interventions in the form of parent training, classroom interventions and peer-based interventions. There are different approaches to parent training but, most commonly, caregivers are taught to discourage undesirable

behaviours through the use of timeouts and to reward more desirable behaviours with positive attention and praise (Young & Amarasinghe, 2010). The evidence for this approach requires some interpretation. A systemic literature review of 55 studies (Charach et al., 2013) showed that in terms of improved child behaviour, *Parent Behaviour Training* outperformed the stimulant drug methylphenidate. Another study (Catalá-López et al., 2017), analysing results from about 190 randomised controlled trials (RCTs) showed that medication combined with behaviour therapy was superior to either one in isolation. Large-scale reviews of evidence suggest that non-pharmacological approaches can have an impact on symptom reduction indirectly, for example through reducing parental stress, increasing parental confidence (Brown et al., 2005; Storebø et al., 2011; Zwi, Jones, Thorgaard, York & Dennis 2011). These reviews also point to the need for more studies researching non-pharmacological approaches.

1.4 Exercise/physiological interventions for ADHD

The benefits of exercise on physical and mental health are well documented in terms of reducing the occurrence of anxiety or depression, managing body weight and reducing the risk of disease among other things (Barbour, Edenfield & Blumenthal 2007; Hillman, Erickson & Kramer 2008). Research also clearly shows that exercise is particularly useful in the management of symptoms associated with ADHD. In a systematic review and meta-analysis of randomized control trials Cerrillo-Urbina et al. (2015) demonstrated that short-term aerobic exercise and yoga both seemed to effectively mitigate symptoms such as inattention, hyperactivity and impulsivity in children with ADHD. One systematic review of 30 studies found that moderate to intense aerobic exercise was beneficial for children and adolescents with ADHD (Ng, Ho, Chan, Yong & Yeo 2017). Similarly, Verret, Guay, Berthiaume, Gardiner & Béliveau (2012) found that 45 minutes of moderate-to-vigorous exercise, 3 times a week, improved attention, thought problems and social behaviour in children with ADHD. There are some limitations to the majority of research, which seeks to measure the impact of exercise on symptoms of ADHD, and this largely relates to the absence of a standardised measure of

physical activity. A meta-analysis conducted by Xie et al. (2021) analysed studies that included a wide variety of intensity and type of physical activity. Some accounted for this by detailing the duration of exercise and others used non-standardised descriptors (e.g., vigorous, moderate-to-vigorous, sedentary). For this reason, it is difficult to draw specific conclusions about effect size. Despite this, the research in this area shows a consistent relationship between higher levels of physical activity and reduced symptoms of ADHD.

The success of exercise in the treatment of ADHD symptoms seemingly makes use of the same neurochemical mechanism that underlies the use of stimulant medication, as described by Wigal, Emmerson, Gehricke and Galassetti (2013). Increased neurotransmission of catecholamines (e.g., dopamine and norepinephrine) relates to motivation, arousal and attention. Research into the effectiveness of stimulant medications led to new hypotheses relating to the pathology of ADHD, with many researchers suggesting that catecholamine dysregulation is a necessary component (Levy, 1991; Levy & Swanson, 2001; Prince, 2008; Solanto, 2002).

The researchers argue that physical exercise naturally stimulates the same catecholaminergic systems as stimulant medications and as a result positively influences brain health (Ma, 2008) and has an anti-depressive effect (Rethorst, Wipfli & Landers 2009). Specifically in relation to learning, researchers have suggested that exercise improves attention, focus and Executive Function and reduces distractibility (Wilens & Dodson, 2004; Winter et al., 2007). Medina et al. (2010) compared the impact that 30 minutes of moderately vigorous exercise had on medicated and unmedicated children with a diagnosis of ADHD and found no group differences. The findings of this study showed that exercise can be beneficial in the treatment of ADHD both on its own and when combined with medication.

1.5 Bouldering as a form of physical exercise

Rock climbing is a form of physical exercise that equips a range of physical and psychological resources. Bouldering is one subtype of rock climbing that involves climbing routes closer to the ground and so does not necessitate the use of either a harness or a rope. Indoor bouldering gyms have thick crash pads all around the centre, which help reduce impact from falls and prevent injury. “Routes” are constructed using man-made holds, screwed into purpose-built walls that elicit various different sequences of movement, varying in difficulty (Bridgeman, Accessed March 2023). A typical bouldering session involves some time mentally planning movement sequences, actual climbing and some rest time. Fencl, Muras, Steffen, Battista and Elfessi (2011) used heart rate monitors to measure the effect of bouldering on young people, by comparing resting heart-rate with active heart-rate. The researchers suggested that regardless of whether participants were engaging in an organised bouldering game or repeatedly climbing the same routes, bouldering was a legitimate physical fitness activity (in terms of a physiological response).

Research evidence (discussed in section 1.4) suggests that exercise can be useful in the management of symptoms associated with ADHD (Cerrillo-Urbina et al., 2015; Ng et al., 2017; Verret et al., 2012). Given that bouldering satisfies the required level of exertion to be considered a legitimate physical fitness activity (Fencl et al., 2011), it is worth exploring further the association between climbing and the management of ADHD symptoms.

1.6 The role of the Educational Psychologist

According to Cameron (2006), one distinctive contribution that EPs offer is to make evidence-based recommendations for intervention. EPs are trained to understand and critique the evidence-base that supports any potential intervention approach. This role applies to the individual children and young people that EPs work with, but also to wider systems-level discussions and/or critiques about the treatment of ADHD in children and young people. Prominent Educational Psychologists

have emphasised the dangers of an over-medicalisation, rather than psycho-social perspective on intervention (A. Allen & Hardy, 2013) and there is a role for EPs to consider non-pharmacological approaches as an alternative or as an intervention to be used alongside medication.

As this research study does not exclude or include participants based on a diagnosis of ADHD, EPs would be able to recommend this intervention, without the need for a diagnosis. In addition, EPs are well-positioned to deliver training for school staff who might be able to facilitate some or all elements of the current intervention. In section 6.7, the current study suggests that Emotional literacy support assistants (ELSAs) would be well-positioned to deliver some of the psychoeducation and emotional literacy aspects of the current intervention. EPs are regularly involved in the training and supervision of ELSAs.

1.7 Theoretical perspective of the current research

The current study explored the impact of a six-week psychologically-informed bouldering intervention on three key areas of Executive Function which are commonly associated with symptoms of ADHD: attention, emotion regulation and cognitive regulation. In terms of the research design, the three areas were identified as dependent variables in the present study.

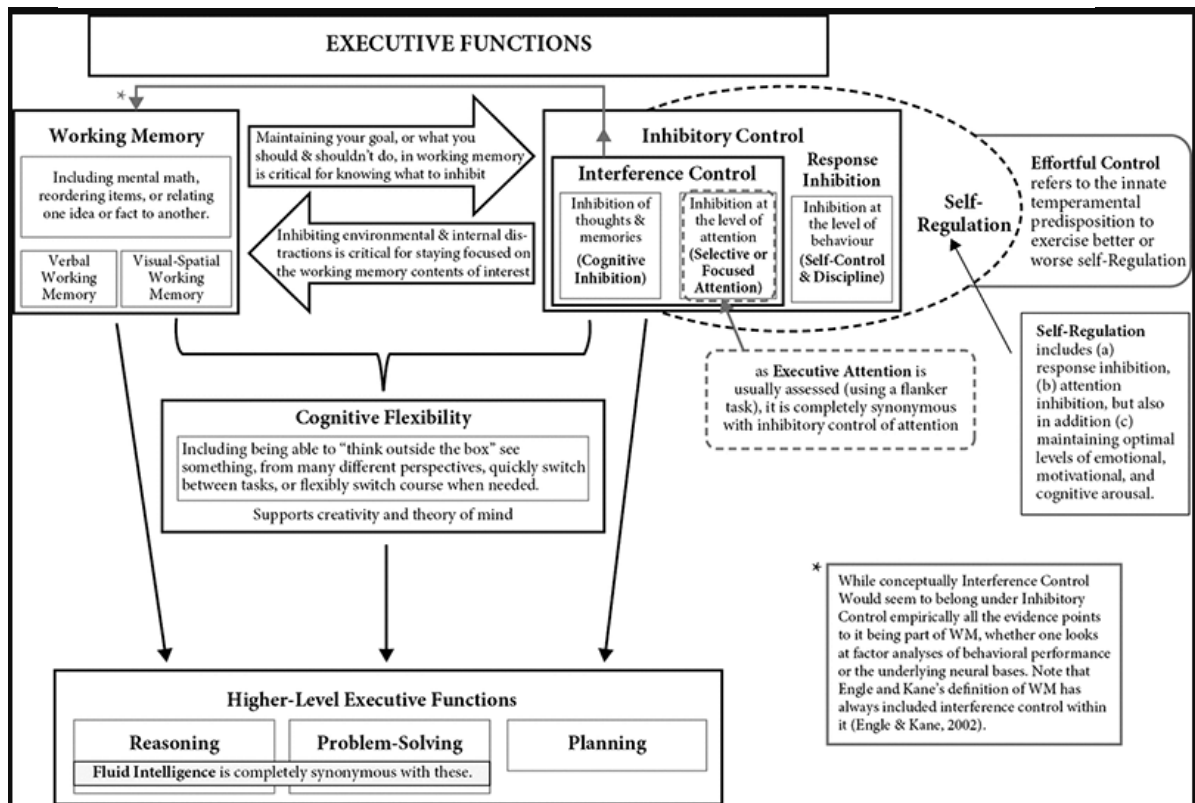
Executive Function is a multidimensional umbrella construct most often used to represent a set of interrelated cognitive abilities that include planning, shifting attention, problem solving, working memory, inhibitory control and cognitive flexibility (Nyongesa et al., 2019). It is generally agreed that efficient use of Executive Function skills relies on a coordinated mobilisation of the various abilities, which are underpinned by attention (Lan et al., 2017). A review of research conducted by Sergeant, Geurts and Oosterlaan (2002) made clear that there are differences in Executive Functioning between child psychopathological groups (e.g. ADHD, oppositional defiant disorder, conduct disorder, high functioning autism and Tourette syndrome) and with typically-developing control group. The researchers did not identify specific Executive Function profiles for each group.

Pennington and Ozonoff (1996) analysed results from 18 studies that used commonly-accepted general measures of Executive Function and a control group. Across the studies, participants with ADHD fairly consistently exhibited significantly poorer performance on measures of Executive Function, however the profile of Executive Function difficulties for children with ADHD was said to be different to other diagnoses. For example, inhibitory control is typically more evident in ADHD, whereas difficulty with cognitive flexibility appears to be more evident in Autism (Pennington & Ozonoff, 1996).

Some researchers suggest that there are three *core* Executive Function skills: working memory, inhibitory control and cognitive flexibility (Diamond, 2013; Logue & Gould, 2014). These three core skills form a foundation for higher-level Executive Function skills: reasoning, problem-

solving and planning (Collins & Koechlin, 2012; Lunt et al., 2012). See figure 1 below for a visual portrayal of how each Executive Function skill relates to one another, taken from Diamond (2016).

Figure 1 - The components that together comprise Executive Functions (EFs) and the relation of EFs to other concepts (Diamond, 2016)



According to Diamond's model (2016) of Executive function shown in figure 1, attention (selective and focused) forms different levels of Inhibitory Control. Diamond also references Executive Attention, referring to the top-down regulation of attention and the work of M. I. Posner et al. (1998). The current study has chosen to conceptualise attention as one of the interrelated skills contained within Executive Function, but accepts the merit of suggestions that attention is a more foundational resource that all Executive Function skills rely upon (Lan et al., 2017).

The current study positioned the role of the cerebellum as essential in Executive Functioning. Researchers have often suggested a link between the cerebellum and Executive Functioning, in particular emotion regulation. Snider (1950) suggested the cerebellum was the great modulator of neurological function and Health (1977) referred to the cerebellum as an "emotional pacemaker" for

the brain. Building on their work, Schmahmann (1998, 2004, 2019) implicated the cerebellum in regulating the “speed, capacity, consistency, and appropriateness of cognition and emotional processes.” Hallowell and Ratey (2021) point out the symptoms of Cerebellar Cognitive Affective Syndrome (CCAS), sometimes known as Schmahmann’s Syndrome, include problems with Executive Function and affective (emotional) regulation.

For the purpose of specificity in exploring potential impacts of the intervention, Executive Function was parsed into three key areas: attention, emotion regulation and cognitive regulation. There will now be discussion of how each area was conceptualised and measured.

1.7.1 The conceptualisation of attention in the current study

In 1890, William James confidently stated that, “Every one knows what attention is. It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought.” However, there has been much debate and disagreement about how best to conceptualise attention over the years. This was articulated in the title of a more recent article, “No one knows what attention is” (Hommel et al., 2019). It is widely accepted in the literature that there are different types of attention (de Jong, Verhoeven, Hooge & van Baar 2016; Fan, McCandliss, Sommer, Raz & M. I. Posner, 2002; M. I. Posner & Petersen, 1990).

M. I. Posner’s model of attention (1990) proposed three networks of attention: alerting (a general state of activation or arousal), orienting (selectively directing attention) and executive control (conflict resolution and working memory). Cooley and Morris (1990) accepted a slightly different three-factor model of attention that included selective, sustained and divided attention. They wanted to integrate the three components into a developmental neuropsychological perspective that could be used for assessment of attention in children. They argued that both sustained and divided attention can be easily conceptualised as special cases of selective attention (defined as the ability to attend to a specific stimulus or activity in the presence of other distracting stimuli). In all three

iterations, they proposed a need for two basic components of attention: attending (the part which identifies relevant stimuli) and inhibiting (the part which inhibits irrelevant or distracting information).

In sustained attention, the same two foundational selective skills are required (attending and inhibiting), but the factor of time is added to assess the maintenance of selective attention over a longer period. In tests of divided attention, participants are required to engage with two selective attention tasks at the same time. In this case the factor of number is added to the foundational skills of selective attention. Relevant literature indicates that selective attention and sustained attention (selective attention with the added factor of time) have important implications for mental health and educational outcomes. For example, research has suggested that an attentional bias towards threat stimuli can maintain and exacerbate levels of anxiety (Mobini & Grant, 2007). In addition, Razza, Martin and Brooks-Gunn (2010) suggested a link between sustained attention, school readiness and the acquisition of receptive vocabulary skills. See section 1.8.1 for a more detailed account of how attention interacts with mental health and educational outcomes.

1.7.2 The conceptualisation of emotion regulation in the current study

Gross (2002) defined emotion regulation as the “processes by which we influence which emotions we have, when we have them, and how we experience and express them,” He also argued that emotions have helped us respond to various recurrent adaptive problems throughout history. Over time, we have developed patterns of experiential, behavioural and physiological responses to different emotions. Despite the necessity and power of our emotions, we are not necessarily compelled to act on them and through a process of emotion regulation we are able to shape our responses to some extent. Amstadter (2008) described emotion regulation as pervasive. In other words, it applies to all aspects of life and from a very early age.

The process model of emotion regulation (Gross, 2002, 2015) divided emotion regulation strategies according to the point in the emotion-generative process at which they are likely to have an impact (world, perception, valuation and action). For example, cognitive change (regulation process) has an impact on the valuation stage of emotion generation (see figure 2 below).

Figure 2 - Process model of emotion regulation. Dots on the line represent stages in the emotion-generative process and boxes show the relevant emotion regulation processes.

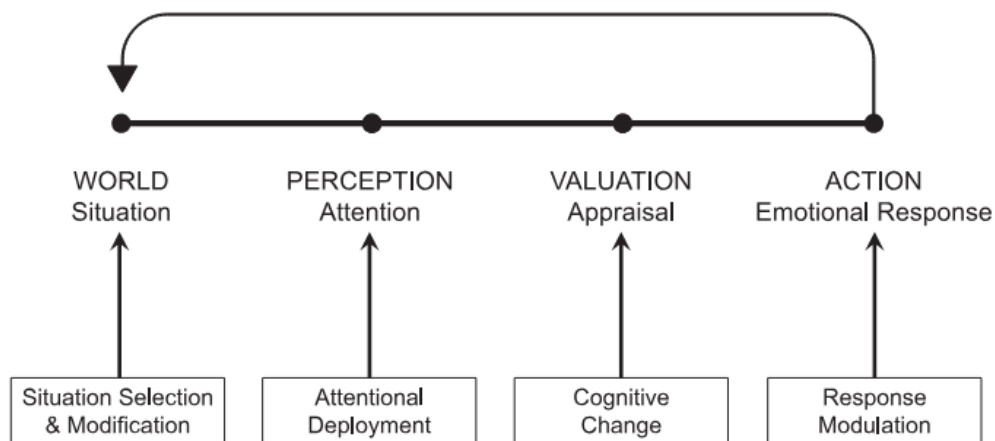
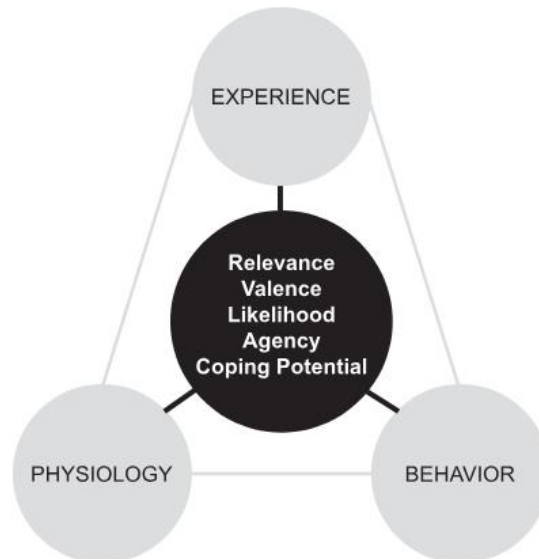


Figure 3 - five common appraisal dimensions identified by Yih, Uusberg, Taxer & Gross (2019)



According to Appraisal theories (e.g. M. B. Arnold, 1960; Ellsworth, 2013; Roseman, 2013), the personal meaning (appraisal) that we extract or decode from any given situation generates the resulting emotion and guides our emotional response. Simply put, if an individual appraises that an approaching dog is friendly, they are likely to feel happy or excited, whereas if the same individual

appraises that the dog is threatening, their emotional response is more likely to be fear or anxiety. Prominent appraisal theorists have identified five appraisal dimensions (see figure 3 below) that are applied during the appraisal process: relevance, valence, likelihood, agency and coping potential (Moors, Ellsworth, Scherer & Frijda, 2013).

In 2019, Yih et al. proposed an integration of the process model of emotion regulation (Gross, 2002, 2015) with appraisal theories (M. B. Arnold, 1960; Ellsworth, 2013; Roseman, 2013). When combined, the five appraisal dimensions give more clarity and depth to the valuation (or appraisal) stage of emotion generation in the process model. According to Yih et al. (2019), cognitive change strategies are directly implicated in the appraisal process (valuation). They suggest that by thinking about a situation differently (reappraising), the emotion generative process is changed (e.g. reappraising a dog's approach as being directed towards someone else, can shift the appraised relevance of the situation and consequently shift the emotional response from fear to relaxation).

The present study accepted the integrated perspective proposed by Yih et al. (2019) and found that it aligned two clinical scales on the BRIEF-2 (Gioia et al., 2015). The Shift scale related best to appraisal (valuation) in these models, because it measured participants' ability to change from one mindset or topic to another. Efficient emotion regulation involves perpetual appraisal and reappraisal of new/changing situations, which relies on the ability to shift mindset freely as the circumstance demands. The emotional control scale relates to emotional lability or emotional explosiveness (Gioia et al., 2015). Poor emotional control can lead to a limited range of options at every stage in the emotional regulation process, especially during response modulation.

1.7.3 The conceptualisation of cognitive regulation in the current study

Schunk and DiBenedetto (2020) posit that there are three prominent theoretical conceptualisations of cognitive regulation: information processing theory, sociocultural theory, and social cognitive theory. Information processing theory construes cognitive regulation mostly from the

perspective of metacognition, through a person's knowledge about a task and of their personal capabilities and interests (Winne, 2017). The Sociocultural theory draws on the work of Vygotsky (1978) and proposes that cognitive regulation skills are acquired through language and the zone of proximal development. The social cognitive theory accepts influences from both previously mentioned models and acknowledges the dynamic interaction of personal, behavioural and environmental factors. In this model, cognitive regulation is viewed as a cyclical process, whereby various factors are monitored and changed throughout the learning process.

According to Schunk and DiBenedetto (2020), cognitive regulation can take place at various points along the process of an individual working towards the attainment of a goal. This can be before engaging in the task, while working on the task, during pauses or breaks and after the task has been completed when individuals might go through a process of reflection. In line with this, Zimmerman (2000) suggested a three-phase model that incorporated forethought, performance, and self-reflection. Zimmerman's three phases have relevance to the psychologically-informed bouldering intervention that was delivered in this study. During the intervention, participants were asked to draw out the physical features of a climb they were trying to complete (e.g. handholds, blocks, footholds). They were also encouraged to label their drawing with instructions for their climbing technique (e.g. left hand or right foot) and this aligned with Zimmerman's forethought phase. Then through a process of trial and error, participants attempted their chosen routes and went back to adjust or make additions to their visual plan. This aligned with the performance and self-reflection phases of the three-phase model (Zimmerman & Schunk, 2004). In order to successfully engage in a process of cognitive regulation, there is a requirement to hold multiple pieces of information in mind and manipulate or update that information (working memory) based on the self-reflection discussed above.

The current study has positioned cognitive regulation as one of three *core* Executive Function skills (Diamond, 2013; Diamond & Ling, 2019; Logue & Gould, 2014). In terms of planning skills,

Diamond (2016) conceptualised this as a higher-level Executive Function skill. Incorporating both working memory and planning/organising scales, the BRIEF-2 defines its Cognitive Regulation Index as a child's ability to control and manage cognitive processes and problem solve effectively (Gioia, Isquith, Guy & Kenworthy 2015).

1.8 The role of study variables in mental health and educational outcomes

1.8.1 The role of attention in mental health and educational outcomes

Given the variability and complexity of ADHD diagnosis (discussed further in section 1.2), it is important to highlight the impact of attention on mental health and educational outcomes, not just through the lens of a medical diagnosis. In terms of mental health, research has suggested that an attentional bias towards threat stimuli can maintain and exacerbate levels of anxiety (Mobini & Grant, 2007). Highly anxious individuals more often fail to attend to signals of safety in their environment (Mathews & MacLeod, 2002). This relationship can be described as bi-directional, because not only does attentional bias play a role in anxiety, but increased anxiety is also likely to impact on attention and increase sensitivity to negative stimuli. A similar bias was found in currently and previously depressed participants, when compared with a control group (Joormann & Gotlib, 2007).

In terms of learning it is worth considering the attentional demands placed on young people in school. An experiment conducted by Massonnié, Rogers, Mareschal and Kirkham (2019) asked children aged 5-11 to perform an idea generation task (creativity) in two conditions: silence and moderate classroom noise (64dB). Results showed that in younger children, good selective attention skills acted as a protection against the effects of noise on creativity in the classroom. Visentin, Pellegatti, Garraffa, Di Domenico and Prodi (2023) compared sentence comprehension performance of 10-13 year-olds in three conditions: quiet, two competing speakers and four competing speakers. Results suggested that selective attention moderated the effects on accuracy and response times. C. Stevens and Bevelier (2012) posit that selective attention impacts on language, literacy, and math skills.

In terms of sustained attention, research suggests a similar relationship with mental health outcomes and educational outcomes. Using the first version of the Test of Everyday Attention for Children (TEA-CH), Morales-Muñoz demonstrated that higher levels of sustained attention at age 8 years were associated with a decreased risk of Borderline Personality Disorder symptoms at ages 11

to 12 years and depression at ages 17 to 18 years. Concerning education, Razza et al. (2010) found that sustained attention would be a suitable area to target efforts in order to enhance school readiness in a population of predominantly poor children and found that it supported the acquisition of receptive vocabulary skills. While Huckeba, Chapieski, Hiscock and Glaze (2008) used a measure of sustained attention (The Test of Variables of Attention computer program; Greenberg, 1993) to show that arithmetic difficulties in a population of children with Tourette syndrome (TS) were correlated with the degree of attentional difficulties. Lindsay, Tomazic, Levine and Accardo (2001) used a different measure of sustained attention (The Conners' Continuous Performance Test; (Conners, 2000) to show that issues with attention were associated with lower arithmetic achievement scores in students with dyscalculia.

1.8.2 The role of emotion regulation in mental health and educational outcomes

In 1995, Gross and Muñoz argued that emotion regulation was 'an essential, yet traditionally underemphasised feature of mental health' and this has been supported by examples of more recent research. Cloitre (2019) found that in a sample of 290 adult women enrolled in a clinical trial for PTSD, levels of emotion regulation mediated the impact of adverse childhood experiences on PTSD symptoms and depression (as well as poor physical health). Other studies have shown that deficits in emotional regulation are strongly implicated in the onset and maintenance of Major Depressive Disorder (Joormann & Quinn, 2014; Moussavi et al., 2007) as well as eating and substance-related disorders (Aldao, Nolen-Hoeksema, Schweizer 2010). In terms of younger populations, a longitudinal study conducted by Chervonsky and Hunt (2019) showed that the use of emotion regulation strategies played an important role in adolescent wellbeing. Results from Morrish, Rickard, Chin and Vella-Brodrick (2018) also supported the relevance of emotion regulation in adolescent wellbeing.

Jacobs and Gross (2014) argued that emotion regulation plays a central role in the experiences and success of CYP in education. They emphasised that efficient emotional regulation supports CYP to monitor their attention/inhibit attention on distractors, to tolerate short-term

negative feelings in the service of long-term goals and to have a positive/adaptive relationship with test anxiety. This is in line with other research suggesting that emotion regulation is positively associated with teacher reports of academic success, productivity in the classroom and standardised early literacy and maths achievement scores (Graziano, Reavis, Keane & Calkins 2007). In terms of tolerating short-term negative feelings (or delaying gratification), research has shown this skill to be predictive of higher academic exam scores (Mischel et al, Shoda & Rodriguez 1989). In terms of test anxiety, research shows that successful emotion regulation can protect some students against excessive worrying or withdrawal from study-related behaviours (Schutz & Davis, 2000; Zeidner, 1998, 2014). For most CYP, learning takes place in a social context alongside their peers, which necessitates the development of social behaviours. Research suggests that emotion regulation is a key component in the development of social behaviours (Blair, Denham, Kochanoff & Whipple, 2004).

Of relevance to the current study, emotion regulation is often identified as being a core facet of ADHD, which persists into adulthood (Beheshti, Chavanon & Christiansen 2020; P. Shaw, Stringaris, Nigg & Leibenluft 2014). Later on follows discussion of how emotion regulation skills can be associated with certain aspects of rock climbing (see section 5.3).

1.8.3 The role of cognitive regulation in mental health and educational outcomes

In terms of working memory and planning (conceptualised as cognitive regulation in the present study), research has highlighted their association with mental health outcomes. A recent meta-analysis of correlative studies, conducted by Moran (2016) showed a moderate, but reliable association between high anxiety and low working memory performance. A similar relationship has been found between reduced working memory capacity and depression (Hasher & Zacks, 1988; Joormann, Yoon & Zetsche, 2007; Owens, Koster & Derakshan, 2013). In addition, deficits in working memory are considered to be a core symptom of cognitive impairment in schizophrenic disorders (Salloway et al., 2008; Walter & Wolf, 2008).

Almost all learning activities rely on the employment of working memory skills. The need to hold in mind and manipulate certain information is often essential. For CYP, working memory plays an important role in school success (Maehler & Schuchardt, 2016). Other researchers have argued for a strong link between poor working memory and educational underachievement (Gathercole & Packiam Alloway, 2008; Packiam Alloway & Gathercole, 2006).

In terms of planning, the research is somewhat limited compared to other areas of Executive Functioning. That being said, researchers have argued that planning skills are an important component of academic achievement (Dembo & Eaton, 2000), particularly in mathematics (Montague & Bos, 1986; Pape & Wang, 2003). Planning/organising (as conceptualised in the BRIEF-2; Gioia et al., 2015) incorporates a clerical element, expressed by a child's ability to keep track of homework assignments or the materials required for their school setting. Langberg et al. (2011) argued that planning and organisation skills are important for academic performance, and they developed the Homework, Organisation and Planning Skills (HOPS) intervention to support children with ADHD who often face difficulties in this area (Langberg et al., 2008). Planning skills can be associated with Mental health outcomes indirectly both in terms of the income-achievement gap (Crook & Evans, 2014) and poorer school attainment (Rahman et al., 2018).

1.9 Approaches to measurement of the study variables

Having set out the theoretical perspective of the current research in relation to three areas of Executive Functioning (attention, emotion regulation and cognitive regulation) there will now be consideration of different approaches to the measurement of each one.

1.9.1 Measurement of attention

The current study opted to measure selective attention and sustained attention separately, while accepting the theoretical stance of Cooley and Morris (1990), that sustained attention is a function of selective attention skills, with the factor of time added. In order to accurately measure levels of attention, participants should be required to focus attention on a target stimulus, whilst simultaneously inhibiting attention on distractors. Although Wilson (2015) makes the point that most measures focus on only one of the above processes, there are a range of methods and tools that have been used to measure selective attention. The Stroop Task (1935) is a classic measurement tool that requires participants to process and name the colour of a word (target stimulus) whilst simultaneously ignoring the meaning of the word itself (distractor). Similarly in the Flankers task (Eriksen & Eriksen, 1974), participants are required to respond to a target stimulus, while ignoring other competing information.

As the current study measured attention in a population of young people it used three subtests from the Test of Everyday Attention for Children, second edition (TEA-CH2). The tests are computer-based and in the form of comic book strips, recognising the need to make materials motivating for a younger population (Lakomy, 2021). During two of the subtests, participants were required to inhibit their attention on certain visual distractors, while simultaneously locating target stimuli and marking them with a pen. On the third subtest, participants were required to listen and count varying numbers of a certain sound (target stimuli), without the presence of an obvious distracting stimuli. In this test of sustained attention, the task deliberately does not grab the participants attention with sometimes long drawn out gaps in between each sound so that

participants are required to self-sustain their attention. In this case, the distracting stimuli is the passage of time itself and the cognitive load associated with maintaining attention on a slow, dull task over this extended time period. Each individual subtest is discussed in the methods section of the current study (see section 7.4.1).

1.9.2 Measurement of emotion regulation

Measures of Emotion Regulation can be grouped into three categories: behavioural, physiological and self-report / observational reports. One behavioural approach to measurement is the Emotional Stroop Task (EST), which is very similar to the original Stroop Task (1935) mentioned in the discussion of attention measures (section 4.1). Participants are asked to name the colour of words as they appear, whilst ignoring varying degrees of emotional content in the 'carrier word.' If participants take more time to respond correctly on emotion words, it is thought that they are more affected by the emotional content of the word (Ben-Haim et al., 2016). Administrators of this test are able to adapt the emotion words to increase relevance to certain populations and a real strength of the measure is the sheer number of experimental studies that have used it previously on patient and non-patient populations (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg & van IJzendoorn 2007). In this measure, the behaviour that helps to regulate emotion is directly observable.

Physiological measures of emotion regulation examine physiological responses such as heart-rate variability (Mather & Thayer, 2018) and Functional magnetic resonance imaging (Ochsner, Silvers & Buhle 2012). Another physiological method involves Electromyography (EMG), which uses surface electrodes to measure activation of facial muscles (Wolf, 2015). Physiological measures of emotion show some promise, but uncertainty around the exact link between emotion and response presents a limitation. For example, Autonomic Nervous System (ANS) response is often used as a measure of emotion, however the ANS response is not only implicated in emotion, but also in digestion, homeostasis and attention (Mauss & Robinson, 2009). This makes it difficult to identify clear associations between ANS activation and emotion.

Self-report and observational measures of emotion regulation take the form of questionnaires that ask individuals, parents and teachers to respond to questions about observed thoughts, feelings and behaviours relating to emotion regulation. The Regulation of Emotions Questionnaire (REQ) developed by K. F. V. Phillips and Power (2007) has 19 items, each giving an emotion regulation technique (some functional and others dysfunctional). This 5-point Likert scale measure is widely used, and the developers reported a Cronbach's alpha between .66 and .76 for individual scales. The Emotion Regulation Questionnaire (ERQ) is a shorter questionnaire, developed by Gross and John (2003), which asks participants to rate on a seven-point Likert scale the likelihood of them using different regulation strategies: cognitive reappraisal (6 items) and suppression (4 items).

A similar measure that relies on observations and behaviour ratings is the BRIEF-2, which involves using questionnaires to provide standardised developmental norms (Kenworthy, Yerys, Anthony & Wallace 2008). The BRIEF-2 provides a quick, effective, and efficient way to examine Executive Function. A real strength of the BRIEF-2 was the large standardisation sample, which was 803 for self-report and 1,400 for parent and teacher forms. In developing the measure Gioia et al. (2015) used stratified proportional sampling across key demographic variables in the U.S. population (age, gender, race/ethnicity, parent educational level as a proxy of socioeconomic status, and geographic region). The strength of this sampling approach lies in its ability to adequately represent each group within the sample and account for potential differences in each subgroups distribution in the wider population. It means that normative comparisons can be more accurate with minimal sampling bias. It should be said however, that the current study used participants living and attending school in the UK, so there would likely be some differences if the standardisation sample had been developed on a UK population. For a more in-depth review of the measure, see McGill (2021).

Of particular relevance to the current study, which used an all-male participant group, the BRIEF-2 provides separate norms for boys and girls and at an age that aligned with the current studies

inclusion criteria (ages 11-13). Additionally, and unlike the ERQ (K. F. V. Phillips & Power, 2007), the BRIEF-2 can be used to collect data about cognitive regulation strategies that are also relevant to the current study (working memory and planning).

Results from the BRIEF-2 will be interpreted in light of the subjective nature of responses and the possibility of bias. Additionally Kassam and Mendes (2013) suggested that simply asking someone to reflect on their emotional state may in fact be altering their emotional state and thus an accurate reading is hard to reach. The cognitive functions required to interpret one's own emotional state (focal attention, information processing) interact with the production of an emotional response (Leventhal & Scherer, 1987).

1.9.3 Measurement of cognitive regulation

The present study focussed on two cognitive regulation skills that fall under most definitions of Executive Function. Those two skills are working memory and planning/organising, and they have been measured using the BRIEF-2. The measure positions its working memory and plan/organise scales as directly involved in cognitive regulation. The present study considered a wide variety of other measures that assess cognitive regulation skills (often referred to as Executive Function). Some use tasks that incorporate navigating, such as the Key Search Task, where participants are asked to devise their own search strategy by drawing a line to depict the directions they would walk to make sure they covered every section of a field, in search of their keys (Canali, Brucki & Bueno 2007). Other measures have tried to incorporate tasks that are more common in real life and thus improve ecological validity. For example, The Children's Cooking Task requires the preparation of two simple recipes using specific instructions (Chevignard, Catroppa, Galvin & Anderson 2010).

The Rey-Osterrieth Complex Figure (ROCF) test is a widely used assessment tool first designed by Andre Rey (1942) and later standardised by Paul-Alexandre Osterrieth (1944). In the ROCF, participants are asked to copy a complex series of lines and shapes that make up different segments and visual components (recognition). Following this, and after a short delay, participants are asked to

draw the same complex figure from memory (recall). A strength of this measure, in relation to the current study, is the multiple equivalent variations of the original figure. This means the same skills can be assessed using different figures at different times and thus reducing any potential learning effect (Zhang et al., 2021). Standardised scoring is another strength of the ROCF and can be done in one of two ways (accuracy scoring method and process scoring method).

The accuracy scoring method is concerned mostly with the likeness of the drawn figure to the original, scores each drawn component with equal weighting and therefore gives insight primarily into visuo-constructional ability and visual memory (Awad et al., 2004). The process scoring method takes more account of the drawing process and notices when the individual draws in a more fragmented/part-oriented manner or in a global/configurational way (Waber & Holmes, 1985). This approach to scoring allows for evaluation of Executive Function and organisational strategy (Davies, Field, Andersen & Pestell 2011), which is of particular importance to the current study. Research suggests that the ROCF test is a reliable measure of Executive Function in adolescence (Nyongesa et al., 2019) and has been used successfully with a range of neuropsychological disorders (Davies et al., 2011), including ADHD (Hyun et al., 2018). It may be useful for future studies to investigate how rock climbing interacts with ROCF performance; however practical issues made this measure unfeasible for the current study.

While the measures of cognitive regulation mentioned so far (Key search task, Children's cooking task and ROCF) can provide valuable insights, they rely primarily on performance-based assessments in a controlled environment. The present study wanted to draw upon a combination of controlled performance and observational reports from multiple respondents in multiple contexts. It was also essential that the measures used in this study were easily accessible and available to the researcher around the time of data collection (pre and post-intervention).

In a scoping review of Executive Function measures that directly implicate working memory and planning/organising conducted by Wallisch, Little, Dean and Dunn (2018), the most widely cited

measure was the Behaviour Rating Inventory of Executive Function (BRIEF). Rather than trying to produce an appropriate test task with ecological validity, the measure uses questionnaires to provide standardised developmental norms (Kenworthy et al., 2008). The updated second version of the same measure (BRIEF-2) also provides a quick, effective, and efficient way to examine Executive Function through behavioural ratings, as mentioned previously. Three different questionnaires can be completed by the individual child, teacher and young person, which introduces a level of triangulation to the scoring process. In the present study it was only possible to collect BRIEF-2 data from the participants and their parents. Although, the interrater reliability of the BRIEF-2 is weak to moderate (Hendrickson & McCrimmon, 2019), it is still considered to be a robust and useful measure for both clinical and research settings.

2. Evaluation and rationale

As outlined in section 2, the current study has parsed Executive Function into three key areas: attention, emotion regulation and cognitive regulation. It was felt that this would be the most effective way of exploring any potential impact of the psychologically-informed bouldering intervention. The following evaluation and rationale section departs slightly from this structure to reflect the way that research in this area appears to be divided up most commonly. In other words, attention and emotion regulation are often not included in research exploring Executive Functioning. This chapter will begin by reviewing relevant literature that explores how participation in rock climbing can be associated separately with attention, Executive Function skills and emotion regulation. It will then consider the link between balance/coordination and self-regulation (the cerebellum link), before evaluating evidence from bouldering as a manualised therapy approach to anxiety and depression. The chapter will then discuss how the current study provides a unique and important contribution to the wider literature, before stating the study's two research questions.

The first three sections of the following evaluation and rationale section were organised around attention, Executive Function skills and emotion regulation to reflect the way that these three concepts are often (but not always) separated out in Educational and Psychological research. After reviewing the relevant literature, the present study then conceptualised attention, cognitive regulation and emotion regulation as three different components of Executive Functioning (see section 3). Thereafter, the study continued to be organised around those three components.

2.1 The association between rock climbing and attention

The research linking rock climbing with the development of attentional skills in CYP is somewhat limited, but there are some useful findings from high-level climbing performers and from the research on mindfulness approaches. A recent study conducted by Angelini et al. (2020) suggested that participation in an 8-week community-based rock climbing program may lead to improved attention. This study recruited five participants, aged 8-13 years old and measured

attention pre- and post-intervention with the Trail Making Test-B (Kortte, Horner and Windham, 2002; Tombaugh, 2004) and the Connor's parent rating scale (Conners et al., 1998). Although there was no statistically significant improvement observed, the sample size was small ($n=5$) and a closer look at individual data indicated an improvement. All scores on the Trail Making Test improved and four out of five Connors parent ratings were improved.

Garrido-Palomino, Fryer, Giles, González-Rosa and España-Romero (2020) investigated the relationship between attention and self-reported climbing ability. Higher level rock climbers had an enhanced level of attention, which suggests that attention is an important component of rock climbing performance. As mentioned, bouldering happens closer to the ground than other forms of rock climbing, but there is still an element of risk, which is likely to provoke a spike in anxiety. Nieuwenhuys, Pijpers, Oudejans and Bakker (2008) noticed differences in body movement and eye gaze when climbers completed identical routes at different heights (level of perceived risk). In the 'high-anxiety condition' participants spent more time standing still and grasped holds for longer. Participants also showed a significant increase in total eye fixations, which suggests an increase in attentional resources being deployed as a result of safely managed risk.

Since the 1970's, the practise of mindfulness has become increasingly well-researched (Williams & Kabat-Zinn, 2013) and there are links both to improved attention and rock climbing. When defining mindfulness, most studies focus on paying attention to the present moment in a purposeful and non-judgemental way (Kabat-Zinn, 1994). There appears to be an axiomatic link between mindfulness practices and attention. Hölzel et al. (2011) consolidate this link in their presentation of four underlying processes in mindfulness: increased attention regulation, stronger body awareness, acute emotion regulation and a change in perspective on the self (see Dweck, 2014). Malinowski (2013) posits that mindfulness meditations improve attention by developing the process of resource allocation. A number of research studies demonstrate that participation in mindfulness is associated with an increase in attentional resources (Moore, Gruber, Deroose & Malinowski 2012;

Pagnoni and Cekic 2007; Schmertz, Anderson & Robins 2009). When compared with cognitive training, Walsh, Saab and Farb (2019) found that mindfulness training resulted in significantly more positive changes in attentional control. In a recent review of 87 studies Sumantry and Stewart (2021) found that mindfulness meditation increased attentional capabilities across the studies.

The direct link between rock climbing and mindfulness is less clear, but there is some anecdotal evidence from the climbing community. Arno Ilgner is an experienced rock-climber, author and climbing coach who founded a method of mental training for climbers (2006) and writes about mindfulness as a way to improve focus and climbing performance. Additionally, the NHS advises that rock climbing can help keep you focused and clear your mind of outside worries (2020). More recently empirical evidence has emerged (Wheatley, 2021) involving 59 participants who were asked to complete the State Mindfulness Scale for Physical Activity (Cox, Ullrich-French & French 2016) a week prior and immediately after the intervention. Participants listened to three short auditory guided meditations in a quiet room, before taking part in one hour of either unsupervised bouldering, or a physical activity control (strength and conditioning training). State mindfulness increased significantly in the bouldering group in comparison to the control. Although the researcher acknowledged that random allocation of participants into group membership would have been a more robust method (see Schulz, 2000), this study provided the first experimental evidence that rock climbing can increase state mindfulness.

2.2 The association between rock climbing and Executive Function skills

The term Executive Function is most often used as an umbrella term to represent a set of interrelated cognitive abilities that include planning, shifting attention, problem solving, working memory, inhibitory control and cognitive flexibility (Nyongesa et al., 2019). For a more detailed description of how the current study conceptualises Executive Function (to include attention, emotion regulation and cognitive regulation), see section 2.

The relationship between physical activity levels and Executive Function skills was demonstrated by Kamijo and Takeda (2010), who found that regular physical exercise improved Executive Function in young adults. Rock climbing is a physical activity requiring a sufficient level of exertion to reap the same benefits (Fencl et al., 2011), but there are also specific aspects that can be associated with visuo-spatial working memory and planning skills. Diamond and Ling (2019) categorise problem-solving and planning as higher-level Executive Function skills and characterise working memory as having a more foundational function. A key skill in rock climbing is route reading: the ability to visually scan a route and interpret or deduce the most appropriate route and movements required (Cordier, France, Pailhous & Bolon 1994). Sanchez, Torregrossa, Woodman, Jones and Llewellyn (2019) used semi-structured interviews to gain the views of elite climbers (who were also registered as climbing coaches). Participants were asked about the key performance parameters of lead sport climbing (a longer form of climbing that require a rope and a safety harness). Route reading emerged as a critical element of performance and participants described the need to “select an accurate and comprehensive movement repertoire relative to the specific demands of the route and reject ineffective movements.” Although bouldering requires a smaller sequence of movements for each climb, some of the same skills are necessary. Boschker, Bakker and Michaels (2002) found that expert climbers were able to recall more information about the functional aspects of a climbing route that included 23 holds, in comparison to novice climbers. They recalled information, such as hold positions/clusters as well as the respective “grasp-ability.”

In relation to a younger population of climbers (as is more relevant to the current study) there are some findings that suggest a similar association between rock climbing and Executive Function skills. Cascone et al. (2013) found that climbers outperformed non-climbers on the ‘Tower of London Test’, where participants were asked to mentally preplan a sequence of moves and execute them one-by-one using three rods of different length (L. H. Phillips et al., 2001). Of most interest to the current study Angelini et al. (2020) used the Trail Making Test (Tombaugh, 2004) to show that a rock climbing program could improve Executive Function in a population of children with a diagnosis

of ADHD. However, there is also evidence to the contrary from a study conducted by Heilmann (2021) who suggested that the cognitive skills of climbers may be context-specific. In other words, any gains in Executive Function as a result of climbing, may not generalise to other settings. The current study explored this further.

2.3 The association between rock climbing and emotion regulation

Kleinstäuber, Reuter, Doll and Fallgater (2017) explored the association between Rock Climbing and Acute Emotion Regulation in participants who had been receiving treatment for Depression. The researchers found that when compared with a relaxation control group (progressive muscle relaxation), rock climbing was significantly more related to a positive emotion regulatory effect. The researchers suggested that the requirement for high levels of concentration and coordination in climbing might help to counteract attentional biases towards negative stimuli which are often implicated in the maintenance of anxiety (Mobini & Grant, 2007) and poor emotion regulation.

To understand the mechanism by which activities such as rock climbing could support emotion regulation, it is useful to consider the work of Stephen Porges and his Polyvagal Theory (2007). Polyvagal theory posits that humans have developed three responses to danger or stress; immobilisation (freeze), mobilisation (fight/flight) and the social engagement system, which is the most recent evolutionary adaptation. All types of climbing involve a certain level of risk, because of the inherent risk of falling. Even in experienced climbers there is evidence that increased height and increased perceived risk produce behavioural difference in terms of body movement and eye gaze (Nieuwenhuys et al., 2008). Physiologically, this risk can imitate the day-to-day stressors that might lead to emotional dysregulation. Rock climbing can be an opportunity to practise downregulation of the Autonomic Nervous System, especially when climbing socially with others (as is often the case). The importance of downregulation in climbing can be explained in terms of safety and performance. In order to mitigate the risks of climbing (and maintain safety) there is a requirement for climbers to

think clearly (e.g. accurately calculate the risk of a particular move and decide on a course of action that protects them from harm). In terms of performance, a heightened stress response (e.g. flight, flight, freeze) is likely to increase muscle tension, which could reduce the climber's chance of success. Porges suggested that via the social engagement system, playful forms of physical activity with others help us transition from aroused states associated with physical movements to calm states (Porges, 2015). By climbing in a group, climbers are likely to access a more relaxed and focussed mental state.

2.4 Balance/coordination and self-regulation (the cerebellum link)

All kinds of rock climbing require a level of balance and coordination in order to efficiently remain, and move upwards, on the wall. Simply put, when a climber's centre of gravity sits too far outside their base of support, there can be an over-reliance on muscular strength and as a result, fatigue. As mentioned previously, Voelcker-Rehage, Godde and Staudinger (2011) asserted that physical activities requiring a high level of coordination have the capacity to improve cognitive control. Kleinstäuber (2017) hypothesised that the association between acute emotion regulation and climbing that they observed might be due to the need for coordination in rock climbing. Jeremy Schmahmann implicated balance and coordination in emotion regulation by studying disorders of the cerebellum and how they related to cognitive and emotional disorders (1998, 2004, 2019). Schmahmann worked with patients who had injuries to the cerebellum and found common difficulties with emotion regulation. He explained that the cerebellum not only supports physical balance/coordination, but "so does it regulate the speed, capacity, consistency, and appropriateness of cognition and emotional processes." Schmahmann was building on earlier work by Snider (1950), who suggested the cerebellum was the great modulator of neurological function and of Health (1977) who posited the cerebellum was an "emotional pacemaker" for the brain.

According to Hallowell and Ratey (2021), Schmahmann "overturned generations of received wisdom" by demonstrating the link between cerebellar function and learning, focus and emotional regulation. They point out the symptoms of Cerebellar Cognitive Affective Syndrome (CCAS),

sometimes known as Schmahmann's Syndrome, include problems with Executive Function and affective (emotional) regulation. There have been some experimental studies investigating the potential for improved cerebellar function as a treatment for various difficulties. Sensorimotor training uses equipment (such as balance boards) to progressively move through a range of static, dynamic and functional movements (Page, 2006). This approach was evaluated by Banaschewski (2001) on a group of children diagnosed with ADHD. In comparison with Cognitive Behavioural Training, Sensorimotor Training was more effective at reducing Hyperactivity. More recently, Blouchou and Nicolson (2020) evaluated a novel internet-based "cerebellar challenge" intervention (www.zingperformance.com; Nicolson, Jensen & Jaccard 2023) with a population of 40 adolescents at risk of school dropout. This intervention involved activities that progressively challenge the vestibular system and cerebellum and the researchers reported improvements in declarative learning, procedural learning and mental health (Blouchou & Nicolson, 2020). The strength of these findings would be improved if there was an active control comparison, as opposed to the School Support as Usual (SSAU) control that was used.

2.5 Bouldering as a manualised therapy used in the treatment of anxiety and depression

The current study proposed a psychologically-informed bouldering intervention to support young people with needs relating to ADHD. In considering other related literature, it also made the case for climbing's wider impact on mental health. It is now relevant to consider other examples where rock climbing (or bouldering specifically) has been used as part of a manualised, therapeutic response to other mental health difficulties. Most of the research in this area has taken place at The Institute for Climbing Therapy, in Austria (www.climbingtherapy.com) and a number of experimental studies provide good evidence for Bouldering (or rock climbing more generally) as a response to anxiety and depression. There is a growing evidence base that supports the link between physical activity and improved mood, which has led to links between physical activity and the treatment of

depression (Blumenthal et al., 2007; Silveira et al., 2013; Trivedi et al., 2006). Bouldering is a form of physical activity that allows participants to decide on their own level of challenge and thus they can participate at a level suitable for them and experience enjoyment/success.

In 2015, research by Luttenberger et al. provided the first evidence that therapeutic bouldering may offer an effective treatment for depression. The researchers used a waitlist-controlled design and found that for both groups, self-report depressive symptoms reduced during the 8-week intervention period and there was a significant difference between the intervention and the waitlist group. Kleinstäuber et al. (2017), found that rock climbing was associated with improved acute emotion regulatory effects (positive affect and coping emotions increased, while negative affect and depressiveness decreased). It is important to note however, that in this study group were not randomly assigned and there were significant differences in Physical Activity level between groups prior to the study taking place. In contrast, Kratzer, Luttenberger, Karg-Hefner, Weiss and Dorscht (2021) did a randomised control group and found that group Bouldering Psychotherapy (BPT) led to clinically relevant increases in the perceived self-efficacy of people with depression. This effect was superior when compared with a home-based physical exercise programme. Other research studies have found that therapeutic bouldering was more effective than general physical activity (Dorscht et al., 2019; Karg, Dorscht, Kornhuber & Luttenberger 2020). BPT incorporates psychotherapeutic content from Cognitive Behavioural Therapy (CBT) with physical activity, in the form of bouldering and was also found to be equally as effective as group CBT (Luttenberger et al., 2022).

2.6 Unique contributions of the present study

The present study has presented and reviewed a range of literature and will now provide a brief overview, before making explicit the gap in literature that the current study addresses. There is a substantial evidence base linking a diagnosis of ADHD with a range of outcomes, including comorbid mental health issues (Secnik et al., 2005), academic difficulties (L. E. Arnold et al., 2020; C. Stevens & Bavelier, 2012) and imprisonment (Young et al., 2015). There are successful examples of both

pharmacological and nonpharmacological treatment approaches. Stimulant medications appear the most common response to ADHD and their ability to manage symptoms (Cortese et al., 2018; Spencer et al., 2005) should be viewed in the context of potential side effects (Cascade et al., 2010). Nonpharmacological treatments, such as Parent Behaviour Training, have in some studies outperformed stimulant medication (Young & Amarasinghe, 2010) and in other studies a combined approach was most effective (Catalá-López et al., 2017). There is strong evidence suggesting that exercise is an effective way of managing symptoms of ADHD (Ng et al., 2017), perhaps through the same neuromechanism as stimulant medication (Wigal et al., 2013). Research has demonstrated the success of climbing as a therapeutic treatment for anxiety and depression in adults (Dorscht et al., 2019; Karg et al., 2020; Kleinstäuber et al., 2017; Kratzer et al., 2021; Luttenberger et al., 2022). The current study has discussed the association between rock climbing and attention, Executive Function and emotion regulation. CYP with a diagnosis of ADHD often have difficulty in those areas, which suggests that rock climbing (or bouldering) is a worthwhile activity to explore for this population.

To the researcher's knowledge there is no research exploring Rock Climbing (or bouldering) as a psychologically-informed approach to the symptoms of ADHD in a young population. The closest study in design asked children with ADHD to take part in a climbing program only, and the intervention did not include any psychological content or skill building (Angelini et al., 2020). The aim of that study was to explore to what extent a regular rock climbing intervention could improve attention and behaviour in a group of children with ADHD.

2.7 Research questions

The purpose of this research study was to pilot the use of a six-week psychologically-informed climbing intervention for young people with identified needs relating to ADHD. As discussed earlier in the literature review, children and young people with identified needs relating to ADHD often have difficulty with Executive Function skills. It was hoped that by supporting the development of three key Executive Function skills (attention, emotion regulation and cognitive regulation) that this would

positively impact the education and mental health outcomes of participants. This study aimed to answer two main research questions:

RQ1: Can a psychologically-informed bouldering intervention improve three key areas of Executive Functioning for children with identified needs relating to ADHD?

RQ2: In what ways does a psychologically-informed bouldering intervention impact on how young people with identified needs relating to ADHD perceive their own levels of Executive Function in three key areas?

3. Content and design of the intervention

The psychologically-informed bouldering intervention that was piloted in this study was designed by the lead researcher, as part of a doctorate in Professional Educational Child and Adolescent Psychology. Decisions about the content and design of the intervention were significantly informed by the researcher's previous professional experience and areas of expertise (both as a trainee EP and as a climbing instructor). The duration of the current intervention was informed partly by examples of climbing being used successfully in a therapeutic setting, that typically took place over eight weeks (Luttenberger et al., 2015, 2022). The current researcher also considered the typical length of UK school terms (6 to 7 weeks) and so decided to deliver six weekly sessions, each lasting for between two and three hours.

3.1 Opportunities for climbing

Bouldering was clearly a core component of the present intervention. Participants would spend on average one hour during each session engaged in this activity and the duration typically increased each week. There is a strong evidence base to support the use of exercise/physiological interventions with ADHD populations (Cerrillo-Urbina et al., 2015; Medina et al., 2010; Ng et al., 2017; Verret et al., 2012; Xie et al., 2021). The decision to position bouldering at the centre of this intervention was based initially on the researcher's personal experiences of rock climbing (see section 7.8) and subsequently on the concept of 'flow,' as conceptualised by Csikszentmihalyi (1975). The term flow or flow state, describes optimal experiences of an event or activity that evoke deep concentration and a sense of effortlessness. According to Csikszentmihalyi, flow occurs when individuals are "so intensely involved in an activity that nothing else seems to matter; the experience itself is so enjoyable that people will do it even at great cost, for the sheer sake of doing it" (Csikszentmihalyi, 1990). Csikszentmihalyi argued that flow experiences are most likely to occur when an activity requires (but does not exceed) all of an individual's attention and skill (Csikszentmihalyi, 1999). In other words, the balance between skill and challenge level is essential (Mao et al., 2016).

Csikszentmihalyi (1997) suggested that during flow experiences the individual should necessarily receive instant feedback, not contingent upon any external party in order to maintain the optimal skill-challenge balance.

Indoor bouldering was well-suited to Csikszentmihalyi's assertions about flow. Participants have the freedom to choose an appropriate level of challenge from a huge number of potential climbing routes and they receive instant feedback about their success and level of competence. The current researcher hoped that by accessing a state of flow, participants would be able to develop their attention and self-regulation skills/resources to the point that it transferred into other contexts.

Linked to the concept of 'flow', the current study has discussed the link between mindfulness and increased attention regulation, stronger body awareness, acute emotion regulation and a change in perspective on the self (Dweck, 2014; Hölzel et al., 2011). Specifically in terms of attention, research suggests that participation in mindfulness is associated with an increase in attentional resources (Moore et al., 2012; Pagnoni & Cekic, 2007; Schmertz et al., 2009). In a recent scoping review exploring associations between climbing and mental health (Hall et al., 2023) the authors asserted that during climbing, "focusing on the present moment is paramount to not falling off." This aligns with most definitions of mindfulness, which focus on paying attention to the present moment in a purposeful and non-judgemental way (Kabat-Zinn, 1994). The potential link between climbing and mindfulness formed part of the rationale for the use of bouldering in the current intervention.

3.2 Visual planning and route reading

In the present intervention, participants were encouraged to draw prominent features of the specific climb that they were working on (e.g. handholds, footholds, other physical characteristics of the wall and the route). Route reading (the ability to visually scan a route and interpret or deduce the most appropriate route and movements required) is an essential part of rock climbing, according to elite climbers (Cordier et al., 1994; Sanchez et al., 2019). Although bouldering routes typically involve

shorter sequences of movement than other forms of climbing (e.g. sport climbing, top roping), there is still a requirement to plan and remember that sequence. In order to successfully complete this aspect of climbing, participants were drawing on aspects of their working memory (e.g. holding information in mind for the purposes of completing a task) and planning/organising skills (e.g. setting goals and developing appropriate steps ahead of time). Research suggests a well-established link between ADHD symptoms and difficulties with working memory and planning/organising (Alderson et al., 2013; Kofler et al., 2018; Kofman, Gidley Larson & Mostofsky 2008; Patros, Tarle, Alderson, Lea & Arrington 2019).

One way to support working memory and planning/organising in learning is through the use of external memory aids, like visuals (Gathercole & Packiam Alloway, 2008; Packiam Alloway & Gathercole, 2006; St Clair-Thompson, R. Stevens, Hunt & Bolder 2010). For CYP with difficulties associated with ADHD, a recent briefing paper from the British Psychological Society recommended the use of visual information (e.g. equipment and task checklists) to supplement verbal instructions (Hill, Pinto & Romney 2022). It was hoped that by engaging with a visual representation of their climbing sequences, participants would be able to develop working memory/planning skills that could transfer to other contexts.

3.3 Psychoeducation

A consistent component of this intervention was centred around the principle of psychoeducation. In Cognitive Behavioural Therapy (CBT), psychoeducation is a key element and focuses on providing the client with information about their condition. The rationale being that increased understanding and self-awareness can lead to positive therapeutic outcomes. Research shows that psychoeducation has been used successfully with ADHD populations previously (Hoxhaj et al., 2018; Khoury & Ammar, 2014; Powell, Parker, Weighall & Harpin 2022). In order to safeguard the psychological safety of participants, the present intervention did not seek to educate about specific medical conditions. Instead, there was a focus on how the body typically responds to stress (e.g. fight,

flight or freeze) and the implication on specific brain functions. For example, during high arousal states, the brain's ability to process rational thinking skills can be compromised in favour of other immediately protective functions (e.g. preparing the body to physically escape).

Participants were introduced to this idea using the Brain-Hand model (Siegel, 1999; Siegel & Bryson, 2012), which was chosen because of its simplicity and potential appeal to CYP. The Brain-Hand model uses different parts of the hand to visually represent the interconnectedness of different neural systems. In the current intervention, the thumb symbolised the brainstem or 'small brain' (responsible for basic regulatory functions and sensory processing), while the other four fingers represented higher order cognitive functions often associated with brain regions such as the pre-frontal cortex (or the 'big brain'). During high arousal states, the fingers can separate from the thumb (known as 'Flipping your lid'), meaning that the thinking part of the becomes disconnected and compromised. It was hoped that participants would start to use this simple heuristic as a framework to understand their own responses to stress and to understand regulatory strategies that could help them to bring the 'big brain' back online. An integral part of Dan Siegel's more recent work (Siegel, 2020) emphasises the importance of relationships in the development of regulation and this was reflected in the decision to conduct the intervention in groups.

3.4 Emotional literacy

In order to cultivate emotional literacy, and therefore emotion regulation skills, the present intervention used two activities from the Anna Freud: Mentally Healthy Schools resource base (accessed February 2023), which provides quality-assured mental health resources, information and advice to UK schools. The first activity ('Things that make me feel...') introduced participants to a wide range of emotion words and encouraged them to relate the emotions to their own and others' experiences. The second activity ('Matching emotions and actions') presented the group with various scenarios and encouraged participants to discuss the possible emotional and behavioural responses

to each one. Both activities aimed to increase participants knowledge and self-awareness about emotions.

Emotional literacy is defined as ‘the ability to perceive accurately, appraise and express emotion, the ability to access and/or generate feelings when they facilitate thought, the ability to understand emotion and emotional knowledge; and the ability to regulate emotions to promote emotional and intellectual growth’ (Mayer & Salovey, 1997). This definition has also been expanded to include concepts of relational-wellbeing, such as having empathy, valuing others and effective communication (Roffey, 2008). Research shows that emotional literacy (as part of wider social-emotional development) has a positive impact on a range of academic and mental health outcomes (Brackett, Rivers & Salovey 2011; Denham, Wyatt, Bassett, Echeverria & Knox 2009; Durlak, Weissberg, Dymnicki, Taylor & Schellinger 2011; Taylor & Dymnicki, 2007), and development in this area is especially important for ADHD populations (Ali, 2024). It was hoped that with increased emotional literacy, accompanied by psychoeducation about physiological state and controlled breathwork exercises, participants would improve their levels of overall emotion regulation.

3.5 Controlled breathwork

During the current intervention, participants were introduced to cyclic sighing (a form of controlled breathwork that emphasises prolonged exhalations; Balban et al., 2023). This was included with the hope that participants might learn to use it as a strategy to regulate their physiological response to stress (enhanced by increased awareness/psychoeducation as discussed above). Breathing is an essential bodily function that sustains life, by regulating the intake of oxygen for aerobic metabolism and the removal of carbon dioxide, which in turn regulate pH levels in the blood (Del Negro, Funk & Feldman 2018; Lavretsky & Feldman, 2021). It has long been established that various emotional and cognitive states can influence the intensity and frequency of the breath (Boiten, 1998; Boiten, Frijda & Wientjes 1994; Guyon et al., 2020). This relationship becomes

bidirectional when considering the impact that changes in breath can have on emotional and cognitive states (Lavretsky & Feldman, 2021; Philippot, Chapelle & Blairy 2002; Yackle et al., 2017).

There are various forms of controlled breathing and the current intervention consulted recent evidence in deciding which forms to incorporate. A recent randomised, controlled study compared the performance of three different breathwork exercises (cyclic sighing, box breathing and cyclic hyperventilation) with an equivalent period of mindfulness meditation (Balban et al., 2023). The researchers reported that breathwork, especially cyclic sighing, produced greater improvement in mood and reduction in respiratory rate compared with mindfulness meditation. The current intervention opted to employ cyclic sighing and box breathing due to their effectiveness demonstrated in the aforementioned study as well as their simplicity in explanation.

It was hoped and predicted that participants in this study would experience a safely managed fear of falling and the typically-associated physiologically associated responses. At this time, they would have had the opportunity to employ either cyclic sighing or box breathing. As it transpired this was not the case and the consolidation of this strategy through experiential learning (Kolb, 2014) was perhaps missed. For a more in-depth discussion of this see section 9.2.

3.6 Cerebellar stimulation

The present intervention made use of cerebellar stimulation not only through bouldering, but also through progressively more challenging discrete balance exercises for around 20-30 minutes at the beginning of each session (e.g. standing on one leg and catching a tennis ball or utilising balance boards). This was included in light of research that has explored the association between injuries to the cerebellum and cognitive/emotional disorders (Schmahmann, 1998, 2004, 2019). This research suggested that the cerebellum, which plays a crucial role in balance/coordination of the body, also has a role in cognitive and emotional regulation. Schmahmann's work, sometimes referred to as the

'cerebellum link,' has been described as a seminal piece of work (Frazier et al., 2022) and is highly regarded by prominent ADHD researchers (Hallowell & Ratey, 2021).

The cerebellum link has been operationalised in various treatment approaches that incorporated balance or other similar activities (e.g. sensorimotor training; Page, 2006) to treat various difficulties. One notable study found that sensorimotor training had been more effective at reducing hyperactivity in a group of children diagnosed with ADHD, than Cognitive Behaviour Training (Banaschewski, Bismans, Zieger & Rothenberger 2001). It has also been reported that a similar approach had improved declarative learning, procedural learning and mental health in a group of 40 adolescents at risk of 'school dropout,' (Blouchou & Nicolson, 2020). It was hoped that the discrete balance/coordination challenges and consistent bouldering throughout the sessions would take advantage of this link between cerebellum function and regulatory processes and therefore improve levels of Executive Functioning.

4. Methodology

4.1 Research design

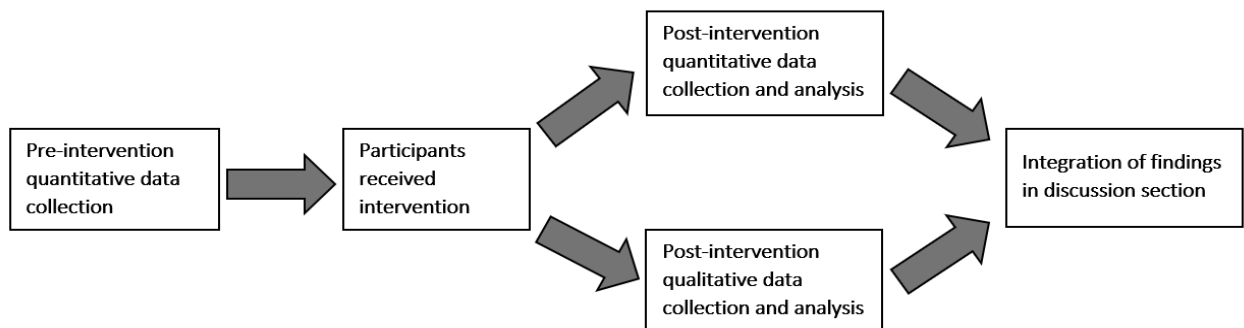
This Convergent Mixed-Methods research study collected both quantitative and qualitative measures to examine the impact of a psychologically-informed bouldering intervention on three areas of Executive Function commonly associated with ADHD (attention, emotion regulation and cognitive regulation) in twelve children and young people aged between 11-13 and with identified needs associated with ADHD. Quantitative measures (TEA-CH2 and BRIEF-2) were collected pre- and post-intervention in order to demonstrate whether or not the intervention impacted each of the three key areas (RQ1). Qualitative measures (semi-structured interviews) were used to explore in what ways any change or improvement came about, through the perceptions of participants (RQ2).

The independent variable in this study was exposure to a six-week psychologically-informed bouldering intervention. Dependent variables measured quantitatively were attention, emotion regulation and cognitive regulation. Outcomes were explored qualitatively through participants' perceptions of any change in their ability to manage inattention, hyperactivity and/or impulsivity on a day-to-day basis. For the purposes of data analysis all participants ($n=12$) were treated as one group and this study is best described as a within-groups design (all participants experienced the same level of independent variable and served as their own control for comparison). Having said that, participants took part in the intervention in two separate groups of 6 and although the intervention plan stayed the same, there are likely to have been differences in the way that it was delivered/experienced. These differences, and the potential impact, will be explored further in the discussion section.

In line with the definition of Convergent Mixed-Methods design provided by J.D. Creswell and J. W. Creswell (2023), quantitative and qualitative measures remained separate during collection and analysis. Both strands of data guided the researcher's overall interpretation of the data in the discussion section. It was hoped that quantitative measures would provide some initial insights into

any changes or development of the three skills identified previously (attention, emotion regulation and cognitive regulation). Following this, qualitative data were used as both a comparative and an explanatory tool to support understanding in reference to the two research questions. The purpose of collecting qualitative data was to help answer questions about participants' individual experience that the quantitative measures may not be able to, including which aspects of the intervention were most helpful or meaningful to each participant. The research design of this study has been represented visually below (see figure 2).

Figure 4 - sequence of Data collection and analysis in the current study



4.2 Methodological paradigm

This mixed-methods research design adopted a Pragmatist methodological epistemology to the overall interpretation of its findings. Pragmatism is not tied to any one system of philosophy or reality (i.e., postpositivism or constructivism) and instead draws on both quantitative and qualitative assumptions (J. D. Creswell & J. W. Creswell, 2018). The standardised, quantitative measures in the current study have been influenced by a postpositivist epistemology in so far as they aim to measure an objective reality, whilst acknowledging that absolute truth of knowledge, particularly relating to human behaviour, can never be found (D. C. Phillips & Burbules, 2000). The current study used semi-structured interviews to elicit how participants perceived their response to intervention and ability to manage behaviour on a day-to-day basis. This aspect of the data collection drew more on a Constructivist worldview, which posits that human beings construct their own subjective meaning and reality of the world (Crotty, 1998). The analysis of qualitative data in the present study called for a

Critical Realist stance, acknowledging the inherent subjectivity of the process and the role of the researcher (Maxwell, 2012). Further discussion of the epistemology of this approach follows in section 7.5.2.

In the Pragmatic worldview, more attention is placed on understanding potential solutions to real-world problems (Patton, 1990). Typically, the researcher uses a range of available approaches to understand the problem (Tashakkori & Teddlie, 2010). For a useful summary of Pragmatism and the key figures involved in its conception, see Cherryholmes (1992).

4.3 Participants and sampling

This study used homogenous purposive sampling and participants were selected with the help of a school SENCo, who is responsible for coordinating day-to-day SEND (Special Educational Needs and Disability) support and therefore has a good understanding of any students requiring additional support (DfE, 2023). Selection of participants was based on the following inclusion criteria:

- Students currently in year 7 or 8 (ages 11-13)
- Identified as having persistent difficulty with symptoms commonly associated with ADHD (inattention, hyperactivity and/or impulsivity), which is acting as a barrier to their engagement with structured learning

In most cases, students in year 7 and 8 are transitioning into a whole new education setting, where there is often an expectation of more independence. Secondary students have to navigate various challenges; lesson timetables, new peer groups, multiple subject-specific teachers and increased academic demands. This transition from primary to secondary school is associated with both positive and negative effects in relation to education and socio-emotional development (Griebel & Berwanger, 2006; Zanobini & Usai, 2002) and so it is an important time for young people to develop a toolkit of strategies that support Executive Function skills.

As mentioned in the introduction (section 1.2), this research did not include/exclude based on formal diagnosis of ADHD or ADD, primarily because of long wait-times for assessment (Lang, 2024; Morris, 2024), but also due to a bias towards more externalising presentations, the context-specific nature of symptom presentation and professional subjectivity in diagnosing. Although the DSM-V sets out a list of symptoms and diagnostic threshold, there is a level of human/clinician interpretation. The current author acknowledges that in utilising the experience/judgement of an individual SENCo, the current study's recruitment is also open to an element of human subjectivity. Additionally, schools with a higher tendency for inclusive practice will likely have created a learning environment which is more manageable and therefore there would be less of a case for formal diagnosis. Therefore, an inclusion criterion based on diagnosis, could have reflected different inclusionary practices, rather than actual differences between potential participants.

This intervention was positioned as a traded service that would be offered to schools through the Local Authority Educational Psychology Service in which the researcher was undertaking a training placement. The researcher attended a SENCO network meeting to introduce the offer to all attending SENCOs. It was explained that there would be twelve total slots available and there would be a cost per place. The cost of the intervention was set to an amount that would cover the venue and instructor costs only, meaning that no profit was made by the Local Authority or by the researcher. Multiple schools requested the intervention, with one school requesting to purchase all 12 available slots. Given that there would be significant practicalities to consider (e.g. travel arrangements and timings) the decision was taken to have all participants coming from one school, which was an all-boys school. As a result, there were no participants in this study who did not identify as male. See section 9.6 and 9.7 for a full discussion of how this might have impacted the findings of the current study and recommendations for future areas of research.

4.4 Data collection methods

As mentioned previously, the current study collected both quantitative (pre and post-intervention) and qualitative data (post-intervention). There will now be an in-depth description of each measure and how it was collected.

4.4.1 Quantitative data collection methods

Attention. Designed for use by clinical, educational and child psychologists, as well as academic researchers, the Test of Everyday Attention Version 2 (TEA-CH2; Manly et al., 2016), is a UK-normed measure of selective, sustained and switching attention. The measure employs a comic-book style administration with the use of computer-based games for some of the subtests. Results from the TEA-CH2 were compared with a national sample of same-aged peers and can be used to create a detailed profile of strengths and needs in the area of attention for individual children (aged 5-15). All quantitative measures were collected on site of the school that all participants were attending at the time of the study. This was in a private, low-sensory space with little to no distractions. Although there was sometimes noise from outside the room, testing conditions were deemed conducive to participants being able to perform to the best of their abilities on that day.

Participants took part in three subtests from booklet A of the TEA-CH2, which was designed for children aged 8-15 years. These were Hector Cancellation (selective attention), Hecuba Visual Search (selective attention) and Vigil (sustained attention). Before each subtest was administered, participants were given an initial demonstration and practice to ensure that they understood what was expected of them. When participants took part in the Hector Cancellation subtest, they were required to mark specific target shapes on a page, while simultaneously ignoring other distracting shapes that were visually similar in shape or colour. The density of distracting shapes was varied across three levels of difficulty (repeated in counterbalanced order). Participants were encouraged to mark as many target shapes as possible on six separate 10-second trials. There were enough shapes

on each page to ensure that participants did not mark them all and therefore could not feasibly reach an upper limit.

The Hecuba Visual Search subtest required participants to take part in a similar visual search task with the same shapes, however this time there was no motor response required (marking shapes with a pen). On Hecuba Visual Search, participants were asked to inspect a series of smaller panels and report vocally whether the target shape was present or not. The participants were scored on how many correct responses they could achieve on two 30-second trials.

The third and final subtest used on the TEA-CH2 was called Vigil and is a measure of sustained attention. It assessed how effectively participants could maintain their attention on a slow, dull task. They were required to listen and count a series of repeated tones. This task deliberately does not grab the participants attention with sometimes long drawn out gaps in between each tone so that participants are required to self-sustain their attention. There were ten trials in total and participants were scored on how successful they were at correctly reporting back the number of tones on each trial.

Emotion regulation. In order to assess participants emotion regulation skills, the present study used the BRIEF-2, which is based on behaviour ratings. The Shift scale and the Emotion Control scale were used on the self-report form, parent form and teacher form. Although the aim was to collect data from all three respondents it was only possible to obtain data from self-report and parent forms. School staff were provided with the resources needed to collect data for the teacher form but this was not possible due to practical issues. In both self-report and parent form, an Emotion regulation index was derived, as per the professional manual (Gioia et al., 2015). During administration, the respondent is asked to respond to a list of statements, answering Never (if the behaviour is never a problem), sometimes (if the behaviour is sometimes a problem) and often (if the behaviour is often a problem).

The shift scale gives an indication of how freely participants can move between different aspects of a problem as the circumstances demand. There were eight items on the self-report form and eight items on the parent form. A key aspect of this is the ability to change from one mindset or topic to another and has implications for how easily someone is able to move beyond a specific disappointment or unmet need. Some questions on this scale focus on the child's reliance or preference for predictability (e.g. "Becomes upset with new situations"), while other questions focus on tendencies to become stuck in certain patterns of behaviour (e.g. "I have trouble changing from one activity to another").

The emotion control scale gives an indication of a child's ability to modulate their emotional responses. There were six items on the self-report form and eight items on the parent form. According to the developers (Gioia et al., 2015), poor emotion control is expressed as emotional lability (rapid or exaggerated fluctuations in mood) or emotional explosiveness (or reactivity). Poor emotion control has clear implications for a child's calm and measured use of other Executive Function skills. In order to capture emotional control as it relates to lability (or fluctuations), the BRIEF-2 includes statements like, "Mood changes frequently." To give an indication of emotional explosiveness, the measure includes statements such as, "Has explosive, angry outbursts."

Cognitive regulation. In order to assess participants cognitive regulation skills, the current study used items on the BRIEF-2, as above for emotion regulation. It used the Task-completion scale (self-report), working memory (self-report and parent form) and then plan/organise scale (self-report and parent form). As with emotion regulation scales the current study aimed to collect data from teachers, but this was not possible. A Cognitive Regulation Index score was derived for the self-report respondents, by combining all three self-report scales, as per the technical manual (Gioia et al., 2015). A Cognitive Regulation Index score could not be derived from the parent form as not enough individual scales were collected.

The task-completion scale (self-report only) is not linked to a specific Executive Function but is thought to be a common consequence of problems in other areas of Executive Function. There were seven items relating to task-completion on the self-report form. Task-completion is described by the developers as more of an 'outcome variable' from the perspective of either failure to complete a task (e.g. "I have trouble finishing tasks [such as chores or homework]") or as slow progress towards completion of a task (e.g. "I am slower than others when completing my work").

Statements on the working memory scale (self-report and parent forms) measured participants' ability to hold information in mind for the purposes of completing a task, like multistep activities, problem solving and mental arithmetic. Caregivers describe children with difficulties in working memory as often losing track of what they are doing as they are working on a task, or forgetting items to retrieve when they are sent out on an errand. There were eight items on the self-report form and eight items on the parent form. Most notably to the current study, the working memory scale included statements that relate to mental tracking problems (e.g. "Has trouble remembering things, even for a few minutes" and "When given three things to do, remembers only the first or last").

The Plan/organise scale, on both self-report and parent forms, combines the planning and organising scales that had been separate on the previous iteration of the BRIEF (Gioia et al., 2000). Although planning and organising have some conceptual differences, the behavioural presentations were very similar, and the two scales were highly correlated. There were ten items on the self-report form and eight items on the parent form. The planning component is defined by the developers as the ability to anticipate events or tasks, set goals and develop appropriate steps ahead of time. It impacts how ready and able a child is to start a task in a timely manner. This component is reflected in statements such as, "Underestimates time needed to finish tasks." The organise component of the scale is focussed on a child's ability to apply order to multiple pieces of information and to recognise the main ideas. The statements reflect what is often described as missing the forest for the trees (e.g.

“Gets caught up in details and misses the big picture”) and having difficulty processing large amounts of information (e.g. “Becomes overwhelmed by large assignments).

Validity scales. Each form of the BRIEF-2 (Gioia et al., 2015) contained three validity scales (inconsistency scale, negativity scale and infrequency scale) that could be used to support the assessor to consider some of the biases that are sometimes seen in rating scales like this one. For the current study, it was decided that due consideration should be given to the time and concentration demands placed on participants during data collection, particularly as the participants were selected on the assumption that they had difficulties in this area (i.e. having persistent difficulty with symptoms commonly associated with ADHD). It was decided that only the statements relevant to the research aims would be collected, so that participants would not be placed under any additional, non-essential pressure to remain focussed and regulated.

4.4.2 Qualitative data collection methods

The qualitative data collection took place post-intervention and within two weeks of the intervention finishing for each group. Eleven semi-structured interviews took place at the school of the participants, in a private, low-distraction room. One of the twelve participants was unavailable or absent on more than one occasion of the researcher attending the school. It was explained to participants that they would be responding to nine total open-ended questions, relating to three broad topics (what they had remembered from the intervention, how they perceived changes in their own skills and overall feedback on the intervention). The purpose of the qualitative arm of the current study was to give some insights into what aspects of the intervention had been most helpful or applicable to each participant and how it might have improved some of their Executive Function skills. In other words, the qualitative was aiming to answer research question two (In what ways does a psychologically-informed bouldering intervention impact on how young people with identified needs relating to ADHD perceive their own levels of Executive Function in three key areas?).

The semi-structured interviews allowed participants to reflect on their own experiences of the intervention and on any personal changes that they had noticed, and in their own words. As mentioned previously, the emphasis on participants' own perceptions adopted a Constructivist worldview (Crotty, 1998). Breakwell, Barnett and Wright (2020) discussed the flexibility of interviews as a strength and this was a significant reason why it was chosen for the current study. Questions were constructed to elicit responses that were directly relevant to research question two. Participants were encouraged to reflect on any changes (rather than improvement) that they had noticed in the three areas of Executive Function being examined in the present study. There was one question directed towards attention, two questions directed towards cognitive regulation skills (separated out into working memory and planning) and one question directed towards emotion regulation. All of the questions in this section were structured in the same way (e.g. "Do you think this group has made a difference to your ability to focus on tasks in everyday life and in the classroom?")

While the researcher followed the same interview structure for each participant (see appendix C), flexibility was achieved in the use of follow-up questions. Although the example given above was a closed-question, depending on the initial response, the researcher then encouraged participants to think of examples when they had noticed the change and to consider which (if any) strategies from the intervention were most useful. Having been involved in delivering the intervention, the researcher was well-positioned to clarify anything technical from the intervention (e.g. the name of strategies or specific elements of strategies that the participant might not have remembered in full).

4.5 Data analysis methods

4.5.1 Quantitative data analysis methods

The quantitative measures in the current study were influenced by a postpositivist epistemology in so far as they aim to measure an objective reality, whilst acknowledging that absolute

truth of knowledge, particularly relating to human behaviour, can never be found (D. C. Phillips & Burbules, 2000).

In terms of the quantitative data, both descriptive and inferential analysis took place. The research used a combination of separate subtests on two assessment tools (TEA-CH2 and BRIEF-2) to collect data on three key areas of Executive Functioning (attention, emotion regulation and cognitive regulation). The TEA-CH2 used a combination of comic book and computer program administration. Scores on two of the subtests (Hector Cancellation and Hecuba visual search) were manually entered into the program by the researcher, who counted up participants' scores for each page. On the third TEA-CH2 subtest (Vigil), participants verbally gave a response which was typed directly into the computer program. When administering the BRIEF-2, the researcher administered the questionnaire either in-person or over the phone and recorded responses on the relevant response form.

Raw scores, scaled scores and percentile ranks were automatically generated by the TEA-CH2 computer program. Scores on each scale of the BRIEF-2 were totalled up manually by the researcher and percentile ranks were calculated using normative comparison tables in the technical manual (Gioia et al., 2015). Where possible, scaled scores were combined to give an index score (e.g. Emotion Regulation Index). The quantitative data were analysed using the Statistical Package for the Social Sciences (SPSS 26: IBM). Descriptive statistics were generated for participants' age and all pre-intervention (baseline) data to ensure that the participants were a suitable fit for the study's inclusion criteria. The results of this descriptive analysis are presented in section 8.1.1.

Before conducting a comparison of the means for each measurement (pre and post-intervention), the current study assessed whether the data met assumptions for parametric testing, as set out by Breakwell et al. (2020). This involved consideration of the level of data, and whether each subject/participant was independent with paired measurements obtained from the same subject. In order to test the normality of the data, Histograms and normal Q-Q plots were examined

and Shapiro Wilk's test was used. All but two of the scales/measures met the assumptions for parametric testing (full discussion in section 8.1.2).

In order to assess the impact of the intervention on three key areas of Executive Function, inferential analysis was conducted, comparing the means of scores before and after the intervention took place. For data that met the assumptions of parametric testing a paired samples t-test was used and for data that did not, a Wilcoxon Signed-Ranks Test was used. Decisions about testing and guidance on how to run the tests was taken from Field (2013).

4.5.2 Qualitative data analysis methods

The present study's approach to qualitative data analysis was rooted in reflexive thematic analysis. This approach prioritises the active involvement of the researcher and differs from other types of thematic analysis (e.g. content analysis) which might prioritise coding accuracy or reliability in order to reach a more objective analysis of the data (Braun & Clarke, 2021). Themes were viewed as evolving through an iterative process of examination and refinement, rather than simply 'emerging' from the data (Terry & Hayfield, 2020). The aim was to capture patterns of meaning across the dataset, while accepting the unavoidable influence that the researcher's positioning would have.

This approach to qualitative data analysis was informed by a critical realist stance (Willig, 1999), which posits that one cannot passively observe the world to unveil universal laws or truths. The observer (or researcher) is positioned as an active participant in the process of meaning making. Critical realism differs from 'simple' or 'naïve' forms of realism, which assume a singular reality that can be directly examined through research. Critical realism is instead premised on the assumption that reality is experienced and moulded by our individual interactions with culture, language and political interests (Braun & Clarke, 2021; Maxwell, 2012).

Braun and Clarke (2021) set out a widely used six-step process for thematic analysis, which is outlined below. Some explanation is given as to how the current research engaged with each step:

1. Familiarisation with the data: repeated listening of each interview and formatting of the transcription allowed for immersion in the data. Throughout this step, the researcher was engaging through the lens of the two research questions.
2. Generating initial codes: NVivo (a widely used software for qualitative data analysis) was used to re-read the data (four times in total) and generate some short labels about extracts from the transcripts that were relevant to the research questions. For example, "I've got better at like, managing my emotions and like calming down quicker..." was initially coded as 'emotions.'
3. Generating themes: all initial codes were listed manually on paper and re-read multiple times. The researcher then began to find associations between codes and group them together into more sophisticated potential themes (e.g. the code, 'emotions' was combined into the potential theme, 'strategies for downregulation').
4. Reviewing themes: equipped with the potential themes from step three as an interpretative framework, the researcher went back to the data to establish whether they were a good fit for the data and for answering the research questions. During this step, the researcher began to construct a thematic map with the generation of 'Overarching themes.' For example, it became clear that the subordinate themes, "Enjoying the social element" and "Peer conflict" could be grouped into the overarching theme: "Group dynamics."
5. Defining and naming themes: the researcher continued to engage with the transcripts (reading and listening multiple times) and went through a process of refining each subordinate theme, overarching theme and the thematic map.
6. Producing the report: using the thematic map as a framework, the researcher selected extracts from the transcripts that were of most interest to the research and best characterised each overarching theme and subordinate theme.

4.6 Discussion of practice effects that might arise from repeated testing

The current study used a repeated measures design that utilised quantitative data collection on two occasions, each around eight weeks apart. This included three separate subtests from the TEA-CH2 (Hector Cancellation, Hecuba Visual Search and Vigil) and the BRIEF-2 self-report and parent questionnaire. A number of factors have the potential to influence test-retest results in this study, as set out by Lineweaver and Chelune (2003), who explored the effect of 'serial assessment' on two commonly used standardised measures of cognitive function. In the current study, practice effects had the potential to bias scores on the TEA-CH2 in particular. This measure requires participants to take part in a number of timed games, producing either correct or incorrect responses. During pre-intervention data collection there was likely to be an element of procedural learning and recall of previously successful strategies. This may have an impact on retest scores (Benedict & Zgaljardic, 1998). Participants may have also felt more comfortable in the testing environment and with the researcher administering the test on their second attempt (post-intervention). Participants' state of relative ease and comfort is likely to impact on performance.

Lineweaver and Chelune (2003) discuss two additional sources of bias that could be applied to the findings of the current study. No test measure offers perfect reliability, and a level of Measurement Error is to be expected. In the current study, observed differences in score may be due to random fluctuations in the measure, as opposed to an effect relating to the studies aims. Secondly, owing to the principle of Regression to the Mean, it is possible that individual participants who are likely to be towards an extreme on any particular measure (either high or low) are likely to be scored as comparatively closer to the population mean when retested at a later timepoint. An individual's true score is thought to be closer to the mean than the observed score, on average.

4.7 Ethical considerations

In designing this study, the researcher considered a number of ethical issues and how they could be addressed, the most pertinent of which are presented here. Informed consent is one of the most important features of research. Gupta (2013) suggests that there are three essential elements of this, which must be satisfied: voluntarism, information disclosure and decision making capacity. In the current study, it was made clear to participants that they were free to decide if they would like to participate (without any adverse conditions) and could decide to leave the research at any point. They were given a Participation Information Sheet (PIS) before deciding, which gave details of what would happen in the study and what the study's aims were (see appendix A).

Participant and researcher safety during the bouldering intervention stage was another key ethical consideration of this study. The soft flooring used in artificial climbing environment provides a more comfortable landing when jumping or falling from the wall, however it does not guarantee safety. Uncontrolled falls could result in injuries, e.g. broken and sprained limbs. As participation in bouldering over six sessions was a necessary part of the study, the researcher was legally bound to ensure that all participants were given a full safety induction before entering the climbing centre (this was also a strict policy upheld by the centre). All but one of the sessions were delivered by a fully qualified in-house Climbing Instructor, with assistance from the researcher, who is also a qualified Climbing Wall Instructor. The one exception to this arrangement was due to availability of the in-house instructor and the researcher led this session.

The psychologically-informed bouldering intervention proposed as part of this study took place during the school day and as a consequence, participants were expected to miss some curriculum time each week. This is a common challenge faced by many school-based approaches to intervention, but it was hoped that any benefits experienced by participants would result in long-term gains in their ability to engage meaningfully with structured learning thereafter. This decision was considered carefully alongside participants, parents and school staff. As mentioned previously,

participants agreed to take part at their own discretion and were free to leave at any point if they believed their time was better spent in school (or elsewhere).

Another key ethical consideration relates to the anonymity of participants. While participants did consent to the content of their interviews being analysed and presented in this research, they did not consent to being personally identifiable. Guaranteeing complete anonymity in qualitative research (i.e. that a participant will never be traceable from the data presented) has been described as an 'idealised view' by Saunders, J. Kitzinger and C. Kitzinger (2015) and as an 'unachievable goal' by Van den Hoonaard (2003). It is possible that certain school staff and climbing venue staff, who were closely tied to the recruitment and/or implementation of the intervention will be able to recognise individual participants based on the data presented. This is referred to as 'internal confidentiality' (Tolich, 2004) and was an unavoidable threat to anonymity in the current study.

The approach taken by the current study balanced the aims of protecting participants' identities, while maintaining the value of the data. The names of key places or organisations (e.g. school name, name of climbing venue, name of local authority Educational Psychology Service) was omitted fully from the study. The university setting, at which the primary researcher was enrolled, could not be omitted as it was a requirement for this piece of work to be made publicly available on the university repository. In terms of participant names, it was decided that generic labels (e.g. participant 2) would be impersonal and make it more difficult for the reader to follow individual narratives, so each interviewee was given a pseudonym. The chosen pseudonyms deliberately could not be associated with participants' own religious, cultural or ethnic background as this could have resulted in 'deductive disclosure' (Kaiser, 2009).

4.8 Reflexivity

The current study aimed to answer its identified research questions accurately but acknowledged the limitations of pursuing an 'absolute truth.' It adopted a Pragmatist methodological

approach, which was not tied to any one system of philosophy or reality (J. D. Creswell & J. W. Creswell, 2018). The present study was influenced by specific theoretical standpoints, which do not make a claim to absolute truth and allow for subjective interpretation: postpositivism (D. C. Phillips & Burbules, 2000), constructionism (Crotty, 1998) and critical realism (Maxwell, 2012; Willig, 1999). Readers are encouraged to construct their own interpretation and evaluation of the current study, with due consideration of the researcher's positioning and involvement throughout the research process. This is in line with Barker and Pistrang's (2005) assertion that transparency is a necessary component of evaluating pluralist research. In order to inform the reader's evaluation, here follows discussion of the researcher's individual interests, context and experience.

At the time of writing, I am a trainee EP in my final year of doctorate level training, with previous experiences as a primary school teacher. Throughout my life I have benefitted from the various physiological and psychological benefits associated with different forms of physical exercise, including rock climbing. I have been taking part in both bouldering and roped rock climbing (indoors and outdoors) recreationally for around 5-6 years and trained as a Climbing Wall Instructor with the British Mountaineering Council for the purposes of delivering the intervention that was examined in the current research. While I do not identify personally with a clinical diagnosis of ADHD, throughout my educational career I have been motivated to understand the experiences of young people who have difficulties associated with learning (e.g. identified or unidentified SEND). I am passionate about making high-quality interventions accessible to the children and young people who need them most. Arising from my own positive experiences of rock climbing, I started this piece of research with a long-held belief that rock climbing has the potential to improve educational and mental health outcomes for young people, through the improvement of Executive Function skills.

As the lead researcher, I was involved in every aspect of this research study, from its initial conception, review of relevant literature, data collection, data analysis and discussion of findings in relation to current literature and future implications. I predicted that I may be biased to look for

examples of rock climbing having a positive influence on the participants in this current study and on the wider world. A number of measures were put in place to minimise the impact of any potential bias. Primarily, I have engaged in a process of reflexive supervision with one academic supervisor and one EP supervisor, who both have notable experience and expertise. They have questioned my hypotheses, scrutinised my data and supported me to approach the research questions with appropriate rigour and balance. I submitted an interim research report of 10,000 words which was reviewed and marked by a third adviser (another member of academic staff) who was acting as an external member of the Research Progress Review panel.

In addition, I opted for methods of data collection and data analysis which were tied to clear guidelines which have been established and used extensively in educational research previously. Specifically relating to the quantitative strand of this study, the TEA-CH2 and the BRIEF-2 are both well-researched and manualised approaches to the measurement of attention and executive function respectively. The same scripts, procedures and testing environment was employed in pre and post-intervention data collection. In terms of the qualitative strand, I created an interview structure (see appendix) prior to conducting interviews and followed clear and well-established steps and general guidance on the principles of reflexive thematic analysis (Braun & Clarke, 2021). It was hoped that by taking a systematic and evidence-informed approach to the study, any potential biases could be reduced.

5. Results

In this chapter, results from the quantitative data collection will be reported first, followed by results from the semi-structured interviews conducted after the intervention. Analysis of each dataset (quantitative and qualitative) will be presented in relation to the specific research question they were intended to answer. Research question one (Can a psychologically-informed bouldering intervention improve three key areas of Executive Functioning for children with identified needs relating to ADHD?) was answered using quantitative data. While research question two (In what ways does a psychologically-informed bouldering intervention impact on how young people with identified needs relating to ADHD perceive their own ability to manage inattention, hyperactivity and/or impulsivity on a day-to-day basis?) was answered using qualitative data.

5.1 Quantitative data results

5.1.1 Descriptive statistics and normative comparisons

Through a strategy of homogenous purposive sampling, this study aimed to recruit a group of participants who shared some of the same (or very similar) key characteristics (e.g. age, year group and level of identified needs in relation to the symptoms of ADHD). All participants were recruited in school year 7 or 8 and aged between 11-12 years and therefore relative homogeneity on these characteristics was achieved. The Mean (*M*), standard deviation (*SD*) and range of participant age was calculated and presented below (Table 1).

Table 1 - Descriptive statistics for age and year group of participants

	<i>M</i>	<i>SD</i>	<i>Range</i>
Age	11.75	.45	1

Quantitative measures collected pre-intervention provided an indication as to how successful the recruitment process was in reference to the second selection criteria (persistent difficulty with inattention, hyperactivity and/or impulsivity, which is acting as a barrier to their engagement with

structured learning). Percentile scores from the TEA-CH2 allow for comparison of a given participant’s score to a national sample of same-aged peers (Manly et al., 2016). Each participant’s scaled score, which was based on their age at the time of the test, their gender and their raw score, is associated with a different percentile score. There were two tests of selective attention (Hector cancellation and Hecuba visual search) and one test of sustained attention (Vigil). In order to place the current research participant group within the national sample, the mean percentile scores were presented below (table 2).

Table 2 – mean and standard deviation for each of three attention measures (pre-intervention)

<i>Participant</i>	<i>M</i>	<i>SD</i>
Hector cancellation	22.42	7.15
Hecuba visual search	18.67	14.74
Vigil	26.67	24.77

A percentile score between 25 and 75 is considered to be within the ‘average’ range. Pre-intervention scores shows that participants generally scored somewhere between the low end of average or below average when compared with the national same-aged sample. This forms part of the evidence for suggesting that the participant sample in this study was in line with the proposed inclusion criteria (i.e. having persistent difficulty with symptoms commonly associated with ADHD).

Percentile scores from the BRIEF-2 self-report and parent forms provided some insight into the baseline levels of executive function in the group, as compared to a national sample of same-aged peers (Gioia et al., 2015). The present study has opted for the term Executive Function, and not Executive dysfunction, which is how scoring is interpreted on the BRIEF-2 (Gioia et al., 2015). In other words, higher scores on this measure indicated lower levels of Executive Function and higher levels of Executive Dysfunction. A mean score for each individual scale of the BRIEF-2 was calculated and this was placed within the national same-aged sample (ages 11-13) in the form of a percentile score. Unlike the TEA-CH2, the BRIEF-2 matches raw scores and percentile scores differently on each of its

scales. For ease, the mean score for each subtest has been rounded to the nearest whole number, to give a percentile score which is indicative of the group. Each score corresponds with particular descriptors (e.g. mildly elevated, potentially clinically elevated and clinically elevated) which are taken from the BRIEF-2 professional manual (Gioia et al., 2015) and used to discuss the sample further. The baseline scores will be considered in reference to two strands (Emotion Regulation and Cognitive Regulation).

In terms of Emotion regulation skills, results from two scales on the self-report form (Shift and Emotional control) and two scales on the parent form (also Shift and Emotional control) indicated that the sample had lower than average levels of Executive Function in this area (higher scores indicated increased Executive Dysfunction). Scores were combined to generate two Emotion Regulation Index scores (one for self-report and one for parent form). All three scores from the self-report would be considered ‘Mildly elevated’ and all three scores on the parent form would be considered ‘Clinically elevated.’ There was a pattern of parents giving higher ratings of Executive Dysfunction across all scales. Both self-report and parent responses on emotion regulation skills support the suggestion that overall the participant sample in this study was in line with the proposed inclusion criteria (i.e. having persistent difficulty with symptoms commonly associated with ADHD).

Table 3 - mean scores for each scale on the BRIEF-2 self-report form that relate to Emotion Regulation (pre-intervention)

Scale	<i>M</i>	<i>SD</i>	Percentile	Descriptor
Shift (self-report)	15	3.25	84 th	Mildly elevated
Emotion control (self-report)	11	2.66	86 th	Mildly elevated
Emotion regulation index (self-report)	26	5.12	85 th	Mildly elevated
Shift (parent form)	18	4.03	96 th	Clinically elevated
Emotion control (parent form)	19	3.42	95 th	Clinically elevated
Emotion regulation index (parent form)	37	6.7	97 th	Clinically elevated

In terms of Cognitive regulation skills, pre-intervention results from three scales on the self-report form (Task completion, Working memory and Plan/organise) and two scales from the parent form (Working memory and Plan/organise) indicated that the sample had above average levels of Executive Dysfunction in this area. The three scales used on the self-report form have also been used to inform a Cognitive Regulation index score. As before, a mean score for each scale was used to calculate a percentile score which is indicative of the group and T scores were associated with descriptors from the BRIEF-2 professional manual (Gioia et al., 2015). As shown in table 4 (below), three out of four mean scores on the cognitive regulation scales were considered to be mildly elevated (T scores of between 60-64). One scale (Plan/organise) was just below this threshold (t score of 59). The combined Cognitive Regulation Index had a percentile score of 87, indicating that 87% of children in the standardisation sample had a score at or below the same value.

Table 4 - mean scores for each scale on the BRIEF-2 self-report form that relates to Cognitive Regulation (pre-intervention)

Scale	<i>M</i>	<i>SD</i>	Percentile	Descriptors
Task-completion	15	2.74	91 st	Mildly elevated
Working memory	17	2.86	91 st	Mildly elevated
Plan/organise	20	2.92	84 th	Not elevated
Cognitive regulation index	51	6.6	87 th	Mildly elevated

Only two scales on the parent-form were collected, meaning that a Cognitive Regulation Index scores could not be generated. The mean group scores on Working Memory and Plan/organise scales suggested that the sample had above average levels of Executive Dysfunction that were considered to be ‘clinically elevated’ for both (Gioia et al., 2015). Both self-report and parent responses on Cognitive Regulation skills support the suggestion that the participant sample in this study was in line with the proposed inclusion criteria (i.e. having persistent difficulty with symptoms commonly associated with ADHD).

Table 5 - mean scores for each scale on the BRIEF-2 parent form that relates to Cognitive Regulation (pre-intervention)

Scale	<i>M</i>	<i>SD</i>	Percentile	Descriptors
Working memory	21	2.66	99 th	Clinically elevated
Plan/organise	21	1.97	97 th	Clinically elevated

When considering all pre-intervention (or baseline) data, there is good evidence to suggest that the sample of participants was in line with the proposed inclusion criteria (identified as having persistent difficulty with symptoms commonly associated with ADHD (inattention, hyperactivity and/or impulsivity), which is acting as a barrier to their engagement with structured learning. This has been demonstrated using measures of some key Executive Function skills (Attention, Emotion regulation and Cognitive Regulation), which are closely linked with the symptoms of ADHD as mentioned above. Of the data collected, only one measure had the potential to contradict this assumption (Plan/organise self-report). The mean raw score and associated T score suggested that this measure was ‘not elevated,’ although the percentile score was 84 (indicating that 84% of children in the standardisation sample had a score at or below the same value). However, responses on the parent form on the same scale would be considered clinically elevated.

This research set out to explore the impact of a psychologically-informed bouldering intervention on young people with difficulties associated with ADHD and considering pre-intervention data, it was assumed that this sample of participants was appropriate.

5.1.2 Can a psychologically-informed bouldering intervention improve three key areas of Executive Functioning for children with identified needs relating to ADHD (RQ1)?

Before conducting a comparison of the means for each measurement (pre and post-intervention), the current study assessed whether the data met assumptions for parametric testing, as set out by Breakwell et al. (2020). Each subject/participant was independent and each of the paired measurements was obtained from the same subject. In order to check the assumption of normality,

histograms and normal Q-Q plots were examined, and Shapiro Wilk's test was performed on the measured differences between pre and post measures. The Shapiro Wilk's values were not significant ($p > 0.05$) for Hecuba Visual Search, Vigil, Emotional control (self-report), Emotion regulation index (self-report), Task completion (self-report), Working memory (self-report), Plan/organise (self-report), Cognitive regulation index (self-report), Shift (parent form), Emotional control (parent form), Emotion regulation index (parent form), Working memory (parent form) and Plan/organise (parent form), meaning that the null hypothesis of population normality was not rejected.

The Shapiro Wilk's values for Hector Cancellation and Shift (self-report) were significant, indicating a potential violation of normality (see table 6 below) and therefore a non-parametric test of difference (Wilcoxon Signed-Ranks Test) was used in those two cases. An approximate effect size for the two non-parametric tests in this study was calculated by dividing the z score for the test statistic by the square root of the number of observations, which was 24. This method gives a correlation coefficient (r value) and is recommended by Field (2013). All effect size were categorised as follows (0.2 = small, 0.5 = medium, 0.8 = large) as recommended by Breakwell et al. (2020).

Table 6- Shapiro Wilk's values for measures that were significant (<.05)

Measure	W	df	Sig.
Hector cancellation	.84	11	.04
Shift (self-report)	.84	11	.03

In reference to RQ1 in terms of attention, a Wilcoxon Signed-Rank test indicated that the median Hector cancellation post-intervention scores were significantly higher post-intervention ($Md = 15, N = 12$), when compared to pre-intervention scores ($Md = 8, N = 12$); $z = -3.07, p = <.01$, indicating an improvement in selective attention, post-intervention. There was a medium effect size of $r = .63$.

A paired samples t-test was used to answer RQ1 on the other two measures of attention (Hecuba Visual search and Vigil). Cohen's d was calculated to give a measure of effect size, using the

same categories as above (0.2 = small, 0.5 = medium, 0.8 = large), as recommended by Breakwell et al. (2020).

The results indicated a statistically significant difference between Hecuba Visual Search scores pre-intervention ($M = 6.83$; $SD = 1.95$) and Hecuba Visual Search scores post-intervention ($M = 11.17$; $SD = 2.59$); [$t(11) = -5.76$, $p = <.001$], indicating an improvement in selective attention post intervention. There was a large effect size of $d = 1.67$. However, results for the Vigil subtest indicated a non-significant difference between pre-intervention scores ($M = 7.5$; $SD = 2.58$) and post-intervention scores ($M = 8$; $SD = 3.46$); [$t(11) = -.41$, $p = .69$], suggesting no meaningful improvement in sustained attention post intervention.

Having considered the three measures of attention, this study now considers RQ1 in reference to the second key area of Executive Function, which was emotion regulation. This was measured using the BRIEF-2 self-report and parent forms with scoring reversed (i.e. higher scores indicated higher levels of executive dysfunction). It was not possible to collect the post-intervention parent form for one of the participants, meaning that 11 were collected. The self-report measures were collected for all 12 participants (pre- and post-intervention). As mentioned previously the Shift (self-report) data did not meet the assumptions of parametric testing so a Wilcoxon signed-ranks test was used and an approximate effect size (correlation coefficient) was calculated using the method recommended by Field (2013). For measures of emotion regulation that met the assumptions of parametric testing, a paired samples t-test was used, and Cohen's d was calculated to give an effect size.

A Wilcoxon Signed-Rank test indicated that median Shift (self-report) post-intervention scores ($Md = 15.5$, $N = 12$), were not significantly lower than pre-intervention scores ($Md = 16$, $N = 12$); $z = -2.13$, $p = .83$. On Shift (parent form) scale, a paired samples t-test indicated that there was no significant difference between pre-intervention scores ($M = 17.36$; $SD = 4.1$) and post-intervention

scores ($M = 17.09$; $SD = 1.92$); [$t(10) = .24$, $p = .82$]. These results suggest that the skills associated with Shift did not improve as a result of the intervention, on either self-report or parent forms.

In terms of Emotional Control (self-report), a paired samples t-test indicated that there was no significant difference between pre-intervention scores ($M = 11$, $SD = 2.66$) and post-intervention scores ($M = 10.5$, $SD = 2.39$); [$t(11) = .78$, $p = .46$]. Similarly on the Emotional Control scale (parent form), a paired samples t-test also indicated no significant difference between pre-intervention scores ($M = 19$, $SD = 3.58$) and post-intervention scores ($M = 18.5$, $SD = 3.64$); [$t(10) = .92$, $p = .38$]. These results suggest that the skills associated with Emotional Control did not improve as a result of the intervention, from the perspective of either parents or children.

Based on the Shift and Emotional Control scales, each participant was given an Emotion Regulation Index score. The results from a paired samples t-test for both self-report and parent form are discussed here. On the self-report measure there was no significant difference between pre-intervention scores ($M = 26$, $SD = 5.12$) and post-intervention scores ($M = 25.83$, $SD = 4.47$); [$t(11) = .161$, $p = .88$]. The results for the parent form were similar as the test showed no significant difference between pre-intervention scores ($M = 36.36$, $SD = 6.89$) and post-intervention scores ($M = 35.64$, $SD = 5.01$); [$t(10) = .54$, $p = .6$]. These results suggest that the skills associated with the Emotional Regulation Index did not improve as a result of the intervention, on either self-report or parent forms.

The present study has presented the differences between pre and post-intervention measures of attention and emotional regulation. There will now be discussion of measures on the BRIEF-2 that relate to cognitive regulation: task-completion (self-report), working memory (self-report and parent form), plan/organise (self-report and parent form) and cognitive regulation index (self-report). As noted above, the BRIEF-2 is scored as a measure of Executive Dysfunction (meaning that higher scores represent lower levels of Executive Functioning on each scale). All data in this area met the assumptions for parametric assumptions.

In terms of Task-completion (self-report) the results of a paired samples t-test indicated that although there seemed to be a difference between pre-intervention scores ($M = 14.67, SD = 2.74$) and post-intervention scores ($M = 13.33, SD = 2.93$), this was not statistically significant; [$t(11) = 1.56, p = .15$]. Although this p statistic did not meet the alpha level for this study ($p = <.05$) it is still relatively close. This means that it is relatively likely that the intervention had some impact on task-completion skills. There was a small effect size of $d = .45$.

In terms of working memory, data were collected using a self-report and parent form. Results from a paired samples t-test indicated that there was a statistically significant difference between self-report scores pre-intervention ($M = 17, SD = 2.86$) and post-intervention ($M = 14.67, SD = 3.65$); [$t(11) = 2.67, p = .02$]. There was a medium effect size of $d = .77$. Results on the parent form for working memory were similar, as the paired samples t-test showed a statistically significant difference between pre-intervention scores ($M = 21, SD = 2.72$) and post-intervention scores ($M = 19.18, SD = 2.86$); [$t(10) = 2.4, p = .04$]. There was a medium effect size of $d = .72$. These results suggest that taking participation in the intervention, improved levels of working memory (as before, lower scores indicate a decrease in dysfunction).

In terms of the Plan/organise scale, these data were collected on the self-report and parent forms. Results from a paired samples t-test indicated a non-significant significant difference in self-report scores between pre-intervention ($M = 20, SD = 2.92$) and post-intervention ($M = 18.75, SD = 3.79$); [$t(11) = 2.07, p = .06$]. Although this p statistic did not meet the alpha level for the present study ($p = <.05$), it was approaching significance, indicating that the intervention may had some positive impact on Plan/organise skills (again, lower scores indicated a decrease in dysfunction). There was a medium effect size of $d = .6$. Results on the parent form for Plan/organise showed a statistically significant difference between pre-intervention scores ($M = 20.73, SD = 2.05$) and post-intervention scores ($M = 18.73, SD = 2.15$); [$t(10) = 3.96, p = <.01$]. There was a large effect size of $d = 1.2$.

An overall Cognitive Regulation Index score was calculated from self-report responses and the results from a paired samples t-test indicated that there was a statistically significant difference between pre-intervention scores ($M = 51.67, SD = 6.6$) and post-intervention scores ($M = 46.75, SD = 8.73$); [$t(11) = 2.78, p = .02$]. There was a large effect size of $d = .8$. As the Cognitive Regulation Index is a combination of three self-report scales (Task-completion, Working memory, Plan/organise) this finding added weight to the results on those individual scales, i.e. participation in the intervention improved levels of cognitive regulation according to self-report measures. When considering results from the self-report and parent forms together, there was a strong case to suggest that participants' levels of cognitive regulation improved as a result of this intervention.

Quantitative data in the current study suggest that there was good evidence for an improvement in two areas of Executive Function (Attention and cognitive regulation), but there was no statistically significant difference in post-intervention scores of emotion regulation. The results strongly suggested that there was an improvement in levels of selective attention (as measured by two subtests of the TEA-CH2). The results also strongly suggested an improvement in some of the Cognitive Regulation scales of the BRIEF-2. Notably, there were large effect sizes for the Cognitive Regulation Index (self-report) scale and for the Plan/organise (parent form). There was also a clear improvement in working memory scores on both the self-report form and the parent form. There was not strong evidence that participation improved levels of sustained attention or emotion regulation. The quantitative results of this study have been integrated with qualitative findings and in the context of other potential influencing factors. The results are placed in the context of wider literature related to this area.

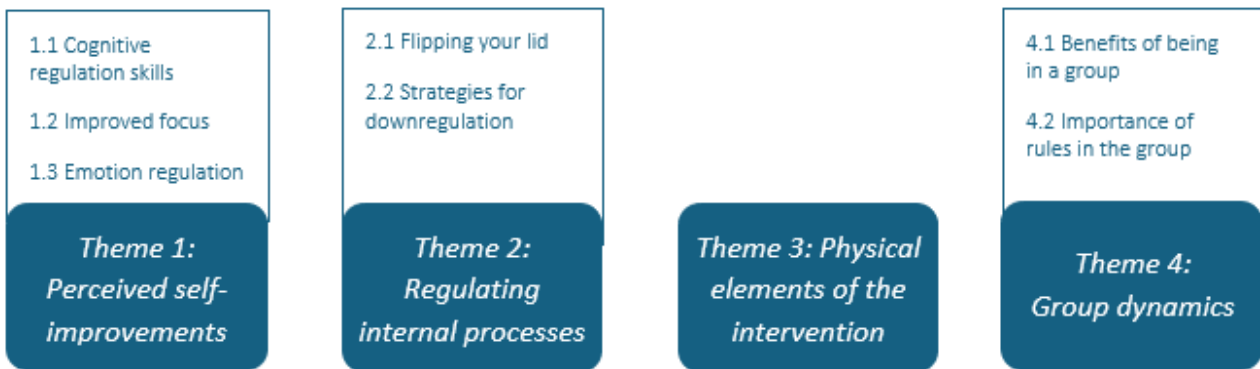
5.2 Qualitative data results

The reflexive thematic analysis used to analyse semi-structured interviews, with the aim of answering research question 2. The results are organised around the four overarching themes.

5.2.1 In what ways does a psychologically-informed bouldering intervention impact on how young people with identified needs relating to ADHD perceive their own levels of Executive function in three key areas? (RQ2)

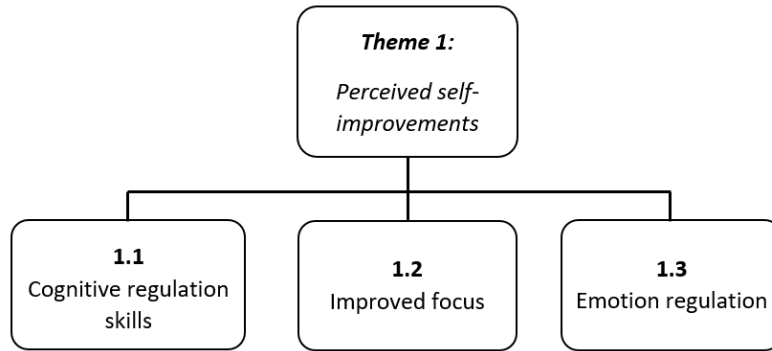
The qualitative analysis identified four overarching themes: (1) perceived self-improvements; (2) regulating internal processes; (3) physical elements of the intervention; and (4) group dynamics. A thematic map was constructed to represent visually each overarching theme and the associated subordinate themes (see figure 3 below). A summary table is presented for each overarching theme, detailing the number of participants referring to each subordinate theme and the number of times coded in total.

Figure 5 - Thematic map showing overarching and subordinate themes



Theme 1: Perceived self-improvements

This overarching theme represented participants' experiences of having noticed changes in the way that they were able to manage challenges in the school context and at home. The majority of participants spoke positively about the impact of participation in the intervention on at least one of the three areas of Executive Function examined in the present study. No participants expressed that they had experienced any negative changes after taking part in the intervention. They shared examples of difficult situations in school (e.g. needing to focus or feeling frustrated) where they were able to manage better than they might have previously.



The subordinate theme **Cognitive regulation skills (1.1)** comprised participants' descriptions of scenarios when they needed to hold in mind different components of a task (working memory) and when they could use planning strategies to support them towards completing a task successfully.

Some examples spoke specifically about the need for this skill during climbing:

Max: I would say it's made me a better multitasker because while I was climbing, I had to, like I had to climb, and I had to hold on whilst I was thinking of what I should do next, so I can climb further up to get to the top.

At different points during the intervention, participants were asked to draw prominent features of the specific climb that they were working on (e.g. handholds, footholds, other physical characteristics of the wall and the route). Participants labelled certain holds with directions (e.g. right hand or left foot). Some examples are included below (figure 4).

Figure 6 - example drawings of climbing routes



During the interviews, participants referred specifically to using this strategy or similar strategies, both during the intervention and in the school classroom:

Amir: Umm yeah cos, when we were... we had to like draw out the climbing wall and figure how we can get to the top in a certain number of moves.

Max: I would say that a perfect example of that is when we have notebooks and we're drawing out our steps so we can so we can get higher up the wall.

Ali: [at school] during my first tasks I'm just like having it maybe write it down or just having it in my head, so that kind of clears my thoughts, so I don't have to be so jumbled up.

Luca: In maths... if there's more than a one-step problem, I like plan it and then do it that way. Yeah, that helps me like section it off into little bits so that before I do it, I look at the task and the way that I'm gonna put it out, and then I'll just write it down.

Other participants spoke about the iterative cycle of planning, attempting, adjusting and retrying which has implications for problem-solving in other contexts:

Max.: so you climb down and then you look at what you did and you try and build on it to get to the next move and climb up.

The subordinate theme **Improved focus (1.2)** referred to participants' perceptions that they could focus (maintain attention) for longer periods of time, without becoming distracted, as a result of the intervention. They were asked what differences (if any) their close friends and family might notice in them:

Ivan: Well I would probably be more concentrated and focussed.

Marco: *[they would notice] my focus, because my focus changed a lot over the time of climbing so you'll probably notice my concentration.*

Max: *[My closest friend] would notice that I was a lot more focussed... like, usually I would just start something and then I would stop it because I've got too bored. But it's like I've got more discipline now.*

Some examples spoke specifically about focus (or attention) in the classroom setting:

Marco: *In classes that I don't like, I never used to focus and now I'm like focussing a bit more... engaging, writing more in my book, writing quicker or being more active.*

Kai: *When I was on the [wall], the first one that we ever did and I was at the top... I was really focussing on how to get down cos I didn't wanna fall down and hurt myself... now when I'm in lessons, it's like I'm doing work and focussing so I don't get in trouble.*

Other participants made their own associations between some of the calming strategies they were shown during the intervention and how they could be used to improve levels of focus (or attention):

Ali: *sometimes we wrote on paper and [talked about] different things that help us focus which are good. Like for example tensing your muscles, to kind of relax yourself [progressive muscle relaxation] or using the four-squared breathing [also known as box breathing]... there's so many things you can do to help yourself.*

The subordinate theme **Emotion Regulation (1.3)** encompasses multiple descriptions from participants of when they had been dealing with intense emotions (e.g. anger or frustration) and had been able to manage them more effectively:

Luca: *I've got better at like, managing my emotions and like calming down quicker.*

Leo: *I still get angry, but I don't get like that angry.*

Ali: *I've kind of changed... because basically, I know more how to control my anger now and I try to stay out of trouble and when I'm at home too.*

Other participants also referred to an improvement in emotion regulation at home:

Marco: *When my sister's annoying me I'm able to just walk away and ignore what she's getting angry about and then later like come back to it and say sorry. I'm able to go back to the scene and then fix it and instead of just leaving it and never talking about it again.*

One account referred to distraction as a positive strategy:

Ali: *In my head, it's like a lot of thoughts and emotions rushing through and it's like very hard... sometimes I have to be doing something, like playing a game. [When climbing] you're not thinking and you just wanna complete it so badly.*

Other participants gave examples of how elements of the intervention (breathing strategies) had supported them to move from an emotionally heightened state to a calmer state, while climbing:

Ivan: *I got up onto that big wall and I was like [Sharp inhale/gasp]... I looked down and it's like so big and scary... but when I stopped looking down and did some breathing, then it was easier.*

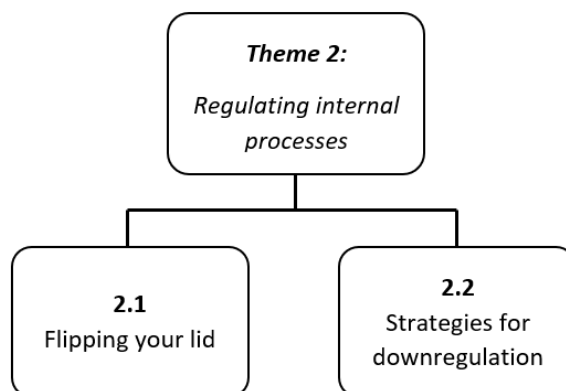
Table 7 - summary of Overarching theme 1: Perceived self-improvements

Subordinate theme	No. of participants referring to subtheme	No. of times coded	Individual extract example
1.1 Cognitive regulation skills	6	14	'I would say it's made me a better multitasker because while I was climbing, I had to, like I had to climb, and I had to hold on whilst I was thinking of what I should do next, so I can climb further up to get to the top (Max).'

1.2 Improved focus	9	19	'[Friends and family would notice]... my focus, because my focus changed a lot over the time of climbing so you'll probably notice my concentration (Marco).'
1.3 Emotion regulation	6	9	'I've kind of changed... because basically, I know more how to control my anger now and I try to stay out of trouble and when I'm at home too (Ali).'

Theme 2: Regulating internal processes

This overarching theme captured participants' accounts of having an improved understanding of how the body responds to stress and what types of skills or thoughts are more difficult in a heightened state (psychoeducation). It also included different examples of when participants had been able to use calming strategies that they were taught during the intervention to consciously exert control over their internal responses to stress.



The subordinate theme **Flipping your lid (2.1)** referred to multiple accounts of participants describing the Brain-hand model (Siegel & Bryson, 2012), which was discussed regularly during the intervention. This model was used as a child-friendly method of explaining how intense emotions can be overwhelming and can cause the 'thinking brain' (or prefrontal cortex) to go offline or become

restricted. After metaphorically 'flipping your lid' (becoming dysregulated), certain strategies can be used to bring the 'thinking brain' back online. Participants' accounts suggested this was an important aspect of their experience on the intervention and that they had been able to grasp the concept:

Max: When you flip the lid, you will not be calm anymore, you're angry, you can't understand reason anymore.

Other participants also spoke about the Brain-hand model (Siegel & Bryson, 2012) in relation to strong emotions:

Ali: you have to try and go like this (gestures hand open to closed), like from angry to like calm. When you cover your thumb, which is like the cause of your anger, there's always a cause to it... but when that's covered up you turn to calmness.

Arlo: You flip your lid when you're angry and like your emotions lose control, but if your lid's closed that's like your brain thinking.

Ivan: When you get angry it flips and then when you get calm it goes back.

The subordinate theme **Strategies for downregulation (2.2)** related to participants' descriptions of strategies that they were shown during the intervention which can help them to stay regulated or to calm them down when they become dysregulated. There were some overlap with subordinate theme 1.2. (Improved focus) as participants made the association between staying regulated and being able to focus for longer. A number of strategies for downregulation were described by participants, including progressive muscle relaxation:

Max: there's some exercises that you can do without anyone noticing, and you'll calm yourself down. There's this one where you progressively tense your muscles from your head to your toes, or your toes to your head whatever way you want.

Ali: *Like for example tensing your muscles, to kind of relax yourself.*

Finn: *One of them is tightening your muscles for a few seconds.*

Other participants spoke about breathing strategies they had learned to use:

Marco: *it helps me concentrate in class, because it calms me down if I do the breathing exercises that you taught me, and then I don't be silly in class [continued...]*

When I feel a bit upset I just do like the breathing and mind exercises in my room by myself.

Arlo: *We learnt methods to calm down and to breathe... like the one where you do the box breathing when we're in rock climbing.*

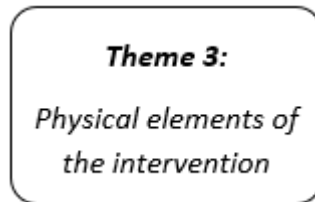
Ivan: *When I stopped looking down and did some breathing, then it was easier.*

Table 8 - summary of overarching theme 2: Regulating internal processes

Subordinate theme	No. of participants referring to subtheme	No. of times coded	Individual extract example
2.1 Flipping your lid	4	4	'You flip your lid when you're angry and like your emotions lose control, but if your lid's closed that's like your brain thinking (Arlo).'
2.2 Strategies for downregulation	10	30	'It helps me concentrate in class, because it calms me down if I do the breathing exercises that you taught me, and then I don't be silly in class [continued...] When I feel a bit upset I just do like the breathing and mind exercises in my room by myself (Marco).'

Theme 3: Physical elements of the intervention

This overarching theme was used to describe accounts from participants that referenced aspects of the intervention that required specific movements and physical activity. Ten out of the



eleven interviews referenced this as an important aspect of the intervention, and they made distinctions between different types of movement. One overarching theme (as opposed to additional subthemes) adequately represented the value of this theme within the interview data. Participants spoke about different styles and types of climbing (i.e. dynamic, overhang) and they spoke about climbing-specific skills that had helped them to progress as climbers. Each session of the intervention began with warm-ups and a range of balancing exercises/challenges. This seemed to be a significant part of the participants' experience.

Participants spoke about the need to be consciously aware of how they moved their body (body perception) in order to improve as a climber:

Luca: You have to manage your body [and] move your body around different places. When I was climbing, I used to think where I should put my hand and where I should put my leg... [I enjoyed] getting to be able to climb and learning how to position my body in different positions.

Participants also referred to specific climbing skills that they were shown by the coaches:

Arlo: We learnt rollovers (footwork), and we learnt to counterbalance as well.

Finn: They teach you how to do different moves to climb.

Bouldering consists of a number of different styled climbs or routes, mostly dependent on the angle of the wall or the size of the holds. The participants were introduced to concepts like dynamic and static climbing and were encouraged to notice different angles of the wall (e.g. overhanging or straight up). Their engagement with these ideas came through during the interviews:

Kai: There was this one [route] where there was an obstacle [volume], and you had to jump on one volume, put your back leg onto the other one, and then use the leg that you put on the volume first to do a dynamic move... then one where you have to go up and then kinda go underneath.

Participants also described the process of progressing and improving as climbers:

Luca: So there's one, two and three... [referring to climbing grades]...One is the easiest and six is the hardest, and you have to make your way up the wall and if you get to level six, you basically completed it.

Finn: Well I'm better at climbing... that'll be the main thing.

Participants recounted other elements of the intervention that involved physical activity but were not necessarily climbing-specific (e.g. balancing exercises and warm-ups that happened at the start of every session). This came up most often in response to the first question of the interview ("If you had to explain the climbing group that you have been a part of for six weeks to someone who hadn't heard of it before, what would you tell them?"). Participants spoke about the benefits of taking part in the balancing exercises and the improvements they had noticed after taking part in them:

Marco: I liked the balancing... it really catches your focus

Ivan: I liked balancing and balancing on one leg... now I can balance properly [and] balance better, because I practised moving my leg backwards, sideways, forwards. Now I can balance on both my legs better.

Participants described the importance of a warm-up before climbing:

Max: *you do some stretches and exercises, so you don't pull a muscle or anything*

Overarching theme	No. of participants referring to subtheme	No. of times coded	Individual extract examples
3. Physical elements of the intervention	10	46	'You have to manage your body [and] move your body around different places. When I was climbing, I used to think where I should put my hand and where I should put my leg... [I enjoyed] getting to be able to climb and learning how to position my body in different positions (Luca).'

Ali: *We made sure that we stretched ourselves so we [didn't] get injured.*

Some participants spoke about 'energy', in terms of being well-suited to the intervention:

Max: *So I think it is a good choice if you're... if you are someone who is very energetic, and you have a lot of energy... then this [the intervention] would be the perfect choice.*

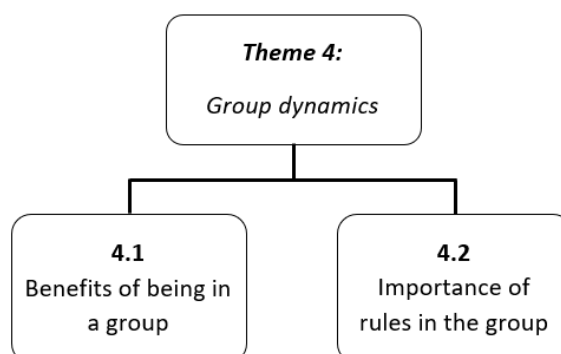
Another participant spoke about feeling energised as a result of taking part:

Marco: *I liked it because it boosted my energy a lot and then made me happy.*

Table 9 - summary of overarching theme 3: Physical elements of the intervention

Theme 4: Group dynamics

This overarching theme encapsulated participants' accounts of how they experienced the group aspects of this intervention. Informed by Polyvagal Theory (Porges, 2015) the present study has



positioned the social engagement system as a helpful way to practice downregulation from aroused states, using playful forms of physical activity in a group setting. It appears that participants also felt this was an important aspect of their experience as it came up a number of times during the interviews. They spoke about the benefits of being in a group and also the need for group processes and rules.

The subordinate theme **Benefits of being in a group (4.1)** described participants' accounts of having enjoyed and benefitted from the social aspect of the intervention:

Marco: I liked it because [...] I was able to interact with [named peers] and all of them... because I didn't really interact with them before, and they let me interact with them so that was nice.

Participants were asked to consider what their close friends and family might notice had changed about them as a result of the intervention:

Kai: Umm... that I can speak to new people more without getting shy. Yeah, cos normally every time I go somewhere new I'm always like (motioned hands in the air as if confused), for like the first few weeks and then after that I can enjoy it properly.

Participants also expressed that they had enjoyed climbing games that they could play in small groups or partners. One such game was named 'Add one':

[Researcher asked: What was your favourite aspect of this climbing group?...] (Max responded) I would say the team climbs where someone would start and they do one move... then the next person goes and they make another move.

[Researcher asks same question]... (Finn responded) We did different activities, like add one. I liked that.

The subordinate theme **Importance of rules in the group (4.2)** demonstrated that most participants shared the view that in order to benefit from this intervention, there needed to be rules in place to stop individuals from lessening their experience. One participant gave an example of when they had found group games frustrating:

Max: This is my personal [issue], but it was very hard because my friends, they made it so hard to reach [when playing add one] because I'm kind of short, and yeah... it made me very mad.

Other participants spoke about the negative impact of individual group members on their experience:

Ali: At the first few weeks, we had a few members who were running around, not listening or like, arguing... but by the end, this decreased, and everyone was listening. They knew it was our last few weeks, so they wanted to make it the best.

One participant suggested ways to manage this issue:

Max: instead of letting people mess around and then making the whole class wait, make them do something where you can time them and then keep them back for how much they wasted. So then other people don't get mad about having to wait.

Another participant spoke about group members getting used to the rules over time:

Luca: Some people might be a bit silly, but after a while, once they understand the rules, it gets easier for them to follow it and then we have more fun as well if we follow the rules, cos we get to do stuff quicker.

Table 10 - summary of overarching theme 4: Group dynamics

Subordinate theme	No. of participants referring to subtheme	No. of times coded	Individual extract examples
4.1 Benefits of being in a group	5	8	'I liked it because [...] I was able to interact with [named peers] and all of them... because I didn't really interact with them before, and they let me interact with them so that was nice (Marco).'
4.2 Importance of rules in the group	5	10	'Some people might be a bit silly, but after a while, once they understand the rules, it gets easier for them to follow it and then we have more fun as well if we follow the rules, cos we get to do stuff quicker (Luca).'

Having considered quantitative and qualitative data separately, the present study will now present an integration of findings, allowing for the development of meta-inferences from the data as a whole.

6. Discussion

The present study set out to explore whether a psychologically-informed bouldering intervention could improve levels of Executive Function in three key areas (attention, cognitive regulation, emotion regulation) for a group of year 7 and 8 students in an English mainstream secondary school. The study also aimed to elicit participants' perceptions of the nature of any impact and what elements of the intervention they felt had been most important.

The first key finding of the current study was that participation in the intervention was associated with an improvement in selective attention and quantitative analyses provided evidence of this on two separate measures. This finding was further strengthened by evidence from the qualitative analyses which suggested that participants had perceived an improvement in their attentional skills and that they had drawn upon specific aspects of the intervention. Interestingly, the quantitative analyses did not provide evidence for the hypothesis that this intervention would improve sustained attention.

The second key finding of the current study was that participation in the intervention was also associated with an improvement in cognitive regulation skills (working memory and planning). This finding was based on quantitative analyses of two respondents (self-report and parent form). The finding was further evidenced by qualitative analyses, suggesting that participants had perceived an improvement in their attentional skills and that they had drawn upon specific aspects of the intervention.

In terms of emotion regulation, the findings are less clear due to a discordance between quantitative and qualitative analyses. Participants perceived that they had improved in this area, but this did not align with quantitative analyses, where there was no significant improvement (full discussion of factors underlying this in section 9.2).

A final finding from this study emerged from qualitative analyses, with no explicit link to the quantitative data, although the current research will argue that this finding is implicitly linked to other

key findings. Participants felt that the shared values of the group during participation (e.g. boundaries and rules) was a relevant characteristic of the intervention and that all participants needed to engage with this in order for progress to be made. Further discussion of how this played out in the current intervention group and implications for other similar groups can be found in section 9.4.

The following sections will provide a more detailed integration of quantitative and qualitative findings, in relation to the conceptual framework underpinning the current study and relevant research and literature. This integration of findings is thought to be a crucial element of mixed methods research, as it allows for the development of meta-inferences, where the researcher draws separate conclusions from quantitative and qualitative inferences and then draws additional conclusions based on a combination of the two; (J. D. Creswell & J. W. Creswell, 2023). In order to facilitate this process, the current study employed the use of a 'Joint Display' at both the interpretation and reporting level (see figure 4 below). This enabled the researcher to examine the coherence (or the "fit) of the data, labelling each finding as either 'Confirmation', 'Expansion' or 'Discordance' (Fetters, Curry & J. W. Creswell 2013; Fetters & Tajima, 2022). Then follows discussion of the current study's strengths and limitations, implications for future research directions and implications for Educational Psychology practice.

Figure 7 - Joint display showing integration and coherence of quantitative and qualitative findings

FINDING	QUANTITATIVE FINDING (RQ1)	QUALITATIVE FINDING (RQ2)	COHERENCE	META-INFERENCES AND RELEVANT LITERATURE
ATTENTION	Statistically significant improvements observed on two measures of selective attention, with medium and high effect sizes.	Subordinate theme Improved focus (1.2) does not address specific types of attention but suggested that perceived levels of 'Focus' had improved.	Confirmation (selective attention)	<p>The present intervention showed promise in its potential to improve levels of attention for CYP with an ADHD-type presentation and this was supported by other research evidence suggesting climbing participation could improve levels of attention (Angelini et al., 2020; Frühauf, Heußner, Niedermeier & Kopp, 2021).</p> <p>This finding adds to growing and strong evidence that exercise and physical activity more generally can reduce the symptoms of ADHD (Cerrillo-Urbina et al., 2015; Medina et al., 2010; Ng et al., 2017; Verret et al., 2012; Xie et al., 2021).</p>
	No observed improvement in sustained attention.		Discordance (sustained attention)	<p>The intervention appeared to interact differently with selective and sustained attention, although participants did not make this distinction. This difference is hypothesised as reflecting the shorter nature of bouldering, as opposed to other forms of climbing that require concentration over a longer time period (Slattery, O'Callaghan, Ryan, Fortune & McAvinue 2022; Stien et al., 2019) Evidence supports the idea that longer forms of exercise that rely more heavily on cardiorespiratory fitness can improve sustained attention (Luque-Casado et al., 2016).</p>
EMOTION REGULATION	No observed improvement in emotion regulation skills.	<p>Subordinate theme Emotion regulation (1.3) suggested that some participants had noticed improvements in this skill. They gave examples of when they had successfully used strategies from the intervention to regulate emotions.</p> <p>Theme 2: Regulating internal process suggested that participants had remembered key psychoeducation information and had successfully used given regulation strategies.</p> <p>Subordinate theme Benefits of being in a group (4.1) indicated that participants enjoyed this aspect of the group (link to polyvagal theory).</p>	Discordance	<p>According to quantitative data the present intervention did not appear to improve emotion regulation skills for CYP with an ADHD-type presentation, although qualitative data hinted at an improvement on some level. The researcher explored this finding in terms of:</p> <ul style="list-style-type: none"> The impact of emotion beliefs on the measurement and use of emotion regulation strategies (De Castella et al., 2015; Ford & Gross, 2019; Kneeland, Dovidio, Joorman & Clark 2016; Kneeland, Nolen-Hoeksema, Dovidio, Gruber 2016; Schroder, Dawood, Yalch, Donnellan & Moser 2015). Key features of other successful intervention approaches that emphasised the therapeutic relationship, such as ELSA (Burton, Traill & Norgate 2009; Hills, 2016; Peters, 2020; Silver, Emanuel & Jones 2024) and The Rochester Resilience Project (Wyman et al., 2010). The lack of opportunities to experience and practice emotion regulation during the intervention, drawing on Polyvagal theory and the Social Engagement system (Porges, 2007, 2015), as well as research from social work training (Sewell, 2020), which emphasised experiential learning (Kolb, 1984, 2014; Schenck & Cruickshank, 2015).

<p>COGNITIVE REGULATION</p>	<p>Clear improvement across all cognitive regulation measures, with medium/large effect sizes.</p>	<p>Subordinate theme Cognitive regulation skills (1.1) showed that participants had noticed improvements in working memory/planning. They gave examples when they had successfully used strategies from the intervention.</p>	<p>Confirmation</p>	<p>The present intervention showed promise in its potential to improve cognitive regulation (working memory and planning) for CYP with an ADHD-type presentation. There was coherence between quantitative and qualitative findings which had a confirmatory relationship.</p> <p>This finding is supported by other research studies that used a ‘climbing only’ approach with similar populations (Angelini et al., 2020). The present researcher argued that the psychologically-informed elements of the current intervention may have enhanced this improvement. Other research supporting this finding, demonstrated that adolescent climbers could outperform non-climbers on tests of planning and problem-solving (Cascone et al., 2013).</p> <p>This finding also relates indirectly to correlational research exploring the cognitive abilities of elite climbers in terms of recall of climbing routes (Boschker et al., 2002), visual and motor memory (Marczak, Ginszt, Gawda, Berger & Majcher 2018; Medernach, Henz & Memmert 2023; Whitaker, Pointon, Tarampi & Rand 2020), cognitive planning (Sanchez et al., 2019). The present study go further than correlational findings and indicates a causal link between climbing and the development of cognitive regulation skills</p> <p>Findings in this area seem to be in contradiction of some research suggesting that cognitive skills in climbing are largely domain-specific (Heilmann, 2021). Consideration should be given to the transferability of skills.</p>
<p>IMPORTANT VALUES OF THE GROUP</p>	<p>The researcher proposes that observed quantitative improvements were influenced by key qualitative findings.</p>	<p>Subordinate theme Importance of rules in the group (4.2) indicated that group rules were an important part of participants’ experience of the intervention and observed improvements.</p> <p>Theme 3: Physical elements of the intervention – almost all participants referenced this as an important part of their experience (e.g. body awareness/perception, climbing-specific skills, balancing exercises).</p>	<p>N/A</p>	<p>Qualitative data from the present study suggested that group dynamics may have indirectly played an important role in the observed Executive Function improvements. The benefits of learning in a group were discussed in light of Self-determination theory (Ryan & Deci, 1985, 2000, 2017), with specific reference to relatedness.</p> <p>The importance of agreed-upon rules and values for the group was discussed as a measure to support the sensory processing of participants in a high-sensory environment (Panagiotidi, Overton & Stafford 2018; Pfeiffer, Daly, Nicholls & Gullo 2015; Scheerer et al., 2024).</p>

6.1 Attention: integration of findings

In terms of selective attention (conceptualised as the ability to attend to a specific stimulus or activity in the presence of other distracting stimuli), the quantitative and qualitative results in this study seemed to support one another, giving some support to the conclusion that this psychologically-informed bouldering intervention improved attention for children with symptoms associated with ADHD. However, during interviews, participants were asked to reflect on any changes they had noticed in their 'ability to focus on tasks in everyday life and in the classroom,' meaning that responses were not separated out into selective and sustained attention in the same way that quantitative measures were. Results from the measure of sustained attention (conceptualised as a function of selective attention skills, with the factor of time added), did not confirm the perceived improvements in attention that participants referred to. In terms of attention more generally, the intervention still shows some promise, and the current study will explore how the intervention interacted differently with different types of attention.

Although research into climbing as an intervention is somewhat limited (particular in terms of children and young people), the current study's finding is in line with those of other studies. Angelini et al. (2020) noticed improvements in attention (as measured by the Trail Making test; Tombaugh, 2004) for young people (aged 8-13 years) who took part in a community-based rock climbing program. Relating to an older population, Frühauf et al. (2021) explored the potential of Therapeutic Climbing (as an add-on treatment option for a variety of disorders) from the perspectives of 30 experts (10 pedagogues, 10 physicians and 10 psychologists). Due to the specific demands of climbing, experts in the study were of the opinion that it could lead to enhancements in attention and concentration.

The present study already established attentional control and regulation as a core component of mindfulness practices (see section 5.1). In light of this, research focusing on mindfulness practices has some relevance to this discussion of attention. In a recent scoping review exploring associations

between climbing and mental health (Hall et al., 2023) the authors asserted that during climbing, “focusing on the present moment is paramount to not falling off.” Some empirical evidence (Wheatley, 2021), suggested that state mindfulness increased significantly for participants who took part in a bouldering session, in comparison a control group who took part in strength and conditioning training. The conclusions of that study serve as evidence that rock climbing can increase state mindfulness and perhaps attention. The present study observed an improvement in attentional skills and there is evidence from research involving experienced climbers that attention is a necessary component of climbing performance (Garrido-Palomino et al., 2020).

While the present study focused on an intervention that involved climbing specifically, the findings add further evidence to the association between exercise and physical activity more generally and a reduction in symptoms of ADHD. The evidence supporting this association is compelling and supported by multiple meta-analyses (Cerrillo-Urbina et al., 2015; Ng et al., 2017; Xie et al., 2021). Similarly, Verret et al. (2012) found that moderate-to-vigorous exercise improved attention in children with ADHD and Medina et al. (2010) found moderately vigorous exercise was beneficial in the treatment of ADHD, both on its own and when combined with medication. Research in this area does not seem to capture the intensity or amount of physical activity needed to bring about improvements in attention. The present study observed improvements in a relatively short time, after six sessions, two hours in length and each a week apart. It is hoped that this can add something relevant to the limitation identified.

In terms of sustained attention, there was an apparent discordance between quantitative measures (which showed no significant improvement) and data from the interviews, in which participants had perceived an improvement in their focus. The author hypothesises that the shorter nature of bouldering, as compared to longer forms of rock climbing, may have influenced this difference in results. Slattery et al. (2022) suggested that physical activity likely targets sustained attention best when the activity requires focus to be continuously maintained on the goal-directed

stimuli. Indoor bouldering, as participants in the current study experienced, involves individual climbs of no more than 8-10 climbing moves. Other forms of climbing (e.g. sport climbing or top roping) consists of considerably more climbing moves and is performed up to higher walls (Stien et al., 2019). In other words, longer forms of climbing might require participants to use (and perhaps improve) sustained attention more regularly.

The physical requirements of bouldering vs longer forms of climbing have been explored in research. Stien et al. (2019) found that boulderers demonstrated higher maximal and explosive strength in all strength and power measurements. Additionally, the study by Angelini (2020) allowed participants to choose between bouldering and top roping. They measured the intensity of climbing for each participant using a measure of heart rate and found that those who chose to boulder more often, were working at a higher intensity. Given the physical differences discussed above, it also seems likely that the cardiovascular requirements of each type of climbing will also be different. This has relevance to the current study in light of evidence to suggest that there is likely a relationship between cardiorespiratory fitness (CRF) and sustained attention (Luque-Casado et al., 2016). Higher levels of CRF seems to be associated with be related to how effectively the heart is able to deliver oxygenated blood to brain structures (Colcombe & Kramer, 2003). It is not clear to what extent the duration of physical activity impacts on the interaction between selective and sustained attention. Medina et al. (2010) found that sustained attention showed improvements straight after physical activity, which was relatively short in duration (30 minutes on a treadmill). Further research is needed to answer this question more comprehensively.

6.2 Emotion regulation: integration of findings

In terms of emotion regulation, findings from the quantitative and qualitative arm of the present study appear to be in discordance with one another. Participants spoke about perceived improvements in their ability to regulate emotions during post-intervention interviews, but there was no statistically significant improvement on quantitative measures. Subordinate theme 1.3 Emotion

regulation, associated with overarching theme 1 (Perceived self-improvements) was coded nine times in total and by six different participants. Overarching theme 2 (Regulating internal processes; 2.1 flipping your lid; 2.2 strategies for downregulation), also seemed to be relevant in this finding. Although the qualitative findings indicate some level of improvement, the absence of a confirmatory relationship with quantitative findings suggests that the psychologically-informed bouldering intervention did not improve levels of emotion regulation in the same way as it appeared to improve attention and cognitive regulation skills (working memory and planning/organising). Drawing on relevant literature, this finding will be considered in light of two broad areas: beliefs about the malleability of emotion and specific elements of other successful emotion regulation interventions.

Firstly in terms of the malleability of emotion regulation, research suggests that beliefs about emotions play a significant role in the acquisition and employment of emotion regulation skills, as well as positive therapeutic outcomes (De Castella et al., 2015; Ford & Gross, 2019; Kneeland, Dovidio, et al., 2016; Kneeland, Nolen-Hoeksema, et al., 2016; Schroder et al., 2015). Ford and Gross (2019) reviewed literature that examined two fundamental beliefs about emotion, specifically whether emotions are perceived as good or bad and whether emotions are controllable or uncontrollable. They proposed that a belief that emotions are generally bad (i.e. undesirable, useless or harmful), could increase the likelihood of responses that aim to avoid feeling emotions. Furthermore, a belief that emotions are relatively uncontrollable could mean that individuals are less likely to identify an emotion as needing regulation and they are likely to consider fewer strategies.

The data collected in the present study focussed on emotion regulation skills, as opposed to emotion beliefs. Given that literature in this area suggests that emotion beliefs have an important role in responses to intervention, it is possible that this could be an unexplored factor that influenced the present study's findings. In other words, if participants and their parents held the belief that emotions are relatively uncontrollable and/or malleable they were less likely to have perceived any improvements as a result of the intervention.

There may also have been specific aspects or characteristics of the psychologically-informed bouldering intervention that did not target emotion regulation skills effectively enough. In other words, the quantitative measures were able to accurately identify that the intervention did not improve emotion regulation skills. Other successful intervention approaches provide some insight as to the mechanisms involved. One commonly used intervention in UK schools, is the Emotional Literacy Support Assistant ELSA (Emotional Literacy Support Assistant) intervention training. In this approach, teaching assistants take part in emotional literacy training, delivered over six days by an EP. Following training, ELSAs deliver intervention one-to-one with CYP, typically over a period of six to eight weeks. The ELSA programme began in 2001, and while the evidence base is relatively small, it is growing (Peters, 2020). An evaluation conducted by Burton et al. (2009) found an increase in emotional literacy teacher ratings and more recently Silver et al. (2024) provided some evidence for the supportive impact of ELSA on emotional literacy levels beyond a six-week interval time phase.

Hills (2016) focussed on primary-aged CYP who had received ELSA support in one local authority and the findings indicated that a number of factors contributed to its perceived effectiveness, including the importance of the therapeutic relationship with the ELSA teacher and having a space to talk and think about feelings. Peters (2020) used in-depth multiple case study design and semi-structured interviews to capture the views of secondary-aged CYP who had received ELSA intervention. Like Hills (2016), Peters' research also emphasised the importance of the ELSA-child relationship. Other successful intervention approaches (The Rochester Resilience Project) prioritised time at the beginning of the intervention for activities that established the 'Resilience mentor' as an empathic adult, who has an understanding of each individual child's life context, strengths and challenges (Wyman et al., 2010).

On reflection, the psychologically-informed bouldering intervention employed in the present study, was not able to replicate the same therapeutic relationship, that appears to have been integral to the success of other approaches. Participants were asked to take part in two emotion-related

activities that required them to reflect on their own personal experiences of emotion. It seems likely that in the absence of a secure therapeutic relationship, established over time in a one-to-one setting, participants may not have felt comfortable engaging to the extent that would have brought out a positive impact on emotion regulation skills. It also seems likely that participants (and their parents) did not make the association between rock climbing and emotion regulation in the same way that they thought about cognitive regulation (working memory and planning) in rock climbing. With that in mind, there was a difference in the amount of exposure. In other words, participants were asked to engage with only two activities relating specifically to emotions throughout the intervention, whereas time spent climbing made up a majority of each session.

During the design of the psychologically-informed bouldering intervention being evaluated in the present study, it was predicted that participants would have ample opportunity to practice emotion regulation skills as they would experience a safely managed fear of falling and the typically-associated physiological responses. It was hoped that by drawing on Polyvagal theory (Porges, 2007, 2015) participants would access their Social Engagement system (by virtue of climbing in a social group with trusted coaches) and practice the downregulation of their autonomic nervous system in response to fear. Given the inherent risk of falling that comes with all forms of rock climbing this made intuitive sense, but it is also supported by research evidence suggesting that climbing height can have a stimulating effect on catecholamine concentration (Baláš et al., 2017), metabolic stress (Gajdošík, Baláš & Draper, 2020) and plasma cortisol levels (Draper et al., 2012). However, the research in this area is heavily-biased towards top rope climbing or sport climbing, which typically involves much taller walls, ropes and safety harnesses. In the present study, participants did not verbalise or exhibit any behaviour that suggested they were experiencing a fear response during bouldering (save for one occasion). This lack of experiential learning has implications for the development of emotion regulation skills.

Sewell (2020) considered different pedagogical approaches to teaching emotion regulation skills in social work students and she emphasised the need for three interconnected approaches (cognitive, physiological and holistic). The present study employed some cognitive strategies (e.g. information sharing, reflection and discussion of examples), but it seems that in terms of emotion regulation, it was not able to draw upon some of the physiological practices suggested by Sewell, in particular drawing on experiential learning. Experiential learning involves a learning cycle of reflection, action, feeling and thinking (Kolb, 1984, 2014), which according to neuroscience can lead to deep learning (Schenck & Cruickshank, 2015). This kind of approach appears to be integral in other successful intervention approaches, such as ELSA, where CYP are able to use emotion regulation strategies in a school setting and review them with their supportive adult. Typically, ELSAs are in the same school and could be available to support the CYP during real-life opportunities to practice emotion regulation. In the psychologically-informed bouldering intervention however, this happened mostly in a cognitive and abstract manner.

Although emotion regulation did not improve quantitatively in the same way as it appeared to improve attention and cognitive regulation skills, it should be emphasised that during post-intervention interviews, participants did speak about improvements they had noticed in this area. Another possibility is that quantitative measures were not able to sufficiently capture this.

6.3 Cognitive regulation skills: integration of findings

The current study conceptualised and measured cognitive regulation skills in terms of Working memory and Planning. The quantitative data strongly indicated that participants' skills and perceived skills in this area had improved after taking part in the intervention. Quantitative effect sizes were medium/large (ranging from Cohen's $d = .45 - 1.2$) and participants referenced specific aspects of the intervention that they felt had supported this improvement to transfer into the school context.

Research exploring climbing effects for children and young people is relatively limited, but one such study had relevance for the current study's findings. The qualitative strand of the study conducted by Angelini et al. (2020) suggested that participants had improved in their ability to plan, set goals and problem solve. Participants in that study took part in eight, weekly climbing sessions each lasting for 60 minutes. After participation, all parents said they had noticed an improvement in cognitive regulation skills (as conceptualised by the current study). One parent said, "(their child) had learned how to problem solve and persevere during high stress situations, which were accomplished by looking at all possible solutions, staying calm and trying again." The current researcher posits that the explicitly taught strategies and psychologically-informed elements of the current intervention might have contributed to the stronger results. Another study, this time looking at adolescents, used an experimental measure of planning and aspects of problem solving (Tower of London test; L. H. Phillips et al., 2001), finding that adolescent climbers outperformed adolescent non-climbers (Cascone et al., 2013).

Most other evidence linking improvements in cognitive regulation and climbing has taken place in adult and elite climber populations. For example, Boschker et al. (2002) found that expert climbers outperformed novice and inexperienced climbers when they were challenged to recall information about 23 climbing holds on a wall (route finding). Similarly, Whitaker et al. (2020) found that a climber's level of expertise was positively associated with their visual memory and memory of planned and performed motor sequences. Again, Sanchez et al. (2019) found that cognitive planning and preparation for route climbing was predictive of sport climbing performance. Another study compared climbers and non-climbers and reported that neurocognitive indicators (including faster recognition and movement memory) were higher in climbers (Marczak et al., 2018). One study conducted by Medernach et al. (2023) found that elite boulderers showed superior memory ability when compared with advanced and intermediate boulderers.

The evidence strongly suggests that experienced climbers are likely to demonstrate increased levels of working memory and planning (cognitive regulation); however, the direction of causation is not securely established in this literature. In other words, it is not clear whether elite climbers are successful because of pre-existing cognitive regulation skills, or if they have developed these skills through the process of climbing participation. Having collected pre- and post-intervention measures, the current study goes some way to indicate a causal link, namely, climbing participation (in this case underpinned by psychologically-informed instruction) can improve working memory and planning for children and young people.

The findings of the current study seemingly contradict the findings of Heilmann (2021) who concluded that the superior cognitive skills of climbers were strongly domain-specific and did not translate into other laboratory tasks. Findings from the current study suggest that improvements in working memory and planning may have translated from the climbing wall into other settings (e.g., the classroom). This was evidenced by the quantitative data (behavioural self and parent reports that were not climbing-related) and qualitative data, in which participants discussed transferring skills explicitly.

6.4 Important values of the group

Another notable finding was related to the benefits of participants learning in a social group and the importance of group dynamics/values. This finding draws on evidence from the qualitative arm of the present study, but likely was an indirect factor in some of the quantitative results (e.g. through increased motivation and engagement). During post-intervention interviews, participants expressed an enjoyment of learning as part of a group, gave specific examples of group climbing activities that they valued and spoke about feeling socially more confident as a result of the intervention (see subordinate theme 4.1: Benefits of being in a group). Self-determination theory (Ryan & Deci, 1985, 2000, 2017) argues that intrinsic motivation is fuelled by a basic psychological need for feelings of autonomy, competency and relatedness. Of most relevance to the current

discussion, relatedness refers to the need to feel closeness and belonging to a social group with some shared values. In the context of the present study, participants were connected by a shared experience of bouldering together and this was underpinned by the contracting of group values, which started at the beginning of the intervention and was reviewed throughout. It is likely that feelings of relatedness contributed to the motivation and engagement of participants and were therefore contributed to some of the observed improvements in Executive Function skills.

During the post-intervention interviews, participants also spoke about the need for rules within the group dynamics (see subordinate theme 4.2 Importance of rules in the group). This again, was not measured directly, but was perhaps an important factor in some of the observed improvements in the present study. This is relevant because although estimates of comorbidity vary, research suggests that ADHD populations consistently demonstrate sensory processing difficulties (Panagiotidi et al., 2018; Pfeiffer et al., 2015; Scheerer et al., 2024) and participants in the present study were all experiencing difficulty with symptoms commonly associated with ADHD. The climbing venue where the intervention took place was a highly sensory environment (e.g. large open spaces, brightly coloured climbing walls, exercise equipment). Contracting of the group rules and the structure of the sessions may have supported participants to self-regulate their sensory experience.

6.5 Strengths and limitations of the current research

A key strength of the current study is the novel contribution that it makes to the wider literature on nonpharmacological interventions that support difficulties associated with ADHD. Other research that explored climbing as an intervention either did not incorporate psychological elements (Angelini et al., 2020; Mazzoni, Purves, Southward, Rhodes & Temple, 2009) or focussed on adult populations with mental health conditions in a therapeutic setting (Dorscht et al., 2019; Karg et al., 2020; Kleinstäuber et al., 2017; Luttenberger et al., 2015, 2022). To the researcher's knowledge, this is the first study to explore Rock Climbing (or bouldering) as a psychologically-informed approach to

the symptoms of ADHD in a young population and although the sample size was small, the findings are suggestive of a positive impact on some key areas of Executive Functioning.

Another key strength of the current study lies in its convergent mixed-methods design. The variety of quantitative and qualitative measures allowed for a more comprehensive understanding of the examined intervention and gave more compelling answers to the research questions. This was notable in the discussion section where findings from each arm of the study were integrated to provide meta-inferences, as recommended by J. D. Creswell and J. W. Creswell (2018, 2023). In both attention and cognitive regulation skills, positive quantitative results were strengthened by the existence of confirmatory qualitative evidence.

In the current study, the role of the researcher was all-encompassing, involving every aspect of the research, and this presented both advantages and disadvantages. Firstly, with prior experience of working with ADHD populations and training as a climbing instructor, the researcher was well-positioned to bring personal experience and knowledge to this specific topic. Secondly, in order for the psychologically-informed bouldering intervention to take place, potential schools were asked to make a financial commitment in the context of an 8% real-terms cut to public spending since 2010-11 (Institute for Fiscal Studies, 2023). The primary researcher met with individual school SENCOs and presented at a local authority SENCO network meeting to encourage interest in the project. It seems probable that the researcher's passion and commitment to this research area contributed to successful recruitment and financial commitment from the participating school. Finally in terms of advantages, it is argued that involvement in both intervention design and delivery increased intervention fidelity. In other words, it was ensured that all participants received the intervention in line with the key features described in section 6 of the current study.

As mentioned, the researcher's role also highlights certain limitations that could be attributed to the current study. Although specific research questions were not discussed at length with participants, it was heavily implied that the aim of the intervention was to improve certain cognitive

and emotional skills. Having developed a relationship with the primary researcher, it is likely that participants' post-intervention data was influenced by a social desirability bias (Grimm, 2010). In other words, responses to the BRIEF-2 (Gioia et al., 2015) and semi-structured interview questions could have been motivated by a desire to emphasise improvements for the benefit of the research, as opposed to giving a true reflection of perceived changes post-intervention.

The findings of the current study could have been strengthened significantly by the presence of a control group. There is strong consensus amongst researchers that a control group is essential in order to compare a treatment/intervention with existing practice (Malay & Chung, 2012). As there was no control group, the current study cannot claim to have controlled a number of possible confounding variables. For example, it could be claimed that improvements in Executive function may well be naturally occurring over a six week period and not necessarily a direct result of the current intervention. In addition, it is possible that only specific elements of the intervention were responsible for the observed improvements. If the current study had multiple control groups (e.g. climbing only, psychoeducation only) it would have been possible to comment on specific aspects of the intervention. This would have been a valuable insight in the process of improving and/or informing future intervention approaches.

In reference to emotion regulation and cognitive regulation, the current study relied on self-report and observational measures (i.e. questionnaires), which allow for the possibility of responder bias (Hendrickson & McCrimmon, 2019). In contrast, it could be argued that quantitative measures collected for attention (TEA-CH2; Manly et al., 2016) were more robust due to their experimental administration. The BRIEF-2 (Gioia et al., 2015), has three additional scales (inconsistency, negativity and infrequency), which allow the administrator to make quantifiable decisions about the reliability and validity of a participant's responses. Due to the time-limited nature of data collection, this was not included, and the researcher opted to focus on the scales of most relevance to the research questions. Had those been included, the impact of responder bias might have been minimised.

Findings relating to emotion regulation and cognitive regulation might have been stronger if the current study had successfully collected teacher responses on the BRIEF-2 (Gioia et al., 2015), as was the initial aim. As mentioned previously, difficulties associated with ADHD often present differently across various contexts (e.g. at home or in school). If teacher responses had been successfully collected, there would have been more opportunity for triangulation of results and the findings might have been more confidently applied to a school/classroom setting. Having provided school staff with the resources to collect this data, responses were returned either incomplete or too delayed to make any meaningful comparison with post-intervention data. In hindsight, the current study might have supported this process by taking a more active role in the collection of teacher responses. Additionally, given the time demands already placed on school staff, it may be worth considering that they are not necessarily in the best position to take on additional roles for data collection or other research roles.

Finally, the current research might have further explored individual differences as a factor in the impact of this intervention. For example, the sample consisted of only boys. While the findings are still of note, the current study was unable to explore differences in how other gender presentations would have interacted with this intervention. Research indicates that ADHD symptoms often present differently in girls for example (Attoe & Climie, 2023; Mowlem et al., 2019; Nussbaum, 2012) and so response to intervention may have been different.

Throughout this research study, the cultural identity of participants was not explored explicitly or implicitly. In order to protect the identity of participants, the choice of pseudonyms ensured that participants' own religious, cultural or ethnic background could not be deduced (Kaiser, 2009). However the cultural identity of participants may have been an important component of how they experienced the intervention. Researchers have highlighted the implicit power dynamic between the researcher and the participant during this pseudo naming process (Lahman, Thomas & Teman, 2023). An alternative approach, might have engaged participants in the selection of their own

pseudonym so they had some autonomy over the extent to which that name represented their identity (R. E. S. Allen & Wiles, 2016). The current study may also have considered the implications of gender in selecting pseudonyms, particularly in reference to transgender and gender-nonconforming people.

6.6 Implications for future research directions

Future directions of research in this area may wish to focus on some of the limitations previously identified. It would be of significant interest to see what differences might occur if the current study were to be replicated with non-male presenting participants, either separately or in mixed gender intervention groups. Additionally, future researchers should consider the use of experimental measures of Executive Functioning (as discussed in section four of the present study). As discussed in the previous section (6.5) a control group is widely considered to be an essential part of any study evaluating an intervention/treatment approach in comparison with standard practice (Malay & Chung, 2012). Future research should look to set up control groups by matching participant groups based on key characteristics. These control groups could be no-treatment/waitlist groups or specific aspects of the intervention could be examined more closely (e.g. climbing only group or psychoeducation only group).

The current study used a small sample size ($n = 12$) and therefore it has been acknowledged that findings are suggestive, although promising. Further exploration might expand the number of participants and therefore give a more robust and comprehensive evaluation of the intervention. Additionally, expansion of the research would expose increasing numbers of CYP with an ADHD presentation to a promising nonpharmacological approach to their symptoms.

6.7 Implications for Educational Psychology practice

As discussed previously EPs have a crucial role in the development of evidence-based intervention to a range of educational and mental health difficulties, including ADHD. Cameron (2006) argued this on the basis that EPs have the skills to effectively critique the evidence-base that supports any potential intervention. The current study proposes a nonpharmacological response to ADHD symptoms that EPs might wish to consider in their work with CYP. This feels particularly important given that many researchers and practitioners are noticing an over-reliance on pharmacological responses to ADHD (A. Allen & Hardy, 2013; Hill et al., 2022; Hill & Turner, 2016; J. Posner et al., 2020).

Recent survey data shows that participation in climbing has gained popularity in the UK. In 2023, approximately 376,000 people participated in climbing in England (Statista, 2024) which represent an increase of almost 100,00 on the previous years' statistics. This suggests that access to climbing may also be on the rise and EPs are more likely to be in a position to recommend this to the CYP that they work. EPs may also wish to consider the evidence presented in the current study that supports the use of other exercise/physiological responses to ADHD (see section 1.4).

Despite this rise in climbing participation, there is clearly a financial cost attached to climbing recreationally within an indoor facility and there was also a financial commitment required from the school who participated in the current study. It is important to consider how elements of the current intervention might be adapted for school settings, who may not be able to meet this financial commitment or perhaps they do not have a climbing facility within a reasonable distance. Many school settings have some form of equipment that can be used to replicate experiences on a climbing wall (e.g. outdoor climbing frames, mini climbing walls, obstacle courses, indoor gymnastics equipment). The current intervention operationalised climbing in three forms (self-directed, group games and instructional), all of which could be replicated on play/climbing equipment in schools. Children participating could be encouraged to plan/choreograph a sequence of movements (or a

'route') and to draw their sequence visually. Similar to the intervention evaluated in the current study, after each attempt, participants could go back to their visual plan and make changes.

In addition, elements of the intervention that were facilitated through group discussion (i.e. psychoeducation, emotional literacy, controlled breathwork) could be easily delivered within a school setting. All that is required is a quiet, low-sensory space for discussion and a facilitator who is able to communicate the content in an accessible way, whilst managing the group dynamic. As an example, this kind of intervention could be delivered by an Emotional literacy support assistant (ELSA) in a school setting. The cerebellar stimulation element of the current intervention (i.e. progressively more challenging discrete balance/coordination activities) requires little equipment and could also be delivered in school.

6.8 Conclusion

The current study explored the impact of a six-week psychologically-informed bouldering intervention on three key areas of Executive Function which are commonly associated with symptoms of ADHD: attention, emotion regulation and cognitive regulation. The results of the current study suggested that the intervention showed some promise in its ability to improve attention and cognitive regulation (working memory and planning) in a group of male students (aged 11-13) with identified needs relating to ADHD. In terms of emotion regulation, there were some tentative indications of improvement. Qualitative data suggested that participants' perceived competence had improved across all three areas of Executive Function. The study provided a unique contribution to the literature and has added to the range of nonpharmacological approaches that might be used to support this population of CYP. Findings provide support for further development of interventions that operationalise rock climbing alongside psychological approaches to support CYP with the symptoms of ADHD.

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Appendices

Appendix A: Participant information sheet

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Participant Information Sheet

A Psychotherapeutic Climbing intervention for young people with differences associated with ADHD: a controlled pilot study.

13th September – 18th October.

Who am I, and what is this project about?

My name is Sam Worth and I would like to invite you take part in a six-week climbing course, that aims to support young people with improved focus, working memory and management of emotion. Upon completion, you will understand the fundamentals of climbing so that you can challenge yourself, while climbing safely. This research forms part of my Doctorate training in Professional Educational, Child and Adolescent Psychology at the Institute of Education, University College London.

Why have I been invited?

You have been identified to take part in this research, because staff at your school believe you would benefit from the opportunity to develop a toolbox of skills to help with focus, working memory and management of emotion. You have also been invited, because we believe you can take those skills into the classroom and become an even better learner.

Do I have to take part?

No, it is up to you to decide. This document includes key information to support you in making a fully informed decision. You are free to withdraw at any time and will not be asked to provide a reason for withdrawal. If you do wish to withdraw or have some questions about the study at any point, please contact the researcher whose contact details are near the end of this document.

What will I be asked to do?

You will take part in a six-week climbing course at The Substation (Brixton) with five other students from your school. Your transport to and from the centre will be organised by your school. Each session will be two hours long and it will happen weekly, during school time. At the beginning of each session, we will meet to discuss and practise some techniques for improved focus, task planning and managing emotions. In this time, we will learn about our body and mind. We will learn some breathing techniques that help with focus and managing emotions. We will discuss different types of emotion and we will practise some strategies

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that help with complicated, multi-step tasks. We will discuss these techniques together in our group and you will be asked to practice some of them at home, and in school. Each week we will also work on improving our balance and we will spend plenty of time climbing.

On four different occasions, you will be asked to take part in some activities to explore your progress. This will happen at your school and the dates will be agreed closer to the time. These may be short, computerised games to explore your reaction time and attention, or questionnaires which will help us to assess how successful the climbing course could be for other young people. You could be asked to rate from 1-7 how much you agree with certain statements (1 = strongly disagree and 7 = strongly agree). For example: *I keep my emotions to myself*. Finally, you will be asked to take part in an interview and discuss your experiences (around one hour).

Are there any risks if I participate?

Climbing, like all sports, involves a risk of physical injury. Uncontrolled falls can result in injuries, and this is why you will be given a full safety induction during your first session on the course. You will always be supervised by qualified climbing instructors who are trained to keep you safe and having fun! When we are talking about emotions, you might be reminded of upsetting or difficult situations. If you don't want to talk about anything upsetting, you do not need to, and you can take a break if ever you need one.

Are there any advantages if I participate?

During this course you will learn some evidence-based psychological tools to support you with climbing and in other areas of your life. You will also be able to develop your climbing skill at whatever pace suits you best. This will hopefully empower you to live a physically and mentally healthier life.

What will happen with the data I provide?

Any personal data that is needed for this project will be stored on a password secured, encrypted OneDrive account, managed by UCL. Anonymised results from your assessments and recording of the interview will be stored securely for up to 10 years, when it will be destroyed.

What will happen to the results of the research study?

Once the research is completed, I will provide you with a summary of what the results suggest about this intervention and how it could support other young people, like yourself.

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There is a possibility that these results will be published in scientific journals at a later date, but this will not include any personal or identifiable data.

Data Protection Privacy Notice

The controller for this project will be University College London (UCL). The UCL Data Protection Officer provides oversight of UCL activities involving the processing of personal data and can be contacted at data-protection@ucl.ac.uk. This 'local' privacy notice sets out the information that applies to this particular study. Further information on how UCL uses participant information from research studies can be found in our 'general' privacy notice for participants in research studies [here](#).

The information that is required to be provided to participants under data protection legislation (GDPR and DPA 2018) is provided across both the 'local' and 'general' privacy notices. The lawful basis that will be used to process any personal data is: 'Public task' for personal data and 'Research purposes' for special category data.

Your personal data will be processed so long as it is required for the research project. If we are able to anonymise or pseudonymise the personal data you provide we will undertake this and will endeavour to minimise the processing of personal data wherever possible.

If you are concerned about how your personal data is being processed, or if you would like to contact us about your rights, please contact UCL in the first instance at dataprotection@ucl.ac.uk

Who do I contact if I would like further information?

Researcher:

Sam Worth

Trainee Educational Psychologist | Institute of Education, University College London

sam.worth.21@ucl.ac.uk

Supervisor 1:

Dr Katie Quy

Lecturer in Psychology | Admissions Tutor, BSc Social Sciences | Thomas Coram Research Unit
UCL Social Research Institute

k.quy@ucl.ac.uk

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Supervisor 2:

Dr Hester Riviere CPsychol

Educational Psychologist

The ATTACH team | Oxfordshire County Council

Hester.Riviere@Oxfordshire.gov.uk

Thankyou for taking the time to read this information sheet and consider your participation in the research study.

Appendix B: Participant Consent Form

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A Psychotherapeutic Climbing intervention for young people with differences associated with ADHD: a controlled pilot study.

Participant Consent Form

This consent form should be completed by participants together with their parent (or legal guardian) and returned to the researcher via email (sam.worth@21@ucl.ac.uk):

Please read each of the statements below, and tick the box to indicate your agreement:

- 1) I confirm that I have read and understood the participant information sheet, and have had the opportunity to consider the information, ask questions, and have had these questions adequately answered.
- 2) I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason.
- 3) In case I am asked to take part in an interview, I know that I can refuse to answer any or all of the questions and that I can withdraw from the interview at any point.
- 4) I agree for the interview to be recorded, and that recordings will be kept secure and destroyed at the end of this project or subsequent thesis project. I know that all data will be kept under the terms of the General Data Protection Regulation (GDPR).
- 5) I agree that small direct quotes may be used in reports and know that real names will be removed.
- 6) I understand that climbing is an activity with a risk of personal injury, and I agree to act responsibly towards other users of the centre.
- 7) I understand that I may lose my place as a participant in this pilot intervention if I act irresponsibly or put other users of the centre at risk.
- 8) I understand that in exceptional circumstances anonymity and confidentiality would have to be broken (e.g., if someone was suspected at risk of harm).

Name of participant:

Signature:

Date:

Name of parent:

Signature:

Date:

Name of researcher:

Signature:

Date:

sam.worth.21@ucl.ac.uk

Appendix C: Interview structure

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INTERVIEW STRUCTURE

Retention of intervention content:

1. If you had to explain the climbing group that you have been a part of for six weeks to someone who hadn't heard of it before, what would you tell them?
2. Can you remember any of the skills or tools that you learnt during the six weeks?

Self-perception of needs:

3. Do you think this group has made a difference to your ability to focus on tasks in everyday life and in the classroom?
4. Do you think this group has changed how easily you can remember different parts of a task while you're working on it?
5. Do you think this group has changed the way that you approach a new task? For example, making a plan that you refer back to and change if needed?
6. Do you think this group has changed the way that you express and manage strong emotions, like stress, frustration or worry?

Overall feedback on intervention and personal change:

7. What was your favourite aspect of this climbing group?
8. If you were in charge of this climbing group in the future, what would you change or add?
9. Think about your family, friends and teachers. If they noticed one thing that was different about you now (after taking part in this climbing group), what do you think they would notice?

Appendix D: Ethical approval

Ethics Approval

Wed 23/08/2023 11:26

Sam Worth - Ethics Approval...
Saved to OneDrive

Start reply with:

Dear Sam

I hope this email finds you well

Thank you for sending through your ethics application. I am pleased to attached your ethics approval letter.

This has been saved to your student file and I encourage you to save this to your research log.

I wish you all the best with your forthcoming research.

Best wishes

Programme Administrator | Centre for Doctoral Education |
IOE, UCL's Faculty of Education and Society | 20 Bedford Way | London | WC1H 0AL

Dear Sam

Thank you for sending in your ethics application.

I am writing to confirm that ethical approval has been granted by the UCL Institute of Education for your doctoral research project titled:

A Psychotherapeutic Climbing intervention for young people with differences associated with ADHD: a controlled pilot study

This ethical approval has been granted from 10th August 2023 and the document you provided has been saved to your student file.

Please can you also upload the approved ethics form to your UCL Research Student Log <https://researchlog.grad.ucl.ac.uk/>.

I wish you all the best for your forthcoming research.

Regards,

Programme Administrator | Centre for Doctoral Education |

Section 10 – Declaration

I confirm that to the best of my knowledge the information in this form is correct and that this is a full description of the ethical issues that may arise in the course of this project.

I have discussed the ethical issues relating to my research with my supervisor.

Yes No

I have attended the appropriate ethics training provided by my course.

Yes No

I confirm that to the best of my knowledge:

The above information is correct and that this is a full description of the ethics issues that may arise in the course of this project.

Name Sam Worth

Date 18/07/2023

Please submit your completed ethics forms to your supervisor for review.

Notes and references

Professional code of ethics

You should read and understand relevant ethics guidelines, for example:

[British Psychological Society](#) (2018) *Code of Ethics and Conduct*

Or

[British Educational Research Association](#) (2018) *Ethical Guidelines*

Or

[British Sociological Association](#) (2017) *Statement of Ethical Practice*

Please see the respective websites for these or later versions; direct links to the latest versions are available on the [Institute of Education Research Ethics website](#).

Disclosure and Barring Service checks

If you are planning to carry out research in regulated Education environments such as Schools, or if your research will bring you into contact with children and young people (under the age of 18), you will need to have a Disclosure and Barring Service (DBS) CHECK, before you start. The DBS was previously known as the Criminal Records Bureau (CRB). If you do not already hold a current DBS check, and have not registered with the DBS update service, you will need to obtain one through at IOE.

Ensure that you apply for the DBS check in plenty of time as will take around 4 weeks, though can take longer depending on the circumstances.

Further references

Robson, Colin (2011). *Real world research: a resource for social scientists and practitioner researchers* (3rd edition). Oxford: Blackwell.

This text has a helpful section on ethical considerations.

Alderson, P. and Morrow, V. (2011) *The Ethics of Research with Children and Young People: A Practical Handbook*. London: Sage.

This text has useful suggestions if you are conducting research with children and young people.

Wiles, R. (2013) *What are Qualitative Research Ethics?* Bloomsbury.

A useful and short text covering areas including informed consent, approaches to research ethics including examples of ethical dilemmas.

Departmental Use

If a project raises particularly challenging ethics issues, or a more detailed review would be appropriate, the supervisor must refer the application to the Research Development Administrator via email so that it can be submitted to the IOE Research Ethics Committee for consideration. A departmental research ethics coordinator or representative can advise you, either to support your review process, or help decide whether an application should be referred to the REC. If unsure please refer to the guidelines explaining when to refer the ethics application to the IOE Research Ethics Committee, posted on the committee's website.

Student name:

Student department:

Course:

Project Title:

Reviewer 1

Supervisor/first reviewer name: Katie Quy

Do you foresee any ethical difficulties with this research?

The applicant has carefully considered potential ethical issues which may arise, and put in place ways in which these can be mitigated.

Supervisor/first reviewer signature 

Doctoral student ethics application form Version 2.1
Last updated 02/12/20

Date: 7/6/23

Reviewer 2

Second reviewer name: Hester Riviere

Do you foresee any ethical difficulties with this research?

None not discussed above

Second reviewer signature: 

Date: 10.08.2023

Decision on behalf of reviewers

Approved

Approved subject to the following additional measures

Not approved for the reasons given below

Referred to the REC for review

Points to be noted by other reviewers and in report to REC:

Comments from reviewers for the applicant:

Once it is approved by both reviewers, students should submit their ethics application form to the Centre for Doctoral Education team: IOE.CDE@ucl.ac.uk.