

## DOCTORAL THESIS

### Executive Functions, Emotion Regulation and Mental Health Problems in Children and Adolescents

Fernandes, Blossom

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**Executive Functions, Emotion Regulation and Mental  
Health Problems in Children and Adolescents**

By

Blossom Fernandes, BSc (Hons), MSc

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Department of Psychology

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## **Abstract**

Executive functions (EF) are crucial for creativity, flexibility, self-control and discipline. A growing body of research distinguish EF by two processes; these include cool EF (abstract and decontextualised processes) and hot EF (affective and motivational decision making). Emotion regulation (ER) is important for maintaining internal arousal, allowing for flexible affective expression where necessary. Research shows that EF and ER are closely related, yet literature measuring the relationship between EF and specific ER strategies is limited.

The first study therefore sought to determine the distinct nature of cool and hot EF and its relationship to ER using a cross sectional design approach. Children (7-11 years), adolescents (12-17 years) and young adults (18-24 years) participated in the first study ( $n = 250$ ). This study also examined how EF and ER are associated to behavioural and emotional difficulties. The results from this study show that hot EF scores were poor for adolescents compared to young adults. These findings were similar for emotion regulation strategies, where adolescents were less likely to employ adaptive emotion regulation skills compared to older participants. Moreover cool EF was found to be positively correlated with adaptive ER in adolescence, whereas hot EF positively correlated with adaptive ER strategies in young adults.

For the final study, the impact of a cognitive behavioural therapy based intervention programme (“Super Skills for Life”; Essau et al., 2014) was tested in a sample of 41 children with behavioural and emotional difficulties to assess whether

EF and emotion regulation strategies could be improved, and reduce emotional and behavioural problems. Results revealed a reduction in emotional difficulties, and maladaptive ER strategies catastrophising and other blame; however no significant improvements were found for hot EF and behavioural difficulties, suggesting that an alternative or rigorous programme would be beneficial in improving hot EF.

Overall the present studies indicate that there is a relationship between EF and distinct emotion regulation strategies in different age groups and how this is implicated in behavioural and emotional problems. Secondly the intervention study showed that the Super Skills Programme was successful in reducing maladaptive ER and improving cool EF. This research highlights the need for examining EF and ER further in clinical populations and the effectiveness of this intervention in a larger sample.

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## **Introduction**

*'All information processing is emotional... emotion is the energy that drives, organises, amplifies and attenuates cognitive activity'*

Kenneth Dodge (1991)

## **Overview of thesis**

The current thesis will examine the relationship between executive functions, emotion regulation strategies, and emotional and behavioural problems, with the additional aim of examining developmental differences between children, adolescents and young adults, specifically focusing on children and adolescents.

Executive functions (EF) also known as cognitive control is often characterised as having three core processes; these include working memory, inhibition and cognitive flexibility; studies continuously report these core process as underlying EF (Davidson, Amso, Anderson, & Diamond, 2006; Miyake et al., 2000). Inhibitory control is the ability to resist a dominant response where appropriate,

allowing individuals to sustain and focus their attention where necessary. Working memory which is often referred to in literature as updating information is the ability to hold or maintain information, and manipulate this information. Finally cognitive flexibility or set shifting allows individuals to switch between task demands and hold information in mind at the same time. These are a set of top down neurocognitive processes activated during the conscious control of thought and action. This is an important area of study, as these functions are crucial for typical development from infancy and predicts outcomes in later life (Best, Miller, & Jones, 2010; Brock, Rimm-Kaufman, Nathanson, & Grimm, 2009; Hooper, Luciana, Conklin, & Yarger, 2004; Zelazo & Carlson, 2012).

Traditionally EF has been measured using abstract and decontextualized tasks, lacking in motivational and emotional salience (Hongwanishkul & Happaney, 2010; Zelazo & Carlson, 2012). Zelazo and Muller (2002) deemed the more abstract processes as ‘cool’ cognitive features, whereas the motivational and affect processing was considered ‘hot’ EF which also demands top down processing. Hot EF is activated during situations involving reward processing and emotional significance. Neuroimaging has shown activation of each area during hot and cool EF tasks, where the construct of hot EF is supported by the ventromedial prefrontal cortex and cool EF is mediated by the dorsolateral prefrontal cortex (Bechara, 2004; Hongwanishkul & Happaney, 2010; Zelazo & Muller, 2002).

Studies show that children as young as three years old are more likely to choose larger more delayed rewards compared to smaller more immediate rewards, however when asked to choose for themselves they are more likely to select immediate rewards compared to four year olds (Prencipe & Zelazo, 2005). Carlson,

Davis and Leach (2005) found that on cool aspects (i.e., abstract representations of the same task) three year olds performance greatly improved. Prencipe and Zelazo (2005) argue that as a result of emotional demands placed by hot EF, hot EF develops slowly compared to cool EF. Hooper et al. (2004) report age related improvements in cool and hot EF, however adolescents performed better than children on hot EF tasks. The results of hot and cool EF tasks has not been found to be correlated suggesting they develop separately as distinct constructs (Prencipe & Zelazo, 2005).

When emotional processing is solely engaged in daily activities, this is considered emotion regulation; this processing of emotion further then influences behavioural changes (Cole, Martin & Dennis, 2004; Gross, 1998). Focusing on aspects of ER such as suppression and reappraisal alone, Gullone and colleagues (2009) found age related differences for participants aged between 9-15 year olds, where adolescents were better at suppression compared to children but exhibited low levels of reappraisal. Zelazo and Cunningham (2007) suggest that ER and EF are closely related; they referred to this as deliberate self-regulation of emotion when the primary goal is at hand, characteristics of EF and ER here becomes less distinct. Detailed description of Zelazo and Cunningham's (2007) theory along with characterisations of EF and ER are explained further in detail in chapter 1.

Impairment in EFs are strongly associated with childhood neurodevelopmental disorders such as attention deficit hyperactivity disorder (ADHD) (Barkley, 1997; Castellanos & Tannock, 2002; Scheres et al., 2006; Sonuga-Barke & Halperin, 2010). ADHD, which is highly comorbid with other behavioural disorders such as conduct problems and oppositional defiant disorder

has been related to deficits in cool EF; however conduct problems alone have also been linked to hot EF (Dolan & Lennox, 2013; Hobson, Scott, & Rubia, 2011). Thus far only cool EF has been associated with internalising difficulties such as depression and anxiety (Andreotti et al., 2013; Roiser, & Sahakian, 2013). Research also shows that emotion regulation is greatly impaired in these group of individuals, further influencing outcomes in later life (Walcott & Landau, 2004; Wheeler Maedgen & Carlson, 2000). Interventions aimed at children with emotional and behavioural disorders have focused on outcomes of EF (Blakey & Carroll, 2015; Treble-barna, Sohlberg, Harn, & Wade, 2015) and ER (Kovacs et al., 2006) individually. More recently however studies show that cognitive behavioural therapy (CBT) has positive impact on both EF and ER (Aldao, Jazaieri, Goldin, & Gross, 2014; Mohlman & Gorman, 2005). Chapter 2 focuses on literature on interventions aimed at EF, ER and the benefits of CBT.

## **Objectives**

The present PhD thesis is comprised of two independent studies; with the findings from the first study being examined in two parts. The main aim of study 1, part I was to investigate the developmental trajectories of hot and cool EF and specific ER strategies in children, adolescents and young adults. As very few studies have focused on the relationship between hot and cool EF and ER, this relationship was studied further in the three different age groups mentioned above (see chapter 4). Study 1 part II was an investigation exploring EF and ER links to behavioural and emotional difficulties (specific aims related to this are outlined in chapter 5).

Following on from the results of the first study, the second study was conducted to examine the impact of a CBT-based programme called Super Skills for

Life (Essau et al., 2014) on EF and ER. This programme was aimed at primary school children, aged between 7-11 years. School teachers referred children with behavioural and emotional difficulties to participate this open trial study (this is detailed further in chapter 6).

# **Chapter 1: Executive functions and emotion regulation**

## **1. Executive Function**

Early neuropsychological studies in adults with frontal lobe damage found intact sensory processing, motor movements, speech and in some cases intelligence, all the while reporting deficits in cognition, emotion and behaviour (Fuster 1991; Stuss & Benson, 1984; Goldman-Rakic, 1995). The overall coordinated cognitive functions of the frontal lobe working together are now considered executive functions (EF). Most prominently defined by Baddeley and Hitch (1974) as “central executive”, which controls and regulates cognitive processes. Lezak (1983) later described EF as an aspect that deals with the ‘how’ of human behaviour; conceptualising executive function as having four main components which consist of goal formation, planning, carrying out these plans and finally effective performance.

Importance of EF can be highlighted in other areas of daily life i.e., during emotional and effortful control (Gonzalez, Fuentes, Carranza & Estevez, 2001)

which has been linked to inhibition deficits and adolescent risk taking behaviours (Eigsti et al., 2006). EF has also been found to be implicated in school performance (Blair and Razza, 2007; Bull & Scerif, 2001) and those with attention and behavioural problems (Friedman et al., 2007; Wilcutt, Doyle, Nigg, Faraone & Pennington, 2005). Jurrado and Rosseli's (2007) meta-analysis suggests the main components of executive functions include set shifting, an ability to switch between response sets rapidly; attentional control, consisting of selective attention, sustained attention and response inhibition. Planning is also considered an executive mechanism whereby a goal is identified, followed by necessary steps are taken to achieve it (Lezak, Howieson, & Loring, 2004), along with verbal fluency i.e., conditions in which words are reiterated that belong to the same category (semantic) or words that belong to the same alphabet (phonemic). Jurrado and Rosseli devised a list of definitions extracted from EF literature (see Table 1), indicating a lack of clarity in explaining the concept of executive function whilst highlighting the importance of it in behaviour.



Table 1. 1

Concepts and components of executive function (Jurado & Rosselli, 2007)<sup>1</sup>.

| Author                     | Concepts and/or components of executive functions   |
|----------------------------|---|
| Lezak (1983)               | Volition, planning, purposive action, effective performance   |
| Baddeley and Hitch (1974)  | Central executive, phonological loop, visual-spatial sketchpad  |
| Norman and Shallice (1986) | Supervisory attentional system  |
| Lafleche and Albert (1995) | Concurrent manipulation of information: cognitive flexibility, concept formation, cue-directed behaviour                          |
| Borkowsky and Burke (1996) | Task analysis, strategy control, strategy monitoring  |
| Anderson et al. (2001)     | Attentional control, cognitive flexibility, goal setting  |
| Delis et al. (2001)        | Flexibility of thinking, inhibition, problem-solving, planning, impulse control, concept formation, abstract thinking, creativity |
| Hobson and Leeds (2001)    | Planning, initiation, preservation and alteration of goal-directed behaviour  |
| Piguet et al. (2002)       | Concept formation, reasoning, cognitive flexibility   |
| Elliot (2003)              | Solving novel problems, modifying behaviour in light of new information, generating strategies, sequencing complex actions        |
| Banich (2004)              | Purposeful and coordinated organization of behaviour. Reflection and analysis of the success of the strategies employed.          |

<sup>1</sup> Jurado, M. B., & Rosselli, M. (2007). The elusive nature of executive functions: a review of our current understanding. *Neuropsychology review*, 17(3), 213-233.

### **1. 1. 1. Functions of executive processes**

Prominent literature shows that EF has been conceptualised by three main functions which include working memory, inhibition and cognitive flexibility (Diamond et al., 2013; Miyake, Friedman, Emerson, Witzki & Howerter, 2000).

### **1. 1. 2. Working Memory**

Working memory is one of the key processes involved in EF where information not perceptually present can be held and mentally manipulated (Baddeley & Hitch, 1974) and this heavily influences our decisions. Baddeley (1998) proposed that the multiple executive functions work simultaneously to support their model of working memory, however in this model executive functions serves to only co-ordinate the operation of the working memory's model to two main systems which is the phonological loop and the visuo-spatial sketchpad. Funahashi (2001) argues that working memory is a mechanism for manipulating and processing information, and for working memory to function as part of EF it needs to be able to access and process stored material, and provide information to other neuronal systems.

Working memory links to EF has been further established by Bull and Scerif (2001), their findings show that poor performance on the Wisconsin card sorting task was associated to lower mathematical skills and deficits in working memory and inhibition. This supports findings of working memory links to attention, whereby poor performance on working memory test and slower processing speed predicted increased rates of inattention and hyperactive/impulsive behaviour in children (Mulder, Pitchford & Marlow, 2011). This suggests that there appears to be a working memory relationship with inhibition, as the ability to maintain information

accurately and rapidly is important, particularly in situations that could be distracting. This depends on cognitive rather than behavioural inhibition (Reddick, Calvo, Gay & Engle, 2011).

### **1. 1. 3. Inhibitory Control**

Another major aspect of EF is inhibitory control (Diamond, 2012; Miyake et al., 2000) which enables control over attention, behaviour and emotional responses. Diamond (2012) argues that controlling attention to override impulses allows for appropriate actions. Functions of working memory and inhibition are considered to be independent aspects of EF (Anderson and Spellman, 1995; Diamond, 2002) yet Miyake et al. (2000) found that they were closely related during task performance. Inhibitory control has been found to be particularly difficult for children, a study looking at age differences on performance of inhibition tasks found adults to have significantly better scores compared to children and adolescents (Davidson, Amso, Anderson & Diamond, 2006). Davidson et al. (2006) report that performance of participants aged between 6-13 years did not differ on these tasks of inhibition.

Although there exists different forms of inhibitory control i.e., inhibition of attention and inhibition of action, this is especially the case when children have to exert self-control in class and then swiftly move over to using self-control to inhibit a response when solving a mathematical problem (Muraven, 2010). Diamond and Lee's (2011) findings suggest that this form of self-control could be dissociated from delay of gratification as their results show that children performed well on executive tasks, with no differences found on delay of gratification tasks. Similarly Berkman, Graham and Fisher's (2012) review claims that the 'domain general' model allows for self-control to be used in various situations and is drawn from a unitary resource;

these authors argued that studies need to consider whether performance of self-control is affected in unrelated domains such as academic, inter-personal and socio-emotional situations.

#### **1. 1. 4. Cognitive Flexibility**

Cognitive flexibility or set shifting is considered another essential component of EF, this is believed to be an ability to shift between various tasks and mental states including the ability to alter perception and view information from a spatially independent standpoint (Garon et al., 2008). Set shifting also requires the competence to switch attention when presented with a certain group of stimulus, for example the Wisconsin card sorting task which is widely used to test set shifting requires participants to sort cards based on the type of colour, number of shapes and type of shapes (Konishi et al., 1999; Stuss et al., 2000). Funahashi (2001) suggests that this aspect of executive control is also linked to inhibition and control of behavioural responses, as the same neural regions in the pre-frontal cortex are also implicated during these processes.

Set shifting tasks measuring cognitive flexibility requires withholding a dominant response and then maintaining it throughout the task, this becomes even more difficult when rules change and the task demands expression of previously withheld response. This effect can be identified on the Stroop test which requires the ability to switch from naming the word to naming the colour (Davidson et al., 2006). This is particularly the case where inhibiting a response is necessary when altering perception, which further taxes working memory (Diamond et al., 2013). Diamond (2005) proposes an 'all or nothing' principle where a dominant response can be inhibited; i.e., performance of not switching anything is better compared to when

having to switch everything. Davidson et al. (2006) found that even 4-8 year old children were faster on non-switch trials where the response required was the same throughout trials; however they found that switching did affect overall speed and accuracy.

### **1. 1. 5. Measures of Executive Function**

Early studies have mainly assessed EF in participants exhibiting deficits in the frontal lobe, therefore common EF test batteries are tasks based on outcomes that point towards processing abilities and capacity, For example the behaviour rating inventory of executive function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000) is a 63 item scale that measures self-control, flexibility, working memory and emotional control. Similarly tasks such as the Cambridge neuropsychological test battery (CAMCOG; Huppert et al., 1995) and the Delis-Kaplan executive function system (D-KEFS; Delis et al., 2001) have been used to measure sensitivity to frontal lobe damage in children and adults. Jurrado and Rosselli (2007) argue that limitations such as lack of ecological validity, fails to transpire into real life experiences of participants and overall scores fail to include planning and reasoning i.e., accuracy and strategy on task. Miyake et al. (2000) argue that assessments such as these fail to link performance of task to precise nature of EF. Also there are few tests that include affective and motivationally significant components.

Complex tasks for EF tend to have low reliability scores; one main reason for this could be that individuals tend to adopt different strategies on each task, or within a test battery (Rabbitt, 1997). Miyake et al. (2000) suggest that novelty is crucial in executive processes as repeated encounters could reduce the tasks effectiveness in targeting executive processes. More importantly as a result of task impurity, some

EF tasks are likely to tap into other cognitive functions that may not be related to the targeted executive function. Miyake et al. argue that low scores on these does not usually mean impaired or inefficient executive functioning.

## **1. 2. Hot and Cool Executive Function**

When tested on the three main executive functions; which included set shifting, working memory ‘updating’ and inhibition, results show that they operate in different domains (Miyake et al., 2000). EF Literature shows that studies measuring executive process indicates that overall EF components are distinct in that they operate separately but are yet unitary process with shared commonalities (Garavan, Ross, Murphy, Roche & Stein, 2002; Carlson, Moses & Bretton, 2002). This sees EF as a top down mental processes that mediate goal directed thought or action, however when tested on a delay of gratification task children who displayed a greater control over delayed gratification task were found to have better self-control, concentration, and were socially competent according to their parents (Mischel, Shoda & Rodriguez, 1989). Zelazo and Carlson (2012) claim that this is an important characteristic of childhood executive process, however until then studies of EF have mainly been investigated using abstract tasks, whilst lacking in motivational and affective significance (Zelazo & Muller, 2002).

Based on lateral brain processing Zelazo and Muller recognised that EF operates in different contexts, they proposed that EF which is characterised by more purely cognitive processes such as working memory, attention, inhibition and set shifting is recognised as cool EF and is mediated by the dorsolateral prefrontal cortex of the brain region. This area is mainly responsible for abstract problem solving i.e., sorting of cards on the WCT or planning and selecting the right moves

on tower of Hanoi task. Whereas hot EF is mediated in the ventromedial prefrontal cortex, capturing the affective aspect of EF and is dominant in motivational and emotional processing. Studies using tests for risky decision making, gambling (Bechara, 2004) and delay discounting (Barkeley, Edwards, Laneri, Fletcher & Metevia, 2001) are considered measures for Hot EF.

Hot EF is considered to be engaged as a result of ventromedial prefrontal cortex activation, since impairments in this region has been found to be indicative of deficits in emotional and social decision making. Particularly when tested on the Iowa gambling task (IGT; Bechara et al., 1994) performance on decision making aspect was poor even though performance on working memory and cognitive flexibility remained intact in adults (Bechara, Dmasio, Tranel & Anderson, 1998). For example when individuals are required to control their impulses when presented with uncertain rewards, those with intact hot EF are able to control these impulses, but this also means that cool EF will be engaged as problem solving processes are involved; As noted by Brand, Recknor, Grabenhorst and Bechara (2007) only during the last trials of the IGT, scores correlated with (cool) executive function tasks.

Studies on hot and cool EF in children have shown that when tested on 'cool' EF tasks, children between 5-8 years were able to perform effectively on complex tasks, and that this ability improved during adolescence and early adulthood (Best, Miller & Naglieri, 2011). Hot EF also emerges during pre-school years (Kerr & Zelazo; 2004) but young adults are shown to make less risky choices and display better emotional processing compared to adolescents and children (Eshel et al., 2007). However research looking into the distinct developmental trajectories of EF

using tests for both hot and cool EF by means of behavioural measures is limited (Prencipe, et al., 2011).

Prior to the hot and cool EF model, Metcalfe and Mischel (1998) suggested two separate mechanisms, one that included an emotional processing system known as the hot 'go' response and the cognitive 'cool-know' system. The cool-know system was lacking in affective significance and was considered to be slow in developing. According to this model, delayed development of cool-system means that hot 'go' process are distinct and occurs automatically, Metcalfe and Mischel claimed that self-regulatory processes mediated by the cool system likely predicted academic scores. This hot 'go' and cool-know systems framework however failed to consider hot system as part of EF but rather sees it as a bottom up emotional influence on behaviour. However previous findings reveal hot EF operates differently and in motivationally significant context that demand top-down processing (Zelazo & Carlson, 2012) and this is further supported by neuro-imaging studies (Li et al., 2010; Bechara, Damasio, Tranel & Damasio, 1997).

### **1. 2.1. Neuro-imaging evidence**

Based on early neuropsychological findings the prefrontal cortex (PFC) region has been found to be crucial to planning, organisation and regulation of human cognition and behaviour (e.g., Luria, 1973). This finding has been further supported by lesion (Stuss et al., 2000), neuro-imaging and primate studies (Konishi et al., 1998). The PFC has furthermore been associated with providing goal directed and attention based control such as selecting, sustaining and dividing attention, working memory, and inhibitory control (Fuster, 2001).



The medial prefrontal cortex is directly connected to processes that manage memory, emotional/affective processing and higher order sensory processing; whilst the lateral prefrontal cortex is connected to other regions to control cognitive processes, these two regions are interconnected for information to be exchanged and integrated into sections of the prefrontal cortex (Wood & Grafman, 2003). To add further support to this, Grossman's (2013) review looking at infant neural development found that studies demonstrate medial prefrontal cortex links to affective processes, but when tested for attention and working memory the lateral prefrontal cortex is activated. This is also supported by research investigating prefrontal cortex processing during childhood (Zelazo & Muller, 2002) and in adults (Fuster, 2001). Grossman et al. (2013) argues that although much of research into the prefrontal cortex is carried out during childhood this is evidence that PFC emerges during infancy, but continues to develop during childhood and adolescence (Zelazo and Muller, 2002).

Within the PFC, recent studies demonstrate that cool EF is modulated in the dorsolateral networks in both children and adult populations; other areas such as the temporal and parietal cortical areas have also been found to be interconnected whilst being activated during cool tasks (Arnsten & Rubia, 2012). This is further supported by Li et al's. (2010) findings where similar regions were engaged for working memory; however during the IGT (Bechara, Damasio, Damasio & Anderson, 1994) where participants were required to make advantageous choices, the ventromedial prefrontal cortex was activated when the two processes in the decision making tasks were coupled together, whilst the anterior cingulate was involved during behavioural decisions (in this case card selection). Li et al., claim that even though these function operate in multiple domains they serve to work cohesively during these tasks.

Studies conducted on risky behaviour and decision making show that orbito-frontal cortex and the anterior cingulate cortex are associated with risk anticipation, however the ventromedial prefrontal region is activated only during negative performance (Rolls et al., 2001). Overall these findings further corroborate the distinct functions of hot and cool aspects of EF that illustrate conscious control of thought involved in logical processes, emotionally salient situations and decision making.

### **1. 2. 2. Behavioural/cognitive measures**

#### **1. 2. 2. 1. Cool Tasks**

As an important mediator of EF, the dorsolateral PFC mediates working memory and cognitive flexibility (Arnsten & Rubia, 2012; Li et al., 2010) examples of measures include the self-ordered pointing task (Petrides & Milner, 1982) where participants are required not to point twice to the same visual stimuli in various trials, all the while having to point to one item and holding in mind previous responses. As investigation of executive components imply that common measures of EF are not 'pure' during assessment (Miyake et al., 2000) by using confirmatory factor analysis, extracting the common variance from different tests measuring the same EF components; the subsequent variable is assumed to be purer test of the EF construct.

Miyake et al argue that the main components of EF comprise working memory, inhibition and set shifting. For example their study contained the letter memory test for working memory where participants had to recall last four letters when presented consecutively; the number-letter test where participants had to state whether the number presented above were odd or even and whether the letters below

were vowel or a consonant and the Stroop task (Stroop 1935) to measure inhibition, this test is considered to reduce working memory demands as the task requires identifying colours or words presented in incongruent (incompatible) stimuli (MacLeod, 1991). Luciana, Conklin, Hooper and Yarger (2005) suggest working memory tasks vary in executive control requirement, for example the backward digit span entails maintenance and manipulation of information to attain a goal, in contrast the simplicity of forward digit span requires only information to be held.

Whilst cognitive flexibility component of EF has been tested using various set shifting tasks such as the classic Wisconsin Card Sorting Task (Milner, 1964) during which cards are required to be sorted based on colour shape or number but the participant have to alter the rules each time the experimenter provides feedback and states the change in rules. Accordingly task switching in the Dimensional Change Card Sort test (DCCS; Zelazo, 2006) occurs only once during the entire test, but the first set of cards need to be sorted by one dimension of colour or shape and the rest of the cards in other dimension.

Children as young as three year olds can complete this task, but then fail to switch in between tasks (Zelazo et al., 2008); adults have also failed to switch between sets as more shifts are introduced in the task (Davidson et al., 2006). This provides an insight of the inhibitory demands of the task, supporting the cognitive complexity and control theory (Zelazo et al., 2003) where children are like to apply rules of task (i.e., inhibition) depending on complexity. Other tasks for inhibitory control and attention include the Flanker task (Erikson & Erikson, 1974) which requires participants to ignore the flanking visual stimuli whilst attending to the central stimulus testing for selective attention.

### **1. 2. 2. 2. Hot Tasks**

Hot EF is measured using tasks such as the delay and temporal discounting task, where participants have the option of choosing a small immediate reward or a large delayed reward. Particularly in temporal discounting the value of amount decreases with time whereas probability discounting refers to uncertainty in receiving the reward; both forms of discounting have been found to be strongly related (Richards et al., 1999). This types of discounting is believed to be similar in that there is a risk involved regardless and there is always something preventing the receipt of this reward when delayed (Green & Myerson, 1994). Scheres et al. (2006) used the temporal reward discounting paradigm to test children and adolescents with and without Attention Deficit Hyperactivity Disorder (ADHD); their findings showed that younger children were more driven for immediate rewards. This aspect of hot EF has been investigated in children extensively using delay of gratification tasks. In this task a treat is presented to participants but they are then asked to wait for a specified period of time to consume it in exchange for a larger treat whilst the experimenter leaves the room (Mischel & Shoda, 1988). All of these tasks reflect the ability to make advantageous decisions based on emotionally significant information i.e., rewards and losses (Metcalf & Mischel, 1999).

A widely used assessment of testing hot EF has been the Iowa Gambling task (Bechara et al., 1994) where participants are provided with a set of four decks of cards revealing a series of gains and losses when turned. By selecting cards from the four decks it would be possible to win as much money as possible, with participants being aware that some of the decks are better than others; according to this task, choosing from the advantageous deck would result in net gain compared to selecting the other leading to loss. Patients with orbitofrontal frontal cortex damage

consistently chose disadvantageous cards (Bechara, Damasio, Tranel & Damasio, 1997) and that comparable results have been found in pathological gamblers (Alvarez-Moya et al., 2011), in drugs abusers (Bechara, 2005) and even smokers (Buelow & Suhr, 2014).

Recent studies reveal significant links with IGT to delay discounting to suggest a link with affective decision making (Monterosso, Ehrman, Napier, O'Brien & Childress, 2001). Hot EF requires controlling impulsivity to advantageously select short term gains against long-term losses. Kerr and Zelazo (2004) devised a similar version of the IGT to investigate hot EF in children, they found that older children were better at selecting advantageous cards; suggesting that hot EF emerges during preschool years.

### **1. 2. 3. Development of hot and cool executive function**

Studies in infants reflect their difficulties on response inhibition tasks i.e., when being prompted to retrieve an object from one location when hidden on tasks; such as the A not B error; Piaget (1954) credited this error to immature recognition of object concept when children at that age fail to apply representation of object location, alternatively this also can be considered as misrepresentation of object location (Diamond, 1996). However this does not explain the underlying structure of executive function, for example whether inhibition occurs as a result of cognitive flexibility.

When tested on the self-ordered pointing task and the DCCS (cool task) 3 year olds continue to misrepresent objects compared to 4-5 year olds, similarly when tested on children's gambling task and delay of gratification, age related improvement were observed (Hongwanishkul, Happeny, Lee & Zelazo, 2010). This

is consistent with findings of PFC development during these years and improvement in performance of EF (Diamond, 2002). Similarly Hongwanishkul et al. (2010) claim that the self-ordered pointing task and the gambling task require the use of working memory, which again highlights the importance of PFC development. At the same time the authors also argue that the gambling task contained affective stimuli, which distinguishes the task from the cool self-ordered pointing task. Findings on this study fail to show how the results from hot differentiated from cool task.

Studies of hot EF in children during preschool years show that 4 year olds perform well on delay of gratification tasks compared to 3 year olds as they were more influenced by personal importance placed on the rewards (Prencipe & Zelazo, 2005). Results from studies investigating affective decision making in children show that with decreased value of motivationally significant stimuli, performance improved as a result of their inability to inhibit their preference for rewards, further indicating that top down control is required (Prencipe & Zelazo, 2005; Carlson, Davis & Leach, 2005; Crone, Bullens, Van der Plas, Kijkuit & Zelazo, 2008).

EF has been found to emerge during infancy and preschool years; however EF continues to develop during childhood and into late adolescence (Zelazo & Carlson, 2008) with complex processing of neural networks further developing later into the years compared to automatic processes (Bunge & Zelazo, 2006; Gogtay et al., 2004). When participants aged between 9-17 years were tested on the IGT, go/no-go and digit span test, clear age related improvements were noted across the age groups (Hooper, Luciana, Conklin & Yarger, 2004). Hooper et al.'s results also show that only the oldest participants performed well on the gambling task compared to results on cool tasks, suggesting that hot EF could develop at a later stage in

adolescence compared cool EF. A study by Davidson, Amso, Anderson and Diamond (2006) examined the development of working memory, inhibition and task switching (cool EF) in children, adolescents and adults; their findings indicates that tasks that required inhibitory demands were associated with slower responses in the youngest age group, on cognitive flexibility tasks children's and adolescents performance differed compared to adults.

In children the prefrontal cortex is continually developing, these changes in neural development occur during early childhood driven by the child's experiences (O'Hare & Sowell, 2008); unlike other regions (i.e., motor and sensory processing, speech and language) PFC development is prolonged (Gogtay et al., 2004). This can be observed on behavioural measure sensitive to PFC regions, for example when tested on tasks of inhibition, children between the ages of 5-8 years show particular improvements; Huizinga et al. (2006) found until the age of 15 years children and adolescents showed continued improvements on the stop signal task and the flanker task, however on the Stroop like task these changes were noted until the age of 21 years. When tested for working memory Luciana et al. (2005) found little performance difference on face recognition task, but the self-ordered search task showed improvements until the age of 16 which indicate that task complexity should be considered when testing working memory development.

As for the ability to switch between complex and numerous rules, this also improves with age, continuing until early adolescence (Huizinga & van der Molen, 2007). Huizinga et al. (2006) also noted that response time for shifts were greater for 7 to 11 year olds compared to those 15 years of age. With age the activation in the inferior frontal and parietal regions was found to be increased in those above 20

years when compared with 10-17 year olds (Rubia et al., 2006). This is further supported by academic performance (Bull & Scerif, (2001) in that 7 year olds had particularly poor math abilities and exhibited poorer inhibition. Children within this age group are also found to have difficulty switching from tasks and display lower working memory capacities (St. Claire Thompson & Gathercole, 2006). Best, Miller and Jones (2010) argue that although these show a link between EF and Mathematics, it fails to indicate exactly specific math abilities rather than general math abilities.

On tests of delayed discounting (hot EF) where participants have the option to select delayed larger rewards compared to immediate smaller rewards, young adolescents were more likely to discount larger rewards more greatly for immediate rewards (Steinberg et al., 2009). These findings are supported by a study investigating age related improvements on hot and cool EF tasks, where the results from participants between 8-15 years showed age related improvements on cool tasks (Stroop and digit span task), in contrast performance on hot EF tests (IGT and delay discounting) improved in the older age groups (Prencipe et al., 2011). However these findings show that hot and cool EF may develop independently during early adolescence where hot EF takes on a slower route compared to cool EF. This implies that although considerable control is placed in certain situations, motivationally significant influences undermine this ability. There is considerable evidence to support the view that hot EF develops slowly (Zelazo, Qu & Kesek, 2010). Zelazo and Carlson (2012) suggest this could explain discrepancies in adolescents understanding of negative consequences and engagement in risky behaviour.



## **1. 3. Executive dysfunction**

### **1. 3. 1. ADHD**

Most prominent theories of ADHD suggest that the main symptoms arise as a result of executive function impairments (Pennington & Ozonoff, 1996; Barkley, 1997; Castellanos & Tannock, 2002). ADHD is a disorder that could last throughout the life-span, and emerges during early childhood; according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM - IV) this is approximately around or before the age of 7, however the latest fifth edition of DSM have changed this to 12 years of age with children having to exhibit these symptoms for at least 6 months. Traits of ADHD include deficits in sustained attention, impulsivity and hyperactivity. The DSM 5 classifies ADHD symptoms based on inattentive (I) presentations, hyperactive-Impulsive (HI) presentations and combined (C) presentation, these symptoms are further assessed based on severity of these symptoms (American Psychiatric Association, 2013).

Prevalence studies show that ADHD is common among 5.29% of the worldwide population (Polanczyk et al., 2007), with males being more likely to be diagnosed with the disorder compared to females (Szatmari, 1992), this has been found regardless of intelligence quotient (IQ) and socioeconomic status (Pastor and Reuben, 2008). ADHD has also been found to have a significant impact on academic achievement in children and adolescents as a result of core executive function impairments (Biederman et al., 2004).

Findings from meta-analysis conducted over the years show that when tested for executive processes those with ADHD have been found to have impairments in all domains of EF this includes set shifting, verbal and spatial working memory,

planning and vigilance even after controlling for age, IQ, reading ability and other psychopathology (Willcutt, Doyle, Nigg, Faraone & Pennington, 2005; Pennington & Ozonoff, 1996). Slow reaction time and increased number of errors of omission were observed when tested for inhibition on the go/no go task (Metin, Roeyers, Wiersman, van der Meere & Sonuga-Barke, 2012).

Barkley (1997) proposes that development of inhibition is crucial for other EF processes which include working memory, internalisation of speech, self-regulation of affect, motivational arousal and motor control fluency syntax. Children and adolescents similarly display impairments on EF tasks; as reported by Martel, Nikolas and Nigg (2007), inattentive subtype tended to have weaker performance on EF tasks; however they failed to find any significant differences between the other subtypes. Willcutt et al. (2005) also found minimal association of hyperactive-impulsive subtype with EF scores, suggesting that ADHD-HI subtype functions independent of cognitive EF, whilst inattention is closely related to EF. These studies are based on the model proposed by Pennington and Ozonoff (1996) where cognitive processes are set towards problem solving behaviour aimed for achieving a certain goal, however because of the subtypes outlined by the DSM IV, studies have failed to find significant differences in these subtype, as result a number of studies are adopting a dual pathway model (Sonuga-Barke, 2005) to highlight the association of executive and motivational delay aversion process' relation to ADHD.

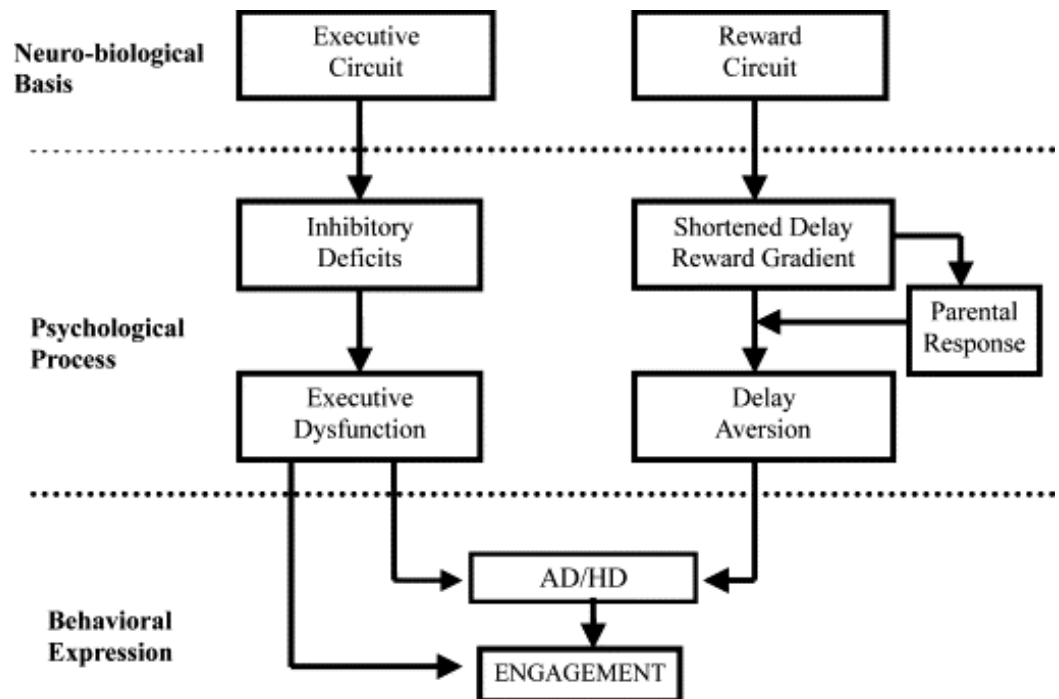


Figure 1 - The Dual Pathway Model of ADHD. The left-hand pathway represents ADHD as executive dysfunction. The right-hand pathway represents ADHD as a delay averse motivational style (Sonuga-Barke, 2003).<sup>2</sup>

The dual pathway model (Figure 1) suggests that a fundamental deficit of ADHD involves problems with delay aversion (Sonuga-Barke, 2003), which has links to fronto-ventral striatal reward circuit. In this case there is an inability to regulate thought and action of the executive pathway where the main deficit lies in inhibitory control, further affecting task engagement. This is comprised of cognitive dysregulation as indicated in children who display difficulties in attentional flexibility, planning and working memory. Secondly the motivational pathway is mediated by behavioural outcome of task engagement and biological link to reward systems emerging mainly during delay aversion (Sonuga-Barke, 2003); this is as a

<sup>2</sup> Sonuga-Barke, E. J. (2003). The dual pathway model of AD/HD: an elaboration of neuro-developmental characteristics. *Neuroscience & Biobehavioral Reviews*, 27(7), 593-604.

result of behavioural dysregulation. According to this model however behavioural dysregulation influence task engagement, therefore implicating cognitive dysregulation. What needs to be noted is that inhibition is dissociable from delay aversion (Solanto et al., 2001) as scores of children with ADHD who were tested on the choice delay task did not correlate with stop signal task.

Studies show that on the stop signal task children with ADHD show significantly poor performance (Lijffijt, Kenemans, Verbaten, & van Engeland, 2005), Castellanos, Sonuga-Barke, Milham and Tannock (2006) argue that not all EF weaknesses are necessary to cause or support most cases of ADHD (Willcutt et al., 2005), similarly deficits in both delay aversion and behavioural inhibition are not required for diagnosis in ADHD.

A main problem of children with ADHD is that they tend to have difficulties with delayed reward processing (Castellanos & Tannock, 2002; Sonuga-Barke, 2002). Children with ADHD are shown to have preference for small immediate rewards compared to larger delayed rewards (Barkley et al., 2001). In adults however the magnitude of reward and delay is greater to achieve temporal discounting (Richards et al., 1999).

More recently, Sonuga-Barke, Bitsakou and Thompson (2010) study on temporal discounting deficits suggest that temporal discounting deficits could be independent. By testing children with ADHD on delay discounting tasks Sonuga-Barke and colleagues (2010) findings revealed that compared to controls, ADHD children exhibited deficits in the domain of timing, reward or inhibition. Based on the heterogeneity of these symptoms Sonuga-Barke et al. suggest that a third pathway should be added to clearly identify the variances in these domains, arguing

that the third pathway for this deficit could share neural regions, such as the basal ganglia which is responsible for inhibiting motor movements (Mink, 1996) and is distinct for the processes required in delay aversion.

Scheres et al. (2006) tested delay aversion and found that the ADHD group performance did not significantly differ compared to controls on the temporal and probabilistic delay task. Scheres et al. (2006) claim that this could be as a result of development of the prefrontal cortex, as children were more likely to be susceptible to reward immediacy rather than delay aversion. Guerts, van der Oord and Crone (2006) also found no significant differences between healthy controls and children with ADHD on tasks for impulsive decision making and inhibition, disapproving the dual pathway model which requires deficits in impulsivity as a critical assessment set by Sonuga-Barke (2003).

### **1.3.2. Hot and Cool Integration**

As a model that takes into consideration both cognitive function and motivational significance of EF, Zelazo and Muller's (2002) model distinguishes executive process' based on behavioural outcomes and neuro-imaging evidence. The cognitive and abstract solving aspect of EF is defined as cool EF whilst the motivational and affective problem solving is seen as hot EF. The cool aspect is related to the executive dysfunction pathway, whilst hot EF mediating motivational and affective features of cognitive control is associated with the motivational dysfunctional pathway. This model also supports Nigg's (2000, 2001) distinction of behavioural inhibition and motivational inhibition, where behavioural aspect entails response inhibition whereas motivational inhibition is linked to personality traits and affective impetus.

When children with ADHD were tested on the stop signal task (Lijffijt et al., 2005), their results revealed behavioural inhibition deficiency. It is expected that children with ADHD displaying deficits in cool EF would have poor performance on stop signal, Stroop and flanker tasks. Particularly because these tasks would require maintaining task instructions or represent them in working memory (Castellanos et al., 2006). Alternatively Ernst et al. (2003) examined ADHD children's performance on gambling task to show that performance in this group of children indicated poor selections, however they were not able to replicate these findings in the adult sample. Castellanos et al. (2006) argue that this fails to consider the hyperactive-impulsive traits or other aspects of ADHD, they suggest that hot EF should be associated with hyperactive-impulsive symptoms, similar to the findings related to IGT outcomes (Behcara, 2004), whereas cool EF deficits would be linked with inattentive symptoms.

Decision making tests related to hot EF show that symptoms of hyperactivity and impulsivity correlated with reduced decision making performance in children with ADHD between the ages of 14-17 years. There is also support to show that normally developing children aged between 6-12 years are likely to exhibit poor decisions by selecting more disadvantageous choices on gambling task (Mata et al., 2011). However this ability to make advantageous choices increases with age in normally developing adolescents, compared to the poor choices made by adolescents with ADHD (Toplak et al., 2005). However cool EF tests continue to appear robust throughout childhood and adolescence in normally developing individuals (Willcutt et al., 2005).

Skogli et al. (2013) compared hot and cool EF performance in children with ADHD and further distinguished them based on the subtypes; their results were similar to previous findings where cool EF was implicated in ADHD. Nearly all children with ADHD performed poorly on working memory tests and verbal fluency. Neuro-imaging findings for EF show reduced activity of the frontal cortices during cool tasks; these were observed in adults who were diagnosed with ADHD as children. The ventral media region of the PFC is however linked to hot processes, and this has been associated with conduct disorder, suggesting comorbid and anti-social behavioural links to these regions (Cubillo, Halari, Smith, Taylor & Rubia, 2012).

### **1. 3. 3. Comorbid Externalising Disorders**

Children with ADHD frequently tend to have co-morbid conduct disorders; this has been established in 30-50% of both clinical and non-clinical samples (Jensen et al., 1997; Satszmari et al., 1989). Children with ADHD and conduct disorder demonstrate high levels of poor self-regulatory processes, impulsivity and defiant, rule breaking behaviour (Kronenber & Meyer, 2001). Studies looking at executive function in adolescents diagnosed with conduct disorder (CD) or oppositional defiant disorder (ODD) with and without ADHD were found to have poor scores on the Wisconsin card sorting task, there are also studies showing that children with CD and ODD alone exhibited no difference on the executive processing tasks (Dery et al., 1999).

Research suggests that impairments in behavioural inhibition are closely linked to children with ADHD and CD, where ADHD on its own is closely related to cognitive impairments (Pennington & Ozonoff, 1996). However children with CD

alone have been found to have lower levels of verbal intelligence (Frick et al., 1992). Hummer et al. (2011) tested adolescents diagnosed with CD and ODD with and without ADHD on tests of EF; their findings support earlier studies which showed EF deficits to be greater when CD and ODD were comorbid with ADHD. Those with CD and ODD diagnosis only did not differ significantly on these tasks of EF; the authors argued that cool EF deficits are primarily affected in children with ADHD and CD/ODD. However hot EF outcomes still remain unclear in this category (Hummer et al., 2011). Oosterlan, Logan and Sergeant (1998) found slower motor inhibition speeds in children with only CD/ODD whereas comorbid ADHD groups displayed slower reaction times on the stop signal tasks.

Hobson, Scott and Rubia (2011) further attempted to clarify hot and cool EF links between ADHD and comorbid CD/ODD. The results from this study reveal that those with ADHD, CD/ODD on its own and co-morbid groups showed impairments on cool tasks for motor inhibition, sustained attention and response execution; no significant differences were observed for cognitive switching task. However when tested on the IGT for hot EF the CD/ODD group independent of ADHD displayed poor performance, this group were also found to have deficits in cool EF tests of inhibitory control (Hobson et al., 2011). Similarly Dolan and Lennox (2012) tested adolescents on tests for hot and cool EF; these results again show a lack of significant difference between groups of ADHD and CD on set shifting tasks. ADHD and CD groups nonetheless had problems with making the right moves on the spatial planning task. As reported by Dolan and Lennox (2012) response inhibition correlated with externalising scores, where performance of those with CD alone and ADHD with conduct disorder show that they were more prone to financial penalty on the card playing tasks indicating poor decision making.



These findings indicate that ADHD and CD/ ODD is implicated in both hot and cool EF deficits, with cool EF being particularly implicated in groups displaying response inhibition deficits (Hummer et al., 2011; Hobson et al., 2011) this could be as a result of common underlying symptoms of ADHD and CD (Dolan & Lennox, 2012). According to a recent review the underlying reduced activation of the amygdala which mediates emotional processing were found in participants displaying callous unemotional traits, CD and those exhibiting symptoms of ADHD, indicating lack of affective processing. The links between ventromedial prefrontal cortex and amygdala suggests that there is a strong association between decision making and emotional feedback ( Rubia et al., 2011). However academic performance and EF impairments were only found in ADHD without CD or ODD independent of callous-unemotional traits (Pardini & Fite, 2010).

#### **1. 3. 4. Callous-Unemotional Traits**

Callous-unemotional (CU) traits are often referred to as lack of guilt and absence of empathy. Children with CD who display CU traits are likely to be more aggressive and engage in disruptive behaviour (Dandreaux & Frick, 2009; Hawes & Dadd, 2005; Moffitt, 2003). Problems with response inhibition and delay modulation have been linked to psychopathy (Lynam, 1997) but the construct of psychopathy cannot be applied to children due to anti-social tendencies. However the concept of adult psychopathy can be extended to children by focusing on callous unemotional traits, these callous unemotional traits have been successfully associated with CD and psycho-social impairments in children (Essau, Sasagawa & Frick, 2003).

Sadeh and Verona (2008) found that psychopathy is closely linked to impairments in perceptual processing capabilities which could explain their tendency

to ignore environmental cues not relevant to their goal i.e., distress. This was further related to both working memory and inhibition. Sadeh and Verona claim these individuals with high risk taking behaviours could be impulsive as a result of having trouble maintaining cognitive control. Children with ADHD are likely to display callous unemotional traits, particularly children displaying severe CD (Barry et al., 2000); this could be linked to reward dominance, which is further linked to behavioural inhibition (Kagan, Reznick & Snidman, 1987). Kochanska (1993) argues that this could be as a result of deficits during early development of guilt and empathy. Barry et al. (2000) further noted that children with behavioural difficulties and CU traits failed to show any levels of anxiety; however those with ADHD and CD without CU traits had the highest levels of anxiety.

### **1. 3. 5. Comorbid Internalising Disorders**

Children with ADHD and co-morbid conduct disorder or oppositional defiant disorder (ODD) are likely to also suffer from co-occurring problems with anxiety (Humphries, Aguirre & Lee, 2012). Anxiety is associated with suppressing hyperactive and externalising behaviours in children with ADHD (Epstein, Goldberg, Conners & Mark, 1997) those with CD/ODD and anxiety were reported as being less aggressive by their peers compared to those children without high comorbid anxiety (Walker, Lahey, Russo & Frick, 1991). Humphries et al. (2012) found that children with ADHD who displayed symptoms of anxiety were more likely to have higher parent reports of CD and ODD. Given that ADHD is commonly co-morbid with anxiety, it is estimated that approximately 25% of children diagnosed with ADHD will also suffer from anxiety (Jensen, Martin & Cantwell, 1997).

More importantly ADHD children displaying symptoms of anxiety tend to have poorer working memory capabilities (Jarrett & Ollendick, 2012), and exhibit sluggish cognitive tempo (Pliszka, 1989). Sluggish cognitive tempo is characterised by lack of mental alertness, confusion, being distracted and day-dreaming, this is mostly associated with children suffering from inattention in ADHD (Frick et al., 1994; Hartmen, Willcutt, Rhee & Pennington, 2004). Studies show that response inhibition is more common with ADHD-C subtype (Nigg, Willcutt, Doyle & Sonuga-Barke, 2005); recent reviews nevertheless based on earlier findings (Jarrett and Ollendick, 2008; Schatz & Rostain, 2006) highlight that anxiety with ADHD may not result in response inhibition (Oosterlaan & Sergeant 1998), on the contrary there is evidence that suggest anxiety serves to increase response inhibition (Manasis, Tannock & Barbosa, 2000). Schatz and Rostain (2006) suggest that having ADHD and anxiety could affect cognitive processes due to fears of poor performance, when in fact these impairments could arise as a result of co-morbid anxiety.

Further investigation of working memory in relation with ADHD and anxiety show that there is little difference in performance on tests of spatial working memory in ADHD children with and without anxiety (Vance, Ferrin, Winther & Gomez, 2013). Vance et al. (2013) suggests that having anxiety prevents further access to storing and processing resources. Testing children with ADHD and obsessive compulsive disorder (OCD) on tests for delay aversion (hot EF) and serial reaction time task (cool EF) Vloet et al. (2010) found that only children with ADHD performed poorly on the delay aversion task, compared to children with both ADHD and OCD, however ADHD and OCD symptoms correlated with choice responses on the delay aversion task, this group also exhibited slower response time compared to

controls. This suggests that ADHD and OCD could have dissociable EF impairments as those with OCD only showed deficits of implicit learning (Vloet et al., 2010).

Impairments of EF in children with ADHD and anxiety remain unclear, however a study investigating behavioural inhibition, visual and verbal working memory, response speed, cognitive flexibility and motor control reveal children with ADHD and higher teacher rated anxiety had slower response and motor speed and enhanced behavioural inhibition (Bloesma et al., 2013). This study again found working memory deficits to be more pronounced in children with ADHD and anxiety. This supports earlier findings by Pliszka (1992), when ADHD children with comorbid anxiety tested on the stop signal task they showed enhanced behavioural response inhibition. These inconsistent findings in regards to motivational and affective processing for ADHD and co morbid anxiety, has led Jarrett and Ollendick (2012) to suggest that a hot and cool EF model as proposed by Zelazo and Muller would serve to define the distinct features associated with cognitive processes and whether there are significant differences associated with motivational process in ADHD and anxiety.

#### **1. 4. Emotion Regulation**

Gross (1998) famously described emotion regulation (ER) as an individual's ability to manage "*Which emotions they have, when they have them and how they experience and express them*".-page 275<sup>3</sup>

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<sup>3</sup> Gross, J. J. (1998). The emerging field of emotion regulation: an integrative review. *Review of general psychology*, 2(3), 271-299.

Emotion regulation (ER) is linked to positive social competence and self-regulation (Denham et al., 2003), where children with high effortful control are reported as being better at managing attention, emotions and behavioural responses; these children are then less likely to express negative emotion (Eisenberg & Spinrad, 2004). Effortful control is therefore considered responsible for the modulation of emotion related activities in specific situations for example these include maintaining, activating and inhibiting, whilst being able to reflect on individual and dispositional differences in various situations as this is a key aspect of temperament (Eisenberg & Spinrad, 2004).

There is convincing evidence to suggest, coping involves regulation of emotion in response to stress (Eisenber, Fabes & Guthrie, 1997). Coping refers to cognitive and behavioural efforts taken to manage stress and overcome adversity (Lazarus & Folkman, 1984). Compas (2009) defined coping as a form of conscious effort to regulate emotion, cognition, behaviour and the environment. There is a large body of research focusing on coping, one such model is the three factor model of coping that has been validated in a large sample of children and adolescents in a culturally diverse population (Compas et al., 2004). According to Compas et al., (2004) these subtypes include primary control engagement coping (directly tackling emotional expression, modulation and problem solving) secondary control engagement coping (which relates to efforts taken to adapt to the source of stress i.e., positive thinking, acceptance and distraction) and finally disengagement coping (this is avoidance of the source of stress, withdrawal and denial). Eisenberg, Fabes and Guthrie (1997) suggest that emotion regulation and coping strategies tend to overlap as they both involve efforts to reduce negative emotion when in stressful situations, however a distinction between the two is that emotion regulation involves retaining

or enhancing positive emotion whereas coping is a down regulation of negative emotion.

In relation to EF, working memory has been found to be associated with both coping and ER (Lezak, Howieson & Loring, 2004), difficulties in working memory could be related to secondary control coping (Hocking et al., 2011). By testing young people with abdominal pain Hocking et al (2011) found that attention regulation was related to a type of coping mechanism, particularly selective attention was related to secondary control coping, suggesting that this allowed them to shift attention to important stimuli; focusing on secondary control coping and reducing anxiety. Similarly Andreotti et al. (2013) tested youths to investigate the relationship between secondary control coping and cognitive reappraisal strategies focusing on working memory; their findings show that secondary control coping was associated with working memory but also negative affect and symptoms of anxiety and depression. Whereas cognitive emotion regulation is seen as managing emotional information through thoughts which include a wide range of emotional processes (Garnefski, Kraaij & Spinhoven, 2001).

Centred on the theory by Thompson and Calkins (1996) where regulatory process encompasses individual's own regulation of emotion, regulation by others, by the emotion itself and its underlying processes, Garnefski et al. (2001) developed a new measure called the cognitive emotion regulation questionnaire (CERQ). The CERQ identifies nine dimensions that categorises the outcome of response to negative life experiences, these are further split by theoretical strategies which include rumination, self-blame, blaming others and catastrophizing, this is considered the less adaptive strategy. The CERQ also measures putatively adaptive

ER strategies consisting of positive refocusing, positive reappraisal, putting into perspective, refocuses on planning and acceptance. These strategies highlight the link between negative life events and symptoms of anxiety and depression (Garnefski et al., 2001).

#### **1. 4. 1. Development of emotion regulation**

Studies show that emotion regulation develops as early as infancy and continues into early childhood (Eisenberg, Champion & Ma, 2004; Thompson, 2004). As this is a period considered important for temperamental development Stegge and Terwogt (2007) suggest that ER is influenced by children's understanding of emotions and their ability to appraise emotion generating situations. Temperament is defined as the individual's reaction based on the speed and intensity of the activated emotion (Cole, Martin & Dennis, 2004); temperament qualities are likely to affect emotion regulation development particularly as a result of caregiver influences (Thompson & Goodwin, 2007).

Research on infants show that they are able to disengage from emotionally arousing situations (Posner & Rothbart, 2000). Toddlers who are high in emotional reactivity as a result of fear or anger are therefore likely to have less emotional self-control (Calkins & Hill, 2007). During preschool years children become aware of managing emotions by ignoring them or removing themselves from the situation and seeking the assistance of caregivers where necessary (Thompson, 1990).

Gross (1998) proposed a process oriented approach to understand ER. According to Gross's (1998) model there are five sets of emotion regulation strategies, these include; (i) situation selection, (ii) situation modification, (iii) attention deployment, (iv) cognitive change, and (v) response modulation. Specific

ER strategies have also been differentiated further as a result of emotional responses these include antecedent focused (i.e., strategies adopted prior to the activation of emotional responses) and response focused (i.e., strategy employed following the experience of the emotion). More importantly the strategies most research has based from the process model is cognitive reappraisal (altering the emotional impact by redefining the emotion eliciting situation) and expressive suppression (the inhibition of emotionally expressive behaviour that is ongoing).

However young adults have been found to differ in the expression of cognitive reappraisal and expressive suppression, as they are more likely to be actively engaged in attempting to repair negative moods and generally being more optimistic which leads to the expression of more positive rather negative affect (Gross & John, 2003). On the contrary, studies also suggest that young adults may actively engage in problem solving approaches, but older adults tend to endorse both emotion regulation and problems solving, especially as older adults are found to be passive and are less likely to engage in suppression, avoidance or withdrawal (Blanchard-Fields, Chen & Norris, 1997; Blanchard-Fields, Stein & Watson, 2004).

Children and adolescents have been found to actively engage in cognitive reappraisal and expressive suppression. Gullone, Hughes, King and Tonge (2010) found that expressive suppression in particular develops with age in that as children get older they are less likely to engage in suppression with participants reporting less of this strategy. However Gullone et al. (2010) found that cognitive reappraisal was less likely used by older participants, suggesting that individuals develop habitual ways of responding to poor performance. However adolescents have been found to have a heightened sense of awareness of the interpersonal consequences of



displaying emotions to different groups of social relationships (i.e., parents, peers or teachers) compared to children (Fuchs & Thelen, 1988; Zeman & Shipman, 1997).

Thompson (1990) claims that children begin to realise that emotions can be managed by ways of internal distraction (i.e., redirection of thoughts, cognitively restructuring the situation or concentrating on the benefits of managing feelings or expression); in adolescence these strategies are personalised based on individual preferences. Zelazo and Cunningham (2007) argue that the reason for this is as a result of growth in EF by displaying abilities of strategic planning, error detection/correction and inhibitory control.

## **1. 5. Executive function and emotion regulation**

Carlson and Wang (2007) suggest three alternative ways where EF and ER could be related, the first possibility being that inhibitory processes are necessary and underlie successful emotion regulation whereby inhibition and ER could function together to prevent impulsive responses and allow individuals to behave in ways that do not correspond with their actual feelings. For example, politely thanking and smiling when given an unwanted gift. However depending on the intensity of emotion there would be higher need for inhibitory control, this would depend on the development of inhibitory control and maturation of the PFC. The second possible explanation for the inter-relation of EF and ER is the likelihood that emotion regulation is crucial for successful inhibitory control, where better emotional coping frees up cognitive resources and effective problem solving. Unchecked emotions on the contrary could impair reasoning and planning ability (Carlson & Wang, 2007). The third possibility considers the outcomes of ER in relation the iterative processing model by Zelazo and Cunningham (2007) where

self-regulation of emotion is mediated by EF processes. This aspect of EF is mostly involved when the primary goal is to regulate emotional expression; during this process EF and ER are considered to be indistinguishable. The iterative processing model however suggests that the process begins with identifying the valence of stimuli, integrating already existing attitudes, context and goal states. Whereas attitudes are only considered representations reflecting the earlier evaluative process, and is accessed from memory. The iterative sequence begins to interpret real or imagined stimuli based on considerations such the stimuli, context and/or current goals.

Along with the PFC (Bechara, 2004) which is responsible for decision making, other main regions to be implicated is the amygdala for automatic evaluation of stimuli and learning, the ventromedial and other subcortical regions are expected to underlie ongoing and reflective processes (Cunningham & Zelazo, 2007). Similarly Eshel et al. (2007) results show that the orbitofrontal cortex and the dorsal anterior cingulate cortex support emotion regulation and response monitoring. Furthermore their results indicated reduced activity in the orbitofrontal/ventrolateral prefrontal cortex and dorsal anterior cingulate cortex in the adolescent sample compared to adults, which was then associated with risky choices. Executive function is similar to effortful control in that it is responsible for inhibiting a dominant response; however effortful control is related to automatic non-conscious responses whereas executive function relies on conscious cognitive self-regulation (Blair & Razza, 2007).

Using the hot and cool EF, model Brock, Rimm-Kauffman, Nathanson and Grimm (2009) found cool EF to be implicated in both academic achievement and

learning related behaviours in kindergartners, their results did not show any significant relationship between hot EF and behavioural outcomes. However Kim et al. (2013) found that hot effortful control tasks predicted emotion regulation in infants and engaged in positive emotion, whereas cool EF only predicted academic performance but not behavioural problems. Kim et al suggests that defects in hot EF require ER abilities; impairments in these domains are linked to the development of psychopathologies (Cole & Deater-Deckard, 2009).

### **1. 5. 1. Development of emotion regulation and executive functions**

ER is linked to several aspects of social functioning in pre-schoolers, this affects their relationship with peers, teachers and highlights popularity depending on social competence which lies in adjustment, shyness and sympathy (Denham et al., 2003). In the classroom children have to play with fellow peers, inhibiting impulses to play with tempting toys, in this case hot EF is implicated whilst cool EF is required in tests of reading, writing and understanding mathematical problems (McClelland et al., 2007).

Brock, Rimm-Kauffman, Nathanson and Grimm (2009) found that cool EF predicted academic abilities and behavioural outcomes in kindergartners (5-6 year olds), for this study cool performance required paying attention in class, waiting for a turn and staying on task however high scores on hot EF predicted positive relations and social skills. Testing children on a motor inhibition task revealed that children's effortful control was significantly linked to how they displayed positive affect when in a negative situation; specifically children with low effortful control displayed less positive affect when given an unwanted present which suggests the involvement of ER in inhibition (Kieras et al., 2005). Similarly Lieberman et al. (2007) found that

children's poor performance on inhibition tasks also exhibited decreased positive effect, as children were unable to display positive behaviour when given an undesirable gift. Children with higher scores on tests measuring working memory and attention had higher parent ratings of inhibitory control and attentional focusing, including teachers rating of behaviour regulation in the classroom (Ponitz, McClelland, Matthew & Morrison, 2009).

Investigating aspects of EF such as working memory, impulse control and set shifting in toddlers between 12-15 months in relation to mother's sensitivity to EF Bernier, Carlson and Whipple (2010) found that children performed better on working memory tasks, conflict and impulse control, indicating that caregiving can have an influence on self-regulation in both behavioural and cognitive domains. Ciairano, Visu-Petra and Settanni (2007) assessed inhibitory control in relation to social competence and co-operative behaviour in children, their findings revealed a strong relationship between co-operative behaviour and inhibition scores, this predicted parent-teacher scores of behavioural problems. Children lacking in inhibitory processes were less able to use verbal and non-verbal strategies in shared goals and usually adapted less socially acceptable behaviours such as aggression (Ciarano et al., 2007).

Furthermore self-regulation in young children has been linked with emerging academic abilities and executive function, in particular inhibitory control positively correlated with reading and math ability (Blair & Razza, 2007). Examining the two strategies associated with ER expressive suppression and cognitive re-appraisal strategies of EF during childhood and adolescence, Gullone et al. (2009) found that suppression scores were lower for younger participants, whereas older participants

reported less use for this strategy; however older participants scored lower on appraisal but found stability over time. Gullone et al. suggest that this could rely on other ER strategies, and maturation process could take longer as the sample group for this study was made up of 9-15 year old children and adolescents, with females being more emotionally expressive compared to male participants.

### **1. 5. 2. Links to Psychopathologies**

Children with ADHD are less effective at emotion regulation but are significantly emotionally reactive (Hinshaw & Melnick, 1995). Children with ADHD commonly display symptoms of frustration, inattentive to social cues and emotionally explosive (Henker & Whalen, 1999), however a direct link between emotion dysregulation has been established with disruptive behaviour (Shields & Cicchetti, 2001), nonetheless executive inhibition and ER studies still remain limited (Hinshaw & Melnick, 1995; Walcott & Landau, 2004). This supports behavioural outcomes of children with ADHD in relation to inhibitory control; however inhibitory processes are further distinguished as motivational inhibition which is a volitional response to novel situations and arises as a result of fear or anxiety whilst executive inhibition is linked to response inhibition as measured on the stop signal task (Nigg, 2001).

Walcott and Landau (2004) recorded young boys behavioural inhibition and regulation of emotional reaction during a frustrating peer competition; they found that boys with behavioural inhibition predicted emotion dysregulation, boys with ADHD had difficulty with managing emotional expression, even when they were directly asked to do so. Social problems in ADHD highly correlated with impaired social adaptation and competence (Hoza et al., 2005) and most commonly

recognised in co-morbid groups of ADHD i.e., those with CD and ODD. Schwenck et al. (2013) tested children with and without ADHD on emotion recognition and found that ADHD children correctly identified emotional faces, suggesting that they may not have deficits in identifying emotional cues.

ADHD is associated with emotional processing disruptions (Musser, Galloway-Long, Frick & Nigg, 2012), taking into consideration the ADHD subtypes to examine ER abilities Wheeler Maedgen and Carlson's (2002) results show that children with ADHD-C were more likely to display their emotions particularly positive emotions, indicating that children with ADHD-C were attempting to regulate their emotions, this further shows that they are able to understand rules in relation to emotional expression. Wheeler Maedgen and Carlson also reports that those presenting ADHD inattentive symptoms displayed intact ER since it is not characterised by inhibitory deficits. This supports Sorensen, Plessen, Nicholas & Lundervold (2011) findings of children with ADHD and co-morbid anxiety displaying higher inhibitory control impairments than children with ADHD alone, impaired attentional control along with working memory deficits further highlighted emotional dysregulation in ADHD. Set shifting was also impaired in this group, Sorensen et al., (2011) suggests that set shifting abilities reflect the ability required to shift from emotional states both of which predicts positive social function (Wilson, 2003).

### **1. 5. 3. Summary & Aims**

There are three main objectives of this research. Firstly, studies thus far indicate that hot and cool EF emerges during early childhood (Bernier et al., 2010; Brock et al., 2009). However the findings in relation to age appear to be mixed for

hot EF with studies by Prencipe et al (2011) suggesting age relating improvements in children and adolescents, whereas Hooper et al. (2004) report significant changes in older adults alone. Therefore the aim of the present study is to examine this developmental trend using a cross sectional design in children, adolescents and young adults. Based on previous studies age related improvements are expected on cool tasks; however improvements in hot tasks are expected in older participants.

Secondly literature consistently report close links of EF with ADHD, there are significant studies suggest impairments in cool and hot EF is associated with ADHD outcomes, whereas conduct problems are related to hot EF deficits (Dolan & Lennox, 2013; Fairchild et al., 2009; Hobson et al., 2011; Willcutt et al., 2005). With limited studies reporting these links in internalising disorders, in particular anxiety, the goal is to investigate how hot and cool EF is associated with emotional problems such as anxiety and depression and how this compares with behavioural problems.

Finally there is strong evidence to suggest that EF is closely related to emotion regulation. Prominently studies report that the inhibitory aspect of EF is linked to emotion regulation skills (Carlson & Wang, 2007; Zelazo and Cunningham, 2007). Using the cognitive emotion regulation scale which identifies 9 emotion regulation strategies, the objective is to explore how these skills are associated with cool and hot EF. For further specific aims see chapter 4.

## **Chapter 2: Interventions in executive functions and emotion regulation**

### **2. 1. Executive functions**

Executive functions (EF) allows individual to plan and carry out goal directed activities (i.e., control of thought emotion and action) (Banich, 2009; Garon, Bryson & Smith, 2008; Gioia, Isquith, & Guy, 2001; Seguin & Zelazo, 2005; Welsh & Pennington, 1988) that are based on three core processes, namely working memory, inhibition and cognitive flexibility (Miyake et al., 2000). Although these EF processes are distinct they are unitary in functions in that they work together to execute certain tasks or suppress dominant/ automatic responses when necessary (Miyake et al., 2000). More importantly goal setting allows individuals to cultivate and plan actions in advance to approach tasks in the most efficient and strategic manner possible (Alexander & Stuss, 2000; Best, Nagamatsu & Liu-Ambrose, 2014). EF's are also considered crucial processes that underlie successful behavioural and academic outcomes (Blair & Diamond, 2008; Blair & Razza, 2007). In healthy individuals, literature on the development of EF shows that children by



the age of two begin to develop skills that allow them to plan and maintain basic information (Bruner, 1973). However during childhood and adolescence considerable maturation occurs in EF skills (Tranel et al., 1994; Welsh & Pennington, 1988; Welsh, Pennington, & Grossier, 1991) but these skills are not comparable with adults (Becker, Isaac, & Hynd, 1987). Recently considerable research suggests that EF is best classified as hot EF (processing of affectively salient information) and cool EF (abstract, affectively neutral processing) (Kerr & Zelazo, 2004; Metcalfe & Mischel, 1999; Zelazo & Muller, 2002). The main difference being that hot EF is considered a proximal affective or emotional stimulus, whereas in cool EF there is not an affective or emotional stimulus.

Impaired EF's are associated with poor socio-emotional adjustment and several behavioural disorders in childhood such attention deficit hyperactivity disorder (ADHD), autism and delinquency (Hughes, White, Sharpen & Dunn, 2000; Ozonoff, 1997; Wilcutt et al., 2005). These disorders emerge in childhood, but during adolescence and adulthood these children experience difficulty in their daily routines as they attempt to live independently and efficiently (Anderson et al., 2002). In typically developing children however, cool EF has been consistently reported to be associated with academic outcomes (Willoughby et al., 2011; Brock et al., 2009) but not hot EF. Studies show that hot rather than cool EF is associated with behavioural problems (Zelazo & Carlson, 2012); based on parent and teacher ratings of preschool children Kim et al. (2013) found that hot EF uniquely predicted behavioural problems.

Fairchild et al. (2009) found that children with behavioural disorders are particularly impaired on hot EF tasks measuring motivational processes including

reward and punishment. As reported in numerous studies, deficits in inhibition are particularly associated with ADHD and other behavioural disorders (Schutter et al., 2011). Several studies have focused on deficits of EF in children with hyperactivity, impulsivity and aggressive behaviour (Alderson et al. 2007; Oosterlaan et al., 1998; Pennington and Ozonoff 1996; Willcutt et al. 2005). On the contrary based on cool EF tasks, working memory deficits have mainly been linked with ADHD alone (Oosterlaan et al., 2005; Willcutt et al., 2005). Therefore several programmes have been developed at improving working memory and inhibitory aspects of EF (Diamond & Lee, 2011; Karr, Areshenkoff, Rast, & Garcia-Barrera, 2014; Tamm, Nakonezny & Hughes, 2014).

### **2. 1. 1. Interventions for executive functions**

Given the wide range of problems that are associated with executive dysfunction, a number of programmes have been developed in recent years. For example, Thorell et al. (2009) developed a computerised training programme that involved 15 minutes of training each day on tasks of visuo-spatial working memory and inhibition, with the children receiving continuous feedback. Preschool children who participated in this programme were found to have an improved effect on working memory tasks, moreover these researchers claim that the effects of these improvements transferred onto tasks of attention (cool tasks) (Thorell et al., 2009). This suggests that working memory training can improve cognitive functioning with additional transfer effects being observed in verbal domains.

Blakey and Carroll (2015) trained preschool children on working memory, cognitive flexibility and inhibitory control tasks with varying difficulties and discovered that working memory greatly improved in comparison with inhibition

and cognitive flexibility, additionally children in the training group were found to be much better at mathematical reasoning compared to control. Other studies reported that working memory training improved academic achievement and allowed the transference of these skills to other working memory tasks (Dahlin, 2011; Dunning, Holmes & Gathercole, 2013; Holmes et al., 2009). In various other studies, children aged between 7-11 who were trained on a working memory task over 10-14 sessions and displayed improved performance on standardised tests of reading and working memory (Loosli et al., 2012; Karbach & Unger, 2014). Training induced working memory improvements can be identified particularly in low achieving students (Holmes & Gathercole, 2013). This is supported by an earlier finding by Dahlin (2011), who found that children with attentional problems and special educational needs improved on reading comprehension and basic number skills.

Additionally, by training adolescents with intellectual disabilities Van der Molen et al. (2010) found an increase in visuo spatial working memory along with improvements on verbal short term memory. Van der Molen and colleagues trained their participants on simple working memory capacity tasks; these included the Jungle Memory and OddYellow task. The jungle memory task features three adaptive complex span tasks that require participants to remember visuo-spatial or verbal information (i.e., locations or numbers) which is then incorporated further in a processing task (word completion, mental rotation, or mathematics). OddYellow presents trainees with three shapes that different in their characteristics: Two are identically shaped and two are black. The participant is required to rapidly (in less than 5 seconds) indicate which item has the unique shape and then indicate (in less than 2 seconds) which item is yellow. Following from either one to seven trials, the participant must recall the spatial locations of all previously presented yellow items.

The results revealed that adolescents with intellectual disabilities had improved working memory performance, with participants recalling stories more accurately. Several studies have further found transfer effects of working memory training, where trained participants have been found to be well equipped to appraise novel information (Jaeggi et al., 2010), have improved attention and even exhibit decrease in ADHD related symptoms (Beck et al. 2010).

Focusing on aspects of metacognition Tamm, Nakonezny and Hughes (2014) developed an intervention programme for ADHD children with the aim to improve EF. Metacognition involves training participants in behaviours that facilitate the allocation of cognitive resources to enhance self-regulation effectively. The intervention included activities to improve attention, inhibition, working memory and hand-eye co-ordination, where children were taught behavioural modification methods including reinforcement of positive behaviours and setting up the appropriate environment. Parents were also involved in the programme but had to attend separate sessions compared to the children. Tamm et al. observed improvements in only visual/auditory attention, working memory and cognitive flexibility (cool EF).

Using principles of metacognition and computerised tasks to train attention in children with brain injury, Treble Barna, Sohlberg, Harn and Wade (2015) found that children with traumatic brain injury had better scores on sustained attention and parent report of EF's. This integration of attention enhancing skills along with metacognitive training alone suggests that this may optimise the likelihood of generalising this treatment to improve mainly attention demanding real world situations. This suggests that working memory training is beneficial in improving

verbal and visuo-spatial ability and could likely allow for transference of skills to other untrained tasks, however as there are fewer number of interventions aimed at inhibition alone in children and adolescents, the extent to which it can be improved remains unclear (Karbach & Unger, 2014).

### **2. 1. 2. Mindfulness based interventions for executive functions**

Mindfulness is referred to the awareness of present moment experience; it involves paying attention to sensory, cognitive and emotional experiences (Germer, 2005). A substantial body of literature has linked enhanced EF to mindfulness training (Chambers et al., 2008; Josefsson & Broberg, 2011; Tang et al., 2012), For example, Flook et al. (2010) used mindfulness awareness training with young children between the ages of 7-9; this programme involved training the children in awareness of self through sensory awareness (i.e., auditory or visual), awareness of others (in particular others thoughts and feelings) and finally awareness of environment (e.g., relationships between people, places and things). Flook et al. noticed improvements in behavioural regulation and aspects of EF such as monitoring attention (working memory) and shifting attention (inhibition), as the children with low EF scores had improved their scores, Flook and colleagues concluded that mindfulness training can be beneficial to children with EF difficulties. Evidence shows that inhibition in particular is strongly linked with mindfulness (Noone, Bunting & Hogan, 2016). Noone et al. (2016) study based on undergraduate students revealed that high scores on the mindfulness questionnaire were related to better performance on EF tasks; therefore Noone and colleagues argue that the relationship between self-regulation and mindfulness is mediated by the inhibition aspect of EF.

### **2. 1. 3. Effects of physical training on executive functions**

More recently literature is emerging on the efficiency of aerobic exercises in strongly improving the prefrontal cortex and EF's (Hillman, Erikson & Kramer, 2008; Karr, Areshenkoff, Rast & Garcia- Barrera, 2014). Davis et al. (2011) measured the effects of aerobic games on EF and academic outcomes by training 7-11 year olds on aerobic games involving running and other physically demanding competitive sport such as basketball, emphasising the importance of enjoyment and intensity. Results from this study revealed that only those who were trained the most hours had improved EF test scores compared to controls and those who trained for fewer hours. Karr et al. (2014) conducted a meta-analysis on the effects of physical exercises on overall executive functions, however the main implications of this was derived from research conducted in older adults. Nonetheless they found that physical training improved working memory capacity and attentional set shifting suggesting the relevance of this to everyday behaviours and importance of this in later life.

Kamijo et al. (2011) conducted a 9 month physical activity intervention in 7-9 year old children with the aim to enhance working memory. The intervention included a 2 hour session twice a week at the end of the school day aimed at improving cardiorespiratory fitness through student engagement in a variety of age-appropriate physical activities. During these sessions, which lasted the whole school year, the children intermittently participated in approximately 70 minutes of moderate to vigorous physical activity; monitored by heart rate. Following the intervention, children who participated in the fitness training were found to have improved task performance and overall response accuracy on a working memory test

compared to waitlist controls; suggesting that regular physical activity is closely related to executive function development.

#### **2. 1. 4. Classroom interventions for executive function**

Interventions set in classrooms and exemplified by the school curriculum have also been found to improve EF, most notably Diamond, Barnett, Thomas and Munro (2007) implemented the tools of the mind programme (Bodrova & Leong, 2007) in preschool children to highlight the improvements in aspects of EF. This programme consisted of activities such as self-regulatory private speech, aids to facilitate attention, memory and role playing; this was included in all academic activities during the school day. Diamond et al. argue that pretend play allows children to plan and focus on their characters requiring the use of inhibition and cognitive flexibility. Children who participated in the tools programme were reported to have outperformed those in the comparison programme on inhibition and set shifting tasks along with enhanced academic performance.

Similarly by having an intervention in a school setting Traverso, Viterbori and Usai (2015) developed a play based intervention for children between the ages of 3 and 5 years, the role playing involved self-regulation practice and metacognitive strategies, focusing on self-esteem and well-being. The results from this study revealed improved performance on all core EF components (working memory, inhibition and cognitive flexibility).

Numerous other studies have focused on cool EF as the only aspect of EF, hence there are fewer studies looking into the benefits of intervention on hot EF, even though research shows that delay of gratification which is an aspect of hot EF is closely related to working memory and inhibition (Yu, Kam & Lee, 2016). In

typically developing children, the delay in the development of cortical structures related to EF negatively affects efficient social interactions. As EF improves, children are better able to identify and process social cues and display prosocial behaviours during complex interactions. This finding highlighted the importance of peer interaction in effective social interactions (Mikami et al., 2010). For children with behavioural disorders such as ADHD, Sonuga-Barke and Halperin (2010) suggest that even though computerised training has the potential to improve attentional control it is difficult to generalise these outcomes to other aspects of EF, therefore psychosocial interventions however delivered by teachers and parents at an early age can be a useful treatment option. Chacko, Koffler and Jarrett's (2014) review suggests that social skills training combined with neurocognitive training in behavioural disorders such as ADHD has the potential to improve ADHD symptoms as EF's are important for social functioning, particularly for children with ADHD (Huang-Pollock & Karalunas, 2010).

## **2. 2. Emotion regulation**

Defining emotion regulation (ER) and emotions has been always been contentious (Cole, Martin & Dennis, 2004). ER however can be described as the evaluation of emotional cues, which impacts behavioural and physiological responses (John & Gross, 2004). Similar to EF, ER is responsible for managing emotional responses that ultimately lead to goal achievement (Eisenberg & Spinrad, 2004); Eisenberg and Spinrad (2004) argue that any attempt at altering or regulating emotion is a feature of ER, despite the likelihood of success in the outcome; consequently the strategies that emerge as a result are considered goal directed. ER can be triggered by conscious or unconscious, automatic or effortful processes (Gross & Thompson, 2007; Thompson, 1994). ER is also involved in the



management of both positive and negative affect and is further implicated in the management and generation of emotions (Campos et al., 2004; Cole, Mishel & Teti, 1994; Gross & Thompson, 2007).

Thompson (1994) characterises emotion dysregulation as difficulties in managing emotions and the expression of it, which influences prosocial behaviours, being sympathetic and general social relationships. Children with internalising problems have been found to frequently demonstrate dysregulation of emotions. As reported by Mash and Wolfe (2002), children who suffer from anxiety are often likely to avoid situations that induce intense emotional arousal. These maladaptive strategies have been further observed in children with social phobia, in that they engage in avoidance behaviours to regulate anxiety provoking situations (Mash & Wolfe, 2002). This means that when anxious children do find themselves in anxiety provoking situations they tend to have limited skills that allow them to manage their emotions (Suveg & Zeman, 2004; Southam-Gerow & Kendall, 2000).

Suveg and Zeman (2004) found that anxious children are likely to report experiencing emotions more intensely, have dysregulated expressions, less adaptive coping and are less likely to be successful at effectively improving their mood compared to non-anxious children. This is supported by an earlier study by Weems et al. (2003) that found anxious children reported having less control over internal reactions to anxiety provoking external events.

More recently mindfulness has also been incorporated into interventions, and in non-clinical samples this has shown to reduce the frequency of negative affect (Chambers, Lo & Allen, 2008). Chambers and colleagues (2008) included a 10 day intensive mindfulness session with novice meditators, their results revealed that

depressive symptoms, rumination, and performance measures of working memory and sustained attention. Mindfulness is related to ER through self-regulation of attention (Bishop et al., 2004), allowing individuals to regulate attention based on immediate experiences. A study by Golding and Gross (2014) report that mindfulness also facilitates emotion regulation, as clinical symptoms, and automatic emotional reactivity to negative self-beliefs in adults with SAD were found to be reduced. Hayes and Feldman (2004) argue that Mindfulness is related to clarity of feelings, perceived ability to repair one's mood and cognitive flexibility, furthermore mindfulness is linked with reducing depressive and anxious symptoms as high scores of mindfulness are associated with lower scores on thought suppression, rumination, and worry.

### **2. 2. 1. Interventions for emotion regulation in internalising problems**

Research shows that young people with internalising disorders have problems with their emotion regulation (Campbell-Sills and Barlow 2007; Hannesdottir and Ollendick 2007; Ladouceur et al. 2005; Southam-Gerow and Kendall 2000; Suveg and Zeman 2004; Zeman et al. 2006). Specifically, findings from these investigations highlight that children with anxiety and depression have problems dealing with sadness, anxiety and anger with a particular deficiency in effective emotional coping with low levels of positive emotional expression being linked to higher levels of depressive symptoms (Feng et al., 2009).

Treatment incorporating emotion focused content has aided emotion regulation (Eisenberg et al., 2001; Zeman, Suveg & Shipman, 2002). Children and adolescents who suffer from depression have difficulties with down regulating negative emotions (Cole et al., 1996), and that they are also less likely to have the

necessary skills required to problem solve or regulate their emotions compared to their healthy counterparts (Campbell-Sills & Barlow, 2007; Garber & Dodge, 1991; Kring & Werner, 2004).

In a study by Silk, Steinberg, Morris (2003), depressed adolescents who had difficulty with effectively regulating their emotions reported intense and labile emotions. Silk and colleagues report that this problem with ER is significantly associated with vulnerability to internalising and externalising problems. Furthermore, depressive symptoms have been consistently associated with maladaptive emotion regulation strategies such as self-blame, rumination and catastrophising (Garnefski et al., 2003, Nolen-Hoeksema & Morrow, 1993). In particular ruminating thoughts have been found to be associated with the onset of depression and the recurrence of depressive episodes (Nolen-Hoeksema et al., 2008). Research also show impaired emotion regulation beyond recovery in individuals with depression (Ehring et al., 2008), in particular impaired emotion regulation which emerges during childhood continues, even when these individuals are no longer depressed (Chaplin et al., 2005; Cole et al., 2004; Kovacs, Sherril, George, Pollock, Tumuluru, et al., 2006).

Kovacs et al. (2006) developed a programme aimed at childhood depression with the focus on emotion regulation called the Contextual Emotion Regulation Therapy (CERT). CERT is targeted at self-regulation of distress and dysphoria, the rationale for this being that maladaptive self-regulation and dysphoria affects children's emerging ability to cope with and facilitate emerging depression. Kovacs et al. (2006) found that by reframing the child's emotion regulatory difficulties and depressive symptoms in the context of stress and coping reduced symptoms of

depression, as the children would become adept at responding to distressful situations and regulating dysphoric emotions. Based on earlier research which suggests that clinically depressed youngsters have fewer and less effective ER skills to manage negative emotions; Kovac et al. (2006) argued that by focusing on aspects such as problem solving and management of behavioural and interpersonal techniques rather than mood alone is useful, as they are necessary for adaptive functioning.

Kovacs and Lopez-Duran (2012) claim that any psychosocial interventions aimed at paediatric depression should highlight the importance of developmental parameters, i.e., as young patients tend to be at different stages of development, therefore their skill level are likely to differ as a result of language skills, executive functions, and social skills, which may then affect treatment. ER treatments aimed at anxiety and depression should reduce these symptoms simultaneously rather than specific treatments for anxiety and depression, because of the high comorbidity rates between these disorders (Trosper, Buzzella, Bennett & Ehrenreich, 2009).

### **2. 2. 2. Interventions for emotion regulation in externalising problems**

Children with attention deficit hyperactivity disorder (ADHD) are highly reactive and exhibit negative emotionality and low effortful control, along with extraversion and the overly reactive positive emotionality (Martel & Nigg, 2006). Similar to that of internalising disorders, externalising disorders such as ADHD show greater deficits in regulation of emotions than those children with ADHD or anxiety alone (Jarrett, 2016).

As emotion regulation deficits are characterised by low inhibitory control, Barkley's (1997) Model suggests that emotion dysregulation could be related to

executive function and effortful control deficits. As effortful control is strongly linked with regulation of emotion and behaviour, effortful control has been linked to the development and maintenance of children's externalising problems, Frick and Morris (2004) claim that impairments in self-regulation are related to reactive and emotionally driven conduct problems, particularly reactive aggression. Reactive aggression is further associated with poor emotion regulation and negatively linked with effortful control (Marsee & Frick, 2007; Xu et al., 2009). McLaughlin, Hatzenbuehler, Mennin and Nolen-Hoeksema (2011) report that emotion dysregulation predicted aggression along with anxiety symptoms and eating pathology. Whereas Garnefski, Kraaij and Van Meeten, (2005) observed that externalising problems were related to event avoiding strategies.

The role of emotion regulation problems in aggressive and disruptive behaviours are emphasised because dysregulated emotional responses are often considered a specific factor associated with externalising disorders (Melnick & Hinshaw, 2000). Although little is known about specific emotion dysregulation in conduct problems, conduct problems has also been found to be associated with emotion regulation deficits as these children display high levels of reactive aggression, they lack inhibitory control and have low effortful control (Blair, 2010; Martel, 2009). Additionally children with conduct problems and callous unemotional traits display poor emotion regulation along with sensation seeking behaviours, fearlessness and disinhibition of aggression, Steinberg and Drabick (2015) argues that children with conduct disorder and without callous unemotional traits are characterised by low effortful control, high reactive aggression and increased fear and executive function deficits. Whereas children with conduct disorder and callous unemotional traits are described as being low on conscientiousness, agreeableness,

decreased fear and empathy along with low effortful control and proactive aggression.

By addressing the importance of maladaptive integration of cognitive control in the expression and regulation of emotional systems, Wyman et al. (2010) devised an intervention programme called the Rochester Resilience Programme to aid children with elevated aggressive-disruptive and socio-emotional problems; the children within this programme were taught behavioural and cognitive skills such as self-control of emotions and monitoring one's own and others emotions to improve self-regulation of emotions. These skills involved reinforcement of adaptive behaviours from caregivers to guide the children, especially when behaviours such as aggression are likely to occur under calm emotional conditions (Wyman et al., 2010). The results from this study showed a positive influence of the children's classroom behaviours and rate of disciplinary incidents, with far fewer aggressive disruptive problems being reported. Moreover results revealed improved on-task learning behaviours and peer social skills with children reporting more assertive behaviours.

Wyman and colleagues suggest that their intervention programme was designed for children to learn cognitive and behavioural skills to assist them in monitoring emotions, thereby decreasing emotional reactivity and increasing self-calming skills. Similarly Blair and Diamond (2008) suggests that emotional development and processes of emotion regulation are directly influenced by the development of executive functions, including working memory, inhibitory control, and mental flexibility important for the effortful regulation of attention and behaviour. This review further highlights that focusing on working memory and

inhibitory skills enhances children's academic attainment; however noting also that emotion regulation is equally important to sustain and focus their attention. Blair and Diamond claim that this can be achieved in classroom and structured play settings.

Webster-Stratton, Reid and Stoolmiller (2008) presented a 'cascading risk factor' model to highlight the link between emotion regulation problems in childhood and conduct problems. According to this model deficits in emotion regulation during childhood lead onto emotional, interpersonal and substance abuse in later life, highlighting the need for an intervention during the early years. This has been found to be beneficial for children with conduct problems in particular as reduction in antisocial behaviours and improvements in school performance were observed (Tremblay, Pagani, Masse, & Vitaro, 1995). By involving teachers as the facilitators of their programme Webster-Stratton et al. (2008) designed a classroom based training for children involving problem solving, anger control, emotional self-regulation and social competence with the aim to reduce conduct problems and improve emotional self-regulation. Webster-Stratton et al. (2008) observed a significant improvement in teachers using specific strategies to address social and emotional skills compared to controls; moreover the children in these classrooms were better at emotional self-regulation, social competence and exhibited reduced conduct problems.

Accordingly studies have focused on emotion based prevention programmes in preschool children such as the promoting alternative thinking strategies (PATHS) programme (Domitrovitch, Cortes & Greenberg, 2007). PATHS focused on problem solving, affect recognition and emotion regulation strategies, the programme also required the involvement of teachers and staff members to lead the programme.

Children who participated in the programme had greater emotion knowledge skills compared to controls; these children were also better at identifying situations that cause different emotions and were reported to have a reduction in anger bias (i.e., correctly identifying emotional expressions which were angry) (Domitrovitch, Cortes & Greenberg, 2007).

Similar findings have been reported by Fishbein and colleagues' (2016) study using PATHS in preschool children, which measured outcomes of emotional and behavioural problems along with attention and inhibitory control. Compared to controls, children participating in PATHS exhibited improvements in motor inhibition, internalising behaviours, aggression, impulsivity and hyperactivity at post-test. Additionally children who have been placed on the PATHS programme demonstrate increasing ability to regulate their emotions and maintain peer relations (Arda & Ocak, 2012; Fishbein et al., 2016; Hamre et al., 2012).

Even though there are numerous studies supporting the efficacy of interventions aimed at improving emotion regulation, they still remain vastly underutilised in healthcare and treatment (Smyth & Arigo, 2009). The interventions in school programs indicate that there are similarities between social competence (i.e., peer relations and prosocial behaviours) and emotion regulation, by aiming to improve behavioural responses in conflict situations allows for individuals to improve on their problem solving skills and improving behavioural responses (Gollwitzer, Banse, Eisenbach & Naumann, 2007).

Overall literature highlights that ER is crucially important during development and is associated with various negative outcomes if impaired during childhood, nonetheless intervention studies which are aimed at improving emotion



knowledge and regulation skills have demonstrated that psychosocial and affective outcomes can be improved in children at risk of emotional and behavioural disorders (Smyth & Arigo, 2009).

### **2.3. Cognitive Behavioural Therapy (CBT)**

The main objective of cognitive behavioural therapy (CBT) is to assist individuals in identifying possible cognitive deficits and distortions, and then question these thoughts, followed by teaching new skills that challenge these irrational thoughts and beliefs (Kendall, 1995). The National Institute for Health and Care Excellence (NICE, 2011) a public body of the Department of Health in the United Kingdom, recommends CBT as a formal psychological intervention and a first step in treatment for those exhibiting symptoms of depression and anxiety, particularly children and adolescents. NICE (2011) characterises CBT as a collaboration with the therapist and individual

*“to identify the effects of thoughts, beliefs and interpretations on current symptoms, feelings states and problems areas. They learn the skills to identify, monitor and then counteract problematic thoughts, beliefs and interpretations related to the target symptoms or problems, and appropriate coping skills.”* - page 48<sup>4</sup>

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<sup>4</sup> National Institute for Health and Clinical Excellence (2011) Common mental health problems: Common mental health problems: identification and pathways to care. Clinical Guideline 123. London: NICE.

CBT is continually used by professionals in the treatment of mental health problems and social difficulties, encouraging individuals to analyse their emotions, contextual triggers and the resulting thought and behaviour (Sheldon, 2011).

In children and adolescents CBT has been successfully used to treat emotional disorders such as anxiety and depression (Cartwright-Hatton, Roberts, Chitsabesan, Fothergill & Harrington, 2004; Manassis et al., 2002; Mendlowitz et al., 1999; Muris, Mayer, Bartelds, Tierney & Bogey, 2001; Muris, Meesters, & Melick, 2002; Spence, Donovan & Brechman-Toussaint, 2000). For example, through cognitive restructuring CBT allows children to recognise anxious feeling and physiological reactions, clarify thoughts that occur during anxiety provoking situations (these are usually unrealistic or negative attributions and expectations). Additionally it teaches children the necessary coping and evaluation skills to use where necessary, and the behavioural training involves role playing, relaxation and exposure to avoidant stimulus (Kendall, 1995).

### **2. 3. 1. CBT for internalising problems**

There are several CBT-based intervention programmes aimed at children with anxiety with promising outcomes and which are easily accessible (Creswell, Waite & Cooper, 2014; Kendall, 1995; Mattis & Ollendick 2002). These programmes highlight the importance of exposure and cognitive restructuring (i.e., contesting the child's catastrophic thoughts during exposure of feared situations). One of the earliest form of manualised treatment for anxiety disorders in young people was the 'Coping Cat' (Kendall, 1994) comprising of psycho-education, identification and modification of negative automatic thoughts, exposure to feared stimuli, problem solving, and training in coping skills. Additionally in most

treatment programmes children and adolescents were taught how to identify emotions, thoughts and physiological reactions (Stark & Kendall, 1996). Following their programme Stark and Kendall (1996) found that anxious children were able to respond to emotions and were successful at navigating anxiety provoking situations.

Cartwright-Hatton et al.'s (2004) systematic review of CBT used in the treatment of childhood and adolescent anxiety disorders identified studies that found 56.5% remission rate in the CBT group in comparison with 34.8% in controls with an odds ratio of 3.3, thus, highlighting the significant benefit for CBT interventions. Compton et al. (2004) reviewed studies randomised control trials (RCT) of CBT in the treatment of anxiety in children and adolescents comparing waitlist and control groups to intervention groups, demonstrating the significant impact of CBT in reducing anxiety symptoms compared to waitlist and controls. Similarly Soler and Weathrall (2007) conducted a review to examine the effectiveness of CBT in childhood and adolescent anxiety disorders compared with waitlist or attention controls and found 56% remission rate in CBT group compared with 28.2% in controls, similar findings were found for individual, group and family/parental formats. The remission of childhood and adolescent anxiety or reduction in clinical symptoms of anxiety in comparison to control and attention control further suggests the effectiveness of CBT in the treatment of anxiety.

CBT has also been found to be effective in the treatment of depression (Cuijpers et al., 2012); in CBT people with depression are taught to monitor and evaluate their thoughts, they learn to identify different moods and recognise how their thoughts have influenced their mood and their behaviour. Beck (1979) claims that individuals who are more prone to depression are likely to have cognitive

distortions which lead to negative perceptions of their self, of their environment and of their future. Treatments of depression using CBT in children and adolescents have shown that CBT is useful in alleviating symptoms of depression (Forti-Burati et al., 2016; Harrington & Clark, 1998; Hetrick, Cox, Witt, Bir & Merry, 2016), and can also prevent relapse (Cuijpers, Weitz, Karyotaki, Garber, & Andersson, 2014; Paykel et al., 1999).

A substantial number of studies have investigated the effectiveness of CBT, particularly anxiety and depression, table 2.1 shows the positive outcomes of using CBT to treat emotional disorders in children and adolescents. Ishikawa and colleagues' (2007) review shows that the effectiveness of CBT in reducing anxiety was maintained at follow up for up to two years. The NICE (2011) guidelines notes that intervention for social anxiety should be based on evidence based treatment manuals. Recently the use of the computerised CBT treatment has been gaining attention, Khanna and Kendall (2010) found that their programme Camp-Cope-A-Lot to be as effective as face-to-face CBT, with reductions at post treatment maintained at 3 month follow up. Similarly the online programme BRAVE for adolescents revealed no significant differences in symptom reduction compared to clinic based CBT post treatment and at follow up (March, Spence & Donovan, 2009). Hudson and Dodd (2012) found that behavioural inhibition in preschool children were significant predictor of childhood anxiety, thus suggesting that interventions should be aimed at young children and families.

CBT has also been notably found to benefit depression in children, however Arnberg and Ost (2014) argue that compared to adults, research in childhood is 'lagging' behind. Anxiety is a common comorbidity with depression (Fonagy et al.,

2005). Chu and Harrison (2007) argue that CBT for depression has been questioned as a result of succession in the use of anti-depressant medications in comparative clinical trials (Treatment for Adolescent Depression Study [TADS] 2004). Nonetheless their review shows that all controlled studies that included either a coping or a cognitive variable reported significant positive change from pre- to post-treatment. More importantly these programmes highlight that treatment approaches that fail to represent suitable real-world conditions of clinical practice are less likely to be sustained over time compared to interventions that do not interfere with everyday practice conditions or constraints (Chu et al., 2015).

Table 2.1 summarizes the results from a selection of widely cited CBT based studies conducted over the years. These studies highlight the effectiveness of treating internalising disorders such as anxiety and disorders in children and adolescents. The studies presented in the table were included if all the participants were aged 18 years or younger and the target disorder of all the participants was anxiety or depression based. These are randomised control trials assessing participants prior to and post intervention, following DSM-IV classification of anxiety and depression. The studies identified in the table were measured using validated questionnaires such as the Child Depression Inventory (Kovacs, 1980), the screen for child anxiety related emotional disorders (SCARED; Birmaher et al., 1999) and Spence Children's Anxiety scale (SCAS; Spence, 1998). Trials that exclusively treated specific anxiety disorders such as obsessive compulsive disorder (OCD), post-traumatic stress disorder (PTSD) or simple phobia were excluded, as Cartwright-Hatton et al. (2004) suggests that the outcomes of these may differ greatly compared with those who have typical anxiety disorder.

Table 2.1

Selected studies using cognitive-behavioural therapy for internalising disorders

| <b>Study</b>                  | <b>Participants</b>  | <b>Primary Disorders</b> | <b>Treatment protocol</b>  | <b>Outcome</b>   |
|-------------------------------|--|--------------------------|--|--|
| Vostanis et al. (1996)        | 57 children and adolescents  | Depression               | CBT based on 3 treatment components which were: (1) recognition and labelling of emotions; (2) enhancement of social skills; and (3) changing negative cognitive attributions. Clinic based and conducted over 9 sessions, over 6 months.                    | At follow up treatment groups maintained a significant improvement on all psychosocial measures, however no significant treatment effect was established.  |
| Asarnow, Scott & Mintz (2002) | 88 children; from 4 <sup>th</sup> to 6 <sup>th</sup> grade school population | Depression               | Depression specific CBT programme called Stress-Busters focused on inclusion of family and videotapes created by children for parents to demonstrate progress. 90 minute each 7 sessions were aimed at children, and a single 90 minute session for parents. | Children in the intervention group showed reductions in depressive symptoms, negative cognitions, and internalizing coping (depressive and anxious responses to stress) compared to children in the control group. |
| Roberts et al. (2003)         | 189 children; 11 to 13 years.  | Depression, anxiety      | A CBT based prevention program aimed at reducing depressive and anxious symptoms, consisting of 12 sessions.   | Programme effects were found for anxiety, emotional and behavioural problems at post intervention and effects for anxiety were maintained at 6 month follow-up.  |

|   |  |            |   |  |
|---|--|------------|---|--|
| Barrett, Farerell, Ollendick & Dadds (2006) | 669 children and adolescents; 10 – 14 years. | Anxiety    | FRIENDS programme, group based treatment of 10 sessions, 70 minutes each. Designed to help children cope with and manage anxiety and emotional distress through the application of learned coping and problem-solving skills. | Fewer high-risk students at 36-month follow-up in the intervention condition than in the control condition.  |
| Goodyear et al. (2007)                      | 208 young people aged 11-17 years.           | Depression | Intervention group consisted of individuals on SSRI's (fluoxetine) and received 19 Individual CBT sessions of 55 minutes each over 28 weeks. Control groups received SSRI's alone.  | Both groups showed improvement in depression, mood, functioning, and suicidality. However based parent reports there was no significant advantage of CBT plus SSRI over SSRI care alone. |
| Stallard et al. (2007)                      | 106 children; 9 to 10 years                  | Anxiety    | FRIENDS Emotional Health Programme, over 10 weekly sessions.  | Anxiety and self-esteem scores remain stable at follow up, however these scores improved when assessed at 3 month follow up.   |
| Bernstein, Bernat, Victor & Layne (2008)    | 61 children; 7 to 11 years.                  | Anxiety    | FRIENDS programme, consisting of 9 weekly group session and 2 booster sessions.   | Participants in group CBT plus parent training showed significantly greater improvement on the Screen for Child Anxiety Related Disorders (SCARED)                                       |

compared to the control group at 6-month follow-up.

|   |                                  |            |   |  |
|---|----------------------------------|------------|---|--|
| Mostert & Loxton (2008)                 | 66 children aged 12 years.       | Anxiety    | FRIENDS program as measured by the Spence Children's Anxiety scale (SCAS) over 10 weeks sessions.   | Significant reductions were found for anxiety symptoms at 6 months follow up.  |
| Rosselló, Bernal & Rivera-Medina (2012) | 112 adolescents; 12 to 18 years. | Depression | CBT and intrapersonal psychotherapy for Puerto Rican adolescents consisting of 24 individual and group sessions which were 2 hours and held over a 12-weeks.  | CBT predicted greater reductions in depressive symptoms compared to intrapersonal psychotherapy. This was also found for self-concept and social adaptation. |
| Abeles et al. (2009)                    | 23 adolescents; 12 to 16 years.  | Depression | Computerised version of the CBT programme 'Stress-busters' of 8 sessions for 30-45 minutes. Sessions were interactive multi-media presentation featuring audio narration synchronized with videos supplemented with animations, graphics and printouts. | Significant reductions in depressive symptoms post treatment; these were maintained at 3 month follow up.  |



|                           |  |                        |  |  |
|---------------------------|--|------------------------|--|--|
| Creswell et al.<br>(2010) | 41 children; 5<br>to 12 years.                                 | Anxiety                | Parent administered self-help treatment, and provided with self-help book. Parents were contacted over 8 weekly sessions to rehearse key skills, and to help problem solve challenges.   | Reductions were reported for anxiety disorders, with 61% of those who completed treatment no longer meeting diagnostic criteria for their primary anxiety diagnosis, and 44% free of all anxiety disorder diagnoses. |
| Stallard et al.<br>(2011) | 20 young<br>children and<br>adolescents;<br>11 to 16<br>years. | Anxiety,<br>depression | Computerised CBT programme (Think, Feel, Do); 6 weekly sessions lasting 30–45 minutes. The programme contains interactive multimedia components such as sounds, photos, cartoons and music, and uses narrators to guide the user through the sessions. | Significant improvements were found post intervention, with participants reporting moderate to high satisfaction.  |
| Comer et al.<br>(2012)    | 9 children; 4<br>to 8 years.                                   | Anxiety                | Coaching Approach behaviour and Leading by Modeling (CALM) programme. 12 sessions of parent child interaction therapy. Providing behavioural parent training via real-time in-session coaching.  | All treatment completers were classified as global treatment responders by independent evaluators, with all but one showing full diagnostic improvements, and all but one  |

showing meaningful functional improvements.

Anxiety levels dropped in the first 2.5 months and then over the next 14.5 months for both intervention and attention-control groups. The same pattern was found for the high-anxiety subgroups of children.

Miller et al.  
(2011)

Study 1 –  
191 children  
with mean  
age 10.1  
years; study 2  
– 253  
children with  
mean age 9.8.

Anxiety

FRIENDS programme conducted over 9 sessions. Study 1 targeted children with anxiety; study 2 was aimed at whole classrooms. Follow up assessments were collected at 5 months and 17 months.

Tobon et al.  
(2011)

40 children; 8  
to 12 years.

Anxiety

The Worry Warriors program is a group programme of 12 weekly sessions of 90 minutes each. A corresponding parent group was offered simultaneously with the children's group.

Late involvement did not predict treatment outcomes, however early involvement predicted reduced anxiety at post treatment.

Essau, Conradt,  
Sasagawa &  
Ollendick  
(2012)

638 children;  
9 to 12 years.

Anxiety

FRIENDS programme, conducted over 10 weeks, with 2 follow up assessments at 6 and 12 months.

Compared to controls reductions in anxiety were significantly greater for participants in the intervention group at the 12-month follow-up.

|                         |                              |         |   |   |
|-------------------------|------------------------------|---------|---|---|
| Thirlwall et al. (2013) | 194 children; 7 to 12 years. | Anxiety | A self-help cognitive-behavioural therapy (CBT) for child anxiety and by involving parents in treatment. 8 sessions of full guided parent-delivered CBT (four face-to-face and four telephone sessions) or brief guided parent-delivered CBT (two face-to-face and two telephone sessions) were delivered. Post assessments were conducted at 12 weeks and at 6 months. | The full guided parent-delivered CBT was found to be effective treatment for child anxiety. At 6-month follow-up, positive clinical outcomes were maintained and there was evidence of sustained improvement. |
|-------------------------|------------------------------|---------|---|---|

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*Note. CBT = Cognitive Behavioural Therapy.*

### **2. 3. 2. CBT for externalising problems**

CBT has been used in the treatment of childhood behavioural disorders, as it targets disruptive behaviours by decreasing children's social cognitive deficits and distortion (Ghafoori & Tracz, 2001). By employing the concept of cognitive restructuring to address issues such as self-control, interpersonal and academic difficulties, self-regulation of behaviour is achieved. In CBT children are encouraged to engage in self-talk to instruct, monitor and reinforce motivational behaviours to enhance self-control of attention and reduce impulsive behaviours (Meichenbaum & Goodman, 1971). CBT has been established to be effective in the treatment of disruptive behaviour, with improvements in behavioural problems being observed by teachers and parents (Ghafoori & Tracz, 2001).

For behavioural disorders such as ADHD, CBT has shown to improve disruptive and impulsive behaviours post interventions (Bloomquist, August & Ostrander, 1991). According to their findings based on a meta-analysis Purdie, Hattie and Carroll (2002) suggest that CBT alone is less significant in reducing ADHD symptoms but requires pharmacological interventions. Regardless, the effectiveness of CBT has been demonstrated consistently in reducing core symptoms of ADHD, conduct problems and problem behaviours (Froelich, Doepfner, & Lehmkuhl, 2002).

Froelich et al. (2002) utilised parent management training and CBT based programme involving problem solving games, self-instructional strategies and skills to deal with social conflict for 6-12 year old children with a diagnosis of ADHD and conduct problems; the results showed that there was a reduction in behaviour problems and ADHD related symptoms, Froelich and colleagues claim that CBT

based programme which includes self-instructional skills, self-assessment and self-monitoring training is more effective in training children with self-guidance.

A meta-analysis conducted by Litschge, Vaughn and McCrea (2010) found that CBT generally does reduce disruptive behaviours and conduct problems in older youths with medium effect size observed for 82% of the studies. Using CBT and motivational enhancement therapy, Kamon, Budney and Stranger (2005) conducted a randomised clinical trial to investigate the efficacy of their treatment in 12-18 year old adolescent substance abusers with conduct problems. Findings from this study revealed that abstinence increased from 37% at intake to 74% post treatment, along with reduction in conduct problems; additionally they found that adolescents also reported a reduction in internalising problems. A meta-analysis by Hogue et al. (2008) further support the claim that CBT does predict a decline in drug use and externalising behaviour problems.

Table 2.2 demonstrates studies that indicate the effectiveness of a CBT based programme in the treatment of behavioural disorders. Lochman and colleagues (2011) suggest that emotion regulation is a key aspect in reducing externalising behavioural symptoms, thus highlighting the necessity of inclusion in treatment. Several studies support the effectiveness of the coping power programme (Lochman, & Wells, 2002; Zonnevyl et al., 2007; van de Weil et al; 2007). The coping power programme focuses on emotion recognition, awareness, anger coping through self-talk and distraction, perspective taking, goal setting, and social problem solving, studies have reported reductions in teacher-rated aggression, and improvements in self-esteem and perceived social competence (Lochman, & Wells, 2002; Larson & Lochman, 2002). CBT appears to be the most promising form of treatment in

treating behavioural problems and maladaptive aggression, however treatment predictors still needs to be examined (Smeets et al. 2013).

Table 2.2 is a selection of studies conducted between the years 1991 and 2016. The studies included in this table have been trials aimed at children and adolescents under the age of 18 years, focusing on externalising disorders such as conduct problems, ADHD and other behavioural disorders including anti-social behaviour disorders, oppositional defiant disorders (ODD) and aggressive behaviours. These were either randomised control trials or open trial studies measured using a mixture of diagnostic interviews and scales following DSM IV and V criteria such as the Child Behavior Checklist (CBCL; Achenbach,1991). Studies using psychosocial treatment aimed at reducing disruptive behaviours were included; in particular these studies have highlighted significant improvement post treatment in reducing externalising behavioural problems. Studies involving pharmacotherapy were excluded from the table.

Table 2.2

Selected studies using cognitive-behavioural therapy for externalising disorders

| <b>Study</b>                          | <b>Participants</b>   | <b>Primary Disorder</b> | <b>Treatment protocol</b>   | <b>Outcome</b>  |
|---------------------------------------|---|-------------------------|---|---|
| Bloomquist, August & Ostrander (1991) | 52 elementary school children.  | ADHD                    | School based CBT program aimed at reducing symptomatic behaviours and improving adjustment in children with ADHD  | Programme improved observed off task disruptive behaviour at post-test and was maintained at follow up. The intervention the intervention had minimal short-term effects on the ADHD children.  |
| Lochman & Wells (2004)                | 183 male children from 6 <sup>th</sup> and 7 <sup>th</sup> grade school population. | Disruptive behaviours   | Coping Power Program with parent and child components included 8 intervention sessions in the 1st intervention year and 25 in the 2nd intervention year. Group sessions lasted for 40–60 min per session. | Delinquent behaviour and parent-rated substance use at the 1-year follow-up was significantly reduced. Teacher-rated behavioural improvements were reported in school during the follow-up year |
| Lipman et al. (2006)                  | 123 families with children aged 7 to 11   | Aggressive behaviours   | Parents/caregivers received 3 skill building group sessions, and children's programme was CBT based called problem called the kNOW Problem Pathway  | Significant improvements were observed for all parent rated measures, however compared to controls there were significant   |

|                                 |   |                                |   |   |
|---------------------------------|---|--------------------------------|---|---|
|                                 | years.                                      |                                | aimed at problem solving process to help children manage their temper.  | improvements were found for child behaviour, parent child relationship and parental stress.   |
| Apsche, Bass & Houston (2007)   | 8 families                                  | Disruptive behaviour disorders | Effectiveness of treatment as usual (TAO) group versus Mode Deactivation Therapy (MDT) incorporating treatment strategies from behavioural, cognitive and dialectical approaches.                               | Post treatment children with Disruptive behaviour disorders exhibited reduction in internalising and externalising scores. MDT was found to be more effective than TAU in improving family relationships. |
| van de Wiel et al. (2007)       | 77 children; aged 8 to 13 years.            | Disruptive behaviour disorders | Coping Power Program (UCPP) and Care as usual (CU), CU consisted of family therapy (FT) and behaviour therapy for children and consisted of 23 sessions over 9 months for children and 15 sessions for parents. | Reduction in overt aggression was significantly larger in the UCPP compared to family therapy condition.  |
| Zonneville-Bender et al. (2007) | 61 children and adolescents; 8 to 13 years. | Disruptive behaviour disorders | CBT based behaviour therapy (Utrecht Coping Power Program; UCPP) or to care as usual (CU) in the Netherlands consisting of 33 weekly sessions.  | Findings show a beneficial long-term preventive effect on delinquency, and in reducing substance use in early adolescence.  |



|   |  |                                |   |  |
|---|--|--------------------------------|---|--|
| Dadds, Cauchi, Wimalaweera & Brennan (2012) | 195 children aged between 6 to 16 years. | Disruptive behaviour disorders | RCT comparing emotion recognised training for children and treatment as usual programme for parents. Both programmes were 4 sessions, with parent programme consisting 1.5 hour sessions of Integrative Family Intervention for Child Conduct Problems  | Significant improvements in children with high levels of conduct problems, the programme was also associated with improvements in affective empathy. |
| Gavița et al. (2012)                        | 97 children; 5 to 18 years.              | Disruptive behaviour disorders | Programme aimed at Romanian foster children, consisting of 4 weekly sessions for 4 hours each, with a follow up 4 hour session. CBT based parent intervention focused on the role of cognitions in parental distress (e.g., rational thinking life self and children acceptance), in relation to children's behaviours; identifying strategies for emotion regulation and stress reduction, and finally exploring disciplining/problem-solving and monitoring techniques. | Programme was successful in in reducing externalizing behaviour symptoms and parental distress.  |
| Taylor et al. (2015)                        | 22 primary caregivers and 29             | ADHD                           | RCT based parenting programme in a school setting for at risk ADHD children (PATCHWORK). Parents participated in semi structured group or individual  | Qualitative analysis showed positive outcomes for parents who were in the intervention group compared to controls.                                   |

|                               |   |                                |  |  |
|-------------------------------|---|--------------------------------|--|--|
|                               | teachers of children aged 4 to 8 years.               |                                | interviews, whereas teachers 1.5 hour session on the details of the programme.   |  |
| Kirkman, Hawes & Dadds (2016) | 47 families; with children aged 3 to 12 years.        | Disruptive behaviour disorders | Clinic based and telemental health behavioural parent intervention treatment RCT. Clinic based treatment consisted of 8 weekly 50 minute sessions. with individualised consultations via videoconference   | Children whose parents had received either intervention showed a significant reduction in oppositional behaviours and ADHD symptoms.                                   |
| Sayal et al. (2016)           | 199 primary caregivers of children aged 4 to 8 years. | ADHD                           | The PATCHWORK programme was delivered to groups of parents of children at risk of ADHD over 3 consecutive weeks. The 2 hour sessions were focused on strategies to improve behaviour, manage behaviour and maintain relationship with their child. | There were no significant reductions observed in children's ADHD related symptoms, however parents rating of hyperactivity and improvements in parental mental health. |

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*Note. CBT = Cognitive Behavioural Therapy; RCT = Randomised Controlled Trials.*

### **2. 3. 3 Transdiagnostic CBT programmes**

Recent research suggests that a transdiagnostic approach would be more effective in treating disorders compared to a single diagnosis approach (Newby, McKinnon, Kuyken, Gilbody, & Dalgleish, 2015). The transdiagnostic approach addresses common and core maladaptive temperamental, psychological, cognitive, emotional, interpersonal and behavioural processes associated with diagnostic symptoms. Transdiagnostic treatments apply a unified protocol for several disorders (McEvoy, Nathan & Norton, 2009), and has particularly been praised for its approach in conceptualising a common process presenting various symptoms, easing the implementation of treatment (Chorpita & Daleiden, 2009).

Support for the use of transdiagnostic approach in treatment resulted from the need to plan treatment for disorder comorbidity (Weersing, Rozenman, Maher-Bridge, & Campo, 2012). Greater levels of comorbidity can be found in internalising disorders such as anxiety and depression, where 25-50% of youths with depression have comorbid anxiety (Angold et al., 1996). CBT based transdiagnostic programmes have successfully shown reduction in clinical severity of anxiety and depression in children and adults (Bullis, Fortune, Essau et al., 2012; Farchione, & Barlow, 2014; Farchione et al., 2012). Chu et al. (2009) used a behavioural activation programme for children and adolescents with either anxiety or depression. This programme was implemented in schools over 10 sessions by trained therapists. These sessions were developed to teach children ways to self-assess their strengths and weaknesses, prevent avoidance behaviours and finally plan and work towards set targets. The results which were presented as case series based on data from 5 children showed that the students were satisfied with the group based setting and were able to establish relationships during the short period. Moreover these students

were then less inhibited to question thoughts, feelings and interpersonal relationships.

Ellard and colleagues (2010) devised a Unified Protocol for Transdiagnostic Treatment of Emotional Disorders (UP) a transdiagnostic CBT based programme, in adults presenting symptoms of anxiety and depression, and constant endorsement of negative affect. The objective of this being to improve emotion regulation skills and awareness whilst facilitating cognitive flexibility. Ellard et al. (2010) reported that following the intervention significant improvements were observed for comorbid anxiety and depression symptoms, in particular severity; with participants reporting lower levels of negative affect.

Similarly Sauer-Zuvala et al. (2012) applied the unified protocol for emotional disorders using a randomised control trial to reduce negative emotion and emotional reactivity, the results showed a reduction in frequency of negative emotions and emotional reactivity along with strong association of this in reducing emotional disorders. The use of transdiagnostic programmes in school highlights the feasibility of running such programmes in reducing emotional and behavioural difficulties (Chu, Colognori, Weissman & Bannon, 2009; Essau et al., 2012). Fraire and Ollendick (2013) recommend that an emotion focused transdiagnostic CBT would be efficient in enhancing children's ability in managing emotional challenges and cognitive distortions.

#### **2.3.4. CBT links to emotion regulation and executive functions**

Research also shows that for effective CBT executive functions skills are imperative (Hariri, Bookheimer, & Mazziotta, 2000; Stein, Westenberg, & Liebowitz, 2002). Mohlman and Gorman (2005) tested the outcomes of EF

following CBT based training, the treatment consisted of 13 weekly sessions consisting of problem solving training, exposure to anxiety provoking situations daily structure exercises, and sleep hygiene exercises. Few studies have investigated the outcomes of CBT in relation to EF, even though CBT has been found to directly influence EF outcomes (Mohlman, 2008).

CBT has also been found to reduce emotional difficulties (Lindsay, 1999; Taylor, Lindsay & Willner, 2008). For example, Scarpa and Reyes (2011) examined the effectiveness of a CBT programme aimed at children aged between 5-7 years with Autism Spectrum Disorders (ASD) with the objective to teach emotion regulation strategies; this programme consisted of 8 sessions focused on building skills such as affective education, stress management, and understanding expressions of emotions. These sessions were facilitated by relaxation exercises, physical and social tools to improve intense emotions. The results demonstrated a significant decrease in emotional outbursts as reported by parents in children in treatment groups compared to controls, moreover children were found to have an enhanced understanding of emotion regulation strategies, along with parental confidence in managing their children's emotions.

Aldao, Jazaieri, Goldin and Gross (2014) focused specifically on adaptive and maladaptive emotion regulation strategies following a CBT programme for individuals with social anxiety disorder, including activities that challenge dysfunctional core beliefs and cognitive restructuring, the outcome of which included a reduction in maladaptive avoidant strategies and an increase in adaptive emotion regulation strategies post treatment. Studies have also used CBT as an effective treatment programme for PTSD and culture bound anxiety syndrome

(ataque de nervios) to improve emotion regulation strategies (Hinton, Hofmann, Pollack & Otto, 2009; Hinton, Hofmann, Rivera, Otto & Pollack, 2011). Hinton et al. (2011) highlights the importance of CBT in improving somatic symptoms and emotion regulation strategies and applicability in other culture groups. Ochsner, Bunge, Gross and Gabrielli (2011) suggest that ER has close links to complex cortical structures and cognitive processes thus influencing reappraisal of negative affect.

To conclude, CBT is one of the most widely researched psychological interventions for a wide range of disorders and problems (Beck et al., 1997). In particular large effect sizes have been observed for internalising disorders including depression and anxiety, and to modest extent behavioural problems (Butler, Chapman, Forman & Beck, 2005). CBT has further demonstrated its effectiveness in improving emotion regulation symptoms, particularly in those with internalising problems, with participants reporting an increase in the use of putatively adaptive emotion regulation strategies (Goldin et al., 2012).

There are far fewer studies measuring the impact of CBT on cool and hot EF in children with behavioural and emotional problems. Following treatment sessions participant completed a maintenance phase and booster sessions. Although conducted in older adults (over the age of 60 years), the results indicated that there was no difference in EF following treatment, however participants without EF deficits benefited from the programme. Mohlman (2008) tested CBT enhanced with attention process training modules with adults with anxiety disorders and reported a significant improvement in executive skills (i.e., working memory, inhibition and cognitive set shifting tasks) in the treatment group. Mohlman (2008) argues that

these results could be extended to other disorders, considering executive skills as mechanisms of effective CBT. These findings suggest that EF skills may mediate the outcome of an intervention, as numerous studies demonstrate that EF can be improved in children and adolescents following interventions based on similar principles as CBT (i.e., social competence and cognitive restructuring).

### **2.3.5 Summary & Aims**

CBT research targeted at internalising and externalising disorders show significant improvements following trial regardless of their mode of delivery (i.e., individually or in a group). Overall, studies showed that up to 50-70% of the young people with anxiety or depression responded positively to CBT (Essau et al., 2012). However a handful of authors have developed a transdiagnostic programme (Bilek & Ehrenreich, 2012; Essau et al., 2014; Norton et al., 2013) that aims to tackle the issues of common core risk factors such as low self-esteem and deficits in social skills. Children with emotional and behavioural problems are often reported to have poor social skills, whereby anxiety is a predictor of low friendship quality, which in turn is a risk for victimisation (Barkeley, 2002; Crawford & Manassis, 2011). More importantly Essau et al. (2014) found that cognitive preparations and video feedback offers children the opportunity to enhance self-impression, thus altering their distorted belief specific to social situations, self focused attention and safety behaviours. Additionally during the early years suggest children with comorbid disorders are often excluded from trials (Kendall et al., 2010).

As research has mainly investigated the effect of intervention in EF following computerised training and behavioural programmes, few have examined the impact

of CBT, even though studies shows EF is influenced by CBT treatment. Therefore one of the aims of this study is to use an established CBT based transdiagnostic programme called Super Skills for Life (SSL) to examine its effectiveness in improving ER skills and EF.<sup>5</sup> Research also shows that transdiagnostic approaches can be effective in reducing both emotional and behavioural disorder (Essau et al., 2012) however the differential effect on emotion regulation and EF is yet to be examined.

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<sup>5</sup> See chapter 6 for further detailed aims.



## **Chapter 3: Study 1 Methodology Overview**

### **3. 1. Introduction<sup>6</sup>**

The present research programme consists of two studies, however data collected for study 1 is presented in two parts, the first part was a cross sectional investigation of the relationship between cool and hot executive functions and emotion regulation strategies in different age groups (Study 1, part I: See chapter 4). The second part examined the association between cool and hot EF, and behavioural and emotional problems, and whether this relationship is mediated by emotion regulation strategies (Study 1, part II: See chapter 5). Study 2 investigated the impact of an intervention programme in improving executive functions and emotion regulation. This chapter outlines the methodology from the first study.

Participants were required to complete computerised tasks to measure outcomes of cool and hot EF, emotion regulation and behavioural and emotional

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<sup>6</sup> The methodology for Study 2 is described in chapter 6 (page 173).

problems were assessed using self-report questionnaires. The measures used in Study 1 and Study 2 were similar; however for the intervention study an additional scale to measure children's anxiety was used.

The findings of these were analysed using correlations to identify the relationship between EF tasks and ER scales. A series of analysis of variance (ANOVA) were conducted to measure performance differences in age groups. This was followed with mediation analyses, with ER as the mediator and EF as the independent variable.

### **3.2. Ethical Approval**

Ethical approval was obtained for the study before any assessments and implementation of the intervention programme, from the ethics board of committee at the University of Roehampton<sup>7</sup>. Initially consent to participate in schools was obtained as opt-in, however, as a result of difficulties in recruitment this was altered to opt-out. The measures and tasks the children completed are comparable with those they would encounter as part of their normal school curriculum. All the materials used in the study (i.e. the questionnaire measures and detailed descriptions of the tasks children will undertake) were left in the participating schools' office, so parents were able to look over the materials if they wish to do so, before their children took part in the study<sup>8</sup>. This was explained to parents in the opt-out consent letter, that they are required to return if they do not want their child to take part. Once a

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<sup>7</sup> See appendix I for ethics confirmation from the department of psychology.

<sup>8</sup> See appendix IV for parent letter.

specified time had elapsed allowing parents/guardians to express their desire to ‘opt out’ (a recommended period of one educational week – Monday to Monday), the children who agreed to participate in the study completed each of the tasks and questionnaires.

Following the completion of the computerised tasks, participants were offered a break for a few minutes if needed. All data gathered was saved anonymously and treated with confidentiality; no names were recorded for any of the students. The schools and the parents were informed that they have the right to withdraw their students/children from participating in the study at any time. Children in schools were verbally debriefed, whereas university student participants in the first study were debriefed at the end of the whole procedure and provided with an information sheet regarding the study and contact details of investigator, along with information of organisations offering emotional support such as the student welfare centre<sup>9</sup>.

### **3.3. Participants**

Participants in this study consisted of 53 children (7-11 year olds), 80 adolescents (12-17 year olds) and 117 adults (18-24 year olds). There were no exclusion criteria for the first study, of which 106 were female participants and 144 were male. These age groups were identified to measure age related differences similar to Prencipe et al. (2011) and Hooper et al. (2004). The adult participants were recruited from the university campus, whilst the children and adolescents were

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<sup>9</sup> See appendix V for student information sheet.

recruited from local primary and secondary schools following consent from the school and parents. The schools were from South West London region, where students from diverse social and cultural backgrounds attended.

### **3.3.1. Recruitment**

The university students for this study were recruited using the University of Roehampton's SONA system, which allows students to register their interest in the study; they were reimbursed for their time with credits. There was no pressure to take part in the project and should the student wished to decline to participate or withdraw their data, their course marks were not adversely affected. Children and adolescents below the age of 18 were tested using opt out consent procedure. A total of 119 primary and 49 secondary schools within South London were invited to participate in the research, from this only one primary school and four secondary schools agreed to allow their students to participate in the first study.

Firstly, the school head-teachers provided consent for the research to go ahead in the school, followed by opt-out letters to gain parental consent. The Head teachers were then asked to sign a letter of consent specifying permission for recruitment and testing in the school during lesson time (see appendix III). All materials and procedures were seen and checked by the Head teacher or special education needs co-ordinator or class teachers as part of this approval. Secondly, parents were provided with a consent letter giving them the option to opt-out their children from the study (see appendix IV). They were informed that they could withdraw their child from the study at any time (this was made clear in the opt-out

consent letter) by contacting the researcher and asking for their child's data to be removed (though data may still be used in a collated form).

### **3.4. Materials**

The computerised tasks were completed online using the millisecond software (Inquisit, 2014); each task script was then saved as a sequence and published on the millisecond website. Therefore participants were able to simultaneously complete the tasks online in a designated room. Based on task sequence allocation, participants first completed the go/no-go task, followed by the balloon analogue risk task, delay and probability discounting task ending with the digit span which was conducted by the researcher. The questionnaire set for the first study was completed on paper following the completion of the tasks.

#### **3.4.1. Cool tasks**

**Digit span** was used to measure working memory. It is a subtest taken from the Wechsler Intelligence Scale for Children (WISC III; Wechsler, 1991) which consists of two tests (forward and backward). For the forward digit, span participants are required to verbally recite a sequence of digits (e.g., 5, 1, 7, 4, 2, 3, 8) immediately after the sequence was verbally presented. However, for the backward digit test they were required to repeat the sequence in reverse order. The test was presented in a fixed order of forward and backward, starting with a sequence of 3 numbers, with the number of digits increasing by one for each sequence and ending with 9 numbers. The task was terminated if the participants scored two or more errors on each trial. Total scores are calculated by adding the number of correct responses on each trial for both tests. The digit span is considered to be a measure of

working memory as the task requires task relevant information to remain active but at the same time demands secondary processing such as comprehension (Conway et al., 2006).

**Go/no-go** was used to measure inhibitory control (Fillmore, Rush & Hays, 2006). The task consisted of 250 trials with four possible target combinations with 125 cues in each target combination of either vertical or horizontal go trial and no go trial randomly presented. Participants were requested to immediately respond to go cues (i.e., the colour green), whilst the no go cue was to inhibit responding to the colour blue. The cue was a rectangle (7.5 x 2.5 cm) framed in a 0.8 black outline presented in the centre of the monitor against a white background. The orientation of the cue varied from either horizontal or vertical. The numbers of responses successfully inhibited on no-go trials were used to measure probability of inhibition (Dolan et al., 2013; Hobson et al., 2011). Go/no-go paradigm has been used to successfully measure response inhibition in various forms with the aim to restrain or suppress a dominant response inappropriate for the present situations (Ding et al., 2014; Nigg, 2001; Thorell et al., 2009).

### **3. 4. 2. Hot tasks**

**The balloon analogue risk task**, youth version (BART-Y; Lejuez, Aclin, Daughters & Zvolensky, 2007) was used as a risky decision making task which means the effect of reward on performance (Fukunaga, Brown & Bogg, 2012). Participants were required to inflate a computer generated balloon to earn reward points, with each pump participants score additional points in the reward meter until they stop pumping and acquire the points. The balloon will pop if pumped past its

explosion point; following the first explosion the amount to be lost is increased with every successive pump. The normal distribution of the explosion points are around 64 pumps, and contain 30 explosion points for each trial (Lejuez et al., 2007; Lejuez et al., 2002). The overall task included 30 balloon trials with the explosion point varying across the trials; participants were made aware that they would have to determine how much they would need to pump the balloon to obtain points, as there could be enough pumps for the balloon to fill the entire screen. During the task participants are able to view the reward meter positioned on the right side of the computer screen which indicates the score based on balloons that were not exploded. The reward metre was a simple metre indicating a bar for low, middle, high and bonus score. The dependent variable of the task is the average number of pumps for balloons that did not explode.

Previous studies have shown that the BART was positively associated with risky behaviours and substance abuse (Lejuez et al., 2005; Lejuez et al., 2005). BART also provides rewards (points) and negative punishment (i.e., when points are revoked as a result of balloon explosions) and has been used as a measure of motivational decision making (Humphrey & Lee, 2011) particularly as participants have been found to exhibit distinct reward seeking and delay aversion signals during decision making on the BART (Fukunaga, Brown & Bogg, 2012).

**Delay and probability discounting task (DPDT)** was used to measure reward related decision making based on the delay of gratification paradigm (i.e., the extent to which the subjective value of a reward is influenced as a result of delay). Participants were given the opportunity to select a variable amount of money and a fixed amount of \$10 that would be delayed by 1, 2, 30, 180 or 365 days. The amount

of reward and the magnitude of the immediate reinforcer start at 0.50 cents and increases at 0.50 cent intervals until it subjectively reaches the value similar to the delayed reward within 70 trials. The dependent variable is referred to as indifference point, which is the duration of delay applied to the reward, thus representing the value of delayed outcome (Odum, 2011).

Indifference points were calculated to estimate delay and probability discount functions for each participant, this was achieved using the random adjusting-amount procedure in Inquisit. Higher values indicate improved performance, Richard, Zang, Mitchell & De Wit (1999) found that as indifference points declined the likelihood of their participants receiving the highest reward declined. Previous studies have analysed the indifference points according to Mazur's (1987) hyperbolic function of  $V = A / (1+kD)$  discount curves were set (Richards et al., 1999; Prencipe et al., 2011), where V is the value of the immediate reinforcer (i.e. immediate smaller amounts and larger reinforcer after a delay), D represents length of delay (1-365) and k is a free parameter which required calculation. In this study however similar to Myerson and Green (1995) and Rachlin, Raineri and Cross (1991) median values for the delay and probability indifference points were used.

Discounting is considered a fundamental process of decision making, for example when conceptualising the choice between immediate and delayed rewards it is a choice between alternatives that differ in relation to the risk involved, as waiting involves a risk of failing to attain the reward. Therefore this model of delay discounting assumes that each unit of delay is involved with identical marginal increase in the degree of risk (Myerson, Green & Warusawitharana, 2001). Moreover poor score on the delay discounting paradigm has been linked to poor cool EF tasks



such as go/no-go, the process involved in delay discounting are considered to be distinct from cool EF processes as these mechanisms rely on decision making in regards to future rewards (Olson, Hooper, Collins & Luciana, 2007).

### **3. 4. 3. Questionnaires**

#### **3. 4. 4. Self-report measures of emotion regulation**

**Cognitive Emotion Regulation Questionnaire** (CERQ; Garnefski, Kraaij & Spinhove, 2001) was used to measure emotion regulation strategies. The CERQ is a 36 item, 5 point Likert scale ranging from 1 (almost never) to 5 (almost always). This questionnaire identifies 9 separate emotion regulation strategies which include refocus on planning (i.e., steps needed to take to deal with negative situations) putting into perspective (i.e., comparing the relativity of the event to previous experiences), acceptance (i.e., referring to acceptance of negative experiences) positive refocusing (i.e., positive thoughts associated with the events) positive reappraisal (i.e., relating a positive meaning to the experience e.g., I think I can learn something from the situation), self-blame (i.e., blaming oneself for events experienced), rumination (i.e., thoughts associated with negative feelings) other blame (i.e., referring to thoughts of blaming others) and catastrophizing (i.e., thoughts emphasising the negativity of the experience).

The school children completed the kid's version (CERQ-K; see appendix X) which is identical to the original version of CERQ (see appendix XI), the CERQ-K however has phrased some of the questions appropriate for children (e.g., item 16 of the CERQ-K reads "I think that worse things happen to others", whereas the original item 16 is stated as "I think that other people go through much worse experiences")

(Garnefski et al., 2006). Jermann et al. (2006) found decent internal consistency ranging from .68 to .87 respectively, suggesting that CERQ is a reliable measure for a wide variety of cognitive strategies associated with emotion regulation.

### **3.4.5. Self-report measures for behavioural and emotional problems**

**Strengths and Difficulties Questionnaire (SDQ)** was used to measure positive and negative attributes (Goodman, 1997) (see appendix XII). It contains 25 item self-report measure that produces scores on five subscales, including emotional symptoms (e.g., ‘I worry a lot’), conduct problems (e.g., ‘I get very angry and often lose my temper’), hyperactivity (e.g., ‘I am restless, I cannot stay still for long’), peer problems (e.g., ‘I am usually on my own. I generally play alone or keep to myself’) and prosocial behaviour (e.g., ‘I have one good friend or more’). Each of these subscales has 5 items. These items are scored on a 3 point Likert scale (0 = not true, 1 = somewhat true, and 2 = certainly true) with subscale score ranging from 0-10. There were additional questions measuring impact of behavioural outcomes (e.g., do the difficulties upset or distress you?). Total difficulties were calculated by adding up all the subscales except for prosocial behaviour. Higher scores on the prosocial behaviour subscale indicate strengths, whereas higher scores on the other four subscales reflect difficulties.

**The Inventory of Callous-Unemotional Traits (ICU; Frick, 2003)** was used to measure callous-unemotional traits among children and adolescents. Confirmatory factor analysis shows that the ICU is three dimensional based on results in adolescents (Essau, Sasagawa & Frick, 2006; Kimonis et al., 2008): callousness (e.g., ‘the feelings of others are unimportant to me’), unemotional (e.g., ‘I do not

show my emotions to others’) and uncaring (e.g., ‘I hide my feelings from others’). It contains 24 items, which can be rated on a 4 point Likert scale ranging from 0 (not at all true) to 3 (definitely true) (see appendix XIV). 12 of the items are positively worded and 12 are negatively worded. Scores are then calculated by reverse-scoring the positively worded items and then summing the items to obtain a total score. The ICU has also been found to have an internal consistency of 0.81 (Kimonis et al., 2008).

The **Levenson’s Self-Report Psychopathy Scale** (Levenson, Kiehl & Fitzpatrick, 1995) was used to measure CU traits among young adults, i.e., 18-24 year olds (see appendix XV). This scale consists of 26 items scored from 1 (disagree strongly) to 4 (agree strongly), and consisted of 2 factors primary (assessing manipulative and uncaring nature) and secondary (measuring impulsivity and ‘self-defeating’ lifestyles) subscales supported by the initial factor analysis (Levenson et al., 1995). Reliability analysis for primary psychopathy (16 items, e.g., ‘Looking out for myself is my top priority’) has found Cronbach’s alpha to be .83 and .82 for secondary psychopathy (10 items, e.g., ‘Most of my problems are due to the fact that other people just don’t understand me’) (Miller, Gaughan, & Pryor, 2008). Analysis of the scale properties has found notable correlations with the Hare’s (2003) Psychopathy Checklist-Revised (Brinkley, Schmitt, Smith, & Newman, 2001).

## **Chapter 4: Relationship between Executive Function and Emotion Regulation**

### **4. 1. Introduction**

According to Zelazo and Muller (2002), executive functions (EF) operate in two separate processes of hot and cool. EF which is characterised by cognitive processes such as working memory, inhibition and set shifting is called cool EF and is mediated by the dorsolateral prefrontal cortex (DPFC) of the brain region. The DPFC is mainly responsible for abstract problem solving and experimental tasks that are used to measure this activity include sorting cards on the Wisconsin Card Sorting Task or planning and selecting the right moves on tower of Hanoi task. Hot EF, on the other hand, is considered to be mediated in the ventromedial prefrontal cortex, capturing the affective aspect of EF that is dominated by motivational and emotional processing, for example, making advantageous choices on a gambling task.

Impairments in this region have been found to be indicative of deficits in emotional and social decision making. Studies using tests for risky decision making, gambling (Bechara, 2004) and delay discounting (Barkeley, Edwards, Laneri, Fletcher & Metevia, 2001) are considered measures for Hot EF. When tested on the Iowa gambling task (IGT; Bechara et al., 1994) even though performance on working memory and cognitive flexibility remained intact in adults, those with deficits in ventromedial region of the PFC took more risks, suffered losses therefore performing poorly (Bechara, Dmasio, Tranel & Anderson, 1999). In a study where individuals were required to control their impulses when presented with uncertain rewards, those with intact hot EF are able to control these impulses, Brand, Recknor, Grabenhorst & Bechara (2007) noted that only during the last trials of the IGT scores correlated with (cool) executive function tasks since this aspect of the task involved problem solving.

Studies have shown developmental differences in individual's ability to perform EF tasks. As shown by Best and colleagues, children between 5-8 years were able to perform well on 'cool' EF tasks, and this ability improved during adolescence and early adulthood (Best, Miller & Naglieri, 2012). Research has also shown hot EF to emerge during pre-school years (Kerr & Zelazo; 2004) but young adults are shown to make less risky choices and display better emotional processing compared to adolescents and children (Eshel, Nelson, Blair, Pine, & Ernst, 2007). Eshel et al found that when tested on decision making tasks involving probabilistic monetary rewards, adolescents exhibited lower levels of cortical activation than adults (ventromedial prefrontal cortex), this region is responsible for behavioural control; furthermore this region was found to be negatively associated with risky

decisions. These findings suggest that as a result of cortical maturity adults are better able to engage their cortical structures compared to adolescents or children.

#### **4. 1. 1. Executive Function and Emotion Regulation**

Emotion regulation in most childhood literature is defined as a ‘rapid response system’ in the way emotions are appraised and experienced, allowing individuals to appropriately act on the situation (Barrett & Campos, 1987; Cole, Martin & Dennis, 2004; Lazarus, 1991). John and Gross (2003) claim that reappraisal is the most commonly used emotion regulation strategy, reappraisal allows individuals to evaluate emotional responses and modulate positive and negative affect. Garnefski et al. (2002) suggest that positive reappraisal is particularly relevant during adolescence because of the novel social and emotional experiences, however, their study indicated adolescents were less likely than adults to use this strategy. Recent review by Casey and colleagues (2010) suggest that adolescents process affect differently to older children or adults, their findings revealed imbalanced activity during adolescence in the ventromedial prefrontal region; this is usually elevated in individuals with anxiety. Moreover studies on adolescents show that enhanced amygdala reactivity as an emotional response potential threat is elevated in adolescence, thus impeding adaptive regulation of emotions (Casey, Duhoux, & Cohen, 2010).

Likewise McRae and colleagues (2012) examined ER using fMRI in children, adolescents and adults on tasks involving negative emotional reactivity and reappraisal ability, their results showed that compared to older children and young adults, adolescents showed lower activation in the prefrontal regions during

successful reappraisal. This suggests that they process emotional stimuli differently to children and adults. McRae et al argue that these findings are similar to verbal working memory studies that show activation in similar regions as reappraisal. Previously reappraisal has been associated to working memory, as this process involves remembering the goal to reappraise, maintaining the selected appraisal consequently monitoring of affect state (Ochsner & Gross, 2008).

As explained earlier (chapter 1) Cunningham and Zelazo (2007) developed a model called the iterative model to determine the development of executive functions and emotion regulation. This model suggests that the automatic processes are complemented by reflective processes managed by the prefrontal cortex (PFC); these processes work together with prior stored information, context and current goals which allow individuals to appraise abstract concepts, self-regulate and operate in complex environments. Here emotion corresponds to the motivational and affective aspect of cognition in goal directed problem solving. Carlson and Wang (2007) suggest three alternative ways in which EF and ER could be related.

1. Inhibitory processes are considered necessary for successful emotion regulation whereby inhibition and ER could function together to prevent impulsive responses and behave in ways that do not correspond with their actual feelings. The higher the intensity of the emotion, the higher would be the need for inhibitory control; however, this would depend on the development of inhibitory control and maturation of the PFC.

2. Emotion regulation is likely to be crucial for successful inhibitory control, where better emotional coping frees up resources for cognitive resources and effective problem solving; inappropriate emotional

responses on the contrary could impair reasoning and planning ability (Carlson & Wang, 2007).

3. The third possibility considers the association between ER in relation to the iterative processing model (Cunningham and Zelazo, 2007). According to this model, evaluative processing (EF) falls on a continuum from relatively automatic to relatively reflective processing. This processing can also occur during ER where the primary goal is to regulate emotional expression.

Carlson and Wang (2007) observed that preschool children's inhibitory control scores related to parent reports of emotion regulation in these children, suggesting that processes are involved in the process of ER and EF. (Using the hot and cool EF model, Brock, Rimm-Kauffman, Nathanson and Grimm (2009) showed cool EF to be implicated in both academic achievement and learning related behaviours in kindergartners; their finding failed to find any significant relationship between hot EF and self-control measures. In the classroom children have to play with fellow peers, inhibiting impulses to play with tempting toys, in this case hot EF is implicated whilst cool EF is required in tests of reading, writing and understanding mathematical problems (McClelland et al., 2007). Similarly findings suggest that children who perform poorly on inhibition tasks have problems exhibiting positive effect (Kieras et al., 2005; Lieberman et al., 2007).

#### **4. 1. 2. Rationale and Aims**

To summarise, research focusing on executive functions have largely been conducted independent of emotional development, however evidence shows that EF



and ER are intricately linked together allowing for informational processing and executing actions. Examination of ER has further demonstrated that it is not merely influenced by affective experiences but rather mediated by cognitive and behavioural functions (Cole et al., 2004). Based on Zelazo and Cunningham's model ER is consistently linked to EF, bearing a reciprocal relationship. Individual differences in EF are therefore likely to determine the extent to which certain emotion regulation strategies are applied within different age groups and its relationship to cool and hot EF. More importantly the relationship between cool and hot EF to specific ER strategies remains to be explored still.

Therefore this study will investigate this relationship further and examine these tasks in three different age groups (children, adolescents and young adults) particularly as studies on hot EF suggest mixed results for adolescents; to our knowledge this is the first study that look at this relationship between EF and across three developmental stages. The specific aims of this study are:

- 1) To further investigate the dissociate relationship of hot and cool EF.
- 2) To examine the hot and cool EF differences in three developmental stages (children, adolescents, adults).
- 3) To examine age related differences in ER
- 4) To explore the relationship between emotion regulation and executive function.

Based on earlier studies, age related improvements are expected on cool tasks (Hongwanishkul & Happaney, 2010; Prencipe & Zelazo, 2014). Additionally as ER and EF share similar processes (Carlson & Wang, 2007),

there is likely to be a relationship between ER and EF. In particular hot EF is expected to be related to ER compared to cool EF.

## **4.2. Method<sup>10</sup>**

### **4.2.1. Participants**

Data of 250 participants are used in the analyses; data from 13 participants were excluded as they failed to complete the questionnaires or finish the tasks. Participants were divided into three age groups: 8-11 year olds (i.e., children) ( $n = 53$ , 31 females and 22 males), 12-17 year olds (i.e., adolescents) ( $n = 80$ , 54 females and 26 males) year olds and 18-24 year olds (i.e., adults) ( $n = 117$ , 96 females and 21 males). The 18-24 year-old sample were made up of students who volunteered to participate from the University of Roehampton. The 11 – 17 year old school pupils were recruited from primary and secondary schools in South-West London, UK.

### **4.2.2. Measures**

#### **4.2.2.1 Cool EF tasks**

Digit Span was used to measure working memory, this is a subtest from the Wechsler Intelligence Scale for Children (WISC III; Wechsler, 1991) consisting of two tests (forward and backward). This is a task used widely to measure cool EF.

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<sup>10</sup> Detailed description of all the measures have been outlined in chapter 3, page 99.

The 15 minutes cued Go/No-Go task was used to test inhibitory control (Fillmore, Rush & Hays, 2006). Participants are requested to immediately respond to go cues i.e., the colour green, whilst the no go cue was to inhibit responding to the colour blue.

#### **4. 2. 2. 2 Hot EF tasks**

To measure risky decision making the balloon analogue risk task, youth version (BART –Y; Lejuez, Aklin, Daughters & Zvolensky, 2007) was used. This is a decision making task that provides the effect of reward on performance.

Delay and probability discounting task (DPDT) was used to measure motivational and affective decision making based on the principles of delay of gratification.

#### **4. 2. 2. 3. Questionnaires**

To measure emotion regulation strategies participants completed the Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski, Kraaij & Spinthove, 2001). The CERQ is a 36 item, identifying 9 separate emotion regulation strategies. Similar to previous studies (Jermann, Van der Linden, d'Acremont, & Zermatten, 2006), acceptable internal consistency score was found for each of the 9 subscale (see Table 4.2).

#### **4. 2. 3. General Procedure**

Following confirmation from the ethics committee, the schools approved the study to be conducted on site. The main ethical issues raised were that participants were questioned on stressful and emotional events and how they manage their

behaviours. In particular some children and those with hyperactive and impulsive traits were expected to find some of the tasks challenging and time consuming between completing questionnaires. Carers were initially sent letters home providing details of the study and informed consent was obtained for their children. University students were tested on campus; all participants were tested in a quiet room with minimal distractions. Each session commenced with participants comfortably seated at a desk to complete the tasks i.e., digit span, go/no-go, delay and probability discounting task and the BART-Y. These tasks were completed on personal computers using the Millisecond Inquisit Software. This was then followed by completion of questionnaires. Participants were individually tested by the researcher on either school or university campus, and were offered assistance if needed (i.e., if the participants failed to understand complex words or questions)

Similarly children and adolescents were introduced to the study by informing them that the investigators were interested in learning about their thoughts and how they manage their emotions. To fully understand the task, the experimenter further clarified the requirements, based on the information presented on screen. Children were given ample opportunities and time to ask questions, to understand the nature of the study. The entire procedure for each participant lasted approximately 60 minutes.

### **4. 3. Results**

The main aim was to examine cool and hot EF in different age groups, therefore a series of analysis of variances (ANOVA's) were conducted to examine age related differences for EF<sup>11</sup> and ER tasks. An additional aim was to investigate the relationship between EF and ER strategies, and for this a correlation analysis was used. Furthermore correlation analysis was carried out to demonstrate the relationship between hot and cool EF and ER strategies in different age groups.

#### **4. 3. 1. Executive Functions**

The assumption of homogeneity of variance was violated for most tasks apart from forward digit span; therefore results from Brown-Forsythe *F*-ratio are reported in this instance. As expected there was a significant effect of age on all tasks of EF.

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<sup>11</sup> Figures 2, 3, 4, and 5 demonstrate age related differences for hot and cool EF tasks respectively.

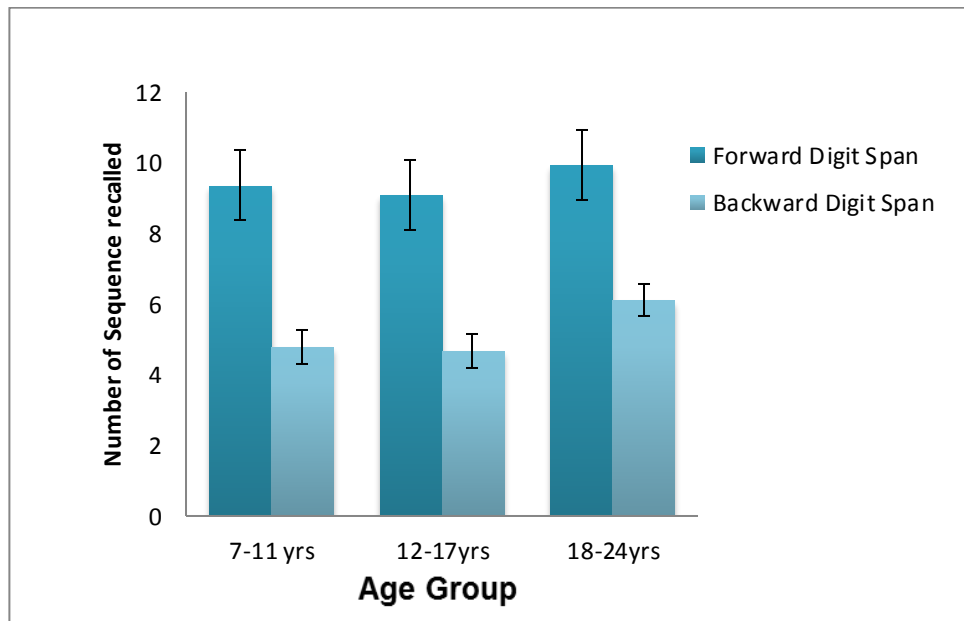


Figure 2 - Digit Span: Mean number of sequences recalled ( $\pm$  standard error) for Forward Digit Span and Backward Digit Span by age groups.

#### *Digit Span*

Bonferroni adjusted alpha levels per task ( $.05/3$ ) were conducted to support the four *a priori* hypothesis. Significant effects of age were found for cool tasks, namely, forward digit span ( $F(2, 247) = 3.39, p = .04, \eta^2 = .04$ ), backward digit span ( $F(2, 249) = 12.43, p < .001, \eta^2 = .09$ ), and go/no-go ( $F(2, 247) = 11.57, p < .001, \eta^2 = .07$ ). For the forward digit span, 18-24 year olds had a significantly higher recall score ( $M = 9.92, SD = 2.29$ ) ( $p = .01$ ) than 12-17 year olds ( $M = 9.07, SD = 2.35$ ), but scores of the 18-24 year olds were not significantly different ( $p = .13$ ) compared to 7-11 year old children ( $M = 9.33, SD = 2.34$ ). However recall performance on the backward digit span varied significantly ( $p < .001$ ) between 7-11 year olds ( $M = 4.77, SD = 1.82$ ) and 18-24 year olds ( $M = 6.09, SD = 2.45$ ); and adolescent age group ( $M = 4.65, SD = 2.05$ ) and adults ( $p < .001$ ). There were no significant differences found on the backward digit span for the adolescent age group compared to children ( $p = .75$ ).

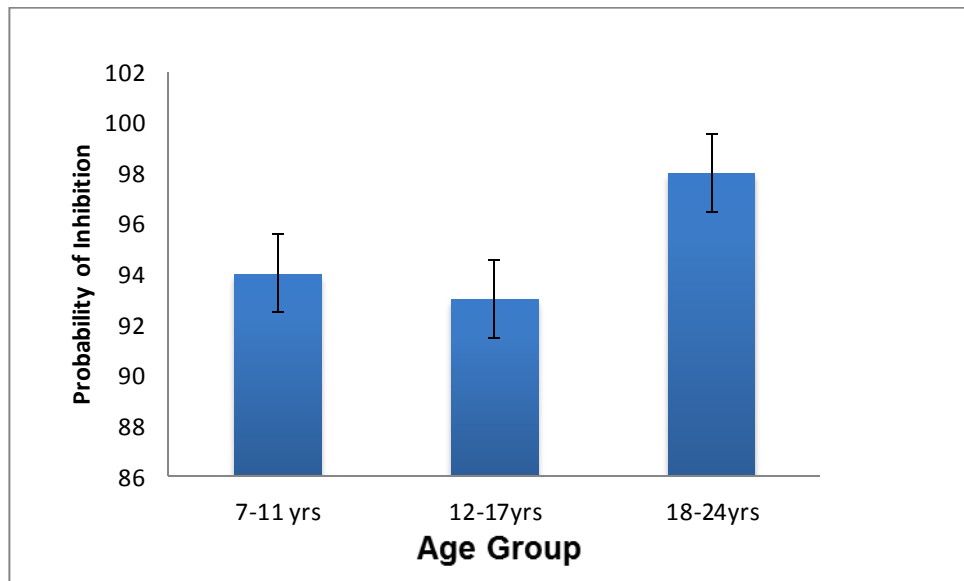


Figure 3 - Go-No/Go: Mean number of responses successfully inhibited ( $\pm$  standard error) on No/Go trials by age groups.

#### *Go/No-Go*

Go/no-go, probability of inhibition scores (i.e. percentage of correct responses) were not significantly different ( $p = .65$ ) between the 12-17 year ( $M = 93.36$ ,  $SD = 12.18$ ) and 7-11 year olds ( $M = 94.00$ ,  $SD = 8.01$ ). However, the 18-24 year olds ( $M = 98.41$ ,  $SD = 1.68$ ) had a significantly higher score for probability of inhibition ( $p < .001$ ) compared to children and adolescents. A further one-way ANOVA looking at reaction time (RT) for go cues showed an effect of age on RT ( $F(2, 247) = 99.95$ ,  $p < .001$ ,  $\eta^2 = .45$ ). In this aspect of go/no-go, however, 12-17 year olds ( $M = 397.28$ ,  $SD = 86.67$ ) had significantly faster RT than 18-24 year olds ( $M = 663.10$ ,  $SD = 71.36$ ;  $p < .001$ ) or 7-11 year olds ( $M = 546.31$ ,  $SD = 240.10$ ;  $p < .001$ ).

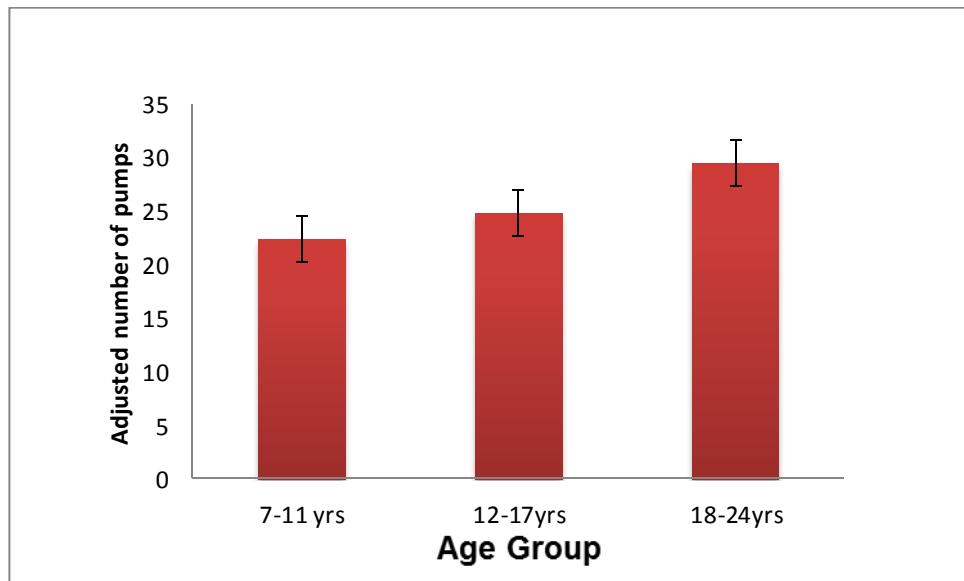


Figure 4 - BART-Y: Mean adjusted number of pumps (total number of pumps on non-exploded balloons) ( $\pm$  standard error) by age groups.

### *BART-Y*

Age effects were observed for hot EF tasks BART-Y ( $F(2, 242) = 9.04, p < .001, \eta^2 = .07$ ) and DPDT ( $F(2, 242) = 13.05, p < .001, \eta^2 = .10$ ). Post hoc analyses of Games-Howell procedure are specified for hot EF tasks that did not meet assumption of equal variances. For BART-Y, the scores for 18-24 year olds scores ( $M = 29.44, SD = 10.18$ ) were significantly higher ( $p < .001$ ) compared to 7-11 year olds ( $M = 22.34, SD = 12.13$ ) and 12-17 year old scores ( $M = 24.79, SD = 10.18$ ), indicating poor performance for adults. This difference was however not significant between the two younger age groups (7-11 and 12-17 year olds,  $p = .64$ ).



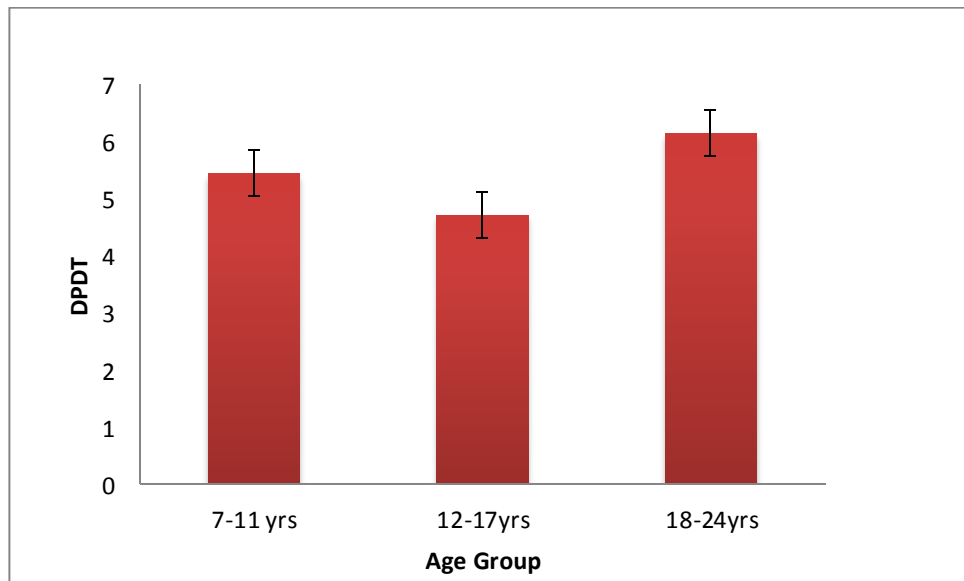


Figure 5 - Delay Discounting: Mean untransformed k values ( $\pm$  standard error) by age groups.

### *DPDT*

Scores for DPDT however suggest that the 18-24 year olds ( $M = 6.15$ ,  $SD = 1.62$ ) were significantly more likely to make significantly better choices ( $p < .001$ ), when compared to 12-17 year olds ( $M = 4.72$ ,  $SD = 2.00$ ) and compared with 7-11 year olds ( $M = 5.45$ ,  $SD = 2.30$ ,  $p = .03$ ). There was further significant difference observed between 7-11 year olds and 12-17 years in this task ( $p = .03$ ).

### **The relationship between cool and hot EF**

Table 4.1 shows the relationship between cool and hot EF. These results show that hot tasks (i.e., BART-Y and DPDT) correlated positively with each other. Similarly, cool tasks (i.e., go no go and backward digit span) correlated positively with each other. A significant relationship was also found between BART-Y and backward digit span. DPDT did not significantly correlate with any of the cool tasks.

Table 4.1

Correlation between cool EF and hot EF

|                |                     | 1     | 2   | 3    | 4     | 5 |
|----------------|---------------------|-------|-----|------|-------|---|
| <i>Cool EF</i> |                     |       |     |      |       |   |
| 1              | Backward digit span | -     |     |      |       |   |
| 2              | Forward digit span  | .40** | -   |      |       |   |
| 3              | Go/No-Go            | .14*  | .04 | -    |       |   |
| <i>Hot EF</i>  |                     |       |     |      |       |   |
| 4              | BART-Y              | .14*  | .12 | .05  | -     |   |
| 5              | DPDT                | -.00  | .02 | -.00 | .24** | - |

*Note.* \* $p < .05$ , \*\* $p < .01$ ; EF = executive functions; ER = emotion regulation; BART-Y = Balloon Analogue Risk Task Youth version; DPDT = Delay and Probability Discounting task.

### 4.3.2. Emotion Regulation

Table 4.2 shows the mean scores and reliability analysis values for ER strategies. Cronbach's alpha shows modest scores for internal consistency for all strategies.

Table 4.2

Summary of means (standard deviations) and reliability analysis for ER strategies.

|                      | Overall     | 7-11 years  | 12-17 years | 18-24 years | $\alpha$ |
|----------------------|-------------|-------------|-------------|-------------|----------|
|                      | Mean (SD)   | Mean (SD)   | Mean (SD)   | Mean (SD)   |          |
| <i>CERQ subscale</i> |             |             |             |             |          |
| Acceptance           | 2.97 (.96)  | 2.68 (.94)  | 2.67 (.95)  | 3.32 (.87)  | .72      |
| Positive Refocusing  | 3.32 (1.00) | 3.17 (1.08) | 2.63 (1.07) | 2.84 (.91)  | .78      |
| Planning             | 2.84 (1.02) | 3.49 (.95)  | 2.81 (1.04) | 3.60 (.86)  | .77      |
| Positive Reappraisal | 3.63 (.94)  | 3.07 (.85)  | 2.70 (.96)  | 3.63 (.94)  | .72      |
| Perspective          | 3.56 (.95)  | 2.89 (.86)  | 2.89 (1.09) | 3.57 (.95)  | .71      |
| Self-blame           | 2.52 (.89)  | 2.52 (1.01) | 2.24 (.85)  | 2.72 (.80)  | .77      |
| Rumination           | 3.06 (.96)  | 3.18 (.98)  | 2.55 (.95)  | 3.35 (.82)  | .74      |
| Catastrophising      | 2.38 (.93)  | 2.77 (1.01) | 2.46 (.89)  | 2.16 (.86)  | .68      |
| Other blame          | 2.02 (.73)  | 2.09 (.93)  | 1.10 (.73)  | 2.00 (.63)  | .71      |

*Note.*  $\alpha$  = Cronbach's alpha; CERQ = Cognitive Emotion Regulation Questionnaire; ER = emotion regulation

The findings indicated that there was a significant effect of age for ER strategy: acceptance ( $F(2, 243) = 13.23, p < .001, \eta^2 = .10$ ), positive refocusing ( $F(2, 239) = 5.50, p = .01, \eta^2 = .04$ ), planning ( $F(2, 244) = 16.37, < .001, \eta^2 = .12$ ), positive reappraisal ( $F(2, 244) = 24.96, p < .001, \eta^2 = .17$ ), perspective ( $F(2, 239) = 15.01, < .001, \eta^2 = .11$ ), self-blame ( $F(2, 245) = 7.45, p = .001, \eta^2 = .06$ ), rumination

( $F(2, 247) = 17.93, p < .001, \eta^2 = .13$ ) and catastrophizing ( $F(2, 238) = 7.80, p < .001, \eta^2 = .06$ ). There was no significant effect of age for other blame ( $F(2, 145) = .332, p = .72, \eta^2 = .003$ ).

Post hoc analyses revealed that for adaptive ER strategies there were significant group differences between 7-11 year olds and 18-24 year old, and 12-17 year olds and 18-24 year olds for acceptance, positive reappraisal, putting into perspective ( $p < .001$ ). Whereas for positive refocusing there were significant differences between children and adolescents ( $p < .001$ ), and children and adults ( $p = .05$ ). For planning significant age differences were found between adolescents and children ( $p < .001$ ), and adolescents and adults ( $p < .001$ ).

Significant age effects were found for maladaptive ER strategies; particularly rumination, which was significantly higher in adults compared to children ( $p < .001$ ) and adolescents ( $p < .001$ ). Whereas catastrophising was significantly higher in adolescents compared to children ( $p < .001$ ) and adults ( $p = .03$ ). Self-blame scores show that adults had a significantly higher mean compared to adolescents ( $p < .001$ ). There were no significant age differences observed for ER strategy other blame.

#### 4. 4. 3. Executive functions and emotion regulation

To further examine whether age did explain for variance in EF and ER a simple linear regression was conducted, the results show that overall age did predict responses in EF ( $R^2 = .16$ ,  $F(5, 233) = 10.27$ ,  $p < .001$ ) and ER ( $R^2 = .28$ ,  $F(9, 229) = 10.27$ ,  $p < .001$ ).

Pearson correlations between EF and ER show acceptance to be positively correlated with forward and backward digit span, go-no/go and DPDT (see Table 4.3). Whereas Forward digit span correlated positively with perspective alone and almost significantly with positive reappraisal. Backward digit span positively correlated with acceptance, positive reappraisal, marginally with putting into perspective and maladaptive ER strategy rumination. This suggests that high scores on cool EF tasks are closely associated with putatively adaptive ER strategies, however this also indicates that cool EF performance is closely linked to the use of maladaptive ER strategy rumination.

In contrast DPDT scores correlated significantly with acceptance and reappraisal whereas BARTY negatively correlated with catastrophising and other blame. A positive relationship between DPDT positive reappraisal and acceptance suggest that the decision making aspect of hot EF is related to positive reappraisal and acceptance. Likewise this indicates that risky decision making is related to maladaptive ER strategies.

Table 4. 3

Correlations between EF and ER.

|                      | Cool EF    |            |          | Hot EF |       |
|----------------------|------------|------------|----------|--------|-------|
|                      | Forward    | Backward   | Go-No/Go | BART-Y | DPDT  |
|                      | Digit Span | Digit Span |          |        |       |
| <i>CERQ</i>          |            |            |          |        |       |
| Acceptance           | .21**      | .21**      | .18**    | -.03   | .23** |
| Positive Refocusing  | -.04       | -.06       | .07      | -.01   | -.01  |
| Planning             | .07        | .08        | .20**    | .06    | 13*   |
| Positive Reappraisal | .10±       | .16*       | .17**    | .07    | 20**  |
| Perspective          | .24**      | .12±       | .21**    | .07    | 13*   |
| Self-blame           | .10        | .09        | .13*     | .00    | .06   |
| Rumination           | .11        | .16*       | .20**    | -.05   | .08   |
| Catastrophizing      | -.03       | -.10       | .01      | -.18** | -.03  |
| Other blame          | .01        | -.01       | -.01     | -.17** | .02   |

*Note.* \* $p < .05$ , \*\* $p < .01$ ; ± $p < .07$ ; EF = executive functions; ER = emotion regulation; BART-Y = Balloon Analogue Risk Task Youth version; DPDT = Delay and Probability Discounting task; CERQ = Cognitive Emotion Regulation Questionnaire.

Table 4.4 shows the correlations between executive functions and emotion regulation for children (7-11 year olds). In this age group, BART-Y alone correlated with ER strategies, suggesting that those who scored highly on risky decision making were less likely to use rumination and acceptance ER strategy.

Table 4.4

Correlations between EF and ER among 7-11 years.

|                      | Cool EF               |                        |          | Hot EF |      |
|----------------------|-----------------------|------------------------|----------|--------|------|
|                      | Forward<br>Digit Span | Backward<br>Digit Span | Go-No/Go | BART-Y | DPDT |
| <i>N</i>             | 53                    | 53                     | 52       | 52     | 51   |
| <i>CERQ</i>          |                       |                        |          |        |      |
| Acceptance           | .01                   | -.01                   | -.01     | -.38** | .15  |
| Positive Refocusing  | .04                   | -.07                   | .2       | .05    | -.1  |
| Planning             | -.01                  | -.13                   | .01      | -.04   | -.15 |
| Positive Reappraisal | .13                   | -.16                   | -.09     | .01    | -.07 |
| Perspective          | .20                   | -.09                   | -.1      | .27±   | -.17 |
| Self-blame           | .08                   | .11                    | -.1      | -.17   | -.2  |
| Rumination           | 0                     | .01                    | -.03     | -.27*  | -.14 |
| Catastrophizing      | .23                   | .15                    | -.17     | -.08   | .09  |
| Other blame          | -.04                  | -.13                   | -.28*    | -.20   | .17  |

*Note.* \* $p < .05$ , \*\* $p < .01$ ; ±  $p = .06$ ; EF = executive functions; ER = emotion regulation; BART-Y = Balloon Analogue Risk Task Youth version; DPDT = Delay and Probability Discounting task; CERQ = Cognitive Emotion Regulation Questionnaire.

Table 4. 5

Correlations between EF and ER among 12-18 years.

|                      | Cool EF    |            |          | Hot EF |      |
|----------------------|------------|------------|----------|--------|------|
|                      | Forward    | Backward   |          |        |      |
|                      | Digit Span | Digit Span | Go-No/Go | BART-Y | DPDT |
| <i>n</i>             | 80         | 80         | 79       | 75     | 75   |
| <hr/>                |            |            |          |        |      |
| <i>CERQ</i>          |            |            |          |        |      |
| Acceptance           | .29**      | .15        | .18      | -.01   | .1   |
| Positive Refocusing  | .02        | -.07       | .06      | .03    | -.15 |
| Planning             | -.01       | -.16       | .23*     | -.14   | .02  |
| Positive Reappraisal | .01        | -.03       | .16      | -.16   | .01  |
| Perspective          | .25*       | -.12       | .25*     | -.02   | .09  |
| Self-blame           | .08        | .11        | .2       | .05    | .04  |
| Rumination           | .2         | .08        | .24*     | .01    | .05  |
| Catastrophizing      | .14        | -.07       | .25*     | .00    | .06  |
| Other blame          | .25*       | .09        | .15      | -.11   | -.04 |

*Note.* \* $p < .05$ , \*\* $p < .01$ ; EF = executive functions; ER = emotion regulation; BART-Y = Balloon Analogue Risk Task Youth version; DPDT = Delay and Probability Discounting task; CERQ = Cognitive Emotion Regulation Questionnaire.

Among adolescents (see Table 4.5), on the other hand, cool tasks (i.e., forward digit span and go no go) were associated with adaptive ER strategy putting into perspective. Go/no-go (cool task) which is a measure of response inhibition was positively correlated with planning, rumination and catastrophising. This indicates that in this group cool EF is associated with both adaptive and maladaptive ER.



Table 4.6

Correlations between EF and ER among 18-24 year olds.

|                      | Cool EF            |                     |          | Hot EF |      |
|----------------------|--------------------|---------------------|----------|--------|------|
|                      | Forward Digit Span | Backward Digit Span | Go-No/Go | BART-Y | DPDT |
| <i>n</i>             | 117                | 117                 | 117      | 117    | 117  |
| <i>CERQ</i>          |                    |                     |          |        |      |
| Acceptance           | .15                | .16                 | .02      | -.07   | .20* |
| Positive Refocusing  | -.15               | -.05                | -.11     | -.06   | .14  |
| Planning             | .06                | .16                 | .06      | -.01   | .17  |
| Positive Reappraisal | .03                | .15                 | -.02     | .06    | .24* |
| Perspective          | .17                | .13                 | .12      | -.15   | .1   |
| Self-blame           | .03                | -.07                | -.05     | -.02   | .09  |
| Rumination           | -.03               | .11                 | .03      | -.11   | -.04 |
| Catastrophising      | -.24*              | -.09                | -.02     | -.23*  | -.05 |
| Other blame          | -.15               | -.01                | -.03     | -.17   | -.08 |

*Note.* \* $p < .05$ , \*\* $p < .01$ ; EF = executive functions; ER = emotion regulation; BART-Y = Balloon Analogue Risk Task Youth version; DPDT = Delay and Probability Discounting task; CERQ = Cognitive Emotion Regulation Questionnaire.

Adults scores (see Table 4.5) show that hot task was significantly correlated with adaptive ER strategy acceptance and positive reappraisal, suggesting that positive decision making is closely related to adaptive ER in this age group.

## **4. 4. Discussion**

### **4. 4. 1. Executive Functions**

The objective of the current study was to investigate the association between hot and cool EF in children, adolescents and adults and to further determine the distinct nature of hot and cool EF. Another aim was to examine the extent to which EF may mediate emotion regulation across the three age groups. Similar to earlier findings (Hooper et al., 2004), age-related improvements were noted for cool task digit span, but not for hot EF task DPDT which differed for adolescents, compared to children and adults; adolescents nonetheless had a better reaction time on cool EF task go/no go than children and adults. These findings are supported by modest effect sizes.

As BART-Y and backwards digit span were the only significant correlations observed between hot and cool EF tasks, this supports the notion that hot and cool EF may develop independently (Zelazo & Carlson, 2012). Furthermore based on the findings of Zelazo and Muller (2002), it is possible to understand the unity and diversity of these executive functions in children, adolescents and adults and whether certain executive functions are likely to develop at different critical periods.

#### *Age differences in hot EF*

These findings showed that adults compared to adolescents are more likely to participate in risky and impulsive decision making; this is not consistent with previous research on poor decision making and high impulsivity in adolescence (Ding et al., 2014; Eshel et al., 2007). Ding and colleagues study found that difficulty in modulating impulsivity is highly related to adolescents who were found

to more likely to make risky decisions. Lejuez and colleagues (2002) claim that in young adults high scores on BART was related to real world risk taking, Mishra and Lalumiere (2009) argue that risk proneness in 18-25 year olds is related to need, where increased risk is associated with the individuals goal or desired state, therefore seeking options that will lead to an optimal outcome. Ferrey and Mishra (2014) found that when young adults were offered monetary reward for participating in their study engaged in greater risk taking on BART compared to those who were not offered any reward. Therefore supporting the view that real world compensation significantly influences risk taking.

Whereas, DPDT results show that adolescents compared to adults were poor at making advantageous choices demonstrating systematic differences in discounting rate for delayed reward. In a study by Bjork et al. (2004), 12 adolescents and 12 adults whilst being scanned to observe neural activities completed a task which required anticipating opportunities for monetary gain and losses whilst being notified of their performance. Adolescents consistently engaged in risky decisions, moreover adolescents showed reduced use of right ventral striatum region (which is responsible for processing reward anticipation) compared to young adults.

Adults are efficient at selecting advantageous options when faced with risky decisions, the neural mechanism underlying these reposes were supported by enhanced activity in the insula (Baird, Fugelsang & Bennett, 2005). Additionally the enhanced salience of peer interaction in adolescence compared to early childhood further allows for subsequent response to potential rewards of risky behaviours (Blakemore, 2008). This suggests that Hot EF is still developing during adolescence; unlike abstract decision making, this aspect of EF is mediated by motivational and

affective responses placing higher demands on orbitofrontal cortex, similar to the findings by Zelazo and Carlson (2012) this results could be a further explanation for the 'lag' in the development of hot EF.

*Age differences in cool EF*

Performance on cool tasks clearly indicated age related improvements on all tasks. Go/no-go task results show that adolescents have lowest scores on probability of inhibition, similar to the results on hot task DPDT. Results of backward and forward digit span revealed adolescents had again poor scores, compared to other age groups. The digit span is a measure largely considered for working memory, in particular backward digit span which requires storage and manipulation of information (Prencipe et al., 2011). As argued by Zelazo and Cunningham (2007) adolescents may have difficulties in engaging in tasks which lack motivational significance. Similar to the present study, Huizinga and colleagues (2006) showed that cool EF is still developing in 15 year olds, which provide support for low scores in adolescents on the go-no/go task. However when mean scores for reaction time were computed the adolescents had faster response time compared to adults and children. A similar study that investigated the neural correlates of EF in children and adolescents (Lamm, Zelazo & Lewis, 2006) found faster mean reaction time for older children on go/no-go; this was further related to better performance on backward digit span.

In accordance with current literature, adolescents in the present study had better reaction time on go/no-go than children. The go/no-go tasks requires the use of multiple aspects of EF, such as working memory, response inhibition and

selective attention; this extensive activation means that when relative EF strategies are employed performance is compensated (Blakemore & Choudhury, 2006). Reaction time along with correct responses for children indicates that they are at an immature stage of neural development where synaptic connections are emerging compared to a more myelinated brain of an adult (Konishi et al., 1999). A study investigating neuro-developmental changes in working memory and inhibition, demonstrate that children under the age of 12 fail to engage their Ventral lateral prefrontal cortex when completing go/no-go; this region is recruited in inhibition and response selection. Adults with damage to this region display poor cognitive control (Bunge & Wright, 2007). Overall these findings suggest that cool EF underlies brain regions which are still developing during adolescence and continues to do so by early adulthood; pattern of change can be observed in performance scores on different tasks. In terms of understanding the diversity of cool executive functions, it appears that the results are generally supportive of the ideas proposed by Zelazo and Muller; their model of linear age related improvements can be particularly applied to the youngest age group (7-11 years). These results suggest that cool EF is independent and provide unique contributions from inhibition efficiency and working memory span.

#### **4. 4. 2. Emotion Regulation**

As expected we found differences in adaptive and maladaptive emotion regulation strategies across the developmental stages. Specifically, in line with previous studies (Lamm et al., 2006), adults were better at employing a wider range of positive ER strategies including acceptance, positive refocusing, positive reappraisal and planning compared to children and adolescents. Children, on the

other hand had higher means on maladaptive strategies. The results of these adaptive strategies could be related to positive affect, well-being and the absence of negative affect (Watson, Clark & Tellegen, 1988). In his socio-emotional selectivity theory, Carstensen (1993) argues that emotional interactions tend to become more taxing with age. As a result, individuals are likely to be more selective with age in the investment they make in people and seek out for emotional support. The adults in this study may have been seeking and receiving emotional support from a group of people than the younger age groups, resulting in their lower reports of “other blame”. As adults may be more adept at problem solving, they could be more likely to have high scores of positive refocusing and positive reappraisal (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). Likewise rumination scores also declined with age, which could be related to the fact that participants in the oldest age group may have become better at avoiding negative situations (Blanchard-Fields, 2007) or in using attentional redeployment to prevent ruminations and negative feelings (Phillips, Henry, Hoise, & Milne, 2008). According to Heckhausen and Schulz (1998), men are less likely to adopt a positive, efficacious, or accepting attitude toward problems. In their study adolescent males were less likely to positively reappraise compared to adolescent females.

The results showed most putatively adaptive cognitive emotional strategies were reported significantly less often by adolescents than by adults. Similar to Garnefski et al.’s (2002) initial findings, the largest difference was observed in the adaptive cognitive coping strategy positive reappraisal, in that adolescents are less often than adults to report trying to create a positive meaning to a negative life event in terms of personal growth. Reappraisal is of particular importance for adolescence,

considering the novel social and emotional experiences; however they are less likely to use appraisal than adults (Garnefski et al., 2002). As reappraisal is frequently employed in adulthood, Garnefski et al. (2009) suggest that this strategy tends to become more adaptive with age. The present findings further indicate that children were better at adaptive emotion regulation strategies than adolescents, as children are likely to recognise that their reactions do not match other emotional reactions they may choose to alter their emotional expression; children's emotional expression are frequently changing and are influenced by social relationships (Zeman, Cassano, Perry Parish & Stegall, 2006). The above results suggest that, although all cognitive coping strategies characterising adults are also reported by children and adolescents, the extent to which these strategies are used shows an increase from childhood to adulthood. This seems especially true for the cognitive coping strategy positive reappraisal. It might be that as Garnefski et al. claims, cognitive coping strategies are likely to be more refined and mature over time. Nonetheless it can be argued that the use of certain cognitive coping strategies can be an important indicator of serious problems for all age groups.

#### **4. 4. 3. Executive Function and Emotion Regulation**

This study revealed that age did have a significant relationship between hot and cool EF, and ER strategies. Of the maladaptive strategies, there was a positive relationship between rumination and backward digit span and BART-Y; this suggests that working memory (cool EF) and affective processing (hot EF) is implicated in rumination. According to Gross (1998) inhibitory processes underlie adaptive ER strategies, whereas working memory may enable maladaptive ER strategy rumination and allow for holding negative emotions in mind. These results

fit in with Zelazo and Cunningham's (2007) model in that deliberate regulation of emotion is mediated by cognitive processing; this aspect of ER is closely linked to executive functions. When ER modulation is secondary to the task at hand, ER and EF are inter-correlated as suggested in the model by Zelazo and Cunningham.

Across most cool EF tasks, adaptive cognitive emotion regulation strategy acceptance positively correlated with digit span and go/no-go. On the contrary, poor scores of BART-Y negatively correlated with rumination. Interestingly poor performance on EF tasks by adolescence is reflected in the poor reports of adaptive cognitive coping strategy. These findings suggest that the social cognitive processes that are often part of successful emotion regulation may be engaged to a greater degree in adolescents than either children or adults. Improvements in adolescents ER strategies are likely to occur as a result of increased activation of the lateral prefrontal regions thought to support working memory, response inhibition and selective attention (Perlman & Pelfrey, 2011).

These findings of cool EF highlight the importance of the prefrontal control systems involved in reappraisal; they fail to consider the social cognitive processes that may also be engaged during reappraisal. The importance of social cognitive abilities, such as mental state attribution, is not like cognitive control abilities because they do appear to improve linearly across development through childhood, adolescence and into adulthood. Long-standing views of child development supported by the findings from the current study show that adolescents might process affect differently than either older children or young adults (Casey et al., 2010), which predicts quadratic rather than linear patterns of socio-affective development. In line with this, neuroimaging studies of the development of social-



cognitive processes in adolescents indicate that they engage medial prefrontal cortices to a greater extent than adults (Blakemore, 2008). Together, these results indicate that the social cognitive processes which are often part of successful reappraisal may be engaged to a lesser degree in adolescents than either children or adults.

#### **4. 4. 4. Conclusions**

This study is the first to report the correlates and differences in hot and cool EF and emotion regulation strategies in children, adolescents and young adults. Two key findings were revealed; firstly there was a non-linear increase in ER ability with age, with differences being observed in children and young adults. Secondly, we found a non-linear relationship between age and hot and cool EF strategies; this relationship meant poor hot EF for adolescents compared to children and young adults. Taken together, these findings indicate that although cognitive ability improves with age, some adolescents may process the emotional value of stimuli differently than either children or adults, as evidenced by lesser advantageous choices and cognitive ER strategies in particular positive reappraisal. These findings are further reflected in hot and cool EF performance and its relationship with adaptive ER strategies, which suggests that both EF and ER strategies are closely linked.

The vast majority of previous work on emotional development has not been able to separate potential age-related differences from the effects of regulation strategies that correspond to emotional responding. There was a positive relationship between ER ability and age; this finding provides support for the notion that some of

the variation observed in cognitive coping strategies over development may be due to the maturation of various cognitive abilities that can be applied to emotion regulation (Luna, 2009). Thus far, EF and emotional skills have largely been examined separately, which has not allowed for the testing of this theory using cognitive processes that deliberately influence emotions. Therefore, measuring emotional well-being at any age may require measuring not just individual differences in how individuals react to situations and cognitive abilities, but whether regulatory skills with the intention of modifying our emotional responses can be improved.

One finding that stands out in the pattern of age related differences is that although the 12-17 year age group exhibited poor advantageous choices, they also exhibited increasing development in working memory. This pattern suggests that engaging in risky behaviour is linked to cognitive maturation and by exploring, the natural development of adolescents occurs. The finding that better working memory and reversal learning are related to less impulsivity suggests that the continued development of these capabilities may eventually overcome the adverse influences of impulsive tendencies, perhaps leading to their decline.

Finally, future work should seek to further clarify the specific EF and ER processes engaged in psychopathologies and whether this increase linearly or non-linearly with age. This is important not only for a model of the basic cognitive architecture of emotion regulation, but also for understanding the behavioural consequences of the differences reported between children, adolescents and adults.

## **Chapter 5: Executive function and emotion regulation: Links to behavioural and emotional problems.**

### **5. 1. Introduction**

Children and adolescents affected by mental health disorders have received substantial interest over the years; a recent meta-analysis based on data from 27 countries revealed that 13.4% of children were diagnosed with some form of mental health disorder (Polanczyk, Salum, Sugaya, Caye, & Rohde, 2015). Polanczyk and colleagues reported worldwide prevalence rate for attention deficit hyperactivity disorder (ADHD) as 3.4% and 5.7% for other behavioural disorders; prevalence rate for any anxiety disorder was 6.5% and depression was found to be 2.6%.

Data emerging from North America in particular show that anxiety disorders were the most common emotional disorder (31.9%), followed by behaviour disorders (19.1%); whereas ADHD was found to be most commonly diagnosed behavioural

disorder (86%) (Egger & Angold, 2006; Merikangas et al., 2010). In a study conducted in the United Kingdom by Ford, Goodman & Meltzer (2003) approximate 1 in 10 children as being likely to have some form of diagnosable behavioural and emotional disorder; a further fifth of these children (2.1%) are likely to have a diagnosis of anxiety, depression or behaviour disorder. Studies in adults with psychiatric disorders have repeatedly shown that a significant number of disorders begin childhood and extend over the whole life span (Wittchen et al., 2011). Furthermore a study examining trends in parents and teacher reports indicate an increase in behavioural and emotional problems in children and adolescents since 1998 in the United Kingdom (Sellers, Maughan, Pickles, Thapar, & Collishaw, 2015). Sellers and colleagues claim that parents now are more willing to report and seek support for their children's emotional and behavioural problems.

### **5. 1. 1. Executive Functions**

It is well established that those who suffer from ADHD tend to exhibit deficits in executive functions and motivational processes (Barkley, 2003; Brown; 2008; Castellanos et al., 2006; Toplak, Jain & Tannock, 2005; Willcutt et al., 2005). The Diagnostic and Statistical Manual of Mental Disorders (5th ed.; American Psychiatric Association, 2013) characterises children with ADHD as having persistent symptoms of inattention, hyperactivity and impulsivity therefore affecting the way in which individuals cope with daily activities. Inhibitory dysfunction is considered a core deficit of ADHD, in particular behavioural inhibition is believed to be impaired (Barkley, 1997). Moreover Disruptive Behaviour Disorders (DBD) has been consistently found to be comorbid with ADHD. DBD is considered to be collectively comprised of conduct disorder and oppositional defiant disorder (ODD).

Individuals with DBD display aggressive, hostile and disobedient behaviours, in most situations towards authority figures (American Psychiatric Association, 1994).

ADHD with and without DBD have been found to have deficits in aspects of both cool and hot EF (motor inhibition, sustained attention, and response execution), whereas DBD sufferers have been found to be impaired on hot EF tasks alone (risky decision making) (Hobson, Scott & Rubia, 2011). Further evidence shows that those diagnosed with DBD tend to have greater impairments in cool EF tasks when comorbid with ADHD (Hummer et al., 2011). Similarly studies show that in typically developing children and adolescents, poor behavioural control is associated with risk taking, poor inhibition and working memory scores (cool EF) (Romer et al., 2009; Shamosh et al., 2008; Tarter et al., 2003). However when Humphreys and Lee (2011) tested children with ADHD and DBD on hot EF using the balloon analogue risk task (BART), they found that children with ADHD and DBD were more likely to have suboptimal scores on hot decision making tasks. This is further supported by studies that report children and adolescents with ADHD as having poor scores on decision making tasks (Luman, Oosterlaan, Knol, & Sergeant, 2008; Scheres et al., 2006).

EF deficits are however also linked with emotional problems. For example, studies among adults have shown that those with major depression have impaired inhibition and decision making (Murphy et al., 2001). Similarly anxiety and major depressive disorders have also been associated with cool EF aspects of cognitive inflexibility and sustained attention compared to healthy controls in adults and adolescents (Fujii et al., 2013; Han et al., 2016; Wilkinson & Goodyer, 2006).

However, findings among adolescents have been inconsistent. As reported by Kyte, Goodyear and Sahakian (2005) there were no differences in adolescents with and without depressive disorders performance on EF tasks. More recently Han et al. (2016) tested adolescents on a cool EF task (the Wisconsin Card Sorting Task) and found that those with poor scores suffered from significant depressive symptoms which further predicted future anxiety symptoms. Robinson, Roiser, & Sahakian (2016) argue that poor working memory (i.e., cool EF) in particular is linked with depression; these authors further argued that an impairment in working memory is almost a trait marker for depression. Similarly those exhibiting depressive traits show negative affective biases towards hot tasks, displaying a reduction in reaction time to positive valence (Erikson et al., 2005). There are however very few studies conducted on reward based processing and depression, considering anhedonia (an inability to experience pleasure from usually enjoyable experiences) which is a key symptom of depression is also related to reward processing (Roiser & Sahakian, 2013).

### **5. 1. 2. Emotion Regulation**

The inability to effectively regulate emotions and the expression of intense and labile emotional responses have been observed in adolescents with behavioural and emotion problems; compared to healthy adolescents, those with emotional disorders such as depression were more likely to engage in rumination and denial (Silk, Steinberg & Sheffield Morris, 2003). Children with behavioural problems (delinquency and aggression) have been noted to be prone to anger, impulsivity and limited regulation compared to children with emotional problems (anxiety, depression, social withdrawal and psychosomatic symptoms) (Eisenberg et al.,

2001). Eisenberg et al. (2000) further found that children with emotional problems scored high on sadness compared to children with behavioural problems and controls. In contrast with typically developing children, children with ADHD have been found to be unable at inhibiting emotional responses towards angry cues (Kochel, Leutgeb & Schienle, 2014).

Emotional dysregulation has been found to be common in individuals with ADHD across the lifespan (Shaw, Stringaris, Nigg & Leibenluft, 2014). Shaw et al. (2014) describes emotional dysregulation as excessive and inappropriate emotional reactions to daily activities, alongside mood shifts and impaired allocation of attention to emotional stimuli. In agreement with Shaw et al. definition, children with ADHD are described as having less effective emotion regulation skills (they highly employ negative responses) compared to typically developing children (Wheeler Maedgen & Carlson, 2000; Walcott & Landau, 2004). In a study by Factor, Rosen and Reyes' (2013) poor emotion regulation is associated with ADHD and comorbid conduct problems (Mannuzza et al., 2004). A study by Sjowall et al (2013) indicated that emotion dysregulation is associated with ADHD regardless of conduct problems.

In a series of studies by Frick and his colleagues (e.g., Frick & Morris, 2004; Frick, Lilienfeld, Ellis, Loney, & Silverthorn, 1999; Frick, Cornell, Barry, Bodin, & Dane, 2003; Loney, Frick, Clements, Ellis, & Kerlin, 2003) youths with conduct problems are more likely to have callous unemotional traits (CU) and have troubles regulating emotions compared to individuals with ADHD; as described by Frick et al., CU traits are characterised by lack of empathy, guilt and emotional expression. Youths with callous unemotional traits have been found to have impairments in

cognitive and affective aspects of empathy (Pardini, Lochman & Frick, 2003). A recent meta-analysis indicated that children with ADHD alone were more likely to have high scores on emotion dysregulation, and noted that co-occurring conduct problems failed to mediate the association between emotion dysregulation and ADHD; this link was however found to be moderated by cognitive functioning (Graziano, & Garcia, 2016).

### **5. 1. 3. Rationale and Aims**

The characteristics of hot and cool EF appear to be mixed in those who have behavioural and emotional disorders (Geurts, Van der Oord, & Crone, 2006), additionally when examining cool or hot deficits, compared to behavioural difficulties far fewer studies have looked into these outcomes in children and adolescents who exhibit emotional problems. More importantly literature shows that far fewer studies have considered the influence of emotion regulation in children with behavioural and emotional problems who exhibit cool and hot EF difficulties. This study will therefore clarify the developmental trajectories associated with EF and emotional and behavioural problems.

The more specific aims of this study are:

1. To understand the developmental differences in the relationship between cool and hot EF and those who experience behavioural and emotional problems.
2. To investigate the association between emotion regulation and how this is related to behavioural and emotional problems in different age groups.



3. To examine if emotion regulation strategies mediate the link between emotional and behavioural problems and EF outcomes.

To our knowledge, this is the first study to explore the relationship between cool and hot EF and emotional and behavioural problems. In line with evidence from prior research the hypothesis is that there will be a relationship between hot EF and behavioural problems, where as cool EF in particular will be associated with emotional problems.

## **5. 2. Method**

### **5.2.1. Participants**

As in Study 1, data of 118 participants consisting of children (n = 53; age 8-11 years), adolescents (n = 80; age 12-17 years) and young adults (n = 117; age 18-24 years) were used in this study. The 8-17 year old participants were recruited from secondary and primary schools from South-West London. The 18-24 year-old sample was made up of psychology students from the University of Roehampton and received course credits for taking part.

### **5. 2. 2. Measures**

Detailed outline of the hot and cool EF tasks along with the questionnaires can be found in chapter 3.

#### **5. 2. 2. 2. Cool EF tasks**

Digit span was used to measure working memory and is a subtest from the Wechsler Intelligence Scale for Children (WISC III; Wechsler, 1991) consisting of two tests (forward and backward).

Go/no go task is a 15 minutes cued task used to measure inhibitory control (Fillmore, Rush & Hays, 2006).

#### **5. 2. 2. 2. Hot EF tasks**

The balloon analogue risk task, youth version (BART –Y; Lejuez et al., 2007) measures decision making that provides the effect of reward on performance.

Delay and probability discounting task measures motivational decision making i.e., delay of gratification. It is a computerised adjusting algorithm which tests the extent to which the subjective value of a reward is delayed.

#### **5. 2. 2. 3. Questionnaires**

Emotion regulation coping strategies was measured using the Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski, Kraaij & Spinhove, 2001).

To assess traits of emotional (anxious/depressive) and behavioural problems (conduct/hyperactivity), the Strengths and difficulties questionnaire (SDQ) was administered (Goodman, 1997).

The Inventory of Callous-Unemotional Traits (ICU; Frick, 2003) was used to measure callous unemotional traits in children and adolescents. It is a 24-item self-report scale; based on a 4 point Likert scale ranging from 0 (not at all true) to 3 (definitely true). 18-24-year-olds completed the Levenson Self-Report Psychopathy Scale (Levenson, Kiehl & Fitzpatrick, 1995) to indicate characteristics associated with CU traits.

#### **5. 2. 3. Procedure**

As the findings for this chapter are derived from the earlier study, the general procedure is outlined in chapter 4. Completion of the SDQ, ICU or Levenson self-report psychopathy scale was done immediately after participants completed the CERQ.

### **5.3. Results**

A series of univariate analysis of variance (ANOVAs) were conducted to examine age differences for all measures. This was followed by correlational analyses to examine the relationship between behavioural and emotional problems, EF measures and ER scales in different age groups. A linear regression was used to examine whether cool and hot EF predicted SDQ subscale variables (i.e., emotional problems, conduct problems, hyperactivity and peer problems). Finally to determine the effect of ER strategies on the relationship between EF and behavioural and emotional problems, a mediation analysis was conducted.

#### **5.3.1. Preliminary analysis and findings**

Table 5.1. Show the means, standard deviations and Cronbach's Alphas of the questionnaires used in this study. Most of the scales presented show a moderate range for reliability, particularly emotional problems, however low levels of internal consistency were observed for conduct problems and peer problems. The mean scores for each age group suggest that SDQ difficulties scores fall in the normal band according to UK population mean scores (Goodman, Meltzer & Bailey, 1998).

#### *ANOVA*

These scores highlight group differences for emotional and behavioural difficulties, in particular one way ANOVA yielded significant age differences

between adults and children ( $p < .001$ ) and, adults and adolescents ( $p < .001$ ) for conduct problems  $F(2, 249) = 32.21, p < .001, \eta^2 = .21$ ). Similarly for hyperactivity there were significant age differences found ( $F(2, 248) = 4.83, p = .01, \eta^2 = .04$ ), these results showed that adults significantly exhibit low levels of hyperactivity compared to adolescents ( $p = .02$ ). These results indicate that hyperactivity and conduct problems were significantly high amongst the 12-17 age group compared to young adults. There were significant age related differences observed for prosocial behaviours ( $F(2, 249) = 14.02, p < .001, \eta^2 = .10$ ) and peer problems ( $F(2, 249) = 23.41, p < .001, \eta^2 = .26$ ), where adults (18-24 year olds) appear to have significantly high scores of prosocial behaviours compared to adolescents ( $p < .001$ ) than children ( $p = 1.00$ ). Whereas scores of peer problems show that young adults were significantly less likely than children and adolescents to have peer problems ( $p < .001$ ). There were no significant age differences found for emotional problems scores across all the age groups ( $F(2, 249) = 1.31, p = .27, \eta^2 = .01$ ).

For outcomes of callous unemotional scale, there were significant age differences found for uncaring subscale ( $t(129) = 8.21, p < .001$ ). Suggesting that children exhibit significantly higher scores for uncaring traits compared to adolescents. There were no significant age differences observed for callous ( $t(125) = -.32, p = .75$ ) and unemotional subscales ( $t(129) = -1.73, p = .09$ ).

Table 5.1

Summary of means (standard deviations) and Cronbach's Alpha.

|                        | 7-11 years   | 12-17years   | 18-24 years  |          |
|------------------------|--------------|--------------|--------------|----------|
|                        | Mean (SD)    | Mean (SD)    | Mean (SD)    | $\alpha$ |
| <i>SDQ subscales</i>   |              |              |              |          |
| SDQ total              | 21.00 (5.09) | 20.69 (5.14) | 23.03 (4.67) | .64      |
| Emotional problems     | 4.24 (2.03)  | 3.55 (2.43)  | 3.88 (2.60)  | .70      |
| Conduct problems       | 3.07 (1.41)  | 3.12 (1.64)  | 1.70 (1.15)  | .46      |
| Hyperactivity Problems | 5.09 (1.51)  | 5.16 (1.73)  | 4.49 (1.59)  | .59      |
| Peer Problems          | 5.15 (1.51)  | 4.55 (1.33)  | 2.83 (2.00)  | .36      |
| Prosocial Behaviours   | 8.28 (1.67)  | 7.12 (2.00)  | 8.39 (1.51)  | .63      |
| <i>ICU subscales</i>   |              |              |              |          |
| Callous traits         | 8.16 (4.69)  | 8.45 (5.03)  | -            | .68      |
| Uncaring traits        | 17.48 (6.28) | 9.20 (5.18)  | -            | .89      |
| Unemotional Traits     | 7.46 (2.73)  | 8.36 (3.06)  | -            | .50      |
| <i>LSRP subscales</i>  |              |              |              |          |
| Primary psychopathy    | -            | -            | 19.25 (5.11) | .76      |
| Secondary psychopathy  | -            | -            | 12.05 (4.19) | .62      |

*Note.*  $\alpha$  = Cronbach's alpha; SDQ = Strengths and Difficulties Questionnaire; ICU = Inventory of Callous Unemotional traits; LSRP = Levenson's Self-Report Psychopathy Scale.

Based on the normative scores for the SDQ in the United Kingdom (Goodman, 2001), these results indicate that the mean scores for emotional problems (0-4), conduct problems (0-3), hyperactivity (0-5) and peer problems (0-3) fall close within the average band of categorisation. However scores of total difficulties (20-40) and prosocial behaviours (6-10) appear to fall in the very high band. These findings therefore share similarities with previous studies investigating the

psychometric properties (Muris, Meesters & van den Berg, 2003) and scale properties (Woerner, Becker & Rothenberger, 2004) of the SDQ.

### *Correlations*

Overall correlations between cool EF and SDQ show that conduct problems are significantly, negatively related to backward digit span. Hot EF tasks DPDT and BART-Y was negatively associated with conduct problems; suggesting that poor scores of hot and cool EF are related to conduct problems. Prosocial behaviours positively correlated with cool EF tasks backward digit span and go/no-go.

Table 5.2

Correlations between EF and SDQ outcomes.

|                     | Emotional<br>Symptoms | Conduct<br>problems | Hyperactivity | Peer<br>problems | Prosocial<br>behaviours |
|---------------------|-----------------------|---------------------|---------------|------------------|-------------------------|
| <i>Cool EF</i>      |                       |                     |               |                  |                         |
| Forward digit span  | .05                   | -.08                | -.01          | -.04             | .12                     |
| Backward digit span | -.04                  | -.18**              | -.07          | -.09             | .21**                   |
| Go/No-go            | .04                   | -.11                | -.01          | -.06             | .12*                    |
| <i>Hot EF</i>       |                       |                     |               |                  |                         |
| BART-Y              | -.04                  | -.20**              | -.07          | -.11             | .09                     |
| DPDT                | -.11                  | -.26**              | -.11          | -.20**           | -.05                    |

*Note.* \* $p < .05$ , \*\* $p < .01$ ; EF = executive functions; SDQ = Strengths and Difficulties Questionnaire; BART-Y = Balloon Analogue Risk Task Youth version; DPDT = Delay and Probability Discounting task.

Table 5.3

Correlations between ER and SDQ outcomes

|                             | Emotional<br>Symptoms | Conduct<br>problems | Hyperactivity | Peer<br>problems | Prosocial<br>behaviours |
|-----------------------------|-----------------------|---------------------|---------------|------------------|-------------------------|
| Acceptance                  | .29**                 | -.10                | .03           | .01              | .15*                    |
| Positive Refocusing         | .00                   | -.14*               | .14*          | .05              | .28**                   |
| Planning                    | -.09                  | -.19**              | -.14          | -.08             | .35**                   |
| Positive Reappraisal        | -.12                  | -.24**              | -.04          | -.17**           | .32**                   |
| Putting into<br>Perspective | .03                   | -.14*               | -.02          | -.13**           | .29**                   |
| Self-Blame                  | .43**                 | -.03                | .20**         | .09              | .12                     |
| Rumination                  | .37**                 | -.02                | .20**         | .09              | .28**                   |
| Catastrophising             | .40**                 | .27**               | .22**         | .31**            | -.01                    |
| Other blame                 | .25**                 | .22**               | .11           | .14*             | -.06                    |

*Note.* \* $p < .05$ , \*\* $p < .01$ ; ER = emotion regulation; SDQ = Strengths and Difficulties Questionnaire (Goodman et al., 1997); CERQ = Cognitive Emotion Regulation Questionnaire (Garnefski et al., 2001).

As with ER, there was a significant negative relationship between conduct problems and putatively adaptive ER strategies such as positive refocusing, positive reappraisal, planning and putting into perspective. Accordingly peer problems significantly negatively correlated with putting into perspective and planning. Putatively maladaptive ER strategies positively correlated with SDQ outcomes, catastrophising in particular was significantly associated with emotional and behavioural problems.

### **5. 3. 1. 1. Relationship between behavioural and emotional problems, EF and ER**

Separate Pearson's correlations were conducted to examine the relationship between EF, ER, emotional problems and behavioural problems. As expected, in children aged 7-11 years (see Table 5.4), there was a significant positive correlation between conduct problems and BART-Y, and BART-Y and uncaring traits. This finding suggested that children with high scores on conduct problems and uncaring traits are more likely to have deficits in hot EF. There was a significant negative correlation between conduct problems and the putatively adaptive emotion regulation strategies positive refocusing, planning and positive reappraisal. There were no significant relationships between cool EF and emotional and behavioural problems.

However prosocial behaviours were significantly linked with high scores of backward digit span, suggesting that working memory is related to positive behaviours. Correlation between ER strategies and SDQ show that ER strategy self-blame was positively linked with emotional problems. Similarly there was a positive relationship between hyperactivity and rumination. These findings suggest that maladaptive ER is linked to behavioural and emotional problems. On the other hand children with emotional problems also appear to have a significantly positive relationship with ER strategy positive refocusing.



Table 5.4  
Correlations for 7-11 year olds.

|                                   | <i>SDQ subscales</i> |                  |                        |               |                      | <i>ICU subscales</i> |                 |                    |
|-----------------------------------|----------------------|------------------|------------------------|---------------|----------------------|----------------------|-----------------|--------------------|
|                                   | Emotional problems   | Conduct problems | Hyperactivity Problems | Peer Problems | Prosocial Behaviours | Callous traits       | Uncaring traits | Unemotional Traits |
| <i>Cool EF</i> Forward digit span | .20                  | -.08             | .06                    | .12           | .21                  | -.02                 | .12             | -.20               |
| Backward digit span               | .00                  | .06              | -.10                   | -.05          | .37**                | -.03                 | .01             | .17                |
| Go-No/Go                          | -.19                 | -.05             | -.16                   | -.14          | .08                  | -.02                 | -.08            | .13                |
| <i>Hot EF</i> BART-Y              | .10                  | .32*             | .22                    | -.11          | -.19                 | .08                  | .30*            | -.10               |
| DPDT                              | -.15                 | .20              | -.10                   | -.10          | -.06                 | .04                  | -.16            | -.10               |
| <i>CERQ</i>                       |                      |                  |                        |               |                      |                      |                 |                    |
| Acceptance                        | .26                  | -.04             | .10                    | .16           | .16                  | .28*                 | -.01            | .04                |
| Positive Refocusing               | .39**                | -.27*            | -.17                   | .23           | .24                  | .20                  | -.18            | .06                |
| Planning                          | .11                  | -.31*            | -.23                   | .20           | .19                  | -.07                 | -.23            | -.22               |
| Positive Reappraisal              | -.12                 | -.30*            | -.15                   | .08           | .08                  | .17                  | -.24            | .03                |
| Putting into Perspective          | -.00                 | .03              | .13                    | -.01          | -.01                 | -.01                 | -.10            | -.15               |
| Self-Blame                        | .29*                 | .26              | .27                    | -.11          | .11                  | .13                  | -.08            | .28*               |
| Rumination                        | .19                  | .14              | .31*                   | .04           | .05                  | .28*                 | -.17            | .04                |
| Catastrophising                   | .33*                 | .31*             | .24                    | .09*          | .08                  | .02                  | .02             | .01                |
| Other blame                       | .15                  | .21              | .01                    | .07           | .07                  | .07                  | -.05            | -.21               |

Note. \* $p < .05$ , \*\* $p < .01$ ;  $n = 53$ ; *EF* = emotion regulation; *SDQ* = Strengths and Difficulties Questionnaire; *ICU* = Inventory of Callous Unemotional traits; *BART-Y* = Balloon Analogue Risk Task-Youth version; *DPDT* = Delay and Probability Discounting Task; *CERQ* = Cognitive Emotion Regulation Questionnaire.

Table 5.5  
Correlations for 12- 17 year olds.

|                                   | <i>SDQ subscales</i> |                  |                        |               |                      | <i>ICU subscales</i> |                 |                    |
|-----------------------------------|----------------------|------------------|------------------------|---------------|----------------------|----------------------|-----------------|--------------------|
|                                   | Emotional problems   | Conduct problems | Hyperactivity Problems | Peer Problems | Prosocial Behaviours | Callous traits       | Uncaring traits | Unemotional Traits |
| <i>Cool EF</i> Forward digit span | .24*                 | .03              | .06                    | -.12          | -.05                 | .16                  | .06             | .15                |
| Backward digit span               | .11                  | -.04             | .10                    | -.15          | .01                  | -.12                 | -.03            | .24*               |
| Go-No/Go                          | .18                  | .15              | .05                    | -.12          | -.05                 | .10                  | .09             | -.08               |
| <i>Hot EF</i> BART-Y              | .10                  | .06              | .04                    | -.13          | -.01                 | -.08                 | -.08            | -.10               |
| DPDT                              | -.10                 | -.28*            | -.07                   | .07           | .11                  | -.26*                | -.04            | .02                |
| <i>CERQ</i>                       |                      |                  |                        |               |                      |                      |                 |                    |
| Acceptance                        | .40**                | .00              | .09                    | .16           | .12                  | .05                  | .28*            | .21                |
| Positive Refocusing               | -.07                 | -.19             | -.06                   | -.19          | .46**                | -.12                 | .36**           | -.13               |
| Planning                          | .10                  | -.20             | .05                    | -.10          | .44**                | -.09                 | .41**           | -.19               |
| Positive Reappraisal              | -.08                 | -.24*            | -.12                   | -.12          | .43**                | -.11                 | .48**           | -.22               |
| Putting into Perspective          | .14                  | -.24*            | .03                    | .00           | .43**                | -.11                 | .50**           | -.02               |
| Self-Blame                        | .49**                | .00              | .10                    | .17           | .09                  | .05                  | .18             | .35**              |
| Rumination                        | .29*                 | -.02             | .12                    | .00           | .26*                 | .10                  | .39**           | -.03               |
| Catastrophising                   | .35**                | -.20             | .26*                   | -.06          | .03                  | .27**                | .15             | .10                |
| Other blame                       | .35**                | .22*             | .17                    | .17           | .11                  | .35**                | -.03            | .06                |

Note. \* $p < .05$ , \*\* $p < .01$ ;  $n = 80$ ; EF = emotion regulation; SDQ = Strengths and Difficulties Questionnaire; ICU = Inventory of Callous Unemotional traits; BART-Y = Balloon Analogue Risk Task -Youth version; DPDT = Delay and Probability Discounting Task; CERQ = Cognitive Emotion Regulation Questionnaire.

Findings in the 12-17 year age group (see Table 5.5) show a significant positive relationship between conduct problems and BART-Y, as high scores on BART-Y indicates poor performance this suggests that conduct problems are significantly associated with poor hot EF. Conduct problems appear to be negatively correlated with adaptive ER strategies and hyperactivity significantly correlated positively with maladaptive ER strategy catastrophising. Similarly emotional problems in this age group significantly correlated positively with maladaptive ER strategies self-blame, rumination, other blame and catastrophising.

The results from the 18-24 year old age group (see Table 5.6) show a significant negative correlation between BART-Y and emotional problems, indicating that poor hot EF is associated with emotional problems in young adults. ER strategies such as positive reappraisal and putting into perspective negatively correlated with emotional problems. However putatively maladaptive ER strategies such as self-blame, rumination, catastrophising and other blame were positively correlated with emotional problems. Similarly conduct problems was found to be positively linked with catastrophising, rumination and other blame and Hyperactivity significantly correlated positively with self-blame and rumination. These results suggest that maladaptive ER is positively associated with behavioural and emotional problems in adults. Prosocial behaviours correlated positively with adaptive ER strategies such as positive refocusing, planning, positive reappraisal and putting into perspective. No further significant correlations were observed between EF measures and SDQ subscales.

Table 5.6  
Ccorrelations for 18-24 year olds.

|                                   | <i>SDQ subscales</i> |                  |                        |               |                      | <i>LSRP subscales</i> |                       |
|-----------------------------------|----------------------|------------------|------------------------|---------------|----------------------|-----------------------|-----------------------|
|                                   | Emotional problems   | Conduct problems | Hyperactivity Problems | Peer Problems | Prosocial Behaviours | Primary Psychopathy   | Secondary Psychopathy |
| <i>Cool EF</i> Forward digit span | -.14                 | -.12             | -.03                   | .14           | .14                  | .04                   | -.09                  |
| Backward digit span               | -.14                 | -.09             | -.05                   | .09           | .19*                 | .12                   | -.03                  |
| Go-No/Go                          | -.13                 | -.15             | -.04                   | -.12          | .03                  | .02                   | -.05                  |
| <i>Hot EF</i> BART-Y              | -.25**               | -.04             | .05                    | .06           | -.06                 | .03                   | -.06                  |
| DPDT                              | .02                  | -.12             | .15                    | -.06          | -.07                 | .01                   | -.11                  |
| <i>CERQ</i>                       |                      |                  |                        |               |                      |                       |                       |
| Acceptance                        | .23*                 | -.27             | .20*                   | -.02          | .12                  | -.03                  | .07                   |
| Positive Refocusing               | -.05                 | .10              | .07                    | -.05          | .06                  | .15                   | -.09                  |
| Planning                          | -.25**               | -.02             | .08                    | -.12          | .10                  | .01                   | -.24*                 |
| Positive Reappraisal              | -.23**               | -.05             | .00                    | -.09          | .20*                 | .08                   | -.23*                 |
| Putting into Perspective          | -.04                 | -.00             | .11                    | -.08          | .19*                 | -.04                  | -.07                  |
| Self-Blame                        | .47**                | .10              | .28**                  | .02           | -.02                 | .01                   | .35*                  |
| Rumination                        | .43**                | .19*             | .25**                  | -.09          | .19*                 | -.10                  | .31**                 |
| Catastrophising                   | .18**                | .27**            | .17                    | .09           | -.03                 | .14                   | .26**                 |
| Other blame                       | .23*                 | .31**            | .13                    | .03           | -.13                 | .19*                  | .26**                 |

Note. \* $p < .05$ , \*\* $p < .01$ ;  $n = 117$ ; *EF* = emotion regulation; *SDQ* = Strengths and Difficulties Questionnaire; *LSRP* = Levenson's Self Report Psychopathy Scale; *BART-Y* = Balloon Analogue Risk Task-Youth version; *DPDT* = Delay and Probability Discounting Task; *CERQ* = Cognitive Emotion Regulation Questionnaire.

*Predictors of behavioural and emotional problems*

Analysis of linear regression showed that BART-Y predicted conduct problems positively and peer problems negatively in all the age groups (see Table 5.8 and 5.10). However emotional problems (Table 5.7) and hyperactivity (Table 5.9) were not significantly predicted by cool or hot EF measures.

Table 5.7

Linear model predictors of emotional problems

|                     | <i>b</i> | <i>SE b</i> | <i>t</i> | $\beta$ |
|---------------------|----------|-------------|----------|---------|
| (Constant)          | .50      | .41         | 1.23     |         |
| Forward Digit Span  | .07      | .07         | 1.02     | .07     |
| Backward Digit Span | -.05     | .07         | -.70     | -.05    |
| Go/No-Go            | .02      | .02         | .88      | .06     |
| BART-Y              | -.03     | .02         | -.20     | -.01    |
| DPDT                | -.02     | .08         | -1.76    | -.12    |

*Note. \*p <.05; BART-Y = Balloon Analogue Risk Task-Youth version; DPDT = Delay and Probability Discounting Task*

Table 5.8

Linear model predictors of conduct problems

|                     | <i>b</i> | <i>SE b</i> | <i>t</i> | $\beta$ |
|---------------------|----------|-------------|----------|---------|
| (Constant)          | .61      | .28         | 2.36     |         |
| Forward Digit Span  | .00      | .04         | .006     | .00     |
| Backward Digit Span | -.12     | .05         | -2.35    | -.16*   |
| Go/No-Go            | -.02     | .01         | -1.56    | .12     |
| BART-Y              | -.03     | .05         | -3.06    | -.13*   |
| DPDT                | -.01     | .05         | -1.99    | -.20    |

*Note. \*p <.05; BART-Y = Balloon Analogue Risk Task-Youth version; DPDT = Delay and Probability Discounting Task*

Table 5.9

Linear model predictors of hyperactivity

|                     | <i>b</i> | <i>SE b</i> | <i>t</i> | $\beta$ |
|---------------------|----------|-------------|----------|---------|
| (Constant)          | .91      | .28         | 3.22     |         |
| Forward Digit Span  | .03      | .05         | .67      | .05     |
| Backward Digit Span | -.05     | .05         | -1.03    | -.07    |
| Go/No-Go            | -.00     | .01         | .29      | -.01    |
| BART-Y              | .00      | .01         | -1.77    | .01±    |
| DPDT                | -.02     | .06         | -.41     | -.12    |

*Note.* ±*p* = .07; *BART-Y* = *Balloon Analogue Risk Task-Youth version*; *DPDT* = *Delay and Probability Discounting Task*

Table 5.10

Linear model predictors of peer problems

|                     | <i>b</i> | <i>SE b</i> | <i>t</i> | $\beta$ |
|---------------------|----------|-------------|----------|---------|
| (Constant)          | 6.57     | 1.64        | 4.00     |         |
| Forward Digit Span  | .01      | .06         | .17      | .12     |
| Backward Digit Span | -.05     | .06         | -.84     | .06     |
| Go/No-Go            | -.02     | .01         | -.92     | .06     |
| BART-Y              | -.03     | .01         | -2.55    | -.17*   |
| DPDT                | -.06     | .07         | -.84     | .06     |

*Note.* \**p* < .05; *BART-Y* = *Balloon Analogue Risk Task-Youth version*; *DPDT* = *Delay and Probability Discounting Task*

### **5.3.1.2. Correlations between psychopathic traits and behavioural and emotional problems**

Bivariate correlation analysis between ICU, LSRP and SDQ (Table 5.11) show that only conduct problems in children and adolescents were associated with uncaring traits. Adults exhibiting high scores of emotional and behavioural difficulties on the SDQ were significantly associated with secondary psychopathy, whereas only conduct problems and hyperactivity were positively associated with primary psychopathy.

Further correlation analysis was also conducted between hot and cool EF, CERQ, SDQ and ICU for 7-11 (see Table 5.4) and 12-17 year olds (see Table 5.5). There was a significant positive correlation between BART-Y and uncaring traits, suggesting that poor hot EF was linked with uncaring traits in children. In adolescents there were significant positive correlations between backward digit span and unemotional traits and negative correlation between callous traits and DPDT. Suggesting that hot EF is negatively associated with callous personality traits.

Based on ER outcomes, the children's age group (7-11 years) show acceptance and rumination to be significantly correlated with callous traits, with self-blame being significantly correlated with unemotional traits in both age groups. For the adolescent age group (12-17 years) however, there was a significant relationship between catastrophising, other blame and callous traits. Unlike callous and unemotional traits, there was a significantly positive relationship found between putatively adaptive ER strategies such as acceptance, positive refocusing, planning, positive reappraisal, putting into perspective and uncaring traits. Uncaring traits was also positively correlated with rumination. On the contrary in the adult sample there

were no significant correlations found for primary psychopathy which measures callous and uncaring behaviours. Significant positive correlations were found between secondary psychopathy and putatively maladaptive ER strategies.

Table 5.11

Summary of inter correlation between ICU, LSRP and SDQ outcomes

|                          | Emotional<br>Symptoms | Conduct<br>problems | Hyperactivity | Peer<br>problems | Prosocial<br>behaviours |
|--------------------------|-----------------------|---------------------|---------------|------------------|-------------------------|
| <i>ICU</i>               |                       |                     |               |                  |                         |
| Callous traits           | .15                   | .40**               | .17           | .11              | -.30**                  |
| Uncaring traits          | .08                   | .02                 | -.06          | .09              | .00                     |
| Unemotional traits       | .03                   | .03                 | .12           | -.03             | -.23**                  |
| <i>LSRP</i>              |                       |                     |               |                  |                         |
| Primary Psychopathy      | .01                   | .26**               | .21*          | .17±             | -.26**                  |
| Secondary<br>Psychopathy | .43**                 | .42**               | .26**         | .17±             | -.09                    |

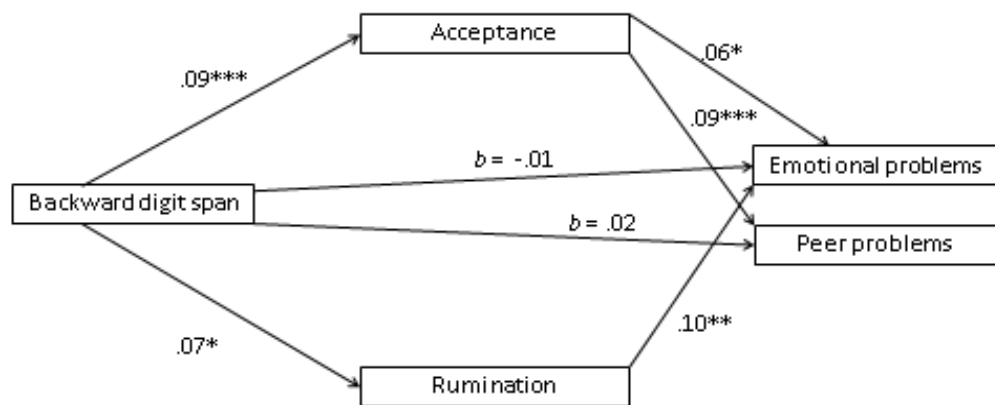
*Note.* \* $p < .05$ , \*\* $p < .01$ ; ± $p < .07$ ; *SDQ* = *Strengths and Difficulties Questionnaire*; *ICU* = *Inventory of Callous-Unemotion*; *LSRP* = *Levenson's Self-Report Psychopathy Scale*.



### 5.3.2. Mediation analysis

A series of mediation analyses were conducted using Process (Hayes, 2012), to explore the extent to which the relationships between different EFs, and behavioural and emotional problems are mediated by ER strategies. Only significant mediation models are reported below.

#### *Backward Digit Span*



Note.  $***p < .001$ ,  $**p < .01$ ,  $*p < .05$ ;  $b = \text{direct effect}$ .

Figure 6. Standardized regression coefficients showing Backward digit span as a predictor of behavioural and emotional problems, mediated by ER strategies acceptance and rumination.

Mediation analyses (Figure 6) revealed a significant mediating effect of ER strategies acceptance ( $b = .006$ , BCa CI [.0003, .0161]) and rumination ( $b = .007$ , BCa CI [.002, .017]) on the relationship between backward digit span and emotional problems. Similarly, results revealed a significant mediating effect of acceptance ( $b = .005$ , BCa CI [.0003, .0138]) on the relationship between backward digit span and peer problems. There were no mediating effects of ER strategies on the relationship between conduct problems, hyperactivity, and backward digit span.

*Forward Digit Span*

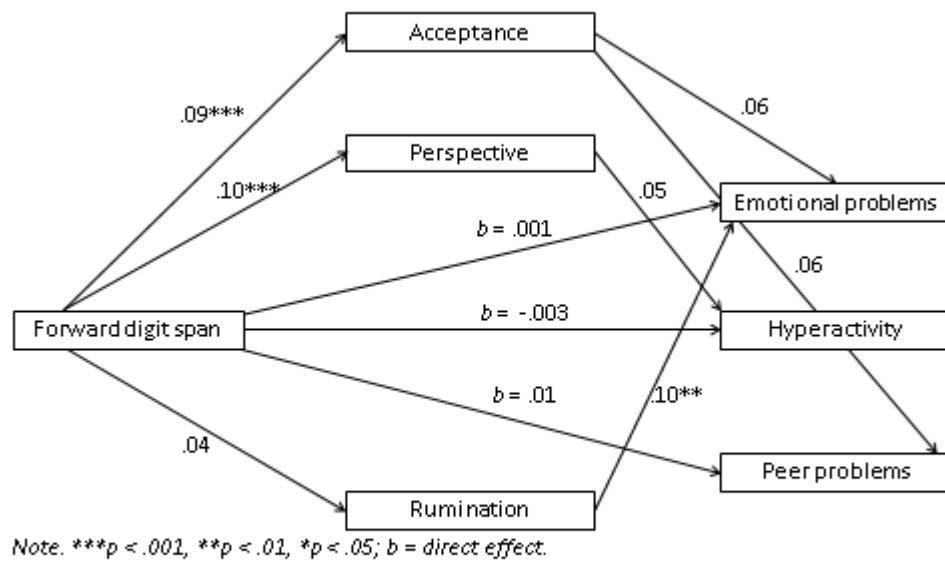


Figure 7. Standardized regression coefficients showing Forward digit span as a predictor of behavioural and emotional problems, mediated by ER strategies acceptance, perspective and rumination.

Figure 7 shows the association between forward digit span, the SDQ variables and the significantly mediating ER strategies. Significant mediating effect of ER strategies acceptance ( $b = .005$ , BCa CI [.000, .014]), and rumination ( $b = .004$ , BCa CI [.000, .013]) was observed on the relationship between forward digit span and emotional problems, similarly the relationship between forward digit span and peer problems was mediated by acceptance ( $b = .005$ , BCa CI [.0003, .0136]). There was also a significant indirect effect of forward digit span on hyperactivity, mediated by ER strategy putting into perspective ( $b = .005$ , BCa CI [.0003, .0126]). There were no significant effect of ER observed on the relationship between forward digit span and conduct problems.

*Go/No-Go*

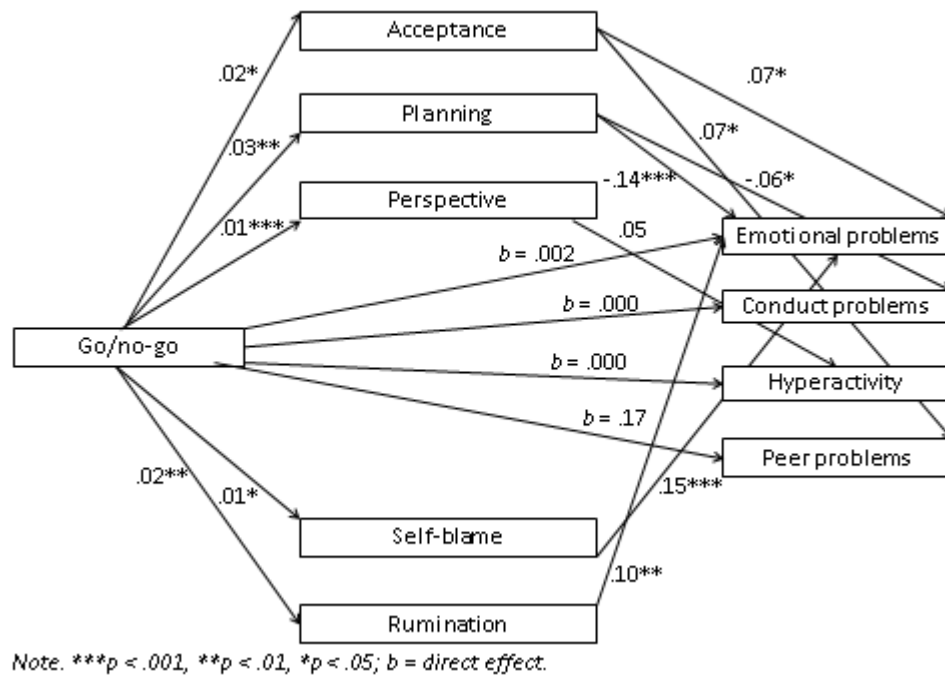
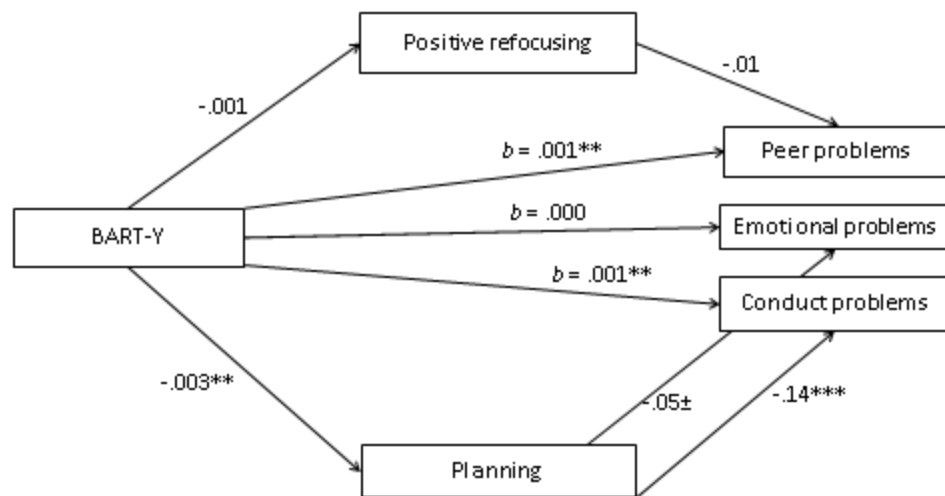


Figure 8. Standardized regression coefficients showing Go/no-go as a predictor of behavioural and emotional problems, mediated by ER strategies acceptance, planning, perspective, self-blame and rumination.

Figure 8 shows the direct effect cool EF task go/no-go on emotional and behavioural problems as mediated only by significant ER strategies. The results from the mediation analysis revealed a significant indirect effect of cool task go/no-go on emotional problems mediated by ER strategies planning ( $b = -.004$ , BCa CI [-.008, -.001]), acceptance ( $b = .001$ , BCa CI [.001, .003]), self-blame ( $b = .002$ , BCa CI [.0003, .0044]) and rumination ( $b = .006$ , BCa CI [.0003, .0161]). Moreover ER strategy planning mediated the interaction between go/no-go and conduct problems ( $b = -.001$ , BCa CI [-.004, -.001]), whereas putting into perspective alone mediated the relationship between go/no-go and hyperactivity ( $b = .001$ , BCa CI [.0003, .0033]). The interaction between peer problems and go/no-go appear to be mediated by acceptance ( $b = .002$ , BCa CI [.0002, .0036]).

*BART-Y*



Note.  $***p < .001$ ,  $**p < .01$ ,  $\pm p < .06$ ;  $b$  = direct effect, BART-Y = Balloon Analogue Risk Task–Youth version.

Figure 9. Standardized regression coefficients showing BART-Y as a predictor of behavioural and emotional problems, mediated by ER strategies positive refocusing and planning.

Further mediation analysis (figure 9) revealed a significant mediating effect of ER strategy planning ( $b = .005$ , BCa CI [.0001, .0009]) on the relationship between hot EF task BART-Y and emotional problems. Additionally planning significantly mediated the relationship between conduct problems and BART-Y ( $b = .002$ , BCa CI [.0001, .0005]). An indirect effect of BART-Y was also observed for peer problems mediated by positive refocusing ( $b = .001$ , BCa CI [.0002, .0003]).

*DPDT*

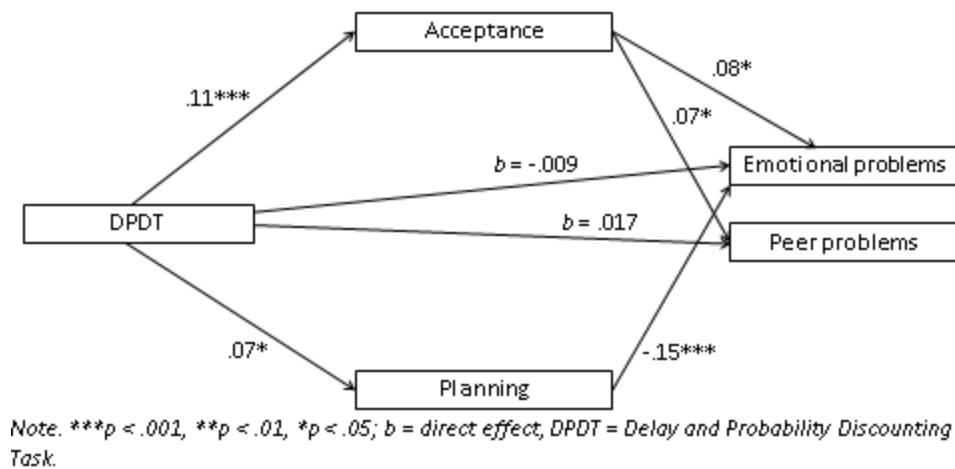


Figure 10. Standardized regression coefficients showing DPDT as a predictor of behavioural and emotional problems, mediated by ER strategies acceptance and planning.

The relationship between DPDT and emotional problems was mediated by planning ( $b = -.010$ , BCa CI  $[-.0221, -.0011]$ ) (figure 10). There was also an indirect effect of EF on emotional problems ( $b = .008$ , BCa CI  $[.0011, .0214]$ ) and peer problems ( $b = .008$ , BCa CI  $.0009, .0071]$ ) mediated by ER strategy acceptance. No further significant indirect effects were observed for EF and SDQ outcomes.

### 5.4. Discussion

The main aim of this study was to examine the relationship between cool and hot EF and emotional and behavioural problems, and how they are related to distinct emotion regulation strategies. As this this was mainly an exploratory study we expected to find links between SDQ outcomes and cool and hot EF tasks. In support of the hypothesis the findings from this study show that cool and hot EF was significantly associated with behavioural difficulties such as conduct problems and peer problems but not hyperactivity. Nonetheless this relationship between EF and

emotional and behavioural difficulties appear to vary in each age group. The results also revealed that those in the 12-17 years age group were more likely to have difficulties with conduct problems and hyperactivity compared to children and adults, on the contrary adult students were found to have poor relations yet the best scores for prosocial behaviours.

#### **5. 4. 1. Primary findings**

Based on the means, conduct problems was found to be related to DPDT (i.e., hot EF) in adolescents, emotional problems in this age group was however linked with forward digit span (i.e., cool EF). High scores of emotional problems in adolescents were significantly associated with maladaptive emotion regulation strategies such as self-blame, rumination and catastrophising. Whereas in children BART-Y (i.e., hot EF) was negatively related with conduct problems and uncaring traits. Similarly conduct problems were then associated with maladaptive ER strategies. In the adult sample emotional problems were linked with poor BART-Y outcomes. The results further revealed that only hot EF significantly predicted conduct problems and peer problems regardless of age, as BART-Y alone was found to be a significant predictor of conduct and peer problems. In terms of limitations, it is important to acknowledge that this was a cross-sectional study in nature thus impeding from determining the directionality of the link between EF, ER and emotional and behavioural problems.

#### **5. 4. 2. EF links to behavioural and emotional problems**

Correlations analysis revealed that various aspects of EF are associated with emotional and behavioural problems in different age groups. Firstly only conduct problems were associated with poor hot EF in children and adolescents. This is in

line with previous studies whereby behavioural difficulties in particular conduct disorders have been associated with poor scores on hot EF tasks rather those with hyperactivity traits (Luman, Sergeant, Knol & Oosterlan, 2010; Matthys, van Goozen, Snoek & van Engeland, 2004; Hobson, Scott & Rubia, 2011). Similar to the findings in this study Humphrey and Lee (2012) found that in children conduct problems were associated with BART-Y (hot EF) task. Poor EF skills could explain risky behaviours within adolescents, as they are least likely to employ effective decision making strategies (Bexkens, Jansen, Van der Molen & Huizinga, 2016) and this could be related to disruptive behaviour disorders (Schweb et al., 2002). Similar to Antonini, Becker, Tamm and Epstein (2015) there was no relationship found between hyperactivity problems and hot EF in any of the different age groups. These non-significant findings are further consistent with previous studies (Geuts et al., 2006; Skogli, Egeland, Anderson, Hovik & Oie, 2014). Antonini et al. (2015) suggest is that this could be because there is a lack of external motivator and this is linked with task performance, increasing the propensity for riskier decision making, this study did not offer participants a reward.

In adolescents emotional problems were linked with poor cool EF, whereas in adults emotional problems were closely related to poor hot EF. These findings are reflective of Han et al., (2012) study where adolescents with depression were found to have impairments on cool EF tasks particularly sustained attention. Similarly they also found that deficits in hot EF were closely associated with mood state.

However as expected there was no significant relationship found between the performance of Hot EF and behavioural problems in adults, but rather they were associated with emotional difficulties. This is similar to previous studies where cool

EF deficits are associated with emotional problems, in particular depression (Rock et al., 2014; Veiel, 1997), however Roiser and Sahakian (2013) suggest that poor performance on cool EF could be as a result of motivational deficits (i.e., hot EF) in those who suffer from depression. A longitudinal study by Han et al. (2016) observed that initial cool EF deficits in depressed adolescents were followed with the development of anxiety symptoms later and poor decision making scores, Han et al. also claim that this could be related to motivational deficits. Similarly using a gambling task, a study found that adolescents with depression were less motivated to seek rewards by betting on lower amounts compared to healthy controls (Rawal, Collishaw & Rice, 2013).

High scores on cool EF were associated with prosocial behaviours in children and adults but not adolescents. This is similar to the findings observed by Brock and colleagues (2009) in their study where children with better scores on cool EF tasks were reported by their teachers as having better prosocial skills in the classroom. Very few studies have focused on prosocial behaviours in adolescence without measuring peer relationships, a review by Burnett, Sebastian, Kadosh and Blakemore (2011) suggest that prosocial behaviours in adolescence is heavily influenced by peers, particularly where risky behaviours are usually the group norm studies show significantly reduced self-reported positive mood following episodes of social exclusion in adolescents than adults.

#### **5. 4. 3. ER links to behavioural and emotional problems**

As expected the results revealed that overall those with emotional difficulties were likely to have poor scores of putatively maladaptive emotion regulation strategies in particular self-blame and catastrophising. Maladaptive ER processes are



believed to be at the core of depression and anxiety (Beck, Rush, Shaw & Emery, 1979). This study additionally found that prosocial behaviours were associated with high scores on putatively adaptive ER, studies support this finding whereby adaptive ER strategy, in particular acceptance is linked with positive outcomes (Hayes et al., 1999; Heffner, Eifert, Parker, Hernandez & Sperry, 2003). Only adolescents and adults with emotional problems were found to have high scores of rumination. This is indicative of the mean scores for rumination in this age group (see chapter 4). This is in line with previous studies where rumination is strongly linked with symptoms of depression and anxiety, as mood related disorders are closely related to maladaptive ER strategies (Aldao et al., 2010).

In line with previous studies and the hypothesis of this study maladaptive emotion regulation strategies were poorly linked with high traits of hyperactivity. Children and adults with high scores hyperactivity were found to have a positive relationship with maladaptive emotion regulation strategy rumination, whereas adolescents with high scores of hyperactivity were positively associated with catastrophising. Regardless this suggests that maladaptive emotion regulation or emotion dysregulation is clearly related to behavioural problems, in particular hyperactivity. Penza-Clyve and Zeman (2002) claim that deficiency in emotional self-awareness is related to emotional reactivity and inconsistent emotion regulation strategies. Children who usually are diagnosed with ADHD or display hyperactive traits exhibit this deficiency in emotional awareness and variability in expression, impairing their ability to regulate these emotions and engage in prosocial goal directed behaviours (Sobanski et al., 2010).

Conduct problems was found to be significantly associated with maladaptive emotion regulation strategies rumination, catastrophising and other blame in adults alone. In children and adolescents conduct problems were negatively linked with maladaptive ER and positively associated with callous traits. The presence of CU traits and its relationship to emotional deficits in this group of children and adolescents with conduct problems are consistent with the construct of psychopathy that has been used to designate a subgroup of antisocial adults (Hare, 1998). Children with conduct disorders are found to be less reactive to threatening and emotionally distressing stimuli (Dadds et al., 2012; Loney, Frick, Ellis & McCoy, 1998) which could therefore influence their ability to efficiently regulate emotions.

#### **5. 4. 4. Emotion regulation strategies as mediators**

Findings from this study show that emotion regulation significantly mediated the relationship between EF and emotional and behavioural problems. Hot EF and emotional symptoms in particular were significantly mediated by ER, Mueller et al. (2010) reports that those with emotional disorders such as anxiety avoid risky decision making, these individuals poorly regulate emotions even though their scores may be better (Werner et al., 2009). Given the neurobiological overlap between ER and EF (Semrud-Clikeman, Walkowiak, Wilkinson, & Butcher, 2010) we were expecting associations with hyperactivity; the mediation analysis highlighted this relationship between hyperactivity and cool EF in particular which was significantly influenced by ER. As reported in numerous studies youths with symptoms of hyperactivity or in its severe form, ADHD have more difficulty controlling their emotions during challenging tasks compared to controls (Melnick & Hinshaw, 2000; Walcott & Landau, 2004; Wheeler Maedgen & Carlson, 2000). It is argued that this

relationship between ER and ADHD may exist as a result of shared EF processes involved in the expression of ADHD (Barkley, 1997).

Both cool and hot EF predicted conduct problems; this relationship was then significantly mediated by adaptive and maladaptive ER strategies. As emotion regulation is closely related to executive functions, individuals with conduct problems have difficulty regulating their emotions (Cole, Teti & Zahn-Waxler, 2003) and exhibit impairments in cool and hot tasks (Hobson, Scott & Rubia, 2011). Fairchild and colleagues (2009b) findings suggest that those with conduct problems are more likely to select risky choices, participants with early onset conduct disorders further displaying impairments in fear and sadness recognition and have high psychopathic traits (Fairchild et al., 2009a).

#### **5. 4. 5. Conclusions**

The findings from this study highlight that both hot and cool EF are associated with behavioural difficulties, particularly conduct problems. In relation to ER, adaptive ER strategies were negatively associated with behavioural and emotional problems. On the contrary maladaptive ER was positively associated with emotional and behavioural problems. This was found in children, adolescents and adults; however the significant strategies varied in each age group. Nonetheless the findings from this study also highlight the role of ER in significantly mediating the relationship between cool/hot EF and emotional and behavioural problems. Children's behavioural regulation during the early years of schooling is uniquely associated with success in academic performance and predicts successful outcomes in later school years (Ponitz, McClelland, Matthews & Morrison, 2009) therefore

future studies could consider a longitudinal design to measure these factors to measure the developmental trajectory further.

## **Chapter 6: The impact of an early intervention on executive functions and emotion regulation in children with behavioural and emotional problems.**

### **6. 1. Introduction**

#### **6. 1. Interventions for executive functions**

As discussed in Chapter 1 executive functions (EF) are set of complex cognitive processes which allow individuals to control thoughts and actions when faced with challenging situations, where an automatic or impulsive response is not useful (Miyake & Friedman, 2012). These functions importantly assist individuals when confronted with everyday demands by suppressing impulsive responses (inhibition), shift between various ideas and tasks (cognitive flexibility) and hold and update information by actively manipulating it in mind (working memory); together inhibition, cognitive flexibility and working memory are considered core underlying aspects of EF (Miyake et al., 2000).

As reported in numerous studies, EF successfully predicts learning abilities (Blair & Razza, 2007), academic achievement (Brock et al., 2009; David et al.,

2014) and social and emotional competence (Hughes & Ensor, 2007; Riggs, Jahromi, Razza, Dillworth-Bart, & Mueller, 2006). Indeed EF difficulties are found to be implicated in developmental disorders (Castellanos & Tannock, 2002; Fairchild, Van Goozen, Calder, Stollery, & Goodyer, 2009). Thus, in recent years interventions have been developed to enhance EF. Most of these interventions have sought to investigate the effect of activities such as sport, mindfulness and classroom training can have on EF (Diamond & Lee, 2011) (see chapter 2).

The common approach of computerised training programs that are set on computer games and gradually increase EF demands have produced mixed results (Diamond & Lee, 2011). Nonetheless these studies have shown transfer effects of training on domains of visuo-spatial working memory, verbal working memory and inhibition in both typically and atypically developing children (Holmes, Gathercole, & Dunning, 2009; Kirk, Gray, Riby, & Cornish, 2015; Klingberg et al., 2005; Klingberg et al., 2002; Rueda, Rothbart, McCandliss, Saccomanno, & Posner 2005; Titz & Karbach, 2014). Furthermore Wass, Scerif and Johnson (2012) found that cognitive training aimed at younger children leads to widespread transfer of training effects. For example a study by Thorell and colleagues (2009) used a computerised inhibition training programme called Cogmed, children who participated in the training programme displayed improvements in non-trained attention, visual-spatial, and verbal working memory tasks (but not on inhibition, problem solving, or processing speed tasks). Similarly

Bergman -Nutley et al. (2011) used an intensive computerised training consisting of 2-5 sessions per week and reported marked improvements in working memory. Interventions have also examined the outcomes of hot EF, for example

Rueda et al. (2012) intense attention focusing training resulted in children being able to reappraise motivational significance and make better choices. Traverso, Viterbori, & Usai (2015) found that their programme improved children's ability to delay a reward and control ongoing responses. Yu, Kam and Lee (2016) suggest that successful delay of gratification predicted working memory and inhibition scores.

Studies consistently show that in young children as a result of continuous cognitive development and limited cognitive abilities (i.e., duration, capacity and control of attention) computerised training may be unsuitable to generate EF improvements (Fernandez-Molina, Trella, & Barros, 2015). To thoroughly engage EF functions Howard, Powell, Vasseleu, Johnstone and Melhuish (2016) used the concept of embedding cognitive activities in everyday activities to control their thinking and behaviour, their findings demonstrated that cognitive flexibility and working memory were improved and were maintained at follow up. This indicates that early EF intervention can yield pronounced and lasting change (Sonuga-Barke & Halperin, 2011; Wass et al., 2012).

Classroom programmes are generally group based, that is usually related to the classroom curriculum (Zhai, Raver, & Li-Grining, 2011), an example of which is Bodrova and Leong's (1996) Tools of the Mind programme which highlights the development of skills such as socio-emotional self-regulation, focusing attention and remembering on purpose. (Diamond, Barnett, Thomas and Munro's (2007) trial of this programme demonstrated that physical exercise in particular significantly influenced positive outcomes of EF. These studies indicate that EF interventions are promising, especially the effectiveness of different strategies that may be useful in

enhancing EF outcomes. More importantly these studies also highlight the effect of early intervention as a prevention strategy.

### **6. 1. 2. Interventions for emotion regulation**

Studies have shown that inhibitory processes are closely linked to ER in young children (Derryberry & Reed, 1996; Rothbart et al., 2000) and remains stable in adulthood (Casey et al, 2011). Moreover there is evidence to show that ER processes are strongly supported by core EF processes such as inhibition and cognitive flexibility (Rueda & Paz-Alonso, 2013; Carlson & Wang, 2007). As reported by Checa and Fernandez-Berrocal (2015), participants who exhibited improved ER skills were less impulsive when responding to cognitive tasks such as the Stroop task. Impulsivity is empirically linked to gratification delay, which requires the capacity to control impulses and postpone an immediate reward in order to obtain a larger reward (Casey et al., 2011; Mischel, Shoda & Rodriguez, 1989). Impulsivity is negatively implicated in ER as difficulties in both ER and EF are associated with emotional and behavioural problems (Eisenberg et al., 2009). Casey et al. (2011) results also revealed that preschool children with less capacity to control impulses, as measured by delayed gratification tasks, displayed low self-control as adults 40 years later.

Interventions aimed at ER largely examine outcomes in relation to internalising disorders (Ferdon & Kaslow, 2008; Kovacs et al., 2006). Most notably Kovacs et al. (2006) used a programme aimed directly at enhancing ER skills in children with depression using the programme Contextual Emotion-Regulation Therapy (CERT). The programme focuses on goal direction and problem solving whilst offering advice such as reframing mood-related incidents in terms of emotion



regulation. According to this framework adaptive self-regulation of distress and dysphoria is compromised as a result of child's inability to cope and facilitate the emergence of clinical depression. Following treatment using this programme self-reported symptom of depression significantly declined immediately and was maintained.

Mindfulness has also been incorporated in psychosocial ER interventions in treating internalising (Evans et al., 2008) and externalising (Zylowska et al., 2008) disorders. Blair (2010) suggests that children with conduct problems and those who are reactively aggressive exhibit increased amygdala activity to emotional stimuli. Zylowska et al. (2008) examined the effectiveness of a mindfulness training programme for adolescents and adults with ADHD, following the programme participants had improved cognitive flexibility and reported a reduction in anxiety and depressive symptoms along with facilitating adaptive emotion regulation.

Boekaerts and Corno (2005) suggest that appropriate programmes should be aimed at and set in the classroom for adequate outcomes, claiming that learning goals are related to wellbeing goals, i.e., motivated students with positive work habits and self-regulation are more likely to make an effort in learning, even when a stressor hinders learning. More importantly they argue that dysfunctional emotion regulation in children results from poor environmental conditions, or being exposed to expressions of negative emotions by adults. This is echoed by Jennings and Greenberg's (2009) review which suggests that teacher's emotional competence and implementation of emotional learning in the classroom affects children's social and emotional competence. Studies consistently show that classroom based interventions aimed at emotion regulation in children with externalising problems such as conduct

disorder have produced significant improvements in behaviour and regulation of emotions (Domitrovitch, Cortes & Greenberg, 2007; Webster –Stratton et al., 2008; Wyman et al., 2010). These studies show that by enhancing children's knowledge on ways in which they could process emotional expressions could improve emotion regulation and overall social-emotional competency.

### **6. 1. 3 CBT based interventions**

Cognitive Behaviour Therapy (CBT) has been successfully utilised to improve symptoms of internalising and externalising problems (Bloomquist, August & Ostrander, 1991; Essau, Conradt, Sasagawa & Ollendick, 2012; Litschge, Vaughn & McCrea, 2010; Seligman & Ollendick, 2011). CBT is based on the principles of cognitive restructuring and exposure to the undesirable stimuli with the aim of clarifying thoughts and dealing with challenging situations (Kendall, 1994). Mohlman (2008) argues that better EF skills are related to successful CBT outcomes, yet the influence of EF on the effectiveness on CBT has received limited attention. Smyth and Arigo (2009) suggest that including ER component to CBT may lead to maximum benefits for the individual. Hinton et al (2011) focused on outcome of ER following a CBT based programme and observed significant improvement in adaptive ER. CBT has also been shown to improve ER as participants reported increased regulation in the expression of anger and anxiety (Scarpa & Reyes, 2011). Successful ER is related to the use of adaptive ER strategies and the lack of maladaptive strategies, this is considered to be instrumental for positive outcomes in children (Garnefski, Rieffe, Jellesma, Terwogt, & Kraaij, 2007).

### **6. 1. 4. Rationale and aims**

Executive functions and emotion regulation are closely related (Cunningham & Zelazo, 2007). Intervention studies have until now however focused on outcomes of emotion regulation and executive function individually, these interventions have failed to clearly identify the extent to which emotional and social development can be influenced as a result of EF. Therefore this study will aim to investigate the impact of super skills for life as related to EF and ER. The SSL programme encompasses aspects associated with improving social competence and ER based coping which studies have shown could potentially improve both EF and ER (Aldao et al., 2014; Diamond & Lee, 2011; Scarpa & Reyes, 2011; Sonuga-Barke & Halperin, 2010). In particular literature suggests that targeting intervention during early years is beneficial to improving EF (Diamond & Lee, 2011).

The more specific aims of the study are to investigate the following:

1. Outcomes of cool and hot EF post intervention.
2. Outcomes of adaptive and maladaptive ER.
3. Outcomes of emotional and behavioural problems.
4. Behavioural indicators of anxiety by comparing the 2-minute speech task taken at sessions 1 and 8.
5. The impact of EF and ER on behavioural and emotional problems following intervention.

Being able to effectively express and regulate emotions is vital to wellbeing and managing health conditions, ER and EF is further crucially related to skills such as social competence effective coping. Based on earlier studies the hypothesis is that there will be improvement in emotional problems and behavioural problems. Additionally as studies have reported improved ER following CBT interventions

(Aldao, Gee, De Los Reyes, & Seager, 2016; Scarpa & Reyes, 2011) the expectation is that the reported use of maladaptive ER strategies will be improved.

## **6.2. Method**

### **6.2.1. Participants**

As the previous study showed poor outcomes of EF and ER in adolescents, pre-adolescent aged children were considered for the programme. According to Lock and Barrett (2003) interventions aimed at primary school children are effective at decreasing internalising disorders later. Participants were selected by the teachers who identified children they considered to have some form of emotional or behavioural problems. Teachers selected the children based on their own experience of working with them; these children were thus considered most likely to benefit from the Super Skills programme. The Forty-five children were then selected to participate, however 1 child was absent for the entire term and a further 3 children's parents withdrew their child's participation from the study. From these 1 child had a special education needs (SEN) statement for ADHD and another for learning disabilities. Participants were 41 children (11 females, 30 males), aged between 8 and 11 years (Mean age = 9.53, SD = 1.09). With regards to the present study the inclusion criteria was set as those students who would benefit from the programme, in particular those exhibiting emotional and behavioural problems.

All the children who participated in the programme were residents from the south west region of London, UK. 49 Schools were approached initially via email with the invitation to take part in an emotional and behavioural problem intervention programme. Only 4 schools agreed to participate in the project. These schools were

mixed gendered community and voluntary aided schools with an Ofsted rating of 'Good'; whereby the school is deemed to be effective in delivering outcomes that provide well for all its pupils' needs and are well prepared for the next stage of their education, training or employment by the inspectors of education and children's services.

### **6. 2. 2. Procedure<sup>12</sup>**

Following approval of ethics from the university ethics committee, the schools were approached via email. Once the school's head teachers confirmed their participation in the study, the SENCO's and deputy heads were then approached by the head teacher to liaise with the researcher. As this was an opt-out study, parents were sent letters informing them of the nature of the study and giving them the opportunity of two weeks to inform the teachers who selected the participants if they wish their child to be excluded from the study. The days and times were set accordingly following confirmation from the teachers.

The programme was delivered by the researcher and two other facilitators, all post graduate students in clinical child psychology with experience of working with individuals with mental health problems. All were cleared by the disclosure and barring service (DBS) before the commencement of the programme. Before implementing the programme, the facilitators received an intensive one day workshop by the director of this study, a clinical child psychologist. The aim of doing this was to maintain protocol commitment and overcome potential challenging

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<sup>12</sup> Appendix II details confirmation of ethics from the Department of Psychology. Also see appendix VIII for school letter and appendix IX for parent letter.

situations. The workshop reviewed each session of the programme, the organisation of these sessions. The workshop also covered topics on issues surrounding child mental health in classroom, and possible issues in running the program with a group of children. The workshop was followed with a session led by the director to demonstrate the structure of the session, group leader and group session skills. Everyone delivering the programme were equipped with a trainer's manual and were expected to adhere to the instructions outlined.

Prior to the intervention, children completed baseline tasks and questionnaires which were also completed immediately post intervention and at follow up 3 months later. They were informed about their participation in the programme and the researcher of this study provided instructions and supported those children who required any further assistance with the completion of the tasks or questionnaires. The children were informed that their responses would remain confidential and that there were no right or wrong answers. The tests were conducted during school hours. The computerised tasks were published online using the millisecond software; the task sequence was set beginning with the dot probe task, BART-Y, followed by the questionnaires which were also completed online as published in the qualtrics website. The whole procedure ended with testing participants on the digit span.

At the start of the programme the children were all provided with a workbook, and were informed that they would be taught specific skills to cope with challenging and anxiety provoking situations. In total 5 children missed one session and only 1 child missed 3 sessions due to absence from school as a result of illness, this child was however briefly updated with an individual session.

### **6. 2. 2. 1. Super Skills Programme and its implementation**

The Super Skills for Life programme (Essau et al., 2014) programme design is based on core CBT principles to assist the children in coping with challenging situations, build emotional resilience, and provide them tools to enhance their social skills to build their support network all the while promoting self-confidence. SSL is based on 5 core components, the first being the use of a transdiagnostic approach in targeting common core risk factors such as low social skills and self-esteem, which has been found to be efficient and cost effective. Secondly the main programme is based to help children cope with anxiety provoking situations. The third component of SSL is the use of video feedback with cognitive preparation to assist children with enhancing their self-perception. Children are placed in an anxiety provoking situation (i.e., having to give a 2 minute speech task which is recorded), children are taught skills to cope with social situations they would otherwise find challenging. The fourth principle of SSL relies on behavioural activation, by encouraging participation and providing positive feedback has shown to improve mood and overall self-esteem (Essau et al., 2014). The final component involves actively teaching children skills to cope with stressful situations (i.e., relaxation techniques).

The programme consists of 8 sessions and delivered over 4 weeks. A novel component of the programme involved providing feedback to participants following a 2-minute speech task which was recorded. Based on Harvey et al.'s (2000) paradigm the effectiveness of explicitly highlighting the differences in behaviours following the video presentation leads to positive self-assessment particularly for those with social phobia. Additional aspects of the programme included behavioural activation and cognitive preparation through role play and exercises. More

importantly SSL includes sessions dedicated to teaching children skills to enhance their behaviour in social situations. Following the programme children reported significant reduction in anxiety related symptoms; however symptoms of hyperactivity and conduct problems were significantly reduced. These effects were significant even at follow up. Essau et al. (2014) suggest that following the programmes positive impact on social skills and self-esteem subsequently leads to reduction in behavioural problems.

### *Implementation*<sup>13</sup>

SSL were implemented twice a week, for the duration of four weeks. Each session lasted approximately 45 minutes, with 6-8 children per treatment group. The commencing session is an opportunity for the children to introduce themselves and understand the purpose of being part of the programme; this is followed immediately by requesting the children present a piece about themselves for a 2 minute video recording in front the group. The following sessions then involved going over the videos as a group and discussing positive features and aspects to improve from the child's presentation. For the remaining sessions children were introduced to topics such as 'recognising feelings', thoughts, and the link between feelings, thoughts and behaviours. Midway through the intervention a session is devoted solely to teaching the children relaxation techniques, by helping them identify different muscles and possible ways to relax them. The following sessions were then focused on topics such as social skills and problem solving steps for social conflicts.

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<sup>13</sup> Appendix XIV summarises in detail the session contents and the main activities involved.



Most of the sessions began with low intensity physical warm up to increase core and muscle temperature which has been found to further improve neuromuscular function (Young & Behm, 2002). Similarly another component of the programme involved dedicating 5-10 minutes of the session to structured play; these were games which required following instructions and being physically active. The programme also required participants to complete home tasks involving activities that were taught in session and which can be applied to their usual setting of playground or home.

### **6. 2. 3. Measures<sup>14</sup>**

#### **6. 2. 3. 1. Cool EF task**

Digit span was used to measure working memory, it is a subtest from the Wechsler Intelligence Scale for Children (WISC III; Wechsler, 1991) consisting of two tests (forward and backward). Participants are required to recite a sequence of digits (e.g., 5, 1, 7, 4, 2, 3, 8) for the forward digit span immediately after the sequence was verbally presented, and then repeat in reverse order for the backward digit test.

Dot Probe Task (MacLeod et al., 2007) was used to measure response inhibition. The task requires participants to identify a non-emotional probe, a symbol, which can appear in one of two spatial locations. Immediately prior to the probe presentation, emotional and non-emotional words appear simultaneously in

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<sup>14</sup> See chapter 3 (page 104) for further details on the digit span, BART and SDQ.

two separate locations. The mean percentage of correct responses was determined for the block of trials for each participant as a measure of inhibition.

The task begins with participants having to focus on the fixation crosses that appear in the centre of the screen. After presentation of the fixation crosses, participants are presented with 2 words from two categories (threat and neutral words). The position of the words is randomly chosen to be either above or below the location of the fixation cross. After a short duration (500 milliseconds), the two words disappear and a probe stimulus ('<' or '>') appears in the location of one of the words (at 1000 millisecond inter-trial interval). Participants are asked to press one key if the probe is '<' and another if the probe is '>'. These symbols matched the keyboard, hence participants were requested to place their fingers on the response keys and respond as quickly and accurately as possible. The location of the probe was randomly determined within the space that the target previously occupied. The task consisted of 10 practice trials followed by 96 test trials. According to Humphries et al. (2004) the effect of visual prioritisation (i.e., preference for responding to stimuli probes presented in certain locations) is mediated by the process of inhibition. It is however possible that the threat words may impact the responses (Matthews & MacLeod, 2002).

### **6. 2. 3. 2. Hot EF task**

The balloon analogue risk task, youth version (BART –Y; Lejuez et al., 2007) was used to measure risky decision making. This task provides the effect of reward on performance.

### **6. 2. 3. 3. Questionnaires**

Chapter 6: The impact of an early intervention on executive functions and emotion regulation in children with behavioural and emotional problems.

Emotional and behavioural problem symptoms were measured using the *Strengths and difficulties questionnaire (SDQ)* (Goodman, 1997). This 25 item self-report scale that produces scores for five subscales: emotional symptoms, conduct problems, hyperactivity, peer problems and pro-social behaviour (see chapter 3 for further details). Modest internal validity was found for SDQ in the current study, with Cronbach's alpha ranging from .55 to .77.

Emotion regulation coping strategies were assessed again using the *Cognitive Emotion Regulation Questionnaire (CERQ)*; Garnefski, Kraaij & Spinhove, 2001). This was the short version consisting of 18 items, on a 5 point Likert scale ranging from 1 (almost never) to 5 (almost always) (see appendix XVI). Similar to the earlier version this questionnaire also identified 9 separate emotion regulation strategies, including refocus on planning, putting into perspective, acceptance, positive refocusing, positive reappraisal, self-blame, other blame, rumination and catastrophizing. Internal reliability for the present data ranged from .26 to .65. Cakmak and Cevik (2010) found decent internal consistency ranging from .63 to .74 respectively in a Turkish sample, suggesting that CERQ would be an effective measure for a wide variety of cognitive strategies associated with emotion regulation.

The Screen for Child Anxiety Related Emotional Disorders (SCARED) (Birmaher et al., 1997) is a 38-item self-report questionnaire used to measure five child and adolescent anxiety symptom dimensions (see appendix XIII). This scale identifies five factors/subscales: somatic/panic (13 items; e.g., "When I feel frightened, it is hard to breathe"), generalized anxiety (9 items; e.g., "I worry about other people liking me"), separation anxiety (8 items; e.g., "I get scared if I sleep

away from home”), social phobia (7 items; e.g., “I don’t like to be with people I don’t know well”), and school phobia (4 items; e.g., “I get headaches when I am at school”). Participants are required to indicate the likelihood of each symptom as experienced on a 3-point scale: 0 (almost never), 1 (sometimes), and 2 (often). Internal consistency for the present study ranged from .51 to .79. Factor analyses from previous studies have showed that the five factors are parallel to DSM-IV classification of anxiety disorders. The SCARED measure has also been found to be strongly correlated with other measures of childhood anxiety disorders (Muris et al., 2002), an earlier study found good internal consistency with Cronbach’s alpha ranging from .74 to .89 (Essau, Muris & Ederer, 2002)

#### **6. 2. 3. 4. Behavioural assessment<sup>15</sup>**

The Social Performance Rating Scale (SPRS; Fydrich, Chambless, Perry, Buergener, & Beazley, 1998) was used to rate behavioural indicators of anxiety in the children’s performance during the 2 minute speech task. Based on this scale 5 behavioural anchors were identified; namely gaze, vocal quality, length, discomfort and conversation. These items were scored on a four-point scale ranging from 1 (Very Poor) to 5 (Very Good), this differed for discomfort where the four point scale ranged from 1 (Very High) to 5 (Very Low). These anchors were coded by observers for session 1 and session 8, rating each behavioural item as exhibited by the children.

Recording of the 2 minute speech task was coded by the researcher and the director of studies who is also a clinician. Inter-rater reliability analysis was

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<sup>15</sup> Description of behavioural anchors for SPRS (Fydrich et al., 1998) is provided in appendix XVIII.

conducted to measure the variation in scoring between the two raters. Intraclass correlation coefficient yielded high values for session 1 ( $\alpha = .99$ ) and session 8 ( $\alpha = .92$ ), confirming reliability of scores on the same behavioural anchor across all scores and all subjects. Table 6.1 details further the categorical evaluations of SPRS; these scores indicate high level of agreement between the two raters. Following on from this, the mean scores of the two raters were calculated for analyses.

Table 6.1

Analysis of agreement between raters on SPRS

|                           | Session 1 |      | Session 8 |      |
|---------------------------|-----------|------|-----------|------|
|                           | K         | Sig. | K         | Sig. |
| <i>Behavioural anchor</i> |           |      |           |      |
| Gaze                      | 1.00      | .00  | 1.00      | .00  |
| Vocal quality             | .71       | .02  | .62       | .12  |
| Length                    | 1.00      | .00  | .67       | .04  |
| Discomfort                | .64       | .04  | .71       | .01  |
| Conversation              | 1.00      | .03  | .71       | .01  |

*Note. SPRS = Social Performance Rating Scale; K = Cohen's Kappa coefficient.*

## 6.3. Results

### 6.3.1. Preliminary analysis

Table 6.2, 6.3 and 6.4 shows the mean differences and standard deviations of SDQ, SCARED, EF and CERQ variables for the children at baseline, post intervention and at 3 month follow up. Results show that participants reported a significant reduction in maladaptive ER strategies.

Table 6.2

Means and standard deviations of self-report measures of SDQ and SCARED

|                              | Pre-test      | Post-test     | 3-month follow up |
|------------------------------|---------------|---------------|-------------------|
|                              | Mean (SD)     | Mean (SD)     | Mean (SD)         |
| <i>SDQ</i>                   |               |               |                   |
| Total scores                 | 16.00 (6.10)  | 13.26 (6.14)  | 13.14 (5.12)      |
| Emotional problems           | 4.24 (2.37)   | 3.08 (2.77)   | 3.10 (2.16)       |
| Conduct problems             | 3.37 (2.68)   | 3.11 (2.20)   | 2.90 (1.81)       |
| Hyperactivity                | 4.48 (2.32)   | 4.14 (2.14)   | 4.48 (2.13)       |
| Peer problems                | 3.25 (2.37)   | 2.80 (1.94)   | 2.67 (1.65)       |
| <i>SCARED</i>                |               |               |                   |
| Total scores                 | 25.56 (13.02) | 25.06 (18.50) | 21.20 (14.71)     |
| Panic disorder               | 6.56 (4.72)   | 6.14 (5.99)   | 4.40 (4.46)       |
| Generalised anxiety disorder | 5.92 (3.50)   | 5.51 (4.56)   | 5.25 (4.01)       |
| Social Anxiety               | 6.04 (3.63)   | 5.64 (3.85)   | 5.10 (3.80)       |
| Separation anxiety           | 6.44 (3.70)   | 5.68 (4.32)   | 5.00 (4.10)       |
| School avoidance             | 1.53 (1.46)   | 1.81 (1.77)   | 1.45 (1.35)       |

*Note. SDQ = Strengths and Difficulties Questionnaire; SCARED = Screen for Child Anxiety Related Emotional Disorders.*

### 6. 3. 2. Outcomes post intervention

A series of analysis of variance's (ANOVA's) were conducted to examine the difference in outcome variables of EF, ER and self-report measures of behavioural and emotional difficulties at pre and post interventions, and at follow up 3 months later. There were no significant effects of time on SDQ variables - conduct problems ( $F(2, 94) = .300, p = .74$ ), hyperactivity ( $F(2, 92) = .26, p = .77$ ) and peer problems ( $F(2, 95) = .74, p = .47$ ). For SCARED, none of its sub-scales showed significant effects of time: panic disorder ( $F(2, 93) = 1.19, p = .31$ ), GAD ( $F(2, 93) = .21, p =$

.81), separation anxiety ( $F(2, 90) = .83, p = .44$ ), social anxiety ( $F(2, 97) = .44, p = .65$ ) and school avoidance ( $F(2, 95) = .44, p = .65$ ).

Table 6.3

Means and standard deviations of EF tasks

|                     | Pre-test<br>Mean (SD) | Post-test<br>Mean (SD) | 3-month follow up<br>Mean (SD) |
|---------------------|-----------------------|------------------------|--------------------------------|
| <i>Cool EF</i>      |                       |                        |                                |
| Forward digit span  | 8.85 (2.50)           | 9.17 (1.98)            | 9.88 (2.14)                    |
| Backward digit span | 3.47 (1.43)           | 4.10 (2.19)            | 4.12 (1.88)                    |
| Dot probe task      | 66.30 (22.24)         | 69.78 (18.53)          | 95.53 (97.52)                  |
| <i>Hot EF</i>       |                       |                        |                                |
| BART-Y              | 21.87 (10.43)         | 23.34 (11.70)          | 23.39 (11.70)                  |

*Note. EF = executive functions; BART-Y = Balloon Analogue Risk Task Youth Version.*

Findings show that there was a significant interaction between time and maladaptive ER strategies catastrophising ( $F(2, 94) = 4.10, p = .02$ ) and other blame ( $F(2, 95) = 2.96, p = .05$ ). Reduction was also found for self-blame ( $F(2, 96) = 2.62, p = .07$ ), and emotional problems ( $F(2, 94) = 2.45, p = .09$ ); and an increase in performance on the dot probe task (cool EF) ( $F(2, 100) = 2.76, p = .06$ ) however this was only marginally significant.

These effects were not observed for BART-Y (hot EF) ( $F(2, 101) = .21, p = .81$ ), forward digit span ( $F(2, 104) = 1.64, p = .20$ ) and backward digit span (cool EF) ( $F(2, 103) = 1.44, p = .24$ ). No significant effect of time was found between ER



strategies acceptance ( $F(2, 92) = .81, p = .44$ ), planning ( $F(2, 92) = .34, p = .72$ ), positive reappraisal ( $F(2, 92) = 1.35, p = .26$ ), positive refocusing ( $F(2, 94) = 1.73, p = .18$ ) and rumination ( $F(2, 93) = 1.90, p = .16$ ).

Table 6.4

Means and standard deviations of self-report measure of CERQ

|                          | Pre-test<br>Mean (SD) | Post-test<br>Mean (SD) | 3-month follow up<br>Mean (SD) |
|--------------------------|-----------------------|------------------------|--------------------------------|
| <i>CERQ</i>              |                       |                        |                                |
| Self-blame               | 5.37 (1.80)           | 4.52 (1.95)            | 5.57 (2.11)                    |
| Rumination               | 5.97 (2.21)           | 5.18 (2.65)            | 4.86 (1.93)                    |
| Catastrophising          | 5.84 (2.23)           | 5.66 (2.62)            | 3.95 (1.69)                    |
| Other blame              | 5.05 (2.36)           | 4.31 (1.98)            | 3.76 (1.37)                    |
| Acceptance               | 5.65 (2.32)           | 5.09 (1.80)            | 5.67 (2.08)                    |
| Positive refocusing      | 5.38 (2.42)           | 4.85 (2.30)            | 4.23 (2.02)                    |
| Planning                 | 4.86 (2.22)           | 4.42 (2.26)            | 4.61 (2.15)                    |
| Putting into perspective | 5.84 (2.23)           | 5.65 (2.62)            | 3.95 (1.68)                    |
| Positive reappraisal     | 5.81 (1.90)           | 5.02 (2.33)            | 5.19 (2.16)                    |

*Note. CERQ = Cognitive Emotion Regulation Questionnaire.*

Post hoc analysis of Bonferroni significantly yielded group differences at follow up for catastrophising ( $p < .001$ ) and other blame ( $p < .05$ ). Marginally significant improvements were observed for cool EF task - dot probe ( $p < .08$ ) and prosocial behaviours ( $p < .08$ ) at follow up when compared to baseline. No further significant differences were found for other variables of SDQ, CERQ and SCARED.

Table 6.5 shows the behavioural changes in the 2 minute speech task recorded at session 1 and session 8. There was a significant difference in scores for all items; the analysis shows that there was a significant improvement for gaze, vocal quality, length and conversation. Additionally scores of discomfort in children were significantly reduced in session 8. There were significant gender differences for mean scores of ‘conversation’ for female (M = 2.67, SD = 1.03) and male (M = 3.52; SD = .79) participants at session 8 ( $F(1, 28) = 4.93, p < .05$ ). No further significant differences were found in this speech task for gender.

Table 6.5

Means (standard deviations) and t-test of SPRS

|                           | Session 1<br>Mean (SD) | Session 8<br>Mean (SD) | <i>t</i> |
|---------------------------|------------------------|------------------------|----------|
| <i>Behavioural Anchor</i> |                        |                        |          |
| Gaze                      | 2.16 (1.21)            | 2.96 (1.03)            | -2.89*   |
| Vocal quality             | 2.36 (.093)            | 3.23 (.93)             | -3.70**  |
| Length                    | 2.58 (.67)             | 3.51 (.69)             | -5.33**  |
| Conversation              | 2.51 (.68)             | 3.34 (.90)             | -6.48**  |
| Discomfort                | 2.22 (.67)             | 3.48 (.83)             | -4.06**  |

*Note.* \* $p < .01$ ; \*\* $p < .001$ ; SPRS = Social Performance Rating Scale.

### 6.3.3. EF & ER as predictors and mediators

Simple regression analyses were carried out to examine the extent to which EF performance at baseline would predict emotional and behavioural problem scores post intervention and further observe any mediation as a result of ER at post intervention. The results show that EF and ER post intervention predicted outcomes for emotional problems ( $F(8, 77) = 2.35, p < .05$ )  $R^2 = .46$  and conduct problems ( $F(8, 80) = 2.48, p < .05$ ) with an  $R^2$  of .47. Whereas EF alone predicted hyperactivity ( $F(4, 77) = 2.89, p < .05$ ) post intervention with an  $R^2$  of .41, suggesting that cool EF and maladaptive ER strategies at baseline significantly influenced emotional and behavioural problems following the intervention programme.

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Table 6.6

Linear model predictors of emotional problems.

|                     | <i>b</i> | <i>SE b</i> | <i>t</i> | <i>β</i> |
|---------------------|----------|-------------|----------|----------|
| (Constant)          | 2.79     | 5.72        | .49      |          |
| <i>EF</i>           |          |             |          |          |
| Forward Digit Span  | .17      | .26         | .68      | .15      |
| Backward Digit Span | -.54     | .56         | -1.02    | -.22     |
| Dot probe           | -.04     | .04         | -.98     | -.23     |
| BART-Y              | .04      | .06         | .63      | .13      |
| <i>ER</i>           |          |             |          |          |
| Self-blame          | 1.46     | .52         | 2.81     | 1.01*    |
| Rumination          | -.13     | .33         | -.40     | -.12     |
| Catastrophising     | .10      | .33         | .29      | .08      |
| Other blame         | -.79     | .46         | -1.73    | -.58     |

*Note.* \* $p < .05$ ; *EF* = executive functions; *BART-Y* = Balloon Analogue Risk Task-Youth version; *DPDT* = Delay and Probability Discounting Task; *ER* = emotion regulation.

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Table 6.7

Linear model predictors of conduct problems.

|                     | <i>b</i> | <i>SE b</i> | <i>t</i> | <i>β</i> |
|---------------------|----------|-------------|----------|----------|
| (Constant)          | -2.73    | 4.33        | -.63     |          |
| <i>EF</i>           |          |             |          |          |
| Forward Digit Span  | .06      | .20         | .35      | .07      |
| Backward Digit Span | .76      | .43         | 1.78     | .43±     |
| Dot probe           | .01      | .03         | .41      | .10      |
| BART-Y              | -.01     | .04         | -.33     | -.06     |
| <i>ER</i>           |          |             |          |          |
| Self-blame          | -.40     | .37         | -1.09    | -.36     |
| Rumination          | -.24     | .25         | -.96     | -.27     |
| Catastrophising     | .44      | .29         | 1.52     | .49      |
| Other blame         | .47      | .34         | 1.41     | .44      |

*Note.* \* $p < .05$ ; ± $p < .09$ ; *EF* = executive functions; *BART-Y* = Balloon Analogue Risk Task-Youth version; *DPDT* = Delay and Probability Discounting Task; *ER* = emotion regulation.

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Table 6.8

Linear model predictors of hyperactivity.

|                     | <i>b</i> | <i>SE b</i> | <i>t</i> | <i>β</i> |
|---------------------|----------|-------------|----------|----------|
| (Constant)          | 4.79     | 4.76        | 1.01     |          |
| <i>EF</i>           |          |             |          |          |
| Forward Digit Span  | .17      | .22         | .78      | .19      |
| Backward Digit Span | .04      | .46         | .08      | .02      |
| Dot probe           | -.04     | .03         | -1.29    | -.33     |
| BART-Y              | -.00     | .05         | -.09     | -.02     |
| <i>ER</i>           |          |             |          |          |
| Self-blame          | .15      | .40         | .39      | .14      |
| Rumination          | .26      | .27         | .97      | .31      |
| Catastrophising     | -.26     | .29         | -.90     | -.31     |
| Other blame         | .07      | .36         | .18      | .07      |

*Note. EF = executive functions; BART-Y = Balloon Analogue Risk Task-Youth version; DPDT = Delay and Probability Discounting Task; ER = emotion regulation.*

Tables 6.6, 6.6 and 6.7 show specific variables of EF and ER as predictors of emotional and behavioural problems. These results reveal that ER strategy self-blame alone predicted emotional problems, whereas cool EF task backward digit span marginally predicted conduct problems. There were no further effects of EF and ER on emotional and behavioural problems.

## **6.4. Discussion**

This study aimed to determine the effect of SSL on EF and ER, as well as to determine the extent to which executive functions may mediate the outcomes of children with emotional and behavioural problems. In line with previous findings (Essau et al., 2014) the results from this study show that there was a reduction in emotional problems. These findings were consistent with the hypothesis; however the expectation of a reduction in behavioural problems at follow up was not supported. Reductions in behavioural problems could be related to motivation, Cohen, Berliner and Mannarino (2010) suggest that successful behaviour change stems from motivation; however this change also depends on family and environment which may then influence treatment outcomes (Cohen et al., 2010).

Although the effects of the programme were not immediately found at post-test, there was a significant reduction in maladaptive emotion regulation strategies catastrophising and other blame at follow up. These findings suggest that SSL successfully improved maladaptive ER, as children reported less use of strategies such as catastrophising and other blame indicating that children may have utilised the cognitive restructuring component of the programme when faced with a challenging situation (Essau et al., 2012). There were no significant improvements observed for adaptive ER strategies following the programme. Research shows that

children who exhibit emotional and behavioural problems are more likely to have negative interactions with their teachers, and are less likely to use adaptive ER strategies (Jennings & Greenberg, 2009). Perhaps the children with behavioural problems would require a more challenging practice to maintain the same rate of improvement following the intervention; this could be an important aspect of the programme that can be investigated further as this study did not measure the extent to which the newly acquired skills were employed by the children following the programme.

Importantly the programme was successful in improving cool EF (working memory and inhibition) similar to the findings observed by Mohlman (2008). Mohlman (2008) found that following an intensive programme of 8 weekly sessions over 90 minutes involving attention training, participant in the intervention group showed improvements on total scores of EF tasks compared to controls. The results from the current study also support the effect of EF in mediating outcomes of emotional and behavioural problems post intervention, particularly cool EF. Mohlman and Gorman (2005) report that those with poor EF scores at baseline who failed to improve post treatment did not respond to CBT, compared to those who had high scores on EF post-treatment. The significant changes observed in EF skills might therefore contribute to the successful control of emotional problems and maladaptive ER, as EF is mediated by the prefrontal cortex a study conducted by Stein et al. (2002) suggest that these frontal processes could be involved in the mitigation of emotional problems.

Data from the behavioural indicators as measured through the 2 minutes tasks also showed that there were significant improvements in the children's performance



after the training. Similar reduction in social anxiety has been noted by Muris and colleagues (2009) following CBT for childhood anxiety. Social anxiety is closely related to ER, in particular positive display of emotions arise as a result of ER which in turn is found to positively correlate with social outcomes (Cisler, Olatunji, Feldner, & Forsyth, 2010). Egloff et al. (2006) showed that participants greatly used ER strategy reappraisal during a speech task; this study further found that reappraisal decreased negative affect without affecting participant's memory performance. Werner and colleagues (2011) further report that those with social anxiety who use cognitive reappraisal can successfully reduce negative affect.

#### **6. 4. 1. Implications of SSL**

This study measured the impact of a transdiagnostic programme on various treatment outcomes. The results revealed that there were significant improvements in maladaptive ER strategies and reduction in emotional problems following the SSL programme in children; similar to Essau et al. (2012) these findings were particularly significant at follow up. Suggesting that over time children with emotional problems are more likely to practice and implement the programme throughout (Essau et al. 2014). However the discrepancies observed in ER scores particularly putatively adaptive ER indicates that aspects of the programme may be appropriate for some children but not for others (Kovacs et al., 2006). Behavioural and emotional problems frequently co-occur in children and adolescents (Wyman et al., 2010), this study shows that regardless of differing patterns in individual symptoms, the transdiagnostic intervention programme reduced problems at certain targeted domains, and prevented the escalation of behavioural problems.

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A key strength of the programme was the use of transdiagnostic approach, which targeted key risk factors associated with emotional and behavioural disorders. Difficulties with ER can be found in children with emotional disorders, with Suveg and Zeman's (2004) study indicating that children with anxiety exhibit greater difficulties managing negative emotions. Therefore within a shared transdiagnostic framework, SSL programme targeted the manifestation of underlying EF processes. Additionally SSL was delivered in a school setting, which may benefit families who otherwise face barriers accessing appropriate services for their child, and make it feasible for children from low socioeconomic background to access appropriate mental health support (Taylor et al., 2015). This programme can be effectively implemented and delivered by teachers in a classroom setting and as part of the curriculum. Research shows that enhancing teacher's confidence in behaviour management in the class could lead to beneficial outcomes for the children (Zhai et al., 2011). This study also used objective measures of treatment outcomes for emotional and behavioural difficulties, along with EF tasks and ER self-report scales. This is considered ideal for screening difficulties, as they are sensitive to behavioural and emotional problems (Muris, Meesters, Eijkelenboom, & Vincken, 2004; Newcorn et al., 2001).

There are a few limitations to consider; the repeated use of the same task could have also influenced some level of improvement in the sample. At the same time studies show that emotional problems such as anxiety disproportionately affects EF performance (Sari et al., 2016), yet there are very few studies exploring the influence of improving anxiety on EF skills (Mohlman, 2008). This was also an open trial, therefore it is important to be cautious about the interpretation its findings.

Regardless of the significance observed, the lack of control group could have inflated this (Fujisawa et al., 2010). Also the short follow up period (3 months) was unlike previous studies, a further 6 or 12 months would examine long term effectiveness of the treatment (Ollendick, Öst, Reuterskiöld, & Costa, 2010). Additionally the sample size of the participants was small compromising statistical power; therefore further studies are required to compare the effect size of SSL with a larger sample size using a rigorous methodology.

Although the referrals were made by teachers, the self-rating measures for children alone were used without further diagnostic interviews due to limited time available, given by the schools. Thus limiting the potential to capture parents and teachers reports on the children's functioning in school and other settings; and obtain a thorough assessment of suspected difficulties. As parents and teachers are considered to be the primary source of information about the children, future studies including caregiver and teacher reports would give a better insight into the development of children. Furthermore, the initial difficulty in recruiting schools could therefore be related to the limited time the school would have been able to dedicate to the programme. Ji and colleagues (2008) suggest that the needs of the school community should be identified, encouraging them to consider alternative strategies and resources (i.e, some of the may have an existing programme in place), or continue to communicate and establish a relationship with the school administrators, allowing time for the administrators.

#### **6. 4. 2. Conclusion**

Rather than focusing on a single problem, this study examined the effect of SSL on EF, ER, internalising and externalising difficulties. Despite the limitations of

this study, SSL programme was significant in improving outcomes of cool EF and maladaptive ER catastrophising and other blame. These findings are consistent with earlier studies in suggesting that EF skills are mechanisms that influence CBT (Mohlman & Gorman, 2005). The results further showed that cool EF predicted emotional and behavioural problems following the intervention, whereas maladaptive ER strategies mediated the relationship between problem behaviours and EF.

This is the first study to our knowledge to further investigate the mediating effect of ER and its durability in maintaining positive outcomes of EF for children with emotional and behavioural problems. It would be informative to include a control group to test the effects of practice on the EF tasks, regardless Mohlman (2009) suggests participants could have derived greater benefits (i.e., daily activities, improved functioning in novel situations) as a result of improved EF skills. Future trials are necessary to identify and compare the role of ER in different groups. Future studies should also include a vast array of EF tasks measuring both cognitive flexibility (cool EF) and affective decision making (hot EF) to understand the implication of using CBT on these domains.

## Chapter 7: General Discussion

### 7.1. Overview

#### Study 1 – Part I<sup>16</sup>

The first study examined age related differences in executive function and emotion regulation during childhood, adolescence and early adulthood, and further explored the relationship between EF and ER. EF in these studies is distinguished based on a model suggested by Zelazo and Muller (2002), where cool EF is identified as abstract decontextualised problem solving processes and hot EF is defined as affect and motivational based decision making process. This distinction is supported by numerous studies investigating the development of EF in children and adolescence (Arnsten & Rubia, 2012; Bernier, Carlson, & Whipple, 2010; Zelazo et al., 2014; Kim, Nordling, Yoon, Boldt, & Kochanska, 2013; Prencipe et al., 2011; Prencipe & Zelazo, 2005; Zelazo, 2015). Studies show age related improvements for cool EF for children, however these findings are mixed in hot EF with some studies

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<sup>16</sup> See chapter 1 and 2 for detailed literature review.

reporting the emergence of hot EF in childhood (Brock et al., 2009; Hooper et al., 2004; Prencipe & Zelazo, 2005).

Similar to earlier studies, the findings from this study revealed that with age cool EF scores were improved, where adults had significantly higher scores on cool EF tasks forward and backward digit span. Similarly for hot EF task balloon analogue risk task (BART), age related improvements were found; however for delay and probability discounting task (DPDT) (hot EF) and go-no/go (cool EF) a significant non-linear trend emerged, whereby the adolescent age group (12-17 years) had poor scores compared to children and adults. This is supported by studies showing that neural regions and aspects of cool and hot EF are still developing in this age group (Ding et al., 2014), which further influences decision making and inhibitory control (Bunge & Wright, 2007). Adolescence has been shown to be a time of complex development, Blakemore and Choudhury (2006) report that during this period of synaptic reorganisation, the brain tends to be influenced by experiential and novel input. Moreover the results showed that there was no relationship between cool and hot EF, suggesting that these EF paths are distinct and are likely to develop independently (Zelazo & Carlson, 2012).

Literature shows that cool EF is closely related to ER, Cunningham and Zelazo (2007) claim that emotion considerably influences the evaluation of a stimulus. Suggesting that ER and EF is specifically linked through inhibitory processes yet arguing that ER is distinct from hot EF. ER allows individuals to appraise and evaluate emotions, and further alter emotional state depending on context (John & Gross, 2004). Studies have substantially focused on positive reappraisal and suppression as adaptive and maladaptive strategies (Gullone,

Hughes, King, & Tonge, 2010; John & Gross, 2004). However Garnefski and colleagues (2004) identified 9 ER strategies which arise in response to life stressors, therefore this study focused on how these 9 strategies are related to hot and cool EF.

Maladaptive ER strategies such as catastrophising, rumination and other blame was negatively related to digit span and go-no/go. The present study results also demonstrated that cool EF tasks go no/go and digit span was related to putatively adaptive ER strategies such as planning and putting into perspective, however this relationship was mainly observed in the adolescent age group. This supports Zelazo and Cunningham's (2007) iterative model in which ER generally is linked to inhibitory aspect of EF, where EF and ER are closely inter-related as a result of shared inhibitory processes. Gross (1998) suggests that response inhibition is necessary for successful ER, more importantly Gross (1998) suggests that maladaptive ER strategy is closely related to working memory as it enables holding negative emotions in mind.

In this study hot EF task BART-Y was negatively associated with maladaptive ER strategies in children and adults. Similarly in adults poor scores on BART has been linked with negative emotions (Heilman, Crian, Houser, Miclea, & Miu, 2010). Heilman and colleagues found that those with high scores on risky decision making (hot EF) are more likely to use adaptive ER strategy reappraisal, indicating that successful reappraisal may underlie decision making.

### **Study 1 – Part II**

Numerous studies have shown that overall EF difficulties are associated with behavioural and emotional disorders such as ADHD, conduct problems, anxiety and depression (Andreotti et al., 2013; Castellanos & Tannock, 2002; Jarrett &

Ollendick, 2008; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). Cool EF has been associated with ADHD related behavioural disorders whereas hot EF is mainly linked with behavioural disorders such as conduct problems (Dolan, 2012; Dolan & Lennox, 2013; Hobson et al., 2011; Rubia, 2011). However very few of these studies have researched the association between cool and hot EF and emotional disorders (Roiser, 2013). Moreover ER has been consistently linked with emotional disorders such as depression and anxiety (Bennett & Ehrenreich, 2009; Joormann, 2010; Paulus & Yu, 2012). This study thus aimed to find out how ER, cool and hot EF are associated with emotional and behavioural problems in children, adolescents and adults.

Findings revealed that overall behavioural problems such as conduct problems are negatively associated with hot EF tasks BART and DPDT. Further analysis showed that hot EF predicted behavioural problems. These findings are supported by prior research showing close links of BART with conduct problems (Humphreys & Lee, 2011). Similar to a study by Bexkens et al. (2016), there was no relationship between cool EF and behavioural problems in the 12-17 year age group. Bexkens and colleagues report poor cool EF decision making task was not related to behaviour disorders in their sample of adolescents, impairments on cool EF were only observed when behaviour disorders were comorbid with intellectual disorders. This finding adds support to existing literature that suggests cool EF's are intact in conduct problems (Hobson et al., 2011; Oosterlaan, Scheres, & Sergeant, 2005).

Results also showed that emotional problems were positively associated with maladaptive ER strategies in line with previous research (Aldao et al., 2014; Garnefski, Teerds, Kraaij, Legerstee, & Kommer, 2004). These strategies mediated



the relationship between EF and behavioural and emotional problems. Maladaptive ER strategies were positively associated with behavioural problems in children, adolescents and adults, behavioural problems however were negatively related to adaptive ER strategies. As Penza-Clyve and Zeman (2002) argue deficiencies with emotion regulation is linked with difficulties in controlling emotional reactivity, which is typical of children who are usually diagnosed with behavioural disorders such as ADHD. Meta-analysis of ER in ADHD shows that individuals with ADHD have difficulty with utilising adaptive strategies, but importantly have difficulties encoding and processing emotional information (Aldao et al., 2016).

There was a significant positive relationship with emotional problems and maladaptive ER strategies, self-blame, catastrophising, rumination and other blame in both the adolescent and adult age group. This is in line with a review of ER and mental health problems by Aldao and colleagues (2010); this meta-analytic review showed that maladaptive ER strategies are linked to psychopathology, in particular rumination was found to predict anxiety, and self-reports of depression (Garnefski & Kraaij, 2006; Nolen-Heoksema et al., 2007).

## **Study 2**

This study was a clinical trial of a CBT programme called Super Skills for Life (Essau et al., 2014) and measured its impact on EF and ER. As findings from the first study revealed that EF and ER is linked to behavioural and emotional problems; the aim of the second study was to measure the impact of a cognitive behavioural therapy (CBT) based programme in improving EF and ER, and in reducing emotional and behavioural problems. EF has been found to mediate the effects of CBT post treatment in anxiety (Mohlman & Gorman, 2005), yet very little

is known in relation to EF improvements, particularly as emotional disorders such as depression is associated with EF impairments (Robinson et al., 2015). CBT has also shown to improve ER; Scarpa and Reyes (2011) report that following a CBT based programme children with autistic spectrum disorders were found to be less aggressive and reactive to challenging situations. Following the intervention programme results from this research revealed that there was a reduction in maladaptive ER strategies particularly catastrophising and other blame. These were significantly found to be reduced at follow up. Similarly Aldao et al (2014) found that following a 16 week intensive CBT programme for social anxiety, there was a reduction in maladaptive ER post treatment and at 1 year follow up; therefore suggesting that the outcome of a reduction in maladaptive ER following CBT can be maintained long term. However the differences in responses observed in other ER strategies particularly adaptive ER indicates that aspects of the programme may be suitable for some children but not for others (Kovacs et al., 2006).

Reduction in emotional problems and increase in cool EF task go-no/go were also found. Results also revealed that cool EF at baseline predicted behavioural problems and ER predicted emotional problems. Additionally ER at baseline mediated the relationship between EF and behavioural and emotional problems. Similar to findings by Mohlman and Gorman (2005) the results from the current study also support the effect of EF in mediating outcomes of emotional and behavioural problems post intervention. Behavioural and emotional problems frequently co-occur in children and adolescents (Wyman et al., 2010), this study shows that regardless of differing patterns in individual symptoms, the transdiagnostic intervention programme reduced problems at certain targeted domains, and prevented the escalation of behavioural problems.

## 7.2. Implications and limitations

In the backward and forward digit span, both relatively cool tasks that lack any obvious motivational significance, substantial improvements in performance were observed in adolescents and adults. This is in contrast to performance on the DPDT, which require reflective responding in the context of reward information. Although the objective of each of this relatively hot task was understood by all, yet only the adults made responses in an effective, goal-directed way. The relationship between cool EF and adaptive ER strategies is consistent with the suggestion that cool EF and adaptive ER work in cohesion, rely on the same underlying mechanisms (e.g., the iterative reprocessing of information in lateral prefrontal cortex), and may be best viewed as falling along a continuum (Zelazo & Cunningham, 2007). Nonetheless these findings suggest that, hot EF may develop later than cool EF, and the ability to implement inhibitory control in relatively hot contexts may be affected by motivationally salient information (Steinberg et al., 2009).

In study 1, even relatively irrelevant reward information interfered with decision making during adolescence. This suggests that although children and adolescents may exhibit considerable control in some contexts, this ability is still easily undermined by information that is motivationally salient. Given that young adolescents are often in situations that require rational reflective responses in the context of strong motivational factors (e.g., peer pressure), this difficulty may have important implications for the kind of risky decisions often observed during adolescence (Prencipe et al., 2011). Overall adolescents may display the ability to apply EF in relatively cool situations but may have difficulty making reflective advantageous decisions in situations that more closely resemble real-life decision making. For now, the single-factor structure of cool and hot EF in the current study

suggests that the set of relatively hot and relatively cool tasks presented here may rely on similar underlying abilities. Past research has not convincingly established whether emotional problems are related to EF independent of ADHD. This study found significant relationship between cool EF and emotional problems.

Clinically, these findings suggest that tests of cool EF may be relevant in the assessment of antisocial behavioural disorders and may ultimately aid diagnosis. The results also indicate that helpful interventions for those with behavioural problems based on CBT may be beneficial as well as coping strategies to deal with impulsive traits and maladaptive ER. Moreover this study reported improved ER, in that catastrophising and other blame decreased immediately after the programme. Further, the intervention may increase children's knowledge of ER strategies as well as participant confidence in being able to manage their emotions. The first study has several limitations that should be considered. The results of the present study are based on cross-sectional data. Thus, making it difficult to draw conclusion regarding the development, course and changes of symptom patterns and patterns of EF and ER in time.

The results from the intervention study have implications for treatment and provides evidence for adapting transdiagnostic approaches in treatments, which can be effectively implemented for children with emotional disorders. These findings demonstrated reductions in emotional symptoms and maladaptive ER as a result of this short intervention protocol, highlighting its acceptability. This study further expanded on the standard prevention evaluation model by examining predictors of outcome other than those solely related to anxiety and depressive symptoms. Specifically, measures assessing positive and maladaptive ER strategies and EF

abilities. Baseline EF scores was a significant predictor of improvement in internalising symptoms, which may explain why some children may find it difficult to manage emotional and behavioural difficulties post treatment. Additionally the examination of various treatment outcomes demonstrates which factor predicted the most positive outcome. There were no significant reductions found for self-reported hyperactivity and conduct problems, which indicates that these issues may be better addressed by other interventions tailored specifically for behavioural problems. Nonetheless these findings suggest that targeting intervention at children during the primary school years may be an optimal time to reduce risk of developing anxiety disorders or depression (Lock & Barrett, 2003). This study further highlights that a classroom based intervention may be effective in reducing subclinical symptoms of emotional problems and reducing the frequency of high risk students.

One of the main limitations of the intervention study is the small sample size and initial group differences; thus they need to be replicated with larger samples in a randomised clinical trial setting with a control group to address possible sample biases. It would have been informative to include a control group to assess practice effects on the neuropsychological battery as well as a range of outcome measures beyond the self-report scales used. The addition of diagnostic interviews along with parent and teacher reports would provide detailed insight into the child's behavioural and emotional problems and circumstances. Studies show that parent and teacher reports are less likely to correspond with children's self-report, nonetheless Baldwin and Dadds (2007) claim that even though parent and teacher reports differ in responses these type of measures usually exhibit identical factor structures.

### 7.3. Future directions

These results provide an impetus for additional research, to include a broader range of hot and cool tasks and examine interrelations using a confirmatory factor analysis to test the hypothesis that hot and cool EF represent separable factors at the behavioural and emotional level. Furthermore, to make tasks more directly comparable across age, future work should vary motivational and affective salience within tasks (Carlson et al., 2005; Prencipe & Zelazo, 2005). This would allow more direct comparisons of the development of relatively hot and cool EF.

Given that ER mediated the relationship between EF and behavioural problems it is important that future studies use a combined categorical and dimensional approach to increase understanding of the significance of observed ER deficits in clinical samples. It is also important to consider that it would be difficult to conclude the directions of influence. It is possible that certain ER strategies lead to emotional problems such as depression and anxiety, as the other way around. Additional variables may account for the relation between the reporting of specific ER strategies and the reporting of symptoms. Prospective studies should therefore be set to investigate whether a temporal order can be found in the emergence of behavioural and emotional symptoms and the use of specific ER strategies.

This intervention study used a mixed group of those with emotional and behavioural disorder, as these children exhibited a wide range of behaviours, it would be interesting for future research to consider the relative contributions of specific internalising problem traits to EF functioning, for example anxiety and depressive symptoms. Although a handful of prior studies showed improvement in emotional functioning after CBT in older children (i.e. 12–14 years old), the current

findings show similar patterns and suggest that a cognitive behavioural approach may benefit adolescents in helping them understand the necessary ER strategies. Importantly the current study indicates, therefore, that a school based anxiety prevention programs may be very effective for treating emotional disorders. Having identified the children with difficulties, this programme can be easily implemented and delivered by teachers in a classroom setting and as part of the curriculum. By implementing such a programme in school, this initiative would also overcome the many barriers to mental health services faced by those families from low socio economic background who would benefit from such help (Stopa, Barrett, & Golingi, 2010).

The investigation of cool and hot EF is yet to be explored in children autism spectrum disorder (ASD), studies consistently report EF deficits associated with ASD (Pennington & Ozonoff, 1996; Willcutt et al., 2005). The extent to which these commonly found patterns in typical development, in particular the role of affective and motivational decision making affects high functioning children with ASD needs to be examined further. In a recent study, Faja (2009) reports that children with high functioning ASD were less likely than controls to develop an advantageous response pattern during the gambling task even after controlling for age and intelligence. Importantly how emotional and behavioural correlates are linked with hot and cool EF in children with ASD should be studied, particularly as children with ASD exhibit high levels of emotional and behavioural difficulties (Charman, Ricketts, Dockrell, Lindsay, & Palikara, 2015; Ozsivadjian, Knott, and Magiati; 2012; Scarpa & Reyes, 2011). Furthermore SSL can be implemented in children with high functioning ASD to improve emotional and behavioural outcomes, as Attwood's (2004) study suggests that CBT can be useful for children with high functioning

ASD in terms of decreasing their anxiety and anger. Moreover Wood et al. (2009) suggest that training specific social skills deficits can be positively addressed using CBT in high functioning children with ASD.

#### **7.4. Conclusions**

These results suggest that although both hot and cool EF rely on similar underlying processes, hot EF tasks may be relatively more challenging during childhood and adolescence. Nonetheless this research using diverse tasks helps to illustrate how similar executive functions can be used in the service of controlling action and emotional expression. Future research, however, might include more controlled attempts to examine development and individual differences in highly similar tasks infused with cool (non-affective) and hot (affective) contexts. The present study raises several issues that remain to be explored in EF-ER interactions, but it provides some answers as well. First, it revealed a significant correlation between individual differences in EF and ER, using behavioural and self-report measures of both constructs. Second, the study uncovered a nonlinear relation between these constructs, in which both low and high levels of inhibition can negatively impact the regulation of emotion in a social context. And finally this study demonstrated that ER skills can be improved using a CBT based approach, facilitating behavioural and emotional outcomes. This research highlights that together executive functions and emotion regulation are crucial interactive contributors to socio-emotional development.



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## **Appendices**

## Appendix I: Ethics approval (Study 1)

Dear Blossom,

### Ethics Application

**Applicant:** Blossom Fernandes

**Original Title:** Executive function and emotional wellbeing in children and adolescents: Implications for ADHD and comorbid disorders

**New Title:** Decision Making and Emotional Wellbeing

**Reference:** PSYC 13/ 095

**Department:** Psychology

Many thanks for your response. I am pleased to confirm that all conditions for approval of this project have now been met. We do not require anything further in relation to this application.

Please advise us if there are any changes to the research during the life of the project. Minor changes can be advised using the Minor Amendments Form on the Ethics Website, but substantial changes may require a new application to be submitted.

Many thanks,

Jan

**Jan Harrison**

Ethics Officer - Research & Business Development Office

University of Roehampton | Froebel College | Roehampton Lane | London | SW15 5PJ

[jan.harrison@roehampton.ac.uk](mailto:jan.harrison@roehampton.ac.uk) | [www.roehampton.ac.uk](http://www.roehampton.ac.uk)

Tel: +44(0)20 8392 5785

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## Appendix II: Ethics approval (Intervention study)

Dear Blossom,

### **Ethics Application**

**Applicant:** Blossom Fernandes  
**Title:** Improving emotional wellbeing and cognitive control using Super Skills for Life (SSL)  
**Reference:** PSYC 15/ 188  
**Department:** Psychology

Many thanks for your response and the amended documents. Under the procedures agreed by the University Ethics Committee I am pleased to advise you that, apart from the items mentioned below, your Department has confirmed that all conditions for approval of this project have now been met.

### **Minor Condition:**

1. Opt-out consent. We note that the Head teacher is giving permission for the use of opt-out consent. We assume that if they prefer to use opt-in consent then this will of course be followed.
2. With regard to response to a child being distressed, please ensure that you will refer/discuss with the relevant teacher or pastoral care team.

As these are only minor conditions it is assumed that you will adhere to these conditions for approval and therefore we do not require a response. We do not require anything further in relation to this application.

Please note that on a standalone page or appendix the following phrase should be included in your thesis:

The research for this project was submitted for ethics consideration under the reference PSYC 15/ 188 in the Department of Psychology and was approved under the procedures of the University of Roehampton's Ethics Committee on 11.02.16.

Please note that University of Roehampton ethics approval will always be subject to compliance with the University policies and procedures applying at the time when the work takes place. It is your responsibility to ensure that you are familiar and compliant with all such policies and procedures when undertaking your research.

Please advise us if there are any changes to the research during the life of the project. Minor changes can be advised using the Minor Amendments Form on the Ethics Website, but substantial changes may require a new application to be submitted.

Many thanks,

Jan

**Jan Harrison**

Ethics Officer

Research Office

University of Roehampton | London | SW15 5PJ

[jan.harrison@roehampton.ac.uk](mailto:jan.harrison@roehampton.ac.uk) | [www.roehampton.ac.uk](http://www.roehampton.ac.uk)

Tel: +44 (0) 20 8392 5785

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**Appendix III: School letter of consent (Study 1)****ETHICS COMMITTEE****PARTICIPANT CONSENT FORM****Title of Research Project: Decision making and emotional wellbeing**

Dear Head teacher,

I am a PhD student based in the Department of Psychology, University of Roehampton, currently conducting a study which seeks to explore a range of factors looking at children's thoughts about the way they regulate their emotions and behaviour. In particular, we want to look at decision making in relation to attention span, working memory and inhibition.

For this purpose, children and young people will be asked to complete a set of questionnaires and computer based tasks which will take a total of about 60 minutes to complete. These questionnaires will be used to assess: a) what children tend to think of their daily activities and b) link between personality and emotion. There will be a simple recall task where they will be asked to repeat a sequence of numbers given by the instructor. The decision making tasks will involve inflating a computer generated balloon, the balloon is expected to pop if pumped past its explosion point. The second task will be measuring how often a hypothetical reward will be delayed.

I will administer the questionnaires to the pupils, and will be present throughout the questionnaire and task completion to provide assistance if needed and to ensure confidential and independent responding. I have been checked by the Disclosure and Barring Service (DBS) previously Criminal Records Bureau (CRB).

Parent(s) or caregiver(s) who do not wish their child to take part in the research will be advised to return a slip at the bottom of the information sheet which indicates they wish to 'opt out' of the proposed research. Parents who return the slip will be assumed to be declining consent for the proposed research, whilst those who do not return the slip (nor do they decline participation through other means, e.g. e-mail to researcher, letter to school, telephone call) will be assumed to be consenting to their son(s)/daughter's participation.

Children will also be asked to give consent before taking part in this research; they are free to withdraw at any time, without giving a reason.

All data relating to the students participation in this study will be held and processed in the strictest confidence, in accordance with the Data Protection Act (1998). No one outside of the research team will have access to any of the data and anonymity will be protected at all times.

We would be most grateful if you would be able to support this research by allowing us to investigate pupils at your school. Please could you confirm this by signing the provided consent slip below.

If you have any further questions you can contact me by telephone on 07985089247 or by email at [fernandb@roehampton.ac.uk](mailto:fernandb@roehampton.ac.uk). If you prefer, I would be more than happy to come in and meet with you to discuss this further. I look forward to hearing from you.

Yours sincerely,

Blossom Fernandes  
Department of Psychology  
Whitelands College  
Holybourne Avenue  
University of Roehampton  
London SW15 4JD

Please note: if you have a concern about any aspect of your participation or any other queries please raise this with the investigator. However, if you would like to contact an independent party please contact the Head of Department (or if the researcher is a student you can also contact the Director of Studies or the co-supervisor).

**Co-Supervisor**

Dr Mark Wright  
Department of Psychology  
Whitelands College  
Holybourne Avenue  
University of Roehampton  
London SW15 4JD  
[mark.wright@roehampton.ac.uk](mailto:mark.wright@roehampton.ac.uk)  
Tel: 020 8392 3642

**Director of Studies**

Prof. Cecilia Essau  
Department of Psychology  
Whitelands College  
Holybourne Avenue  
University of Roehampton  
London SW15 4JD  
[c.essau@roehampton.ac.uk](mailto:c.essau@roehampton.ac.uk)  
Tel: 020 8392 3647

**Head of Department**

Dr Diane Bray  
Department of Psychology  
Whitelands College  
Holybourne Avenue  
University of Roehampton  
London SW15 4JD  
[d.bray@roehampton.ac.uk](mailto:d.bray@roehampton.ac.uk)  
Tel: 020 8392 3627

**Some examples of questions to be used in this study: For children/adolescents questionnaires**

I usually do as I am told

- Not True True                       Somewhat True                       Certainly

I have many fears, I am easily scared

- Not True True                       Somewhat True                       Certainly

I finish the work I'm doing. My attention is good

- Not True True                       Somewhat True                       Certainly

I do not show my emotions to others.

- Not at all true definitely true     somewhat true                       very true

I care about how well I do at school or work.

- Not at all true definitely true     somewhat true                       very true

About negative experiences...

I think of something nice and not about what happened

- (almost) never always     Sometimes     regularly     often     (almost) always

I think of how I can change it

(almost) never     Sometimes     regularly     often     (almost) always

***Please complete and return this form. Thank you!***

**Title of Research Project: Decision making and emotional wellbeing**

I agree for the students in my school to take part in the study and I understand that they have the right to withdraw from the study at any time.

School name \_\_\_\_\_

Date \_\_\_\_\_

Head teachers Signature \_\_\_\_\_

## Appendix IV: Parent letter (Study 1)



London

ETHICS COMMITTEE

### PARENT CONSENT FORM

**Title of Research Project: Decision making and emotional wellbeing**

Dear Parent / Guardian,

I am a PhD student based in the Department of Psychology, University of Roehampton, currently conducting a study looking at children's thoughts about the way they regulate their emotions and behaviour. In particular, I want to look at the way they regulate their emotions with regard to decision making.

Your child will be asked to complete a set of questionnaires and computer based tasks which will take around 40-45 minutes to complete. These questionnaires will be used to assess: a) what children tend to think of their daily activities; b) link between personality and emotion; and c) your child's age and gender (but not their name). There will be a simple recall task where they will be asked to repeat a sequence of numbers given by the instructor. The decision making tasks will involve inflating a computer generated balloon, the balloon is expected to pop if pumped past its explosion point. The second task will be measuring how often a hypothetical reward will be delayed.

The questionnaires and tasks will be completed anonymously, which means that your child's name will not be requested. In order to match your child's data, all responses will be assigned a unique code. The responses will be kept confidential and only be used for research purposes.

Consent has been provided by the school whereby the head teacher has approved the materials to be used in the study. I have also been checked by the Disclosure and Barring Service (DBS) (Previously Criminal Records Bureau, CRB). Children do not have to take part on the day if they do not want to and can skip over any questions if they like and there are no right or wrong answers. Your child is free to withdraw at any time, without giving a reason, and you are free to withdraw your child's data after the study, though once all data has been collated their data may be used in an anonymised form.

If you do NOT want your child to take part then please sign and return the slip below by \_\_\_\_\_.

If you have any further questions or would like to know more about our research, please feel free to contact me or my supervisor.

Sincerely,

Blossom Fernandes

Department of Psychology  
Whitelands College  
Holybourne Avenue  
University of Roehampton  
London SW15 4JD  
Tel: 07985089247  
[fernandb@roehampton.ac.uk](mailto:fernandb@roehampton.ac.uk)

However if you would like to contact an independent party please contact the head of the department (as the researcher is a student you can also contact the director of studies).

**Co-Supervisor**

Dr Mark Wright  
 Department of Psychology  
 Whitelands College  
 Holybourne Avenue  
 University of Roehampton  
 London SW15 4JD  
[mark.wright@roehampton.ac.uk](mailto:mark.wright@roehampton.ac.uk)  
 Tel: 020 8392 3642

**Director of Studies**

Prof. Cecilia Essau  
 Department of Psychology  
 Whitelands College  
 Holybourne Avenue  
 University of Roehampton  
 London SW15 4JD  
[c.essau@roehampton.ac.uk](mailto:c.essau@roehampton.ac.uk)  
 Tel: 020 8392 3647

**Head of Department**

Dr Diane Bray  
 Department of Psychology  
 Whitelands College  
 Holybourne Avenue  
 University of Roehampton  
 London SW15 4JD  
[d.bray@roehampton.ac.uk](mailto:d.bray@roehampton.ac.uk)  
 Tel: 020 8392 3627

**Some examples of questions to be used in this study: For children/adolescents questionnaires**

I usually do as I am told

- Not True True                       Somewhat True                       Certainly

I have many fears, I am easily scared

- Not True True                       Somewhat True                       Certainly

I finish the work I'm doing. My attention is good

- Not True True                       Somewhat True                       Certainly

I do not show my emotions to others.

- Not at all true definitely true     somewhat true                       very true

I care about how well I do at school or work.

- Not at all true definitely true     somewhat true                       very true

About negative life experiences.....

I think of something nice and not about what happened

(almost) never     Sometimes     regularly     often     (almost) always

I think of how I can change it

(almost) never     Sometimes     regularly     often     (almost) always

I do not want my child to take part in the research, as described in the letter.

Child's name .....

Relationship to the child (i.e., parent, guardian or other) .....

Name .....

Signature .....

Date .....

**Appendix V: Student consent form (Study 1)****ETHICS COMMITTEE****PARTICIPANT CONSENT FORM**

**Title of Research Project: Decision making and emotional wellbeing**

**Brief Description of Research Project:**

The aim of the study is to look at the link between aspects of executive function and emotion regulation. Emotion regulation refers to the processes by which we manage our emotions. Whereas executive function (EF) is a general term for cognitive processes (e.g., attention).

You will be required to complete a series of questionnaires on how often you experience being in a state of hyperactivity, impulsivity and other behaviours relating to how you manage your emotions in stressful events. You will then be asked to take part in a set of computer based tasks where you have to respond to instructions provided on screen; you will also be doing a simple recall task where you will be asked to repeat a sequence of numbers given by the instructor. The whole procedure should last no more than an hour.

All data gathered during this study will be held securely and anonymously. If you wish to withdraw from the study, contact me with your participant number and your information will be deleted from our files. There is no compulsion or academic pressure to take part in the project and should you decline to participate or withdraw your data, your course marks will not be adversely affected

**Investigator Contact Details:**

Blossom Fernandes

Department of Psychology

Whitelands College

Holybourne Avenue

University of Roehampton

London SW15 4JD

[fernandb@roehampton.ac.uk](mailto:fernandb@roehampton.ac.uk)

**Consent Statement:**



I agree to take part in this research, and am aware that I am free to withdraw at any point. I understand that the information I provide will be treated in confidence by the investigator and that my identity will be protected in the publication of any findings.

Name .....

Signature .....

Date .....

Please note: if you have a concern about any aspect of your participation or any other queries please raise this with the investigator. However, if you would like to contact an independent party please contact the Head of Department (or if the researcher is a student you can also contact the Director of Studies or the co-supervisor).

| <b>Co-Supervisor</b>   | <b>Director of Studies</b>   | <b>Head of Department</b>  |
|--|--|--|
| Dr Mark Wright   | Prof. Cecilia Essau  | Dr Diane Bray  |
| Department of Psychology   | Department of Psychology   | Department of Psychology   |
| Whitelands College   | Whitelands College   | Whitelands College   |
| Holybourne Avenue  | Holybourne Avenue  | Holybourne Avenue  |
| University of Roehampton   | University of Roehampton   | University of Roehampton   |
| London SW15 4JD  | London SW15 4JD  | London SW15 4JD  |
| <a href="mailto:mark.wright@roehampton.ac.uk">mark.wright@roehampton.ac.uk</a> | <a href="mailto:c.essau@roehampton.ac.uk">c.essau@roehampton.ac.uk</a> | <a href="mailto:d.bray@roehampton.ac.uk">d.bray@roehampton.ac.uk</a> |
| Tel: 020 8392 3642   | Tel: 020 8392 3647   | Tel: 020 8392 3627   |

**Appendix VI: Debrief form (Study 1)**

ETHICS COMMITTEE

PARTICIPANT DEBRIEF

**Title of Research Project: Decision making and emotional wellbeing**

Thank you very much for taking part in our study, we greatly appreciate your contribution.

The main purpose of this study is to find out how executive functioning such as working memory, attention span and decision making is related to aspects of cognitive emotion regulation. Emotion regulation can be understood as an individual's efforts to control their emotions following personal experiences, thus helping people cope with stressful events (Thompson, 1991).

This study also aims to find out how personality types affect behaviour and influence the way people react to certain situations. *Please note that the questionnaires are designed simply to look at normal variation in aspects of mood and emotional states in the population; not as tools to diagnose mental illness.*

All data gathered during this study will be held securely and anonymously. If you wish to withdraw from the study, contact us with your participant number (above) and your information will be deleted from our files. Please be aware, however, that data in summary form may already have been used for publication at the time of request.

Should you have any concern about any aspect of your participation in this study, please raise it with the investigator in the first instance.

**Investigator Contact Details:**

Blossom Fernandes

Department of Psychology  
Whitelands College

University of Roehampton  
 Holybourne Avenue  
 London SW15 4JD  
[fernandb@roehampton.ac.uk](mailto:fernandb@roehampton.ac.uk)

However, if you would like to contact an independent party please contact the Head of Department (or as the researcher is a student you can also contact the co-supervisor or director of studies.)

**Co-Supervisor**

Dr Mark Wright

Department of Psychology  
 Whitelands College  
 Holybourne Avenue  
 University of Roehampton  
 London SW15 4JD  
[mark.wright@roehampton.ac.uk](mailto:mark.wright@roehampton.ac.uk)

Tel: 020 8392 3642

**Director of Studies**

Prof. Cecilia Essau

Department of Psychology  
 Whitelands College  
 Holybourne Avenue  
 University of Roehampton  
 London SW15 4JD  
[c.essau@roehampton.ac.uk](mailto:c.essau@roehampton.ac.uk)

Tel: 020 8392 3647

**Head of Department**

Dr Diane Bray

Department of Psychology  
 Whitelands College  
 Holybourne Avenue  
 University of Roehampton  
 London SW15 4JD  
[d.bray@roehampton.ac.uk](mailto:d.bray@roehampton.ac.uk)

Tel: 020 8392 3627

If you are a student at Roehampton University and are troubled or worried about any aspect of the study, or issues it may have raised, you may find it helpful to contact one of the Student Welfare Officers who will be able to advise you on agencies that can deal with your particular concern.

**Digby Stuart**

Mike Owens

Tel: 020 8392 3204

**Southlands**

Jo Eskdale

Tel: 020 8392 3402

**Froebel**

Hanna Desmond

Tel: 020 8392 3304

**Whitelands**

Louise Walton

Tel: 020 8392 3502

If you feel your concerns are more serious or complex you may wish to contact the **Student Medical Centre** on **Ext 3679**.

If you are not a student at the University of Roehampton your GP should be able to advise you further.

## Appendix VII: Task appendix (Study 1)

### Task Appendix

#### Experimental tasks

*Backwards/Forwards digit span test* (Wechsler Intelligence Scale for Children –WISC III, Wechsler, 1991) - this is a test for verbal working memory, the experimenter will read aloud a set of numbers and the participant is required to repeat the sequence in the same order. If succeeded a longer sequence is presented, however after failing on two attempts the task is stopped.

*Go/no go task* - this measures selective attention and motor response inhibition; participants are requested to respond to go signals on a computer screen, but have to inhibit their response when a sporadic stop signal appears. (this includes responding to different shapes such as the one seen below). These are immediately followed by go signals; depending on participants succession rate the length of delay is shortened. Reaction time is calculated by subtracting mean time from reaction to go signals from the mean of stop signal delay.



*The balloon analogue risk task* (BART – Lejuez et al., 2002) - for this task a small stimulated balloon supplemented by a balloon pump is presented on a computer screen, each pump inflates the balloon and acquires a small prize. The balloon is expected to pop if pumped past its explosion point, this means all the money in the temporary bank is lost, and a new un-inflated balloon appears on the screen. The participants are able to stop at any point and collect the money/prize and transfer into a permanent bank. After each balloon has exploded or rewards collected, a new balloon appears for a total of 30 trials, with a different probability of explosion. Following the first explosion the amount to be lost is increased with every successive pump. BART has been utilised to demonstrate the reliability of investigating positive correlation of risky behaviour in adolescents.

*Delay Discounting* (Richards et al., 1999) – this task is set to measure delay of gratification, discounting refers to the decline in subjective value of a reward when delayed. Participants will be given a series of hypothetical choices between a variable immediate amount of money and fixed amount that would be delayed by 1, 2, 30, 180 or 365 days. The amount of immediate reward and the order of presentation varies with participant choices, for each choice an adjusting amount algorithm manages the amount for immediate rewards (for example immediate value begins with 50 cents and increases in 50 cent intervals) until it reaches the equivalent value of the delayed reward.

### **Questionnaires**

*The strengths and difficulty questionnaire, along with measure for psychopathy are not used as diagnostic tools for behavioural and emotional problems. These questionnaires are usually considered a measure for determining traits in relation to the relevant constructs; also the researcher is not a qualified clinician to make a formal diagnosis.*

*Cognitive Emotion Regulation Questionnaire for children (CERQ - K; Garnefski & Kraaij, 2006) - A 24 item questionnaire which will be used to assess emotional experiences after negative life events in children, adolescents and adults.*

*The Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) - this is a 25 item measure for conduct problems, hyperactivity, anxiety and depressive symptoms with additional questions on emotional distress as a result of the behavioural outcomes.*

*The Inventory of Callous-Unemotional Traits (ICU; Frick, 2003) - children and adolescents will be tested on the ICU. Consisting of 24 items and measuring uncaring, unemotional and callous traits.*

## Appendix VIII: School letter of consent (Intervention study)



Department of Psychology  
University of Roehampton  
Whitelands College  
Holybourne Avenue

May 07, 2016

Dear Head teacher,

I am a researcher based in the University of Roehampton. I am currently working on a project aimed at exploring the benefits of using "Super Skills for Life" (SSL) programme to empower children to enhance their social skills. Previous research in 14 primary schools across London indicated that the SSL is effective in increasing children's self-confidence and social skills. The current study is aimed at critically exploring the same further and further find out if emotional wellbeing and cognitive control (i.e., inhibition and working memory) can be improved.

This programme will be conducted over a period of 4 weeks in your child's school, with each group session lasting for about 45 minutes. We aim to have 2 groups with ideally 6-8 children in each group. Children will be taught specific strategies including: identifying activities to increase self-esteem, using coping skills (e.g., relaxation), and various social skills (e.g., communication skills). All the sessions, including a 2-minute speech task, will be video-recorded to ensure the most accurate observation of the child's social/communication skills. During the 2 minute speech task they will have the opportunity to talk about any subject they wish to (e.g. their hobbies/interests). They will have the opportunity to see how they have done in this task and how they could enhance their social/communication skills throughout the programme. Therefore the teachers will be required to select the students they feel will benefit from this programme the most. We would however like to know whether these children are registered on Personal, Social, Health and Economic (PSHE) subject and/or the Social and Emotional Aspects of Learning (SEAL): Improving behaviour, improving learning programme.

The children will complete a set of questionnaires and complete attention based tasks before and after the programme, and as part of follow up (i.e., an additional testing session to see how the students are progressing) 3 months later. The computer based tasks will involve students having to respond to instructions provided on screen. The decision making tasks will involve inflating a computer generated balloon, the balloon is expected to pop if pumped past its explosion point. There will be a simple recall task where they will be asked to repeat a sequence of numbers given by the instructor. The questionnaires will measure Children's self-esteem, what children tend to think of their daily activities, themselves; and their ability to regulate emotions. The whole procedure should last approximately 45 minutes. If held during class hours those children participating in the programme are expected to leave the class quietly without disrupting the other children in the room, the rest of the class continues with the ongoing lesson.

Children will be required to provide their verbal consent, Parent(s) or caregiver(s) who do not wish their child to take part in the research will be advised to return a slip at the bottom of the information sheet which indicates their wish to 'opt out' of the proposed research. 'Opt out' means parents who return the slip will be assumed to be declining consent for the proposed research, whilst those who do not return the slip (nor do they decline participation through other means, e.g. e-mail to researcher, letter to school, telephone call) will be assumed to be consenting to their son(s)/daughter's participation. Students will be able to withdraw from the study at any time if they wish to do so, in particular if they feel distressed during any of the sessions they will then be given the opportunity to leave.

The data connected to the participation of the children will be held and administered in the strictest confidence as required by the Data Protection Act (1998). The data will be kept within the research team and anonymity will be protected at all times. A unique identification number will be used, which will however be treated with strictest confidentiality by the research team. Moreover, the video footage will be kept anonymous and will be held by the university for 10 years.

We would appreciate you supporting the SSL programme by allowing us to conduct this research at your school. Please could you confirm this by signing the provided consent slip below.

In the meantime I am happy to answer any questions you might have about any aspect of the study. You can email me (the best way to be certain of reaching me) on [fernandb@roehampton.ac.uk](mailto:fernandb@roehampton.ac.uk) or call me on 020 8392 3684.

Sincerely,

Blossom Fernandes

[fernandb@roehampton.ac.uk](mailto:fernandb@roehampton.ac.uk)

Department of Psychology

Whitelands College

Holybourne Avenue

University of Roehampton

London SW15 4JD

Please note: if you have a concern about any aspect of your participation or any other queries please raise this with the investigator. However, if you would like to contact an independent party please contact the Head of Department (or if the researcher is a student you can also contact the Director of Studies or the co-supervisor).

**Director of Studies**

Prof. Cecilia Essau

Department of Psychology

Whitelands College

Holybourne Avenue

University of Roehampton

London SW15 4JD

[c.essau@roehampton.ac.uk](mailto:c.essau@roehampton.ac.uk)

Tel: 020 8392 3647

**Head of Department**

Dr Diane Bray

Department of Psychology

Whitelands College

Holybourne Avenue

University of Roehampton

London SW15 4JD

[d.bray@roehampton.ac.uk](mailto:d.bray@roehampton.ac.uk)

Tel: 020 8392 3627

***Please complete and return this form. Thank you!***

**Title of Research Project:** Improving emotional wellbeing and cognitive control using Super Skills for Life (SSL)

**Consent Statement:**

*I agree to take part in this research, and am aware that the student is free to withdraw at any point without giving a reason, although if they do so I understand that their data might still be used in a collated form. I understand that the information provided will be treated in confidence by the investigator and that student's identity will be protected in the publication of any findings, and that data will be collected and processed in accordance with the Data Protection Act 1998 and with the University's Data Protection Policy.*

- 1) I agree with the op-out consent procedure.
- 2) I have seen the materials and am happy with them.
- 3) I am aware that students will take part during school hours.
- 4) I understand that students/parents have the right to withdraw from the study at any time.
- 5) I am happy for teachers to select students they feel would benefit from the programme.

School name\_\_\_\_\_

Date\_\_\_\_\_

Head teachers Signature\_\_\_\_\_



**Appendix IX: Parent letter (Intervention study)**

Department of Psychology  
University of Roehampton  
Whitelands College  
Holybourne Avenue

June 07, 2016

Dear Parent,

I am a researcher based in the University of Roehampton. I am currently working on a project aimed at exploring the benefits of using "Super Skills for Life" (SSL) programme to empower children to enhance their social skills and your child has been selected by their teacher to take part in this project. Previous research in 14 primary schools across London indicated that the SSL is effective in increasing children's self-confidence and social skills. The current study is aimed at critically exploring the same further.

This programme will be conducted over a period of 4 weeks in your child's school, with each group session lasting for about 45 minutes. We aim to have 2 groups with ideally 6-8 children in each group. Children will be taught specific strategies including: identifying activities to increase self-esteem, using coping skills (e.g., relaxation), and various social skills (e.g., communication skills). All the sessions, including a 2-minute speech task, will be video-recorded to ensure the most accurate observation of the child's social/communication skills. During the 2 minute speech task they will be able to talk about any subject they wish to (e.g. their hobbies/interests). They will have the opportunity to see how they have done in this task and how they could enhance their social/communication skills throughout the programme.

The children will complete a set of questionnaires and complete attention based tasks before and after the programme, and as part of follow up (i.e., an additional testing session to see how the students are progressing) 3 months later. The computer based tasks will involve students having to respond to instructions provided on screen. The decision making tasks will involve inflating a computer generated balloon, the balloon is expected to pop if pumped past its explosion point. There will be a simple recall task where they will be asked to repeat a sequence of numbers given by the instructor. The questionnaires will measure Children's self-esteem, what children tend to think of their daily activities, themselves; and their ability to regulate emotions. The whole procedure should last approximately 45 minutes. If held during class hours those children participating in the programme are expected to leave the class quietly without disrupting the other children in the room, the rest of the class continues with the ongoing lesson.

The data acquired will be treated anonymously, which means that your child's name will not be requested; a unique identification number will be used, which will however be treated with strictest confidentiality by the research team and solely be used for the purpose of follow up. All observational and computer data will also be kept confidential and only be used for research purposes. Moreover, the video footage will be kept anonymous and will be held by the university for 10 years.

Your child will be required to provide their verbal consent, if you do not wish for your child to take part in the research you will be advised to return a slip at the bottom of the information sheet which indicates your wish to 'opt out' of the proposed research. 'Opt out' means parents who return the slip will be assumed to be declining consent for the proposed research, whilst those who do not return the slip (nor do they decline participation through other means, e.g. e-mail to researcher, letter to school, telephone call) will be assumed to be consenting to their son(s)/daughter's participation.

Your child or yourself has a right to withdraw from the programme at any time. There is no compulsion or academic pressure to take part in the project, and should your child or you decline to participate or subsequently withdraw, your child will not be adversely affected. Should your child wish to withdraw he/she needs to quote the ID number provided so that the researchers will be able to identify his/her data. Students will be able to leave the study at any time if they wish to do so, in particular if they feel distressed during any of the sessions they will then be given the opportunity to leave.

If you do NOT want your child to take part then please sign and return the slip below

In the meantime I am happy to answer any questions you might have about any aspect of the study. You can email me (the best way to be certain of reaching me) on fernandb@roehampton.ac.uk or call me on 020 8392 3684.

Sincerely,

Blossom Fernandes

[fernandb@roehampton.ac.uk](mailto:fernandb@roehampton.ac.uk)

Department of Psychology

Whitelands College

Holybourne Avenue

University of Roehampton

London SW15 4JD

Please note: if you have a concern about any aspect of your participation or any other queries please raise this with the investigator. However, if you would like to contact an independent party please contact the Head of Department (or if the researcher is a student you can also contact the Director of Studies or the co-supervisor).

**Director of Studies**

Prof. Cecilia Essau  
Department of Psychology  
Whitelands College  
Holybourne Avenue  
University of Roehampton  
London SW15 4JD  
[c.essau@roehampton.ac.uk](mailto:c.essau@roehampton.ac.uk)  
Tel: 020 8392 3647

**Head of Department**

Dr Diane Bray  
Department of Psychology  
Whitelands College  
Holybourne Avenue  
University of Roehampton  
London SW15 4JD  
[d.bray@roehampton.ac.uk](mailto:d.bray@roehampton.ac.uk)  
Tel: 020 8392 3627

-----

I do not wish for my child to participate in the study as described:

Child's name .....

Relationship to the child (i.e., parent, guardian or other ) .....

Name .....

Signature .....

Date .....

Please note: if you have a concern about any aspect of your participation or any other queries please raise this with the investigator.

## Appendix X: Cognitive Emotion Regulation Questionnaire – Kid’s

### CERQ- K

© Garnefski & Kraaij, 2005

#### How do you cope with events?

Sometimes nice things happen in your life and sometimes unpleasant things might happen.

When something unpleasant happens, you can think about it for a long time.

When something unpleasant happens to you, what do you usually think?

|   | (almost)<br>never | some-<br>times | regu-<br>larly | often | (almost)<br>always |
|---|-------------------|----------------|----------------|-------|--------------------|
| 1. I think that I am to blame   | 1                 | 2              | 3              | 4     | 5                  |
| 2. I think that I have to accept it   | 1                 | 2              | 3              | 4     | 5                  |
| 3. Again and again, I think of how I feel about it                            | 1                 | 2              | 3              | 4     | 5                  |
| 4. I think of nicer things  | 1                 | 2              | 3              | 4     | 5                  |
| 5. I think about what would be the best for me to do                          | 1                 | 2              | 3              | 4     | 5                  |
| 6. I think that I can learn from it   | 1                 | 2              | 3              | 4     | 5                  |
| 7. I think that worse things can happen                                       | 1                 | 2              | 3              | 4     | 5                  |
| 8. I often think that it’s much worse than what happens to others             | 1                 | 2              | 3              | 4     | 5                  |
| 9. I think that others are to blame   | 1                 | 2              | 3              | 4     | 5                  |
| 10. I think that I have been stupid   | 1                 | 2              | 3              | 4     | 5                  |
| 11. It just happened; there is nothing I can do about it                      | 1                 | 2              | 3              | 4     | 5                  |
| 12. I often think of what I am thinking and feeling about it                  | 1                 | 2              | 3              | 4     | 5                  |
| 13. I think of nicer things that have nothing to do with it                   | 1                 | 2              | 3              | 4     | 5                  |
| 14. I think of how I can cope with it   | 1                 | 2              | 3              | 4     | 5                  |
| 15. I think that it makes me feel ‘older and wiser’                           | 1                 | 2              | 3              | 4     | 5                  |
| 16. I think that worse things happen to others                                | 1                 | 2              | 3              | 4     | 5                  |
| 17. Again and again, I think about how terrible it all is                     | 1                 | 2              | 3              | 4     | 5                  |
| 18. I think that others have been stupid                                      | 1                 | 2              | 3              | 4     | 5                  |
| 19. I think that it’s my own fault  | 1                 | 2              | 3              | 4     | 5                  |
| 20. I think that I can’t change it  | 1                 | 2              | 3              | 4     | 5                  |
| 21. All the time, I think that I want to understand why I feel that way       | 1                 | 2              | 3              | 4     | 5                  |
| 22. I think of something nice and not about what happened                     | 1                 | 2              | 3              | 4     | 5                  |
| 23. I think of how I can change it  | 1                 | 2              | 3              | 4     | 5                  |
| 24. I think that there are good sides to it as well                           | 1                 | 2              | 3              | 4     | 5                  |
| 25. I think that it’s not as bad as other things that could happen            | 1                 | 2              | 3              | 4     | 5                  |
| 26. All the time, I think that this is the worst thing that can happen to you | 1                 | 2              | 3              | 4     | 5                  |
| 27. I think that it’s the fault of others                                     | 1                 | 2              | 3              | 4     | 5                  |
| 28. I think that it’s all caused by me  | 1                 | 2              | 3              | 4     | 5                  |
| 29. I think that I can’t do anything about it                                 | 1                 | 2              | 3              | 4     | 5                  |
| 30. I often think of how I feel about what happened                           | 1                 | 2              | 3              | 4     | 5                  |
| 31. I think of nice things that have happened to me                           | 1                 | 2              | 3              | 4     | 5                  |

|  |   |   |   |   |   |
|--|---|---|---|---|---|
| 32. I think of what I can do best                      | 1 | 2 | 3 | 4 | 5 |
| 33. I think that it's not all bad                      | 1 | 2 | 3 | 4 | 5 |
| 34. I think that there are worse things in the world   | 1 | 2 | 3 | 4 | 5 |
| 35. I often think about how horrible the situation was | 1 | 2 | 3 | 4 | 5 |
| 36. I think that it's all caused by others             | 1 | 2 | 3 | 4 | 5 |

**Thank you for filling out the questionnaire!**

## Appendix XI: Cognitive Emotion Regulation Questionnaire - Adults

### CERQ

© Garnefski, Kraaij & Spinhoven, 2001

#### How do you cope with events?

*Everyone gets confronted with negative or unpleasant events now and then and everyone responds to them in his or her own way. By the following questions you are asked to indicate what you generally think, when you experience negative or unpleasant events.*

|   | (almost)<br>never | some-<br>times | regu-<br>larly | often | (almost) always |
|---|-------------------|----------------|----------------|-------|-----------------|
| 1. I feel that I am the one to blame for it   | 1                 | 2              | 3              | 4     | 5               |
| 2. I think that I have to accept that this has happened                                       | 1                 | 2              | 3              | 4     | 5               |
| 3. I often think about how I feel about what I have experienced                               | 1                 | 2              | 3              | 4     | 5               |
| 4. I think of nicer things than what I have experienced                                       | 1                 | 2              | 3              | 4     | 5               |
| 5. I think of what I can do best  | 1                 | 2              | 3              | 4     | 5               |
| 6. I think I can learn something from the situation   | 1                 | 2              | 3              | 4     | 5               |
| 7. I think that it all could have been much worse   | 1                 | 2              | 3              | 4     | 5               |
| 8. I often think that what I have experienced is much worse than what others have experienced | 1                 | 2              | 3              | 4     | 5               |
| 9. I feel that others are to blame for it   | 1                 | 2              | 3              | 4     | 5               |
| 10. I feel that I am the one who is responsible for what has happened                         | 1                 | 2              | 3              | 4     | 5               |
| 11. I think that I have to accept the situation   | 1                 | 2              | 3              | 4     | 5               |
| 12. I am preoccupied with what I think and feel about what I have experienced                 | 1                 | 2              | 3              | 4     | 5               |
| 13. I think of pleasant things that have nothing to do with it                                | 1                 | 2              | 3              | 4     | 5               |

|   |   |   |   |   |   |
|---|---|---|---|---|---|
| 14. I think about how I can best cope with the situation                                | 1 | 2 | 3 | 4 | 5 |
| 15. I think that I can become a stronger person as a result of what has happened        | 1 | 2 | 3 | 4 | 5 |
| 16. I think that other people go through much worse experiences                         | 1 | 2 | 3 | 4 | 5 |
| 17. I keep thinking about how terrible it is what I have experienced                    | 1 | 2 | 3 | 4 | 5 |
| 18. I feel that others are responsible for what has happened                            | 1 | 2 | 3 | 4 | 5 |
| 19. I think about the mistakes I have made in this matter                               | 1 | 2 | 3 | 4 | 5 |
| 20. I think that I cannot change anything about it                                      | 1 | 2 | 3 | 4 | 5 |
| 21. I want to understand why I feel the way I do about what I have experienced          | 1 | 2 | 3 | 4 | 5 |
| 22. I think of something nice instead of what has happened                              | 1 | 2 | 3 | 4 | 5 |
| 23. I think about how to change the situation   | 1 | 2 | 3 | 4 | 5 |
| 24. I think that the situation also has its positive sides                              | 1 | 2 | 3 | 4 | 5 |
| 25. I think that it hasn't been too bad compared to other things                        | 1 | 2 | 3 | 4 | 5 |
| 26. I often think that what I have experienced is the worst that can happen to a person | 1 | 2 | 3 | 4 | 5 |
| 27. I think about the mistakes others have made in this matter                          | 1 | 2 | 3 | 4 | 5 |
| 28. I think that basically the cause must lie within myself                             | 1 | 2 | 3 | 4 | 5 |
| 29. I think that I must learn to live with it   | 1 | 2 | 3 | 4 | 5 |
| 30. I dwell upon the feelings the situation has evoked in me                            | 1 | 2 | 3 | 4 | 5 |
| 31. I think about pleasant experiences  | 1 | 2 | 3 | 4 | 5 |
| 32. I think about a plan of what I can do best  | 1 | 2 | 3 | 4 | 5 |
| 33. I look for the positive sides to the matter   | 1 | 2 | 3 | 4 | 5 |

|   |   |   |   |   |   |
|---|---|---|---|---|---|
| 34. I tell myself that there are worse things in life       | 1 | 2 | 3 | 4 | 5 |
| 35. I continually think how horrible the situation has been | 1 | 2 | 3 | 4 | 5 |
| 36. I feel that basically the cause lies with others        | 1 | 2 | 3 | 4 | 5 |

**Thank you for filling out the questionnaire!**



## Appendix XII: Strengths and Difficulties Questionnaire

### Strengths and Difficulties Questionnaire

S 11-16

For each item, please mark the box for Not True, Somewhat True or Certainly True. It would help us if you answered all items as best you can even if you are not absolutely certain or the item seems daft! Please give your answers on the basis of how things have been for you over the last six months.

Your Name .....

Male/Female

Date of Birth.....

|  | Not True                 | Somewhat True            | Certainly True           |
|--|--------------------------|--------------------------|--------------------------|
| I try to be nice to other people. I care about their feelings    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I am restless, I cannot stay still for long                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I get a lot of headaches, stomach-aches or sickness              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I usually share with others (food, games, pens etc.)             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I get very angry and often lose my temper                        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I am usually on my own. I generally play alone or keep to myself | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I usually do as I am told  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I worry a lot  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I am helpful if someone is hurt, upset or feeling ill            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I am constantly fidgeting or squirming                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I have one good friend or more                                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I fight a lot. I can make other people do what I want            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I am often unhappy, down-hearted or tearful                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Other people my age generally like me                            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I am easily distracted, I find it difficult to concentrate       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I am nervous in new situations. I easily lose confidence         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I am kind to younger children                                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I am often accused of lying or cheating                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Other children or young people pick on me or bully me            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I often volunteer to help others (parents, teachers, children)   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I think before I do things                                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I take things that are not mine from home, school or elsewhere   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I get on better with adults than with people my own age          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I have many fears, I am easily scared                            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I finish the work I'm doing. My attention is good                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Do you have any other comments or concerns?

**Please turn over - there are a few more questions on the other side**

Overall, do you think that you have difficulties in one or more of the following areas: emotions, concentration, behaviour or being able to get on with other people?

| No                       | Yes-<br>minor<br>difficulties | Yes-<br>definite<br>difficulties | Yes-<br>severe<br>difficulties |
|--------------------------|-------------------------------|----------------------------------|--------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/>      | <input type="checkbox"/>         | <input type="checkbox"/>       |

If you have answered "Yes", please answer the following questions about these difficulties:

- How long have these difficulties been present?

| Less than<br>a month     | 1-5<br>months            | 6-12<br>months           | Over<br>a year           |
|--------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

- Do the difficulties upset or distress you?

| Not<br>at all            | Only a<br>little         | Quite<br>a lot           | A great<br>deal          |
|--------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

- Do the difficulties interfere with your everyday life in the following areas?

|                    | Not<br>at all            | Only a<br>little         | Quite<br>a lot           | A great<br>deal          |
|--------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| HOME LIFE          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| FRIENDSHIPS        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| CLASSROOM LEARNING | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| LEISURE ACTIVITIES | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

- Do the difficulties make it harder for those around you (family, friends, teachers, etc.)?

| Not<br>at all            | Only a<br>little         | Quite<br>a lot           | A great<br>deal          |
|--------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Your Signature .....

Today's Date .....

**Thank you very much for your help**

Appendix XIII: Screen for Child Anxiety Related Emotional **Disorders**

**Screen for Child Anxiety Related Disorders (SCARED) Youth Version**

|  |   |
|--|---|
| <p><i>Directions: Below is a list of sentences that describe how people feel. Read each phrase and decide if it is "Not True or Hardly Ever True", or "Somewhat True or Sometimes True", or "Very True or Very Often True" for you. Then, for each sentence, write the number that corresponds to the response that seems to describe you <u>for the last 3 months</u> .</i></p> | <p>0 = Not True or Hardly Ever True<br/>                 1= Somewhat True or Sometimes True<br/>                 2= Very True or Often True</p> |
| 1. When I feel frightened, it is hard to breathe   |   |
| 2. I get headaches when I am at school.  |   |
| 3. I don't like to be with people I don't know well.   |   |
| 4. I get scared if I sleep away from home.   |   |
| 5. I worry about other people liking me.   |   |
| 6. When I get frightened, I feel like passing out.   |   |
| 7. I am nervous.   |   |
| 8. I follow my mother or father wherever they go.  |   |
| 9. People tell me that I look nervous.   |   |
| 10. I feel nervous with people I don't know well.  |   |
| 11. I get stomachaches at school.  |   |
| 12. When I get frightened, I feel like I am going crazy.   |   |
| 13. I worry about sleeping alone.  |   |
| 14. I worry about being as good as other kids.   |   |
| 15. When I get frightened, I feel like things are not real.  |   |
| 16. I have nightmares about something bad happening to my parents.   |   |
| 17. I worry about going to school.   |   |
| 18. When I get frightened, my heart beats fast.  |   |
| 19. I get shaky.   |   |
| 20. I have nightmares about something bad happening to me.   |   |
| 21. I worry about things working out for me.   |   |
| 22. When I get frightened, I sweat a lot.  |   |
| 23. I am a worrier.  |   |
| 24. I get really frightened for no reason at all.  |   |
| 25. I am afraid to be alone in the house.  |   |
| 26. It is hard for me to talk with people I don't know well.   |   |
| 27. When I get frightened, I feel like I am choking.   |   |
| 28. People tell me that I worry too much.  |   |
| 29. I don't like to be away from my family.  |   |
| 30. I am afraid of having anxiety (or panic) attacks.  |   |
| 31. I worry that something bad might happen to my parents.   |   |
| 32. I feel shy with people I don't know well.  |   |
| 33. I worry about what is going to happen in the future.   |   |
| 34. When I get frightened, I feel like throwing up.  |   |
| 35. I worry about how well I do things.  |   |
| 36. I am scared to go to school.   |   |
| 37. I worry about things that have already happened.   |   |
| 38. When I get frightened, I feel dizzy.   |   |

|  |  |
|--|--|
| 39. I feel nervous when I am with other children or adults and I have to do something while they watch me (for example: read aloud, speak, play a game, play a sport). |  |
| 40. I feel nervous when I am going to parties, dances, or any place where there will be people that I don't know well.   |  |
| 41. I am shy.  |  |

## Appendix XIV: The Inventory of Callous-Unemotional Traits

ICU

(Youth Version)

***Instructions:*** Please read each statement and decide how well it describes you.

Mark your answer by circling the appropriate number (0-3) for each statement. Do not leave any statement unrated.

|   | Not at<br>all true | Somewha<br>t true | Very<br>true | Definitely<br>True |
|---|--------------------|-------------------|--------------|--------------------|
| 1. I express my feelings openly.  | 0                  | 1                 | 2            | 3                  |
| 2. What I think is "right" and "wrong" is different from what other people think. | 0                  | 1                 | 2            | 3                  |
| 3. I care about how well I do at school or work.                                  | 0                  | 1                 | 2            | 3                  |
| 4. I do not care who I hurt to get what I want.                                   | 0                  | 1                 | 2            | 3                  |
| 5. I feel bad or guilty when I do something wrong.                                | 0                  | 1                 | 2            | 3                  |
| 6. I do not show my emotions to others.   | 0                  | 1                 | 2            | 3                  |
| 7. I do not care about being on time.   | 0                  | 1                 | 2            | 3                  |
| 8. I am concerned about the feelings of others.                                   | 0                  | 1                 | 2            | 3                  |
| 9. I do not care if I get into trouble.   | 0                  | 1                 | 2            | 3                  |
| 10. I do not let my feelings control me.  | 0                  | 1                 | 2            | 3                  |
| 11. I do not care about doing things well.  | 0                  | 1                 | 2            | 3                  |
| 12. I seem very cold and uncaring to others.                                      | 0                  | 1                 | 2            | 3                  |
| 13. I easily admit to being wrong.  | 0                  | 1                 | 2            | 3                  |
| 14. It is easy for others to tell how I am feeling.                               | 0                  | 1                 | 2            | 3                  |
| 15. I always try my best.   | 0                  | 1                 | 2            | 3                  |

|   |   |   |   |   |
|---|---|---|---|---|
| 16. I apologize (“say I am sorry”) to persons I hurt.     | 0 | 1 | 2 | 3 |
| 17. I try not to hurt others’ feelings.                   | 0 | 1 | 2 | 3 |
| 18. I do not feel remorseful when I do something wrong.   | 0 | 1 | 2 | 3 |
| 19. I am very expressive and emotional.                   | 0 | 1 | 2 | 3 |
| 20. I do not like to put the time into doing things well. | 0 | 1 | 2 | 3 |
| 21. The feelings of others are unimportant to me.         | 0 | 1 | 2 | 3 |
| 22. I hide my feelings from others.                       | 0 | 1 | 2 | 3 |
| 23. I work hard on everything I do.                       | 0 | 1 | 2 | 3 |
| 24. I do things to make others feel good.                 | 0 | 1 | 2 | 3 |

## Appendix XV: Levenson's Self-Report Psychopathy Scale

### Levenson's Self-Report Psychopathy Scale (LSRP)

**Instructions:** Please read each statement and decide how well it describes you. Mark your answer by circling the appropriate number (1-4) for each statement. Do not leave any statement unrated.

|  | Disagree<br>strongly | Disagree<br>somewhat | Agree<br>somewhat | Agree<br>strongly |
|--|----------------------|----------------------|-------------------|-------------------|
| Success is based on survival of the fittest; I am not concerned about the losers.      | 1                    | 2                    | 3                 | 4                 |
| For me, what's right is whatever I can get away with.                                  | 1                    | 2                    | 3                 | 4                 |
| In today's world, I feel justified in doing anything I can get away with to succeed    | 1                    | 2                    | 3                 | 4                 |
| My main purpose in life is getting as many goodies as I can                            | 1                    | 2                    | 3                 | 4                 |
| Making a lot of money is my most important goal  | 1                    | 2                    | 3                 | 4                 |
| I let others worry about higher values; my main concern is with the bottom line        | 1                    | 2                    | 3                 | 4                 |
| People who are stupid enough to get ripped off usually deserve it                      | 1                    | 2                    | 3                 | 4                 |
| Looking out for myself is my top priority  | 1                    | 2                    | 3                 | 4                 |
| I tell other people what they want to hear so that they will do what I want them to do | 1                    | 2                    | 3                 | 4                 |
| I would be upset if my success came at someone else's expense                          | 1                    | 2                    | 3                 | 4                 |
| I often admire a really clever scam  | 1                    | 2                    | 3                 | 4                 |

|  |   |   |   |   |
|--|---|---|---|---|
| I make a point of trying not to hurt others in pursuit of my goals                 | 1 | 2 | 3 | 4 |
| I enjoy manipulating other people's feelings                                       | 1 | 2 | 3 | 4 |
| I feel bad if my words or actions cause someone to feel emotional pain             | 1 | 2 | 3 | 4 |
| Even if I were trying very hard to sell something, I wouldn't lie about it         | 1 | 2 | 3 | 4 |
| Cheating is not justified because it is unfair to others                           | 1 | 2 | 3 | 4 |
| I find myself in the same kinds of trouble, time after time                        | 1 | 2 | 3 | 4 |
| I am often bored   | 1 | 2 | 3 | 4 |
| I find that I am able to pursue one goal for a long time                           | 1 | 2 | 3 | 4 |
| I don't plan anything very far in advance  | 1 | 2 | 3 | 4 |
| I quickly lose interest in tasks I start   | 1 | 2 | 3 | 4 |
| Most of my problems are due to the fact that other people just don't understand me | 1 | 2 | 3 | 4 |
| Before I do anything, I carefully consider the possible consequences               | 1 | 2 | 3 | 4 |
| I have been in a lot of shouting matches with other people                         | 1 | 2 | 3 | 4 |
| When I get frustrated, I often "let off steam" by blowing my top                   | 1 | 2 | 3 | 4 |
| Love is overrated  | 1 | 2 | 3 | 4 |



## Appendix XVI: Cognitive Emotion Regulation Questionnaire

(Short)

Garnefski, Kraaij & Spinhoven, 2001

### How do you cope with events?

Everyone gets confronted with negative or unpleasant events now and then and every one responds to them in his or her own way. By the following questions you are asked to indicate what you generally think, when you experience negative or unpleasant events.

|   | (almost)<br>never | some<br>-<br>times | regu-<br>larly | often | (almos<br>t)<br>always |
|---|-------------------|--------------------|----------------|-------|------------------------|
| 1. I think that I have to accept that this has happened                         | 1                 | 2                  | 3              | 4     | 5                      |
| 2. I often think about how I feel about what I have experienced                 | 1                 | 2                  | 3              | 4     | 5                      |
| 3. I think I can learn something from the situation                             | 1                 | 2                  | 3              | 4     | 5                      |
| 4. I feel that I am the one who is responsible for what has happened            | 1                 | 2                  | 3              | 4     | 5                      |
| 5. I think that I have to accept the situation                                  | 1                 | 2                  | 3              | 4     | 5                      |
| 6. I am preoccupied with what I think and feel about what I have experienced    | 1                 | 2                  | 3              | 4     | 5                      |
| 7. I think of pleasant things that have nothing to do with it                   | 1                 | 2                  | 3              | 4     | 5                      |
| 8. I think that I can become a stronger person as a result of what has happened | 1                 | 2                  | 3              | 4     | 5                      |
| 9. I keep thinking about how terrible it is what I have experienced             | 1                 | 2                  | 3              | 4     | 5                      |
| 10. I feel that others are responsible for what has happened                    | 1                 | 2                  | 3              | 4     | 5                      |
| 11. I think of something nice instead of what has happened                      | 1                 | 2                  | 3              | 4     | 5                      |
| 12. I think about how to change the situation                                   | 1                 | 2                  | 3              | 4     | 5                      |
| 13. I think that it hasn't been too bad compared to other things                | 1                 | 2                  | 3              | 4     | 5                      |
| 14. I think that basically the cause must lie within myself                     | 1                 | 2                  | 3              | 4     | 5                      |
| 15. I think about a plan of what I can do best                                  | 1                 | 2                  | 3              | 4     | 5                      |
| 16. I tell myself that there are worse things in life                           | 1                 | 2                  | 3              | 4     | 5                      |
| 17. I continually think how horrible the situation has been                     | 1                 | 2                  | 3              | 4     | 5                      |
| 18. I feel that basically the cause lies with others                            | 1                 | 2                  | 3              | 4     | 5                      |

**Thank you for filling out the questionnaire!**

## Appendix XVII: Super Skills for Life content and activity description

| Session   | Topic                                   | Description/Activities   |
|-----------|---|--|
| Session 1 | Introduction                            | <ul style="list-style-type: none"> <li>- Introduce the group to Super Skills for Life.</li> <li>- Highlight session rules and reward system.</li> <li>- 2 minute video presentation.</li> <li>- Introduction to the concept of self-esteem and ways to enhance it.</li> </ul>  |
| Session 2 | Feelings                                | <ul style="list-style-type: none"> <li>- Introduction to and discussion of feelings</li> <li>- Feelings detective game - Role playing various feelings.</li> <li>- 2 minute presentation video-feedback.</li> </ul>  |
| Session 3 | Thoughts                                | <ul style="list-style-type: none"> <li>- Description of thoughts.</li> <li>- Recognising helpful and unhelpful thoughts.</li> <li>- Building goals and setting targets.</li> </ul>   |
| Session 4 | Linking Thoughts, Feeling and Behaviour | <ul style="list-style-type: none"> <li>- Explaining the link between thoughts, feelings and behaviours</li> <li>- Understanding how thoughts, feelings and behaviours can be altered in challenging situations.</li> <li>- Recognising body signals.</li> </ul>  |
| Session 5 | Learning to Relax                       | <ul style="list-style-type: none"> <li>- Practicing relaxation techniques such as deep breathing, visualisation, humour, and progressive muscle relaxation.</li> <li>- Understanding the difference between being tensed and being relaxed.</li> </ul>   |
| Session 6 | Social Skills                           | <ul style="list-style-type: none"> <li>- Explanation of various types of social skills and group discussion.</li> <li>- Understanding how individuals react to friendly and unfriendly behaviour.</li> <li>- Methods on how to introduce oneself and approach people for the first time using role play; and how to end conversations politely.</li> </ul> |
| Session 7 | Problem Solving Steps                   | <ul style="list-style-type: none"> <li>- Learning to cope with conflicts arising within peers and other social situations.</li> <li>- Introduce problem solving step system and the</li> </ul>   |

appropriate application.

- Role playing possible conflict situations and applying the step system to solve the issues.

Session 8      Review

- Overview of previous sessions.
- 2 minute video presentation.
- Individual highlights of the programme.

**Appendix XVIII: Behavioural anchors for the SPRS (Fydrich et al., 1998)**

Slightly modified from: Thomas Fydrich, Dianne L. Chambless, Kevin J. Perry, Friederike Buergener, & Maria B. Beazley. (1998) *Behaviour Research and Therapy*, 36, 995-1010.

Summary of the coding:

|                       | 1 (very poor) | 2 | 3 | 4 | 5 (very good) |
|-----------------------|---------------|---|---|---|---------------|
| Gaze                  |               |   |   |   |               |
| Vocal quality         |               |   |   |   |               |
| Length                |               |   |   |   |               |
| Conversations on flow |               |   |   |   |               |
|                       | 1 (very high) | 2 | 3 | 4 | 5 (very low)  |
| Discomfort            |               |   |   |   |               |

**A.1. GAZE**

- (1) Very Poor: Child completely avoids looking at the group/camera or stares continually during the 2-minute speech task.
- (2) Poor: Child avoids eye contact (or stares) for majority of time. Disruptive to performance.
- (3) Fair: Child frequently avoids eye contact (or stares). Gaze pattern is mildly disruptive to performance.

- (4) Good: Child occasionally avoids eye contact or tends to look too much (stares)
- (5) Very Good: Child keeps eye contact during the 2-minute speech task, does not stare; shifts focus during pauses and conversation.

## **A.2. VOCAL QUALITY**

- (1) Very Poor: (a) Child speaks in a flat, monotonous voice; or (b) speaks at a low volume or mumbles; or (c) speaks overly loudly, or has intrusive tone (harsh or unpleasant voice quality).
- (2) Poor: (a) Child demonstrates no warmth, enthusiasm, or interest in verbal expression; or (b) volume somewhat low and speech somewhat unclear; or (c) speaks a little bit too loudly, or tone is somewhat intrusive or sarcastic.
- (3) Fair: (a) Child shows some warmth in verbal expression but at most times sounds unenthusiastic or uninterested; and (b) speaks in appropriate volume (given partner's volume); has clear voice quality; and (c) does not have an intrusive or sarcastic tone.
- (4) Good: (a) Child shows moderate warmth and but inconsistent enthusiasm or interest. Could also be too 'gushy' (seems fake or forced); and (b) and (c) are as in Fair.
- (5) Very Good: Child is warm and enthusiastic in verbal expression without sounding condescending or gushy.

## **A.3. LENGTH**

- (1) Very Poor: Monosyllabic ('hmmm', 'yeah', 'OK') speech turns; or responses so long that partner must interrupt or cannot utter reply.

- (2) Poor: Child makes mostly short statements with very long pauses; or speaks in long phrases that monopolize the conversation.
- (3) Fair: Child mostly speaks one sentence at a time with occasional long pauses between sentences; or s/he tends to talk excessively (or tangentially) most of the time.
- (4) Good: Child mostly speaks in statements of one or two sentences without any major pauses, but there are other occasions where speech is short or excessive or tangential.
- (5) Very Good: At most times, child's utterances are two or more sentences long.

#### **A.4. DISCOMFORT**

- (1) Very High: Complete rigidity of arms, legs or whole body. Constant leg movements or fidgeting with hands, hair or clothing. Extremely stiff face or constant facial tics. Frequent nervous throat clearing, swallowing, or stuttering. Frequent inappropriate giggling or laughing. Look of extreme discomfort and desire to flee situation shown by 2 or more breaks in role. Child does not pay attention to the role-play tasks most of the time.
- (2) High: Rigidity or fidgeting for majority of time. Difficulty sitting still is somewhat disruptive to conversation. Stiff face or frequent facial tics. Some nervous throat clearing or swallowing. Some inappropriate giggling or laughing. Child shows signs of discomfort by frequently looking around.

- (3) Moderate: No rigidity. Slight movement of legs, fidgeting, throat clearing, or swallowing. Participant shows only brief periods of discomfort. Focuses on the 2-minute speech task most of the time.
- (4) Low: No rigidity, nervous throat clearing, or swallowing. Minimal fidgeting that is not disruptive to performance. No notable signs of discomfort. Remains focused on the 2-minute speech task. At times may appear relaxed and at ease (smiling or gesturing).
- (5) Very Low: Relaxed body posture and natural body movement. Child laughs and smiles at appropriate times. S/he shows effective gesturing (to be distinguished from fidgeting). Child focuses on the task all the time, does not appear at all uncomfortable, but at ease in situation.

#### **A.5. CONVERSATION FLOW**

- (1) Very Poor: Child makes few attempts to initiate the speech. Even when prompted by the facilitator, child cannot maintain the speech.
- (2) Poor: Child tries to talk but is only successful about half the time. The conversation does not flow smoothly.
- (3) Fair: For the most part, the child is able to maintain the speech with little help from the facilitator, although the speech is still somewhat awkward and stalls at times.
- (4) Good: Child is able to keep talking with little to no help from the facilitator. The speech flows smoothly.
- (5) Very Good: Child easily maintains the conversation and talks fluidly. Child shows genuine interest in the speech.