UNIVERSITY OF SOUTHAMPTON

# Delay Aversion in ADHD: attentional and interpretive processes

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Submitted in partial fulfilment of the

Doctorate in Clinical Psychology

Faculty of Social Science

Department of Psychology

October 2001

19,353 words

Delay Aversion in ADHD: attentional and interpretive processes

Abstract

The dissertation explores the motivational signifcance of delay for children with ADHD from an information processing perspective. The literature review discusses Sonuga-Barke's proposal that delay aversion represents a mediating link in a motivational pathway to ADHD. Preliminary findings suggest that hyperactive children display attentional biases towards delay cues, indicating they are motivated to detect delay. Information processing models suggest that attentional biases are often associated with other information processing biases, leading to a cognitive pattern that is more likely to maintain emotional disorder. Implications for the application of information processing models to understanding the motivational significance of delay in ADHD are discussed.

In the empirical paper attentional and interpretive biases for delay were investigated using modified versions of the forced choice dot probe task and the ambiguous situations task. Previous findings of an attentional bias towards delay in hyperactive children were not replicated with a clinical sample, some support for an interpretative bias towards delay was found. Delay situations were found to be more associated with anger than anxiety for all participants. No differences were found in participant's reports of how they would respond to delay situations. The findings of the study give mixed support for the motivational significance of delay in ADHD; limitations and directions for future research are discussed.

Acknowledgements

I would like to thank Edmund Sonuga–Barke, my supervisor, and Lusia Stopa, clinical tutor, for their help and guidance throughout the process. I am also very grateful to the following people for their invaluable help and support with recruiting participants: Rene Westbroek, and all of the CAMS team at the Central Health Clinic in Southampton, Margaret Thompson and the Ashurst Team, Dr. Coppen, Cheryl Evans and the staff and students of Coxlease School, and finally the staff and students at Canford Heath Middle School and Hammworthy Middle school.

## CONTENTS

**LITERATURE REVIEW PAPER: DELAY Aversion In ADHD and Information Processing Biases: Discussion of the models, and avenues for further research.**

**EMPIRICAL PAPER: Investigating the motivational significance of delay in ADHD: attentional and interpretive processes.**



**APPENDICES**

# Delay Aversion in ADHD and Information Processing Biases: Discussion of the models, and avenues for further research.

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Delay Aversion in ADHD

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**Delay Aversion in ADHD and Information Processing Biases: Discussion of the models, and avenues for further research.**

Abstract

ADHD has been conceptualised as resulting from deficits in response inhibition, arousal/activation levels, or an aversion to delay. In congruence with genetic findings, more recent research suggests these models represent independent co-existing mechanisms in ADHD. Sonuga-Barke proposes that delay aversion represents a mediating link in a motivational pathway to ADHD, and that delay has special motivational significance in this disorder. Preliminary findings suggest that hyperactive children have attentional biases towards delay cues. Biases in attentional processes are well documented in anxiety disorders, and have also been found in people with high trait anger. Information processing models suggest that attentional biases are often associated with other information processing biases, leading to a cognitive pattern that is more likely to maintain emotional disorder. Implications for the application of information processing models to understanding the motivational significance of delay in ADHD are discussed.

## Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is currently the most predominantly used term to describe a syndrome in child psychiatry characterised by poor sustained attention, impulsiveness and hyperactivity. The large amount of attention that ADHD has been given in the research literature over the past three decades seems to be justified by the findings that it is a prevalent and persistent disorder, which is associated with poor outcomes into adolescence and adulthood (Tannock 1998). The last decade has seen a shift in the literature however from descriptions and validations of the syndrome, to a focus on pathogenesis and underlying mechanisms (Tannock 1998).

Conceptualisations of ADHD have historically been based around deficit models. Recent conceptualisations of ADHD centre on the construct of poor response inhibition. However, this model is challenged by research that suggests poor response inhibition is motivated and mediated by an aversion to delay. More recently studies have provided evidence for poor response inhibition and delay aversion being independent and co-existing characteristics of ADHD (Solanto et al 2000).

In order to further explore the motivational significance of delay in hyperactive children Sonuga Barke has carried out preliminary investigations, which suggest that hyperactive children display an attentional bias towards delay cues (Sonuga Barke, Hayes and Bareham 2001). Investigating biases in information processing is a paradigm that has been used in research into emotional disorders. Studies have found that both clinically anxious children

and oppositional children have biased or distorted processing of threat related information. These biases are thought to be instrumental in the maintenance of these disorders. Although the studies into processing delay information in children with ADHD are preliminary, they may provide a fruitful line of investigation for exploring the maintenance and course of the behavioural symptoms of this disorder.

*Definition & Description*

For the past two decades poor sustained attention, impulsiveness and hyperactivity (or motor restlessness) have been considered the core features of the 'hyperactive' syndrome ADHD (Tannock 1998). The current DSM IV (American Psychiatric Association 1994). places these behavioural symptoms into two clusters whereby inattention is distinguished from impulsiveness and hyperactivity. This has lead to 3 subtypes of the disorder: primarily inattentive, primarily impulsive and hyperactive, and combined. In contrast the ICD-10 classification (World Health Organisation 1993) requires the presence of all 3 symptoms for diagnosis, and therefore corresponds most closely with the combined type (Tannock 1998). Research on the inattentive subtype suggests different aetiology and course from the combined and impulsive subtypes (Barkley 1997). Previous definitions of ADHD and recent theories and studies seem to have focussed on what are now delineated as the impulsive and combined subtypes, therefore the term ADHD will be used in this review as representative of these presentations.

ADHD is one of the most prevalent disorders seen in the child mental health services. It is estimated to affect from 3 – 11% of all children and occurs more frequently in boys with a male to female ratio of 3:1(Zametkin &

Ernst 1999). Affecting children from early child hood, follow up studies have found that ADHD can also persist into adolescence and adulthood (Klein & Mannuza 1991). It is associated with greater risks for: poor educational attainment, expulsion and delinquency, additional psychopathology, poor family and peer relationships in childhood; higher incidence of substance misuse and road accidents as well as difficulties with employment and relationships in adulthood (Barkley 1997). ADHD has been the focus of much research, and, given the level of prevalence, persistence and poor outcome, it is clear that this disorder is of high priority in child psychiatry and psychology (Tannock 1998).

*Category vs. Continuum*

Research that is carried out on ADHD largely depends on how this disorder is defined. Definitions of diagnostic manuals, such as the ones stated above, are useful in providing standardised criteria for communication, assessment and research purposes. A drawback of the diagnostic approach however is the implication that the categorisation reflects a discrete syndrome. Research suggests that ADHD is more likely to be dimensional in nature, representing the extreme expression of behaviours that vary genetically throughout the whole population (Levy et. al. 1997). In keeping with this view is the finding that associated risk factors increase with rising levels of severity; rather than risk being conferred only at diagnostic level (Ferguson & Horwood 1993). Although full discussion of this issue is beyond the scope of this paper, it is noted that a categorical approach may have lead to a bias in the literature towards deficits and impairments. Exploration of the functionality or normality

of behaviour has also been suggested as a useful path to gaining further understanding of the development and maintenance of disorders (Sonuga Barke 1998).

*Co morbidity*

A further issue, which affects the understanding of ADHD as a disorder, is that of co-morbidity. Recent reviews have shown that ADHD is more likely to occur co-morbidly with other disorders, than occur on its own (Kadesjoe & Gilberg 2001, Jensen et.al. 1997). The highest rate of co-morbidity occurs with oppositional defiant disorder (ODD) and/or conduct disorder (CD), with between 40% and 90% of children with ADHD also being diagnosed with other disruptive or externalising disorders (Jensen et.al. 1997). Jensen and colleagues (1997) also found that approximately 25% of children with ADHD have anxiety disorders, 20% will also have specific learning disabilities, and between 15-20% will suffer mood disorders. Given these high rates of co-morbidity it is likely that multiple co-morbid diagnoses are not unusual for children diagnosed with ADHD.

Tannock (1998) reports that co-morbidity is a confound in much of the literature, with few studies using the full design necessary to ascertain the effects of co-morbidity on findings. She suggests that a full design for ascertaining the effects of co-morbid conditions on findings should incorporate four groups: the comorbid condition (e.g. ADHD *and* conduct disorder), the two component conditions in isolation (ADHD *or* conduct disorder), and a normal comparison group (no clinical conditions). Difficulties with the effects of co-morbidity continue to confuse the literature. In trying to define the

heterogeneous syndrome of ADHD, clinically measurable distinguishing features at the genetic, neurological and psychological level, are a central concern.

*Aetiology*

Recent family studies provide consistent evidence that there is a higher incidence of ADHD amongst first-degree relatives of children with ADHD (Faraone & Biederman, 1994, Tannock 1998). Further, twin studies report higher incidence of ADHD in mono-zygotic twins than in di-zygotic twins (Goodman & Stevenson 1989, Levy et al. 1997) and adoption studies report a strong genetic component in variance of ADHD (47%) in siblings adopted separately (Van der Oord, Boomsma & Verhulst 1994, cited by Tannock 1998). All of these factors indicate that genetic predisposition plays a part in the development of ADHD. However, high incidence of co-morbidity complicates the understanding of genetic factors in this disorder: indicating that either one set of genes possibly influences all the disorders, or that several genetic and non-genetic factors may independently, or interactively, cause ADHD (Tannock 1998).

Non-genetic or psychosocial factors may therefore have some part to play in the onset, maintenance and outcome of ADHD. Biederman et.al. (1995) found that adversity factors such as maternal psychopathology, Social Economic Status and family conflict were positively associated with: ADHD, measures of ADHD related psychopathology, and poorer outcome. Sandberg & Garralda (1996) discuss mechanisms by which poor early attachments, neglect, and negative parent –child interactions, might relate to the behavioural symptomatology of ADHD. The studies do indicate the

importance of psychosocial factors in the maintenance and outcome of children diagnosed with ADHD. However with all of the studies into psychosocial factors there is little or no specificity of effects for ADHD, these factors also being important for conduct disorders and other psychopathologies. Most of the empirical findings suggest interaction with contributing child factors such as the genetic/ biological base discussed above.

In trying to understand the specificity of genetic and biological effects in ADHD researchers have worked backwards from the finding that methylphenidate, and other similar psycho-stimulant medications ameliorate the behavioural symptomatology of ADHD (Swanson et.al. 2000). As the effects of methylphenidate centre mainly around the dopaminergic system, the genes and the neurobiological structures which are related to dopaminergic pathways in the brain have been the focus of a great deal of research in these fields (Swanson et. al. 2000). Preliminary findings suggest that variations in the expression of the DAT1 gene, and the DRD4 gene, (related to dopamine transport and synaptic reuptake respectively) are associated with ADHD. Further the DRD4 findings are also related to high impulsive behaviour (Tannock 1998).

Recent studies suggest however that it is most likely that it isn't any one gene, but a number of genes, and interactions between them, which are implicated in the development of the behaviours related to ADHD (Auerbach 2001, Farone 2000). Genes related to the dopaminergic pathways are very active in the prefrontal cortex (Barkley 1998), This is an area also implicated in the pathogenesis of ADHD by neuro-imaging studies. Neuro-imaging

studies suggest decreased blood flow and glucose metabolism in the frontal lobes, and specifically the fronto-striatal networks (Tannock 1998, Kado & Takhagi 1996). These areas of the brain are involved in the cognitive mechanisms of attention, motor activity and executive function, all which are involved in psychological theories of ADHD .

However findings from both neuro-imaging and genetic research are limited by small sample sizes, and little control for developmental factors, gender and co-morbidity (Tannock 1998). Faraone (2000) reports that when co-morbidity is taken into account, research findings indicate genetic and psychosocial heterogeneity for ADHD, suggesting that there is more than one pathway to this disorder, and that different genetic and psychosocial pathways may delineate different subtypes. This suggestion also indicates the complexity of trying to extrapolate ADHD from co-morbid diagnoses to find features that are specific to the diagnosis of ADHD. Tannock (1998) suggests that a more precise understanding of the phenotype is required, and wherever possible the focus should be on theory-based phenotypes. We need a clearer understanding of the behaviours, the psychology of ADHD, and a theoretical structure to fit this into, in order to better understand the aetiology of the disorder.

*Conceptual Shifts in theories of ADHD*

Researchers and clinicians have been struggling however, to define and understand ADHD for nearly a century now, with the earliest descriptions of this disorder appearing in the early 1900s (Still,1902, cited by Sandberg &Barton 1996). Sandberg & Barton (1996) relate that initially, what we now

term as ADHD, was viewed as a biological defect in 'moral control' inherited or incurred through early brain damage. This view of ADHD as 'minimal brain damage' predominated for the first half of the century. However, with the findings of the effectiveness of pharmacotherapy in the 50s and 60s, the view of minimal brain damage as the only basis for ADHD was challenged, and was replaced with the term minimal brain dysfunction, which suggested more than one route to the symptoms observed. The view of ADHD as arising only from organic factors was also challenged; more psychological models of ADHD began to emerge. Overactivity was presented as the primary and most explanatory feature of this syndrome at that time (Chess 1960, cited by Sandberg & Barton 1996).

In the 1970s and 80s the emphasis shifted to the attentional and impulsive aspects of ADHD (Douglas 1972, Douglas & Peters 1979). Zentall & Zentall's 1983 optimal stimulation theory of ADHD argued that over-activity and impulsiveness arise from low levels of arousal, or a high stimulation threshold, which leads to higher levels of activity when confronted with low levels of stimulation. Barkley (1998) relates that other theories centred on these deficits as resulting from difficulties with motivation (Glow & Glow 1979) or deficient rule-governed behaviour (Haenlein & Caul, 1987).

Quay (1988) used Gray's (1982) neuropsychological model of anxiety to explain the origin of impulsiveness seen in ADHD. Gray proposes a model of opposing behavioural activation and behavioural inhibition systems (BAS and BIS respectively). The BAS is sensitive to signals of reward, whilst the BIS is sensitive to signals of non-reward and punishment. Quay proposed that children with ADHD have a persistently under active BIS, they are less

sensitive to signals which indicate inhibition, and therefore have a deficit in response inhibition. Following Quay's theory, emphasis on response inhibition, as having central importance in ADHD, seems to have been characteristic of research and conceptualisations over the past decade (Tannock 1998). However, the way that difficulties with response inhibition are formulated differentiates the current theories of ADHD. How delay aversion fits in with these theories and the evidence for the motivational significance of delay in ADHD will be discussed in the following section.

## Theories of ADHD and the Motivational Significance of Delay

### *ADHD as resulting from dysfunction: Deficits in inhibition/ activation*

Barkley's (1997) model of response inhibition as a central deficit provides one of the most comprehensive theories of ADHD to date. He draws on a wide experimental literature that suggests difficulties with response inhibition in children with ADHD. He argues that a deficit in this ability is central to ADHD and leads to further difficulties with self-regulation, overactivity and attention. Barkley (1997) defines response inhibition as comprising of three inter-related features: the ability to inhibit a response before you make it (pre-potent response); the ability to inhibit a response once it has already started (ongoing response); and the ability to inhibit other responses whilst already engaged in a response (interference control).

Barkley argues that response inhibition is directly related to motor control; i.e. response inhibition is necessary in order not to respond impulsively. Further to this, he proposes that response inhibition is a necessary condition for four executive functions (working memory,

internalised speech, regulation of affect/motivation, and reconstitution), and that these executive functions are also directly related to motor control. Therefore a deficit in response inhibition leads to not only to impulsivity, but also secondary deficits in executive functions. These, in turn, lead to decreased ability to control action through "internally represented information and self directed action" (Barkley 1997). Furthermore, these executive functions are directly related to goal orientated behaviour and persistence, and these are necessary features of sustained attention. Thus the model provides an explanation of why children with ADHD present with attention difficulties, despite the lack of evidence supporting attentional deficits (Van der Meere 1996).

Barkley (1997) employs a wide array of empirical evidence to support his framework. Although persuasive, Barkley acknowledges that the evidence is far from unequivocal. There is support for difficulties in a number of areas of executive functioning in ADHD, however it is unclear whether a difficulty with response inhibition is a precursor, or a consequence of these executive functioning deficits (Clark, Prior, Kinsella 2000). The strongest support for Barkley's model comes from the literature on response inhibition. As Barkley (1997) indicates, a number of studies have suggested that the poor performance of children with ADHD on various tasks reveals a deficit in response inhibition. Such tasks include the Matching Familiar Figures Test - MFFT (DuPaul, Anastopoulos, Shelton, Guevremont, & Metevia, 1992) and the Continuous Performance Task CPT (Corkum & Siegal 1993). On the both the MFFT and the CPT children with ADHD respond more quickly than normal controls and make more errors. However many of these tasks have been

criticised, as they do not clarify what mechanisms underlie the difficulties with response inhibition, or even whether difficulties on the task directly relate to response inhibition (Oosterlaan, Logan & Sargeant 1998).

One task that seems to stand up to these criticisms though is the Stop Signal Task (SST) (Schachar & Logan 1990, Oosterlaan et.al. 1998). Sonuga-Barke (2001) explains that "the SST tests an individual's ability to inhibit an already initiated pre-potent response to a 'go signal' (typically visual) when signalled to do so by a 'stop signal' (typically auditory) presented at varying intervals prior to the expected time of the individuals 'go' response"(p.5). Response inhibition is measured by the stop signal reaction time (SSRT) and the inhibition function (which is calculated by plotting the probability of inhibition against mean go signal reaction time minus the stop signal delay).

A meta-analysis of studies using the SST found consistent and robust evidence for a response inhibition deficit in ADHD (Oosterlaan et.al 1998). These findings have also been supported by subsequent studies (Nigg 1999, Schacar, Mota, Logan, Tannock, Klim, 2000). The findings were inconsistent with Barkley's proposal however, that response inhibition deficit is specific to ADHD; children with Conduct Disorder showed a similar level of difficulties on the SST to children with ADHD. It is not clear whether this finding reflects the same dysfunction in both disorders, or different processes underlying the same impairment in response inhibition.

Oosterlaan et.al. (1998) suggest that, although the findings of their meta-analysis are supportive of Barkley's model, poor response inhibition in ADHD could also be explained by a dysfunction in activation levels. Based on

the cognitive energetical model of information processing from Sanders (1983), Van der Meere (1996) proposes that children with ADHD have a non-optimal activation state, this causes impaired or slowed motor processing, which results in difficulties for both the execution and inhibition of responses. Oosterlaan et.al. (1998) suggest that this theory can also explain their finding that ADHD children have a slower execution process in the SST.

It seems then, that in a reversal of Barkley's argument, Van der Meere suggests that activation of motor control is a necessary condition for response inhibition. Van der Meere (1996) argues that children with ADHD have difficulty adjusting their level of activation, and refers to a number of studies which support this position; For example children with ADHD have been found to perform poorly in conditions of slow and fast event rates in comparison to control subjects, but when events are presented at a medium rate performance levels are the same for both groups (Van der Meere, Stemerding & Gunning, 1995). Van der Meere (1996) also proposes that a deficit in activation explains difficulties with sustained attention found in ADHD: tasks with moderate-high event rates do not find poorer sustained attention in ADHD, but tasks with slow event rates do show poor sustained attention, elucidating the situational variation of this behaviour. Again there is no clear indication that deficits in activation levels are specific to ADHD. Although Van der Meere's model seems less complete in explaining all of the behaviours associated with ADHD, both models have explanatory power; Nigg's (1999) findings give support to both models, and he suggests that further theoretical integration may be needed.

*ADHD as resulting from function: an aversion to delay*

Both Barkley's and Van der Meere's theories centre around the assumption of dysfunction. In comparison, Sonuga-Barke's Delay aversion theory (Sonuga-Barke, Taylor, Sembi & Smith 1992) is based on the assumption that behaviours in ADHD are adaptive responses that serve the function of minimizing the experience of delay. Sonuga Barke (2001) outlines his model as follows:

> When children are faced with a choice between immediacy and delay they will choose immediacy, when no choice is available they will act on their environment to reduce their perception of time during delay by either creating or attending to non temporal features of the environment (p.5)

Therefore delay aversion relates to the behavioural features of ADHD in the following ways: choice of immediacy leads to the behaviours associated with impulsivity, whilst attending to non-temporal features relates to inattentive features of ADHD, and creating non-temporal features (e.g. by fidgeting) relates to overactivity. Sonuga-Barke (2001) argues that research supporting the concept of a response inhibition deficit could also be understood in terms of a motivational style orientated towards the reduction of delay.

Hyperactive children have been found to choose smaller immediate rewards rather than larger delayed rewards, on traditional delay gratification tasks, and this has been taken as supportive evidence for a deficit in response inhibition in ADHD (Rappoport, Tucker, Dupaul, Merlo & Stoner 1986, Barkley 1997). However Sonuga Barke et. al. (1992) found community-identified hyperactive children did not differ from normal controls when response style

was not related to the length of the task. If a delay was imposed after the immediate small reward that was equal to the pre-reward delay on the large reward, both hyperactive and control groups chose large rewards. This result challenges the response inhibition deficit view, and suggests that when the confound of delay is removed hyperactive children are able to wait.

In further manipulations of the task parameters, hyperactive and control children both chose immediate rewards when this maximised overall reward and did not effect, or reduce, session length. However when overall length of task was connected to response style, i.e. consistent choice of immediate small reward lead to a significant reduction in task length, but also less overall reward, then hyperactive children were significantly more likely to choose small immediate rewards and reduce the overall time of the task. Their responding styles over the different tasks indicated an overall sensitivity to delay.

The effects for the fourth form of the task (termed the choice delay task –CDT), that children with ADHD will choose minimisation of delay over reward, has been replicated in further studies. The CDT consistently differentiates between ADHD groups and normal control groups (Solanto et.al 2001, Kuntsi, Oosterlaan & Stevenson 2001). The original study did not control for effects of co-morbidity, however Solanto et.al (2001) found the effects were the same for ADHD with and without comorbid CD/ODD. In contrast , Kuntsi et.al. (2001) found that this effect was not significant once co-morbidity with CD was controlled for, suggesting that for their sample, delay aversion only characterised the co-morbid group. No studies have investigated the CDT with a CD/ODD only group, so it is unclear whether this

effect is specific to ADHD, co-morbid ADHD, or CD. However the CDT seems to provide robust evidence for an aversion to delay as an important feature of ADHD (Solanto et.al. 2001)

Sonuga-Barke and colleagues also investigated whether delay aversion could provide an alternative explanation for effects that suggest children with ADHD have poor performance on tasks measuring memory and attention. Sonuga-Barke, Taylor and Heptinstall (1992) found that community-identified hyperactive girls gave themselves significantly less time to attend to 'to-be-remembered stimuli' under self imposed conditions, and made significantly more recall errors. However when presentation time was externally imposed, and participants were encouraged to attend, the hyperactive group performed equally as well as the control group. These findings imply that hyperactive children do not have a deficit in memory, but that the amount of time they attend for limits the amount of information they encode. The findings were specific for hyperactive groups, and were not found in clinical or normal comparison groups. Hyperactive children also recalled more information about stimuli that wasn't in the "to-be-remembered" category than controls; this may have been as a result of a more diffuse attentional style, possibly related to the reduction of temporally related stimuli, as suggested by the delay aversion theory outlined above.

These findings are suggestive that hyperactive children use attentional strategies which minimise the experience of delay, either in self imposed conditions, by reducing amount of time attending to stimuli, or under externally imposed conditions, by attending to more features of the stimuli. Sonuga-Barke, Taylor and Heptinstall (1992) comment however that the findings could

also be explained by dysfunctional self regulation theories, i.e. the hyperactive children may have been unable to sustain their attention on their own, but the experimenters instructions may have provided a linguistic framework which enabled them to regulate their attention (Similarly to Barkley's suggestions). Therefore these finding do not conclusively support the delay aversion theory.

In a further study, Sonuga-Barke, Houlberg and Hall (1994) found that impulsive response times of children with ADHD, on the Matching Familiar Figures Task, disappeared when overall length of task was controlled for, again indicating that these findings are not explained by an inability to inhibit responding. When response on a trial immediately lead to the next trial presentation, and therefore quick responding reduced the overall time of the task, hyperactive participants responded significantly more quickly and made more errors than controls. When trial times were the same, regardless of when the response was given, there was no difference between the groups on response times. These findings again indicate that when delay is controlled for, and not contingent upon response style, hyperactive children are able to wait.

However, despite taking more time to reflect, hyperactive participants continued to make significantly more errors than controls. One of the explanations for these effects put forward by Sonuga-Barke et.al. (1994), suggests that the higher level of errors may have been as a result of the hyperactive children reducing the experience of delay by attending to non-task related (non temporal) stimuli. When Sonuga-Barke, Williams, Hall and Saxton (1996) made task length contingent on correct responding however, thus controlling for motivation to reduce delay, the same pattern of effects

were found. Although the level of errors reduced in the contingent condition, hyperactive children still made more errors than controls. Both groups were motivated to reduce delay, but the ADHD group seemed to have difficulty using the extra time to improve their responses.

Sonuga-Barke et.al. (1996) postulate that inefficient use of time may be a developmental consequence of delay aversion; children avoid delay, and therefore do not develop skills for coping effectively in delay conditions. He also suggests that, conversely, delay aversion may be the consequence of innate difficulties in processing temporal stimuli, which enable people to organise responses efficiently, as related to deficits in response inhibition and executive functioning. In the memory study the experimenters encouragement may have been the factor that enabled hyperactive participants to use their time efficiently, however the mechanism by which this was achieved (altering motivation, or supporting self regulation) was not clear.

*Function v. Dysfunction, two paths to ADHD*

The evidence from the CDT studies suggests that hyperactive children are more motivated to reduce delay than normal controls, and when delay is controlled for, they are capable of ongoing response inhibition. However further studies, whilst supporting these findings, also suggest potential confounds with response inhibition/executive functioning theories. Sonuga Barke (2001) points out that it is difficult for the delay aversion theory of ADHD to account for the robust findings of response inhibition deficits (as represented in the Stop Signal Task (SST) findings of Oosterlaan et.al. 1998). He also suggests that, equally, it is difficult for theories based on deficient

inhibitory control to account for the findings that support the delay aversion theory cited above. Sonuga Barke (2001) suggests two possible ways that these accounts may be related. Slower stop signal response times on the SST may be the result of different inter-stimulus-interval durations between stop and go signals, rather than a true reflection of inhibitory problems. If this were the case, this finding could be related to the impact of delay on attention. Conversely, deficits in inhibitory control could lead to failure or punishment in delay situations, leading to delay becoming associated with negative emotions, which would lead a child to be motivated to avoid delay. Both of these explanations would predict a high correlation between performance on the SST and the CDT (Sonuga-Barke 2001), however this does not seem to be the case.

In a recent "head to head" study Solanto et al (2001) tested out this prediction by comparing performance of ADHD children on the SST, the CDT, and various rating scales and observational measures. This study was part of the NIMH multi treatment study, and the project was co-ordinated by a researcher who was independent of the teams proposing the different models. The prediction that stop signal response time (SSRT) would be correlated with higher probability of choice for large rewards in the CDT was not supported: there was no association between performance on these two tasks. However robust group mean differences were found between hyperactive and control groups on both tasks; both tasks were significantly related to observations of ADHD, the CDT was also related to Teachers ratings; and both showed significant sensitivity and specificity. Solanto et. al (2001) suggest that the lack of relation of SSRT scores to teachers ratings of hyperactive behaviour may

indicate that the two paradigms may be related to different features of the ADHD phenotype. They postulate that the 'stopping' involved in the SSRT may be a discrete component of executive control which may be dependent on "unique neural mechanisms", but that further research is required to validate the distinctions between the self-control processes involved in these two tasks.

These findings suggest then that both delay aversion and response inhibition may be independently implicated as important features of ADHD. Therefore, at the present time, all the models discussed seem to provide explanatory power for features of ADHD. Sonuga-Barke (2001) interprets these findings as supportive of the notion of heterogeneous pathways for the development of ADHD (as suggested by genetic studies noted above); he proposes a dual pathway model of the development of ADHD. One suggested pathway to ADHD is through a primary deficit in inhibitory control, this results in cognitive and behavioural dysregulation, which in turn mediates task engagement, and the symptoms of ADHD. The alternative proposed route to ADHD is through motivational style, where biological and psychosocial features contribute to altered reward mechanisms, and aversion to delay mediates between these altered mechanisms and the symptoms of ADHD. This model, and the findings discussed above suggest therefore, that for a proportion of children with ADHD, delay has special motivational significance.

*Investigating the motivational significance of delay*

In further investigating the motivational significance of delay, Sonuga-Barke and colleagues (2001) have conducted preliminary studies on the role

of attentional processes in the detection of delay cues. As discussed above, previous studies that have involved actual delay are ecologically valid, but are confounded with the processing of temporal stimuli, which may be also be affected by deficits in state regulation/executive functioning. Studies of attentional bias however, have been more specifically related to motivational factors (Williams, Watts, MacLeod & Mathews 1997). Sonuga Barke et.al. (2001) argue that " if delay has a particular motivational significance for hyperactive children then these children should develop an attentional bias to cues that signal its presence within the environment"(p.4 Sonuga-Barke et.al. 2001). Children with ADHD should be hyper-vigilant for delay cues.

Sonuga Barke et.al (2001) used a dot probe paradigm that was developed to measure attentional bias to threat words in anxious adult populations, and had also been successfully used in child populations (MacLeod & Matthews, 1988; Vasey, Daleiden, William &Brown 1995). They measured reaction times to probes following neutral, social threat, physical threat and delay words. In comparison to normal controls, community selected hyperactive children responded more quickly to probes following delay words than probes following neutral words, indicating a bias towards delay cues. Both groups displayed a bias towards physical threat words, and neither group displayed a bias towards social threat words. The finding of a differential bias towards delay cues in hyperactive children is supportive of the idea that hyperactive children are sensitive to the detection of delay in the environment.

Sonuga-Barke et.al. (2001) note however that this study was exploratory and contained a number of limitations, it did not control for the

effects of co-morbidity, and may not have included children with problems of clinical significance; it was also unclear how well the words used in the study represented the concept of delay (e.g. the word wrong was used both as a social threat and delay word). Despite these limitations, the findings indicate that the investigation of delay aversion through paradigms associated with information processing models of motivationally/ emotionally significant stimuli may be a fruitful line of research. This is a new direction for investigating delay aversion. In order to examine the possible utility of these models and research methods to delay aversion and ADHD, the next section will consider how these models have been applied and investigated in other disorders.

## Information Processing Models

### *Cognitive Theories of Emotional Disorder in the Adult Literature*

Williams and colleagues (1997) relate that two theories were especially influential in the development of cognitive research on emotional disorders in the adult mental health literature: those of Beck (Beck 1976; Beck, Rush, Shaw & Greenberg 1979; Beck, Emery & Greenberg 1985) and Bower (Bower 1981, 1987). Beck proposed that dysfunctional schemata are responsible for selective processing of information in depression and anxiety. For example, he suggests that individuals suffering from anxiety have overly activated danger-schemata, which lead to increased attention to danger cues, interpretation of ambiguous information as threatening, and a bias in memory towards threat relevant information and dangerous experiences.

Bower's (1981) semantic network theory, proposes that each emotion is represented as a node in an associative network in memory. Emotions are

thought to affect both the encoding of information, and the retrieval of information, biasing the way connections are formed and searched in congruence with the emotion. Both models suggest that emotional disorders should be associated with mood-congruent biases in all aspects of information processing: attention, memory, and reasoning.

These theories lead to research using experimental paradigms that investigated these proposed biases; Williams et al (1988, 1997) summarise the empirical literature investigating biases in anxiety and depression. Studies of attentional biases involved investigations into: auditory perceptual thresholds using dichotic listening tasks (Foa & McNally 1986), visual perceptual thresholds using tachistoscopes (Small & Robbins 1988), interference in colour naming of emotional words on stroop tests (Mathews & MacLeod 1985), and allocation of attention to emotional words/pictorial stimuli on dot probe tasks (MacLeod, Mathews & Tata 1986, Asmundson &Stein 1994). Research into memory biases explored: the valence of memories elicited in mood states (Burke & Mathews 1992), recall of mood congruent information given mood at encoding and mood at retrieval (Bower, Gilligan & Monteiro 1981, Teasdale & Russell 1983, Matt, Vacquez & Campbell 1992), and implicit memory for primed words in word stem completion tests (Denny & Hunt 1992) and lexical decision tasks (Bradley, Mogg & Williams 1994). Investigations into biases in judgements or reasoning explored judgements of: past performance (Cane & Gotlib 1985); future risk (Byrne & MacLeod 1997); the covariation between events (McNally & Heatherton 1993); and interpretation of ambiguous words (Amir, Foa & Coles 1998), sentences

(Eysenck, Mogg, May, Richards & Mathews 1991), and situations (Butler & Mathews 1983).

Williams et al.'s reviews of the literature (1988,1997) found that, in contrast to Beck and Bowers theories, biases in information processing seemed to be differentiated by disorder. Attentional biases, and implicit memory biases seemed to be found with anxiety disorders but not with depression (MacLeod et.al. 1986, Bradley, Mogg, Millar & White 1995), whilst explicit memory biases were mostly found in depression and not anxiety (Mogg, Mathews & Weinman 1987). The underlying mechanisms for biases in judgements were not clear, cognitive processes thought to be involved included: selection and encoding; interpretation; storage and subsequent recall (Alloy & Tabachnick 1984). Therefore both attentional and memory processes are indicated, and biases in judgements have been found in both anxiety and depression; however differences in judgement biases between disorders may be mediated by other dimensions such as time orientation i.e. future or past (MacLeod, Rose & Williams 1993).

Based on these findings Williams et al. (1988,1997) suggested that biases involved in priming (pre attentive processes and selective attention) are related to anxiety, with individuals exhibiting high trait anxiety orientating towards threat, and individuals with low trait anxiety orientating away from threat. Biases involved in elaborative processes, which facilitate awareness of relationships between different types of information, were thought to be more related to depression. Williams et.al. suggest that the differentiation of biases maps more naturally onto the functions that are served by the different

emotions (Oatley & Johnson-Laird 1987): anxiety is related to quick avoidant action, whilst depression is related to processing and reflection on loss.

Mogg & Bradley (1998) extend Williams et al's model, by suggesting a cognitive-motivational view to take account of the different biases found in anxiety and depression. Mogg & Bradley draw upon psychobiological and personality theories of emotion which suggest that emotions are mapped onto two primary dimensions of valence evaluation and goal engagement (Lang, Bradley & Cuthbert 1990). In this framework anxiety is characterised by a negative valence and external goal engagement, which involves monitoring threat and anticipating risk. Depression however, (also characterised by negative valence) involves disengagement from external goals, an inward focus and a reduction in interest and pleasure.

Mogg & Bradley's proposed differentiation in goal engagement accounts for the differential biases in anxiety and depression, discussed above; in addition it accounts for the lack of attentional biases in anxious individuals who are also depressed (Mogg, Bradley & Williams 1995). Mogg & Bradley (1998) also draw on LeDoux's (1995) neurobiological formulation of anxiety, in proposing that the valence evaluation system appraises the stimulus using both automatic processes, and integrative processes drawing on information from memory and context. They seem, therefore, to be suggesting that anxiety is related to biases at both the priming and elaborative stages suggested by Williams et.al.(1997).

They propose that high trait anxiety is caused by over-sensitivity of automatic processes in the valence system such that low or trivial threat information is appraised as highly threatening. They argue that Williams et al's

suggestion, that low trait anxious individuals orientate their attention away from threat, would not be adaptive in situations of actual danger. In support of this, they report that normal populations also display attentional biases to threat given sufficiently anxiety provoking stimuli. Thus attentional biases, which would be seen in the normal population for highly threatening information, are triggered by much milder threat cues for highly anxious individuals.

Further to this, Mogg & Bradley propose that over-activity of the valence evaluation system, may not only lead to increased appraisal of threat but also impaired functioning of strategic appraisal processes and/or the failure to integrate these two sources of information. Following from this, they suggest that phobias may result from a failure to integrate high automatic (pre-conscious) threat appraisal with rational strategic appraisal (elaborative processes), whilst generalised anxiety may be a combination of increased sensitivity to threat cues alongside distorted appraisal of safety (i.e. ability to cope). Their theory suggests then, that biases in information processing at different stages of appraisal, can interact, or dissociate from one another. Mogg and Bradley (1998) go on to discuss how the association/disassociation of the stages relates to different forms of anxiety, and indicates different forms of therapeutic intervention.

Mogg & Bradley's (1998) model could also be extended to other emotions. Although anger has not been discussed in the above models, it seems that attentional biases would also be present in relation to anger, as this emotion runs along similar dimensions to anxiety (negative valence + external goal focus). There seems to have been less focus on cognitive

processes in anger disorders, than there has on anxiety and depression in the adult literature, however there have been some recent studies of relevance. These studies indicate high trait anger is associated with high attentional bias towards anger cues (Eckhardt and Cohen, 1997; Cohen, Eckhardt & Schagat 1998) stereotypic judgement biases (Bodenhausen, Sheppard & Kramer 1994) and attributional biases towards blaming people rather than situations (Keltner, Ellsworth & Edwards 1993).

Lerner and Keltner (2001) investigated what differentiates judgements between anxious and angry individuals, given that these emotions have similar valence and external goal engagement. They found that angry people expressed optimistic risk estimates and risk-seeking choices, whereas anxious people expressed the opposite pattern (pessimism and risk minimisation). Emotion was mediated by appraisals of control and certainty (i.e. appraisal of whether I can cope with this situation, based on current information, past experience, and view of self). It could be suggested therefore that anger and anxiety are differentiated at the elaborative/strategic appraisal stage of information processing.

*Information processing and emotion in the child literature*

In contrast to the adult mental health literature, in the child literature there is a large body of work that has investigated information processing biases in anger or aggression; much of this work has been conducted by Dodge and colleagues who have extensively researched the social information processes of aggressive/oppositional children.

Drawing upon this work, Crick and Dodge (1994) propose a six-stage information-processing model for understanding cognitive biases in aggressive children. They argue that in the context of the child's biologically limited capabilities, and database of memories and past experiences (including schemas, rules etc.) children process information, or cues in the environment, through the following six stages: encoding, interpretation, clarification of goals, response access/construction, response decision and response enactment. They propose that biases at earlier stages can effect processing at later stages, leading to associations between the different steps in the process. They also argue however, that this process is not linear but circular, and whilst information flows through the stages, each stage can also interact with one other. In addition, they suggest that many of these circular processes would be going on simultaneously in the appraisal of cues in the environment.

Crick & Dodge's model has also been used to understand information processing biases in other childhood disorders: Daleiden & Vasey (1997) use Crick and Dodge's theory, in combination with Kendall & Ronan's (1990) schema theory, to explore biases in childhood anxiety. They relate that the model proves to be a useful tool for exploring the flow of information processing through cognitive systems, and how processing at one stage may interact with or be independent of another stage.

The first stage in the model: encoding, relates primarily to attention mechanisms, and is conceptualised along the dimensions of selectivity and intensity (Daleiden & Vasey 1997). This may be similar to the priming stage discussed in the adult literature. Research suggest that aggressive children

show biases at this stage: they are less attentive to relevant social cues (Dodge & Tomlin 1987), and require fewer hostility cues before attributing hostility to others(Dodge & Newman 1991).This could indicate that they experience hostility cues more intensely (Dodge & Newman 1991), or that they may require fewer cues before reaching a conclusion. Aggressive children were also found to have difficulty shifting their attention away from aggressive stimuli (Gouze 1987), and showed selective recall of hostile social cues (Dodge & Frame 1982).

Crick & Dodge (1994) note however, that there is a lack of research into automatic processes (such as auditory thresholds on dichotic listening tasks) in the child literature. Following on from the adult literature, this aspect seems to be starting to be addressed in the child anxiety literature. Children with clinical anxiety, or high trait anxiety, were found to exhibit selective attention to threat information on stroop tasks (Kindt, Brosschot & Everaerd 1997) dichotic listening tasks (Mannassis, Tannock & Masellis 1996) and dot-probe tasks (Vasey et.al. 1995, Vasey, El-Haag, Daleiden 1996, Taghavi, Neshat-Doost, Moradi, Yule & Dalgleish 1999). Furthermore the findings of Neshat-Doost, Moradi, Taghavi, Yule, & Dalgleish (2000) also support the findings of differentiated attentional biases in anxiety and depression reported in the adult literature. It seems then that the information processing biases, thought to contribute to the maintenance of emotional disorders in adulthood, are also present in childhood.

At the second stage of the model: interpretation, encoded information is evaluated in terms of its meaning, the reason for its occurrence, and its probable outcome (Crick & Dodge, 1994). Both aggressive and anxious

children have been found to display interpretational biases. Children with conduct problems are more likely to incorrectly interpret emotional stimuli as anger (Cadesky, Mota & Schacar 2000). Aggressive children are also more likely to interpret others intentions as hostile, especially in ambiguous situations (Dodge, Murphy & Buchsbaum 1984, Lochman & Dodge 1998). Children with high trait anxiety and/or clinical anxiety show interpretational biases towards threat on a pictorial homophone task (Hadwin, Frost, French & Richards 1997); are more likely to interpret ambiguous situations as threatening (Chorpita, Albano & Barlow 1996), and non-hostile vignettes as hostile (Bell-Dolan 1995); they are also more likely to expect a disproportionate number of negative outcomes (Leitenberg, Yost & Carroll-Wilson 1986).

Barret, Rappee, Dadds and Ryan (1996) found that both anxious, and oppositional children were more likely to interpret the same ambiguous situations as threatening. Daleiden & Vasey (1997) raise the question of whereabouts in the information processing sequence differentiation occurs between oppositional and anxious children. Lerner & Keltner's (2001) appraisal processes discussed above suggest that this differentiation may occur in interactions between the more elaborative stages of the model (such as interpretation, goal clarification, response decision) and the data-base of personal information and memory.

The third stage is goal clarification. Crick & Dodge (1994) relate that goals are focused arousal states that function as orientations toward producing particular outcomes. Daleiden & Vasey (1997) suggest current methods of assessment for goal clarification(asking participants to explain

reasons for action, or choose preferred goals) confound this stage with biases in response access, selection and enactment. They argue that greater theoretical clarification is needed in order to investigate this as a specific stage of processing. However Crick & Dodge (1996) have found assessment of goal preference differentiates different forms of aggression in that proactive aggressive children demonstrate a bias towards instrumental goals (i.e. hitting someone is a good way of getting the toy they want), whilst normal peers and children who are reactive in their aggression did not show a bias in goal selection.

The final three stages relate to biases in response access, selection and enactment. Biases in responding may be due to difficulty accessing or constructing appropriate responses, or they may be due to a bias in over-selecting inappropriate responses. Response access has been assessed by asking children to generate responses to hypothetical situations: Richard & Dodge (1982) found that aggressive boys generated fewer responses than popular boys; whilst Dodge, Pettit, McClaskey & Brown (1986) found that aggressive boys generated a similar number of overall responses, but more of the responses were aggressive. Daleiden and Vasey (1997) report that no differences have been found in response access in anxious children. They suggest that difficulties in access may only arise under threat conditions, when cognitive resources are allocated to detection of threat, and there may be few resources available for other types of processing. It seems that anxiety and aggression are clearly differentiated at this point, and currently the evidence suggests that children with disordered anger may have a limited

understanding or appreciation of appropriate responses, whilst anxious children are generally able to generate appropriate responses.

Daleiden and Vasey (1997) also propose however, that access to appropriate responses in anxiety, suggests that these children have a bias in response selection. When asked to select a particular response anxious children have been frequently found to choose inappropriate avoidant responses to anxiety provoking situations (e.g. Barret et.al.1996). Daleiden and Vasey (1997) suggest that response bias may be mediated by earlier interpretive biases such as suspected outcome. This is similar to the valance appraisal system discussed by Mogg & Bradley (1998). Similarly Crick & Dodge (1994) report a number of findings of a response bias towards aggression in aggressive children, this is especially true for pro-active aggression. They suggest that this bias is also associated with an increased tendency to view these responses as effective, i.e. hitting people gets me what I want.

The final stage in the model is behavioural enactment, this stage is not directly subject to biases, but even appropriately chosen behaviours can be enacted inappropriately. Daleiden & Vasey (1997) suggest that deficits at the enactment stage can arise through insufficient information processing resources, or through skills deficit. Crick &Dodge (1994) report that due to biases at earlier stages aggressive children are more likely to choose inappropriate responses, therefore they are less likely to have practice of socially appropriate responding. Daleiden & Vasey (1997) report that socially anxious children have been found to be so self-conscious in interaction tasks that it impairs their social performance.

Thus processing biases at early stages can lead to further biases and difficulties at later stages. In addition anxious children may have chosen to avoid situations so often that they may also have failed to develop appropriate coping strategies, leading to a further reliance on avoidant strategies. Difficulties in the enactment stage, or inappropriate responses, lead to less positive interactions or experiences in the environment. This, in turn, provides confirmation of originally biased processes, alongside providing further potentially threat related cues in the environment to begin the information processing cycle again. In this way biases in information processing can maintain maladaptive patterns of thought and behaviour in emotional disorders (Daleidin & Vasey 1997, Mogg & Bradley 1998).

*Clinical Implications of Information Processing Models*

Successful therapeutic interventions, in cognitive behavioural therapy have been based on the information processing models of emotional disorder, and some paragigms, such as the emotional stroop task, and the dot probe, have been used as measures of clinical change, with clinically anxious patients demonstrating a reduction in biases in these measures following treatment (Williams et.al. 1997). Mogg & Bradley (1998), and Crick & Dodge (1994) suggest that the aetiology of emotional disorders is related, to a number of factors including biological predisposition, development etc.; but they argue that biases in information processing play a part in the maintenance of these disorders. Breaking this maintenance cycle is thought to be the mechanism by which therapeutic intervention works.

Further to this, identifying the stages at which biases or deficits occur, could lead to more efficient therapeutic approaches to specific emotional disorders, and at the individual level. Aggressive children with biases mainly at the encoding and interpretive stages may be better helped by self esteem work, whilst children with biases in response access and selection stages may find skills training and contingency management more helpful (Crick & Dodge 1994). In exploring underlying processes in emotional disorders, the information processing research has given further understanding of how emotional disorders may be differentiated, measured, maintained and treated.

## Delay Aversion and Information Processing

The aetiological research, examined at the beginning of the paper, strongly suggests that there are genetic and neurobiological bases to ADHD. This research also suggests however that these bases occur in, and are interactive with, the child's developmental and social context. So far the empirical literature seems to indicate that ADHD is a heterogeneous disorder, and that there may be many pathways to this disorder, and a number of underlying processes. Solanto et.al.'s (2001) findings suggest that delay aversion is an independent underlying process in ADHD.

Sonuga-Barke's (2001) motivational style pathway to ADHD suggests that biological predisposition interacts with psychosocial variables in such a way that delay becomes aversive, and this aversion to delay leads to the behaviours seen as characteristic of ADHD. Based on this model, and

previous findings supportive of delay aversion, Sonuga Barke et.al. (2001) suggest that the motivational significance of delay in ADHD should lead to a cognitive 'delay detection' system.

Their findings of an attentional bias towards delay cues in hyperactive children are supportive of the delay aversion model. But given the noted limitations further investigations are required to support this finding. Initially the findings need to be replicated with a clinical sample. In addition Mogg & Bradley's (1998) review proposes that in anxiety, biases are related to a higher sensitivity to threat. If delay aversion is related to a high sensitivity to delay, then this could also be explored in ADHD using techniques that assess more highly automatic, or priming effects, which measure sensitivity such as dichotic listening tasks, or shorter/subliminal exposure on the dot-probe task.

Both Mogg & Bradley's (1998) and Crick and Dodge's (1994) theories of information processing biases in emotional disorders suggest that attentional biases are associated with biases at other stages of information processing. Their theories also relate that these biases are instrumental in the maintenance of the cognitive and behavioural features of the disorders. Extrapolating these models to the delay aversion theory of ADHD could potentially explain how inappropriate behavioural responses to delay in ADHD might be maintained.

In accordance with the information processing models discussed above, automatic biases, and selective attention towards specific cues in the environment would be likely to lead to a biased interpretation of a situation. Because of an attentional bias towards delay or delay cues, children with ADHD may be more likely to experience normal situations as involving a

delay. Other biases may also be present at the interpretation stage. Children with ADHD may be more likely to expect a delay, develop biased attributions about the delay, or biased appraisals about themselves or others in relation to delay.

In anxiety and aggressive disorders adults and children are more likely to see others as threatening or to blame for the situation. If biases in delay aversion follow a similar pattern, children with ADHD will be less likely to see themselves as to blame for a delay. These biases could be assessed using the similar methodology as used to assess interpretive biases in other disorders, such as the ambiguous scenarios used by Barrett et. al. (1996),. It would also be interesting to assess interpretive biases in actual delay situations, both through observation, and interview.

Interpretational biases, and emotional responses are likely to be influential in the goal clarification, and response access/selection/enactment stages of the model. The nature of the negative emotions, associated with delay in the motivational style pathway, is unclear. The above review of the information processing literature suggests that attentional biases are likely to relate to anxiety or anger. It maybe that delay aversion in ADHD is related to anxiety, or anger, or both.

The co-morbidity literature discussed earlier indicates that ADHD is highly associated both with anxiety and conduct problems. Delay aversion could be a specific form of anxiety – a delay phobia. Sonuga-Barke's theory talks about the behavioural symptoms of ADHD being an avoidance of delay, and avoidance responses are mainly displayed in relation to anxiety (Daleidin & Vasey 1997). However, delay could also lead to anger related emotions

such as annoyance and frustration. These emotions would also be experienced as unpleasant and lead to avoidance, however they may also lead to more attributions of blame to people, rather than situational factors (Keltner, et.al. 1993), and to more aggressive response selection and enactment (Crick & Dodge 1994). Emotional response to delay could be assessed through rating scales, interview, and observation of behaviour in delay situations.

In his delay aversion theory, Sonuga-Barke relates that delay aversion results in a bias towards a goal of delay reduction and a bias towards selection/enactment of behavioural responses that will reduce the experience of delay. Sonuga-Barke argues that children diagnosed with ADHD will be biased towards choosing actions that will reduce actual delay- and these actions are likely to be considered impulsive. The results of the studies using the choice delay task indicate that in comparison to normal groups, children who score highly on scales assessing hyperactivity, and children diagnosed with ADHD are more likely to choose to reduce delay rather than receive a small monetary reward.

If reduction of actual delay is not possible then Sonuga-Barke proposes that children with ADHD will choose to engage in behaviours that will reduce the experience of delay such as attending to off task (non-temporal/delay related) stimuli, or creating their own non-temporal stimulation, such as fidgeting or making noise. It seems however, that in many situations any of these behaviours would interfere with the performance of the task at hand. This could lead to the task taking longer, or having to repeat the task, which

would actually increase the experience of delay; leading to a cycle of cognitive biases, and inappropriate behavioural responding.

Further research is necessary to investigate response selection and enactment in ADHD. However, in the application of the information-processing model to the delay aversion theory, it has been possible to explore how cognitive biases may lead to the maintenance of maladaptive behaviours patterns in ADHD. Further to this, the suggested information- processing biases towards delay may be the means by which delay aversion mediates between biological/social predispositions, and behavioural symptoms, in the motivational style pathway to ADHD.

The therapeutic implications of this extension of theory, are the ways information processing biases towards delay may inform intervention. Cognitive behavioural therapy could address interpretive biases: encouraging the child with ADHD toward more balanced appraisals of situations ; exposure/experiential work could be applied to help with high sensitivity to delay; and skills training, and behavioural management could help with response selection and enactment. Some of these interventions are already being carried out with children with ADHD (Roth & Fonagy 1996), but investigation of an individual's cognitive biases, in relation to delay, may help to inform the therapist about how to tailor their intervention.

This literature review has explored how information-processing biases towards delay cues may contribute to the mediating role of delay aversion, and the maintenance of behavioural symptoms, in the motivational style pathway to ADHD. Bringing together these two areas has generated a number of further hypotheses about the motivational significance of delay in ADHD,

and future research should endeavour to investigate how, and whether, these models of information processing may be related to delay aversion and ADHD.

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# Investigating the motivational significance of delay in ADHD: attentional and interpretive processes

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# Investigating the motivational significance of delay in ADHD: attentional and interpretive processes

## Abstract

The present study explores the motivational and emotional significance of delay cues for children with ADHD from an information processing perspective. Eighty five 8-12 year old boys were recruited for the following groups ADHD only (26), oppositional/ conduct disordered (OD) only (12), co-morbid for both ADHD/OD (24), and non-clinical controls (23). Attentional and interpretive biases for delay were investigated using modified versions of the forced choice dot probe task and the ambiguous situations task. Previous findings of an attentional bias towards delay in hyperactive children were not replicated with a clinical sample, some support for an interpretative bias towards delay was found. Delay situations were found to be more associated with anger than anxiety for all participants. No differences were found in participant's reports of how they would respond to delay situations. The support found for motivational significance of delay in ADHD was mixed, limitations and directions for future research are discussed.

## Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is the current label for a syndrome that comprises of the core behavioural features: impulsivity, inattention and hyperactivity. It is a prevalent and persistent disorder associated with poor social outcome. These factors have warranted a prolific research interest over the past three decades (Tannock 1998). Attentional processes have been a focal point of research in ADHD, with deficient attentional processing being proposed as a central mechanism (Douglas 1972). Yet a number of studies have failed to find deficient attentional processing (Van der Meere 1996), and the difficulties with sustained attention, noted in hyperactive children, have more recently been ascribed to dysfunctions in response inhibition or activation states (Barkley 1997, Van der Meere 1996). However, in an interesting twist on the attentional processing literature, Sonuga-Barke (1998, 2001), suggests that the attentional style of hyperactive children may actually be an attempt to reduce the experience of delay, and that this "delay aversion" may in itself lead to selective patterns of attention (Sonuga-Barke, Hayes & Bareham 2001).

Sonuga-Barke's theory of delay aversion suggests that hyperactive children will be more motivated than normal children to choose immediacy over delay when given the option. However in situations where they cannot choose to avoid delay they may try to reduce the perception of delay, either by attending to non-temporal (or non task related) stimuli, or through self stimulation, such as fidgeting. Thus the delay aversion theory provides explanations of processes which would lead to the three core symptoms of ADHD: choice of immediacy relates to impulsivity,

attending to non temporal stimuli relates to inattention, and self stimulation relates to hyperactivity or motor restlessness.

Investigating this theory, Sonuga-Barke and colleagues found that on tasks featuring a choice of delay reduction vs. small monetary reward (Choice Delay Tasks –CDT) hyperactive children behave in ways that suggest they are more motivated to reduce delay than normal comparison groups (Sonuga-Barke, Taylor, Sembi & Smith 1992). This finding has been replicated (Solanto et.al 2001, Kuntsi, Oosterlaan & Stevenson 2001), and Solanto et.al also demonstrated that performance on the CDT showed high specificity for distinguishing children with ADHD from a normal comparison group. Further to this, Solanto et al.'s findings suggested that processes underlying performance on the CDT were independent of processes related to performance on response inhibition tasks. This indicates that motivation to reduce delay may be a separate mechanism underlying behaviours in ADHD.

Drawing upon these findings, Sonuga-Barke (2001) proposes a dual-pathways model of ADHD. One pathway – the Dysregulation of Thought and Action Pathway (DTAP) represents the underlying processes of deficient response inhibition. The other, Motivational Style Pathway (MSP), represents the underlying process of delay aversion. Sonuga-Barke suggests that in this pathway delay aversion is the mediating link between altered reward mechanisms and the behavioural symptoms of ADHD. He argues that in the MSP children have a predisposition towards impulsivity, which may be caused by a shortened delay of reward gradient. This predisposition is thought to be shaped up through interaction with cultural and familial norms. For example, in an environment that is intolerant of impulsivity, delay will be more frequently associated with punishment and failure.

Thus delay could acquire aversive properties through association with the negative emotions experienced in these situations, and this aversion to delay is proposed to relate to the behavioural symptoms of ADHD.

Further to this, Sonuga-Barke (2001) relates that there may be a secondary impact of delay aversion on cognitive systems. Delay aversion is thought to reduce the amount of effective processing time spent on tasks, which in turn would lead to a disruption in the ability to utilise time, as found by Sonuga-Barke, Williams, Hall and Saxton (1996). In addition, Sonuga-Barke et al. (2001) suggest that the motivation to reduce delay, may lead to a cognitive 'delay detection system' whereby hyperactive individuals show an attentional bias towards delay cues. This phenomenon is seen in other disorders where the motivational significance of perceptual cues leads to biases in information processing, (Crick & Dodge 1994, Daleiden & Vasey 1997). For example anxious individuals are found to attend more quickly to threat cues than normal comparison groups (Mogg & Bradley 1998).

Sonuga-Barke et.al.(2001) investigated the hypothesis of a 'delay detection' system using an attentional dot-probe task. In this task participants are presented with word pairs placed one above the other on a computer screen, and asked to read the top word out loud. On some trials the word pair contains a threat word, and on these critical trials a probe, in the form of a dot, replaces one of the words. Participants are asked to press a button as soon as they see the probe, and reaction time to the probe provides a measure of attention allocation to the words presented. For example if participants respond more quickly to probes replacing threat words, than to probes replacing neutral words, this indicates an attentional bias to threat cues (Taghavi, Neshat-Doost, Moradi, Yule & Dalgleish 1999).

Sonuga-Barke et.al. (2001) compared a teacher-nominated group of hyperactive children with a non-hyperactive group on attentional allocation towards delay, social and physical threat words. In support of the delay detection proposal, they found hyperactive children showed an attentional bias towards delay words, which was not found in the comparison group, also neither of the groups displayed a bias towards social threat words, whilst both groups displayed a bias towards physical threat words. This finding seemed to demonstrate the specificity of the delay bias. These preliminary findings are supportive of the theory that delay has high motivational significance to children with ADHD.

Sonuga-Barke et al. (2001) note however that co-morbidity was not controlled for in their study, therefore it is not clear whether these processes are specific to hyperactivity. They also suggest that different results might be obtained from children with clinically diagnosed ADHD, in comparison to children with high teacher ratings of hyperactivity. Further to this, the dot-probe method used by Sonuga-Barke and colleagues has been criticised for using data from only a small number of trials, which leads to increased task length and greater variance in the data (Mogg & Bradley 1999). In addition the study used a fairly limited number of delay cues, and they commented that it was unclear how well these cues related to the concept of delay. Given these noted limitations, this study aimed to replicate and extend Sonuga-Barke et.al.'s (2001) findings, investigating the motivational significance of delay from an information processing perspective.

Further to the dot-probe task findings, Sonuga-Barke et.al. did not make clear the nature of the motivational significance of delay in hyperactive children. Sonuga-Barke (2001) suggests that delay is associated with negative emotions, and becomes aversive, but it is not clear which emotional processes are involved.

Much of the information processing literature on attentional biases has been related to anxiety, whilst similar biases have not been found in depression (Neshat-Doost, Moradi, Taghavi, Yule, & Dalgleish 2000). Research suggests a link between anxiety and ADHD (Perrin & Last 1996); and it is possible that delay detection represents a specific form of anxiety in hyperactive children, the response to which is avoidance: a sort of delay phobia. The participants in Sonuga-Barke et.al's (2001) study could have responded to the delay cues more quickly because they found them worrying. This possibility could initially be investigated using a simple word-rating task to assess whether hyperactive participants rated these words as more worrying than other participants.

Information processing perspectives on emotional disorders (Crick & Dodge 1994, Daleiden & Vasey 1997) suggest that biases at the encoding stage – such as attentional biases on the dot probe, are also associated with biases at other stages of information processing, such as interpretation, and response selection. If you selectively attend to threat cues in a situation, you are more likely to interpret that situation as threatening, and select responses accordingly. It is therefore possible that if delay is of high motivational significance to children with ADHD, and they display attentional biases towards delay cues, then they may also display biases at other stages of information processing.

Barret, Rappee, Dadds & Ryan (1996) found that both anxious and oppositional children were significantly more likely to display interpretive biases towards threat, when given ambiguous scenarios, than children from normal comparison groups. Children from both clinical groups were also less likely to choose pro-social responses to these scenarios than normal peers. However the groups were differentiated by the response types selected: oppositional groups

chose more aggressive responses and anxious groups chose more avoidant responses. These findings indicate that threat is of motivational significance to both anxious and aggressive children, but that further appraisal processes seem to differentiate these motivations (Daleiden & Vasey 1997).

If we apply this information processing approach to investigating the motivational significance of delay in ADHD, one might also expect hyperactive children to show an interpretive bias towards delay, and that responses to these interpretations might also differentiate them from their peers. For example the responses of children with ADHD might be expected to map on to those proposed by the delay aversion theory when a delay is inevitable: they may respond by attending to non-task related (non-temporal) stimuli (displacement), or by creating their own non-temporal stimuli (disruption).

A further factor that might mediate between interpretation and response to delay in ADHD could be the form of emotional significance attached to the interpretation. Anxiety might be associated with an attentional and interpretive bias, and an avoidant response in delay aversion, as discussed above. However anger has also been associated with interpretive biases (Barret et.al 1996, Crick & Dodge 1994), and recent research in the adult literature suggests that anger is also associated with attentional biases (Cohen, Eckhardt & Schagat 1998). As the emotional significance of delay aversion is not clear it may also be useful to investigate the emotional significance of delay interpretations, and how this relates to response to delay.

This study aimed, therefore, to investigate the delay aversion theory of ADHD by exploring the motivational significance of delay to children diagnosed with ADHD, and the specificity of this significance to this disorder. From the delay

aversion theory, and Sonuga-Barke et.al's (2001) findings, it was predicted that children with ADHD would display attentional and interpretive biases towards delay cues. Further to this it was hypothesised that children with ADHD would be more likely to select displacement or disruptive responses to interpretations of delay. The study also aimed to explore whether delay cues were related to anxiety for children with ADHD, and what emotional significance might be attached to interpretations of delay. These aims were addressed by using clinical samples, with both clinical and normal comparison groups to control for co-morbidity. A modified version of the dot-probe was used to assess attentional biases, taking into account the limitations noted above. A word-rating task was used to assess how worrying participants found the cues used in the dot probe. And a modified version of Barret et.al's (1996) ambiguous scenarios was used to investigate interpretive biases, their emotional significance, and their effect on response selection.

## Method

### *Participants*

Participants in the study were 85 boys, ranging in age from 8 to 12 years, group membership was as follows: 26 children were diagnosed with ADHD, 12 were diagnosed with conduct/oppositional defiant disorder (OD) or had pervasive behavioural problems, 24 were diagnosed as being co-morbid for both disorders, and 23 were non-clinical controls. Sample sizes were based on those reported by previous studies (Sonuga Barke et.al. 2001, Taghavi et.al 1999), this study aimed for group sizes of 20-30, recruitment to the OD group was limited by the age range and exclusion criteria. Children for the clinical groups were recruited from five child and adolescent mental health teams (CAMHs), two paediatric outpatient

departments and two specialist schools for children with severe oppositional behaviour problems, across four localities.

Selection criteria for the ADHD group was diagnosis of ADHD (hyperactive or combined type) or Hyperkinetic disorder according to DSM-IV or ICD-10 criteria, without a concurrent diagnosis of oppositional/conduct problems or pervasive oppositional behaviour problems. Selection criteria for the oppositional group was a diagnosis of oppositional defiant disorder or conduct disorder meeting the DSM-IV or ICD-10 criteria, or attendance at a school for children with severe oppositional behaviour problems, without a concurrent diagnosis of ADHD. Children meeting the criteria for both the ADHD and oppositional groups were placed in the co-morbid group. Diagnoses were made by psychiatrists, paediatricians, or clinicians. The control group was recruited from schools and consisted of children with no history of mental health problems according to parents and teachers. Teachers were asked to approach all boys whom they felt met the criteria. Exclusion criteria for all of the groups included: a diagnosis of learning disabilities or developmental disorders such as autism, a diagnosis of dyslexia, or not meeting the age range stated above. The response rate for clinical groups was, on average, 1 in 10. The response rate for control groups was 1 in 8, although control groups were given a much shorter time in which to respond than clinical groups.

## *Measures*

### *Measures of participant characteristics*

To provide a check on the diagnostic groups stated above, participants' parents and teachers were asked to complete strengths and difficulties questionnaires (SDQ) (Goodman 1997). ). The SDQ is a short behavioural

screening questionnaire that takes five minutes to complete. It is highly correlated with the Rutter questionnaires (Elander & Rutter, 1996, Goodman 1997) and with the Child behaviour checklist (CBCL; Achenback, 1991, Goodman & Scott 1999) indicating good sensitivity and specificity as a measure. It also has high internal reliability (Goodman & Scott 1999). The SDQ provides information on five dimensions: hyperactivity, conduct problems, emotional symptoms, peer problems and prosocial behaviour; scores on the first four dimensions are summed to create a total difficulties score. Cut offs are provided to indicate clinical significance for each of the dimensions and total difficulties (Goodman 1997). To ensure the integrity of the control group data from children in this group who scored above cut off on hyperactivity or conduct disorder scales were not included in the analyses. Seven children were eliminated from the research population on this basis.

In order to control for the affects of IQ and reading ability participants were assessed using a short form of the Wechsler Intelligence Scales for Children, third edition (WISC-III) and the basic reading test from the Wechsler Objective Reading Dimensions (WORD) (Wechsler 1991, 1992). The short form comprised the following subtests: similarities, arithmetic, picture completion and block design (Kaufman, Kaufman, Balgopal and McLean 1996). If participant's estimated IQ was below 70 they were not included in the analyses. As the words included in the dot-probe experiment required a minimum reading age of 8, children with an estimated reading age equivalent below 7.9 were excluded from the dot-probe analysis. This resulted in dot probe data of 2 children from the control group, 3 children from the ADHD group, 3 children from the comorbid group, and 1 child from the oppositional group, being excluded from the dot-probe analysis.

In order to control for and explore the affects of anxiety on participant's responses, all participants completed the Revised Children's Manifest Anxiety Scale (RCMAS: Reynolds and Richmond 1985). The RCMAS is a self-report measure designed to assess trait anxiety in children between the ages of 6 and 19 years. It provides standardised t-scores for overall level of anxiety, and scaled scores for subscales assessing the dimensions of physiological anxiety, worry/oversensitivity and social concern/concentration. The RCMAS also contains a lie subscale that assesses the level to which the child's positive responses on the scale are related to social desirability. Scores greater than 60 on the total anxiety scale, and greater than 13 on the subscale scores indicate high anxiety.

*Dot probe task*

Given the limitations of Sonuga-Barke et.al's (2001) study noted above, a pilot study was carried out (Appendix 3) to determine which words used in the previous study were most related to delay. The six words most highly related to delay were used as target words in the forced-choice version of the dot-probe task (Mogg, Bradley & Williams 1995). This method of carrying out the dot probe was designed to correct for the criticisms raised against the original dot-probe method, used by Sonuga-Barke et.al. (2001). In the forced choice dot-probe each word-pair is followed by a probe, and participants are asked to press a button corresponding to the position of the probe (top or bottom) after each trial. As every trial is used the task length is shorter.

To investigate specificity of bias towards delay cues, physical and social threat cues were also included. Given the limited number of delay cues available, target words were repeated to increase the data set and reduce variance. Each

delay, social threat and physical threat word was paired with neutral words of the same length and frequency, as had been used in Sonuga Barke et.al's study. The target words used can be found in Appendix 2. A further 49 neutral-neutral word pairs were also taken from the Sonuga Barke et.al (2000) study, to be used as fillers.

The dot-probe task consisted of 5 practice trials and 121 experimental trials. The experimental trials were presented in a new random order to each participant. Word pairs appeared one above the other; words were in lower case and were black on a white background. Word pairs were presented for 1250msec. Following this, a small probe in the form of a plus sign appeared in the spatial location of either the upper or the lower word. The probe disappeared when participants responded to it. The inter trial interval was 500ms. Each target word occurred in each location (upper and lower) and each probe position (upper and lower); giving four response times for each word, and twenty-four response times overall for each word category. These response times were used to calculate the dependent variable for this experiment (discussed in results section).

The dot probe programme was presented using a Toshiba Satellite Pro 4200 series portable computer with a 21 cm thin film transistor monitor. Participants made their responses using a small keypad that was held in their hands. Participants were instructed to read the top word out loud, the number of mispronunciations and omissions were recorded .The data of participants who made more than 18 reading errors on this task were excluded from further analysis for the dot probe experiment. (This led to the further exclusion from the dot probe analysis of four participants from the comorbid group, and one participant from the oppositional group). Participants were instructed to press one of the two response

buttons to indicate the position of the probe on the screen (upper or lower) and were told to respond as quickly as possible, and to be careful to avoid mistakes. Full instructions for the dot probe experiment can be found in Appendix (2)

*Word rating*

The word-rating experiment was employed to explore whether the target words used in the dot-probe were seen as anxiety provoking. The target words, and the neutral words they were paired with, were included in a wordlist. The top of the wordlist showed a likert scale going from 1-5. The 1 was anchored with a picture of a man relaxing, and the word calm. The 5 was anchored with a picture of a man panicking and the word worrying. Participants were asked to rate each word on the list according to the scale (Prieto, Cole and Tageson 1992).

The word rating scale, and the instructions given to the children before completing the scale are included in appendix (4). The researcher asked the child to read each word out loud to check for understanding, if a child did not know what a word meant, the word was explained by the researcher. The wordlist yielded a mean rated response score for each word type: delay, social threat, physical threat, and neutral words.

*Ambiguous situations*

The interview for the ambiguous situations experiment was adapted from the one used by Barret et.al. (1996). To investigate the specificity of interpretive biases, ambiguous scenarios for delay, social threat and physical threat were included. Three scenarios with high face validity were selected from each threat type: physical threat and social threat. A further three scenarios were also constructed to

be ambiguous for delay. The ambiguous scenarios were constructed from information gathered in the pilot study (Appendix 3).

The situations were presented in a randomised order. In line with Barret et. al's research participants were asked to generate their own interpretation for each situation, they were then asked to choose which interpretation they thought would be most likely from a list of four. In addition to Barret et.al's format, a question on how the participant would be feeling if their interpretation were true was added to the interview, this was to enable the researcher to explore the emotional significance of an interpretation of delay, and how this related to response selection. Participants were then asked what response they would give if they were in the discussed situation.

Types of explanation given by each participant to the first two questions were scored as salient to the construct if they indicated potential social threat in the ambiguous social threat situations (e.g. they think I'm dumb, I'll get in trouble); personal danger in the ambiguous physical threat situations (e.g. the dog wants to bite me, there's a burglar); or having to wait, either directly or indirectly, in the ambiguous delay situations (e.g. She'll be ages and I'll have to wait, the bus is always late, or: she's talking to a friend, the bus is stuck in traffic). Measures derived from this were the total number of interpretations generated and chosen which were salient to the construct, (social threat, physical threat, and delay).

The emotions participants responded with were scored as belonging to the following categories: Angry (encompassing, annoyed, cross, mad), Anxious (encompassing scared, worried, nervous frightened), Upset (encompassing sad, unhappy, fed up, disappointed), Okay (encompassing happy, proud, okay, alright

calm), Bored, and Embarrassed. Measures derived were the total score for each emotion for each construct.

In accordance with Barret et.al. (1996), the solutions to the social and physical threat situations were scored as: avoidant (any solution that suggested that the child would try to escape from, or avoid potential harm or embarrassment in some way, ie. Hiding, leaving the situation); aggressive (any solution that suggested a course of action that was potentially harmful or embarrassing to others, i.e. hitting or calling names); or prosocial (any solution which recommended a constructive, effective solution, to the scenario). Solutions to delay situations were scored as: displacement (distracting self from time passing by engaging in other activities whilst waiting, i.e. colouring in, looking at toys); disruptive (any solution which would disrupt others in the situation, ie nagging mum, throwing things); waiting (waiting without using either of the above strategies); prosocial (engaging in the task when waiting not expected). The measures derived were the *total number of avoidant, aggressive, and prosocial solutions across situations* for both threat types, and the total number of displacement, disruptive, waiting and prosocial solutions for the delay situations. The ambiguous situations interview used, and the instructions for the participant can be found in appendix (5).

Because of drop-out and researcher restrictions a number of participants did not complete the ambiguous situations, and word rating task, the remaining group numbers were as follows: 22 in the ADHD group,12 in the oppositional group, 23 in the co-morbid group, and 15 in the normal comparison group. Fifty percent of the responses were scored blind to the diagnostic group. A further twenty per-cent of the responses were scored by another researcher to check for reliability: all of the variables were significantly correlated at the.05 level or above, and had a

spearman's rho correlation co-efficient of .568 or above, the average correlation co-efficient was .834.

### *Procedure*

Full medical ethical approval was received from local research ethics committees in the four localities. Potential participants for the clinical groups were selected by professionals working within the CAMHs teams, paediatric clinics and specialist schools. Potential participants for the control group were selected by teachers at the respective schools. Participants' parents were sent an information letter, consent form and SDQ through the post, or given them when they attended clinic, control children were given these forms to take home from school.

When parents completed and returned consent forms they were contacted to arrange an appointment. In order to remove possible medication effects, parents whose children were taking medication for ADHD (Ritalin, Dexedrine), agreed that their child would not take the medication for at least twelve hours prior to their appointment. Children were seen at home, school or in the clinic, according to the preference of the parent. The research was always conducted in a quiet room, with distractions minimised, and was carried out by postgraduate psychology students.

The participants were firstly administered the RCMAS, basic reading test from the WORD and short –form of the WISC III, in accordance with manual protocol for each measure. They were then asked to complete a task on the lap-top (analysed as part of another project and therefore not included in this analysis). Participants then completed the dot-probe task, the ambiguous situations task and the word-rating task, following the instructions given by the researcher. Experimental tasks were presented in this order so that presentation of words and

scenarios related to delay would not influence performance on the dot-probe task. Further to consent from parents, and children's participation in the research, teachers were contacted and asked to complete an SDQ, where teachers had previously completed an SDQ for clinic purposes, within the last year, this information was used instead. Following participation children were thanked for taking part and given the opportunity to ask any further questions about the study.

## Results

### *Participant Characteristics*

Participants characteristics were analysed using descriptive and inferential statistics. Means and Standard deviations were calculated for age, estimated IQ, WORD basic reading standardised score, scores on the RCMAS, and scores on the parents and teachers SDQs.

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Insert Tables 1 and 2 here

*Age, IQ and reading ability*

To establish whether there were any significant differences between the groups on these variables, one way analyses of variance and post hoc multiple comparison tests(LSD, $p<.05$) were conducted. Significant differences were found for: age, $F(3,81)=6.88, p<.01$; IQ , $F(3,81)=5.19$; and reading ability $F(3,81)=3.7, p<.05$. The control and ADHD groups were significantly younger than the co-morbid and oppositional groups. The control group scored significantly higher than the co-morbid and oppositional groups on the WISC short-form, and

the ADHD group also scored significantly higher than the oppositional group. The comorbid group had significantly lower scores on the WORD basic reading test than the control and ADHD groups.

*RCMAS scores*

Total standardised score for the RCMAS, and the four subscale scores were entered into a multivariate analysis of variance (MANOVA), with experimental group as the independent variable. Post-hoc multiple comparison tests (LSD $p<.05$) were also conducted. An overall difference between the groups was found $F(15,212)=1.74, p<.05.$, the significant differences between the groups were on the social subscale, $F(3,81)=3.66$, $p<.05$, and the lie subscale $F(3,81)=3.24$ $p<.05$.The comorbid and ADHD groups scored significantly higher than the control group on the social worry subscale, the comorbid group scored significantly lower than the control group on the lie subscale.

*SDQ scores*

As not all participants had data for both SDQs, parents and teachers SDQs were analysed in separate MANOVAs. There was an overall group difference for the parent's SDQ $F(18,195)=10.83$ $p<.001.$, and for the teacher's SDQ $F(15,171)=.287$ $p<.001$. There were significant differences between the groups on each of the subscales of the SDQ for both teachers and parents, as might be expected given their diagnostic status – i.e. hyperactive children were rated more highly hyperactive than conduct disordered children. (see Appendix 6 for further details).

### *Group Membership*

Participants were placed into groups on the basis of diagnosis, this was checked against the hyperactive and conduct subscales on the SDQ using Chi-Square, to see how well diagnosis was associated with clinical cut-offs on the SDQ. There was a significant association between scoring above cut off on the hyperactive subscale of the SDQ for both parents and teachers, and being in the ADHD or comorbid groups, $\chi 2$ (1)=15.18 $p<.01$. There was also a significant association between scoring above cut off on the conduct subscale of the SDQ for both parents and teachers, and being in the comorbid or oppositional groups $\chi 2$ (1)=16.43 $p<.01$.

### *Dot Probe Task*

To maintain the integrity of the data, trials with errors were excluded from the data set, trials with response times (RTs) less than 100ms and more than 3000 ms were excluded (Neshat-Doost et.al 2000). To further remove the influence of outliers RTs which were more than three standard deviations above each participants mean were also eliminated (Mogg, Bradley, De Bono & Painter 1997), this resulted in 8.7% of the trials being removed.

Mean RTs were calculated for each participant for each combination of the following conditions: type of word, position of target word, and position of probe. In order to explore the direction of attention for each group, means and standard deviations of these combinations were calculated for each diagnostic group (Table 3 ). The descriptive statistics do not seem to reveal any clear trend and all groups showed high variance in response times.

Insert Table 3 here

To examine the extent and direction of attentional bias on the dot probe task Neshat-Doost et.al. (2000) used a single index. To calculate the index of attentional bias the appropriate reaction time data for each participant were substituted into the following equation, where TL means target location, PP means probe position, 1 indicates the upper position, and 2 indicates the lower position:

$$\frac{[(TL1,PP2 - TL1,PP1) + (TL2,PP1 - TL2,PP2)]}{2}$$

If a participant shifts attention towards the position where the threat word appeared, they will detect the probe faster in that area and the equation will produce a positive value. In contrast, if a participant shifts attention away from the position where the threat appeared, they will detect the probe more slowly in that area and the equation will produce a negative value.

Mean attentional bias scores were calculated for the four groups, and for the three word types (Table 4). The descriptive statistics suggest that only the co-morbid group has a bias towards delay words, however again there is high variance of scores within groups. A repeated measures ANCOVA was carried out with diagnostic group (control, ADHD, comorbid and oppositional) as the between-participants variable, and word type (delay words, social threat words and physical threat words) as the within participants variable. As the groups had differed significantly on the variables of age, estimated IQ, reading score, and the RCMAS social and lie subscales, these were entered as covariates into the analysis. Neither the main effect of group [$F(3,61)=1.88$ $p>.05$], nor the main effect of word

type [$F(2,61)=.563$ $p>.05$] were significant. The interaction between group and word type also did not approach significance [$F(6,122)=1.07$ $p>.05$]. As a further check on diagnostic grouping, the same analysis was run on groups determined by SDQ scores rather than by diagnosis, a similar pattern of results was found. To further investigate the effects of the repeated presentation of target words, the same analysis was also carried out for data from the first two word presentations only. Bias scores were not significantly different from overall bias scores and a similar pattern of non-significant results was found.

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Insert table 4 here

*Word Ratings*

Participants ratings for: delay, social threat, and physical threat words, and their neutral pairs, were subjected to analyses of variance in which diagnostic group was the between participants factor, and word type (delay, social threat, physical threat, and neutral) was the within participants factor. Age, estimated IQ, RCMAS social and lie subscale scores were entered as covariates. There was a main effect of word type [$F(3,63)=3.06$ $p<.05$], but no main effect of group. Neither were there any significant interaction effects. The mean ratings of each group for each word type are represented in table 5: participants rated physical and social threat words as worrying, and neutral and delay words as calm.

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Insert Table 5 here

## *Ambiguous Situations*

### *Interpretations*

Table 6 shows the mean total number of generated interpretations that corresponded with each construct for each group (i.e. participant gave an interpretation which indicated delay in a delay scenario). This data was analysed using multivariate analysis of variance where diagnostic group was the between participants variable, scenario type was the within participants variable (delay, social threat, physical threat) and covariates were age, estimated IQ, and RCMAS social and lie subscale score. There was no significant main effect of scenario type. However there was a significant interaction effect between group and scenario type $F(6,98)=2.47$ $p<.05$. Post hoc pair wise comparisons (LSD, $p<.05$) were carried out: the ADHD, co-morbid, and oppositional groups were significantly more likely to give delay interpretations to ambiguous delay scenarios than the normal comparison group.

Table 6 also shows the mean number of fixed choice interpretations that corresponded with the construct for each group. These data were entered into a multivariate analysis of variance with the same variables and covariates as above. In contrast to the generated interpretations there was no significant interaction effect, but there was a significant effect of scenario type: $F(2,62)=5.14$ $p<.01$. Pair wise comparisons (LSD, $p<.05$) showed that all of the groups were more likely to choose interpretations that corresponded with construct for scenarios ambiguous for delay and social threat, than for scenarios ambiguous for physical threat.

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Insert Table 6 here

*Emotions*

For the participants' responses to how they would feel about their interpretation of the scenario, an initial multivariate analysis of variance was carried out in a 4x3x6 mixed design. Diagnostic group was the between participants factor, scenario type (delay, social threat and physical threat) and emotion (angry, anxious, upset, happy, bored, embarrassed) were the within participants variables. The means and standard deviations of the total number of emotions endorsed in each condition are displayed in Table 7. The same covariates as above were entered into the analysis (age, IQ, RCMAS social and lie subscales). The variables recording participants' total fixed choice interpretations for each scenario type were also entered as covariates, to control for the effect of types of interpretations on emotions both within and between scenarios.

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Insert Table 7 here

There was a significant difference between the types of emotions endorsed by participants [$F(5,54)=3.9$ $p<.01$] and a significant interaction between the types of emotions endorsed by scenario type [$F(10,49)=2.6$ $p<.05$], but the interaction between diagnostic group and emotions [$F(15,149)=0.80$ $p>.05$], and group, emotions and scenario type [$F(30,144)=0.70$ $p>.05$] were not significant. Therefore some emotions were endorsed more than others by the participants. From Table 7 it can be seen that children said they would feel anger related emotions, or positive (okay) emotions more frequently than anxiety or embarrassment in response to these scenarios. Further to this different emotions were endorsed for the different scenario types. Table 7 indicates that boredom and anger were endorsed more for

delay scenarios; upset emotions were endorsed more, and positive emotions endorsed less, in the social threat scenarios; anxiety also seems to be endorsed slightly more highly in the physical threat scenarios than in the other two scenarios. Differences between groups on types of emotions endorsed were not found to be significant.

The proportion of times an emotion was endorsed given an interpretation of delay or threat was also investigated. A significant difference was found in the types of emotions endorsed [$F(5,23)=2.69$ $p>.05$], however interaction between scenario type and emotions was not significant, nor were there any group effects. Although the means displayed in table 8 do seem to indicate trends in responding there were also large variances, which may explain this lack of significance.

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Insert Table 8 here

*Responses*

As the responses to the delay scenarios were qualitatively different to the other two scenarios, each scenario type was analysed separately. Multivariate analyses of variance were carried out. The between participants variable was diagnostic group, covariates were age, IQ, RCMAS social and lie subscale scores. To control for the effects of interpretation on response, each analysis also included the fixed choice interpretation score for that scenario. The means and standard deviations for total number of responses endorsed for each group in each scenario type are displayed in Table 9.

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Insert Table 9 here

*Responses to delay scenarios*

The within participants variable on this analysis was delay responses (pro-social, wait, disrupt, displace). No effects were found for the mean total number of responses endorsed overall [$F(3,60)=1.21$ $p>.05$ ], or interaction between group and response [$F(9,146)=1.25$ $p>.05$ ]. Interpretation of the scenario as indicating delay did have a significant effect on the response which participants said they would give [$F(3,60)=10.49$ $p<.01$ ]. Further analysis of the proportion of responses endorsed, given an interpretation of delay, did not reveal any significant differences after the above covariates were entered into the analysis. The distribution of means (table 10) suggests some trends indicating differences between responses endorsed, and groups, but there are large variances.

*Responses to social threat scenarios*

The within participants variable was response to social threat (pro-social, aggressive, avoidant). There was no significant difference between the mean number of response types given to social threat scenarios overall [$F(2,60)= 0.2$ $p>.05$ ], but there was a significant interaction between responses and group [$F(6,120)= 4.26$ $p>.01$]. Interpretation of the scenario as involving a social threat also had a significant effect on the response the participants said they would give [$F(2,60)= 8.58$ $p>.01$]. Multiple post hoc comparisons (LSD $p<.05$) indicate that the normal control group was more likely to give pro-social responses than the clinical groups, the co-morbid, and oppositional groups were more likely to give aggressive responses than the normal control group, and the ADHD group was more likely to give avoidant responses than the other groups. Analysis of the proportion of

responses endorsed, given an interpretation of social threat, reveals the same pattern of results, means and standard deviations are displayed in table 10.

*Responses to physical threat scenarios*

The within participants variable was response to physical threat (pro-social, aggressive, avoidant). There was no significant difference between the mean number of response types given overall [$F(2,60)= 0.66$ $p>.05$ ], and no significant interaction between group and response [$F(2,60)= 0.66$ $p>.05$ ], interpretation of physical threat did not have an effect on the type of response participants said they would give [$F(2,60)= 0.66$ $p>.05$ ]. Descriptive analysis of proportion of responses endorsed, given an interpretation of physical threat, (Table 10) suggests differences between groups on types of response given, however this is not supported by multivariate analysis which reveals the same pattern of results as for the mean number of responses overall.

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Insert Table 10 here

*Associations between interpretation, emotion and response:*

To investigate whether there was an association between emotion and response given an interpretation of delay, or social/physical threat, Spearman's rho correlations were carried out. Tables of these correlations can be found in appendix 6. Given an interpretation of delay, anger or annoyance was negatively associated with waiting ($r= -.23$, $p<.05$), and positively associated with disruptive responses ($r= .40$, $p<.001$). Conversely, feeling alright or happy was positively associated with waiting ($r= .31$, $p<.01$), and negatively associated with disruptive response ($r= -.32$,

p<.01).Participants who reported they would feel bored in a situation where they would have to wait were more likely to report they would respond with displacement activity (*r*= .27, p<.05).

Given an interpretation of social threat, how participants said they would feel was not significantly associated with how they said they would respond. Given an interpretation of physical threat, if participants reported that they would feel annoyed or angry, they were more likely to report they would respond in an aggressive way (*r*= .27, p<.05).

*Exploring Associations between task performance and anxiety*

To assist in the analysis of responses to tasks, associations between task response and anxiety scores on the RCMAS were carried out using spearman's rho. Tables of these correlations can be found in appendix 6. There was no significant association between attentional bias scores and the total or subscales scores of the RCMAS. Rating of physical threat words as worrying on the wordlist was significantly positively associated with the RCMAS standardised total score (*r*= *.25, p<.05* ), and physiological subscale (*r*= *.32, p<.01* ), rating of social threat words as worrying was also significantly associated with the physiological subscale (*r*= *.22, p<.05*).

Generated delay interpretations were negatively associated with the worry subscale (*r*= - *.26, p<.05)*, generated social threat interpretations were significantly positively associated with the RCMAS total score(*r*= *.25, p<.05* ) , they were also significantly negatively associated with the lie subscale (*r*= - *.31, p<.01*). Fixed choice delay interpretations were positively associated with the physiological subscale ( *r*= *.23, p<.05*), and negatively associated with the lie subscale ( *r*= - *.31,*

*p<.01*). Fixed choice social threat interpretations were positively associated with the RCMAS total score ( *r= .35, p<.01*), the physiological subscale ( *r= .24, p<.05*), the worry subscale ( *r= .23, p<.05*), the social/concentration subscale ( *r= .41, p<.01*), and negatively associated with the lie subscale ( *r= - .25, p<.05*).

## Discussion

The aim of this study was to replicate and extend the findings of Sonuga-Barke et.al.(2001) through investigating the motivational significance of delay in ADHD from an information processing perspective. The study failed to replicate the findings of Sonuga-Barke et.al (2001) with a clinical sample: children in the ADHD groups did not display an attentional bias towards delay cues in the dot-probe task. Delay cues did not seem to be related to anxiety for children with ADHD, but seemed to be related to feelings of anger or boredom for all groups. Children with ADHD did however seem to display an interpretive bias towards delay information. However there were no significant differences between the groups on their responses to delay scenarios.

One interpretation of the failure to replicate Sonuga-Barke et.al.'s (2001) results is that children with clinically diagnosed ADHD may not have an attentional bias towards delay cues. These children may be more likely to represent the dysregulation of thought and action pathway discussed by Sonuga-Barke (2001), rather than the motivational style pathway, therefore delay would be less likely to have motivational significance for them. If this were true then the dot probe may have clinical utility in differentiating the two pathways proposed by Sonuga-Barke. However replication of this finding would be needed to support this interpretation of

the data, and large variances in response times, and a lack of trends in the descriptive data, suggest that alternative explanations also need consideration.

There were significant differences between the groups on all the variables controlled for: age, IQ, reading ability and anxiety, and this will have introduced a great deal of variance into the data. However this was controlled for as much as possible through introducing these variables into analyses as covariates. Further to this, accurate diagnostic grouping was checked against scores on the SDQ and found to be significantly associated to SDQ grouping. It is difficult therefore to explain the lack of significant findings by inaccurate group allocation.

An alternative reason for the large variances in the data could be that children in the clinical groups may have had difficulties sustaining attention. However the variances were large for all groups; and the length of the dot-probe task was shorter than that used by Sonuga- Barke et al. (2001). It is possible that the high variance could have been related to the repetition of stimulus words. Words only have a small amount of emotional valence (Mogg & Bradley 1998), and may not have strong enough motivational significance attached to them to draw attention when repeated in quick succession. However further analysis of data from the first two word presentations only, indicated similarly non-significant findings, and high variances.

A further explanation could be that the forced choice dot-probe paradigm places too many processing demands on children, which obscures any attentional bias effects. In the original dot-probe method children simply press a button to indicate the presence of a probe, whereas in the forced choice paradigm, participants have to discriminate between probe positions and press the button accordingly. On average, response times to probes were longer for all groups in

this study than for the participants in the Sonuga-Barke et.al.(2001) study, possibly indicating increased cognitive processing. Although not published, other researchers have also had difficulty replicating attentional biases found using the original paradigm when they have used the forced choice paradigm with children (personal communication Vasey 2001).

A further difficulty was finding words that would be highly related to delay for this age group: the data set was fairly small. To try and get around this difficulty Sonuga-Barke and colleagues have been exploring attentional biases towards colours that have been associated with delay or immediacy in a conditioning task. Preliminary findings from this study suggest that children with a diagnosis of ADHD do display attentional biases towards cues for both delay and immediacy (personal communication Sonuga-Barke). An alternative way to get around the difficulties of paradigm and word complexity could be to investigate attentional biases in older ADHD groups. Evidence points towards the persistence of ADHD into adolescence and adulthood (Tannock 1998), assessment of attentional processing of delay in these age groups may provide further information about the development of delay aversion in ADHD.

Sonuga-Barke et.al's(2001) study found an attentional bias towards delay cues, and his further work discussed above suggests this is the case with clinical groups of children with ADHD. However the nature of the motivational significance of this bias is unclear. In this study a word list was employed to investigate whether any potential bias was related to anxiety. Participants were asked to rate how worrying they found the target words used in the dot-probe. Children with ADHD did not rate delay words as more anxiety provoking, or worrying, than children from

other groups. Overall, delay words were not rated as worrying whilst physical and social threat words were rated as worrying by all groups.

The finding that children with ADHD did not rate the delay words used in the dot-probe as worrying could indicate that anxiety is not associated with delay cues for this sample. In support of this is the finding that delay word ratings were not associated with self-reported anxiety, whilst the physical and social threat word ratings were significantly associated with self reported anxiety. But, given that the participants did not display an attentional bias toward the delay cues, it may be that the cues used in the dot-probe and word list did not adequately represent delay, and therefore were not seen as worrying. However, findings from the ambiguous situations task also suggest that delay was not related to anxiety for children in the ADHD and co-morbid groups.

Interpretations of Delay were associated with anger and boredom, not with anxiety, and generated interpretations of delay were negatively associated with anxiety scores on the RCMAS. The findings suggest that all the groups have a similar emotional response to delay. However it would be interesting to investigate whether these emotions were rated as the same intensity for all groups; mild threat cues are experienced more intensely by people with anxiety disorders, (Mogg & Bradley 1998). It would also be interesting to compare emotions elicited from hypothetical situations to those elicited from more ecologically valid situations (Crick & Dodge 1994).

In further investigating the motivational significance of delay in ADHD, the findings from the ambiguous situations task suggest that children with a diagnosis of ADHD have an interpretive bias towards delay. Whilst the bias was specific to delay (biases towards threat were not demonstrated), this bias was not specific to

this disorder, as children with oppositional problems also displayed an interpretive bias towards delay. Delay may be of general significance to externalising disorders, or there may be different processes underlying the interpretive bias in the different disorders, as there are different processes underlying the bias towards threat in anxious and oppositional populations. The specificity of performance on the CDT tasks used to assess delay aversion, is not clear (Kuntsi et.al. 2001). In further investigating the specificity of delay aversion to ADHD it would be interesting to investigate how groups with OD without ADHD performed on this task.

Children from the ADHD, OD and co-morbid groups generated more interpretations of delay than children from the normal comparison groups. But when faced with a fixed choice of interpretations, all groups chose a higher number of delay and social threat interpretations. A possible explanation for the high overall bias in the fixed choice interpretations may be that the situations aren't really ambiguous for delay. However this explanation would predict bias to be high overall for both generated and fixed responses. It may be that the fixed choice options available for each scenario were differentially biased towards more interpretation of delay across the situations, rather than each choice having equal probability.

The researcher generated the fixed-choice options, and validity was not checked in a pilot study prior to research, indicating that this is a potential limitation. Further to this, it is possible that the ambiguous situations do not tap delay situations that are particularly aversive for children with ADHD, and this could be a possible explanation for the findings of no response bias. Further research, perhaps in the form of a survey, or time estimates, is needed to address what situations are definitely associated with delay, and which are ambiguous.

Observational studies could also be employed to address which delay situations children with ADHD find most difficult to wait in.

Other studies investigating interpretational biases in children have explored interpretations of definite vs. ambiguous situations. For example Bell-Dolan (1995) found that high trait anxious children did not provide more interpretations of threat for ambiguous vignettes than normal children, but did provide more hostile interpretations for non-hositle vignettes that normal controls. Children with ADHD may also be more likely to interpret delay in non-delay situations, or overestimate delay.

The finding that children with ADHD did not consistently choose more inappropriate responses to delay than normal controls does not support the delay aversion theory that, given cues to delay, children with ADHD should respond by actively or passively avoiding delay. This could suggest that behaviour difficulties in ADHD are more a result of what Barkley (1998) describes as not being able to put knowledge into practice. However limitations of this method of assessing responses also suggests alternative explanations. As discussed earlier it may be that the situations used to not adequately tap into the type of delay which is aversive for children with ADHD. It would also be interesting to investigate responses with more delay scenarios, differentiating between those where the participant could be appropriately in control of delay, and others where delay was unavoidable, to explore how different groups respond with the different types of delay. This could be done both with interviews, and with actual scenarios. For example Antrop, Roeyers, Van Oost and Buysse (2000) found that children with ADHD used more displacement, and qualitatively different types of displacement, in

a waiting situation they couldn't avoid, suggesting there are aspects of responding to delay which were not tapped into by the ambiguous situations format.

A further limitation of some of the analyses may have been the power level, given the high number of variables used. Although the number of participants in the study is fairly similar to other studies investigating attentional biases, studies investigating interpretation biases have used slightly higher numbers. The inclusion of four experimental groups, and three conditions, alongside a high number of dependent variables in the emotions and responses analyses, may have lead to insufficient power to detect significant differences in the trends displayed in the descriptive data. Therefore differences in response patterns may have been present but not detected for ADHD groups. However differences in response selection were detected for the social threat scenarios, indicating that there is sufficient power to detect differences, and supporting findings from previous studies of inappropriate response selection for ADHD and oppositional groups (Barrett et.al. 1996, Crick & Dodge 1994, Matthys, Cueperus & Van Engeland 1999 ).

In conclusion, there was no finding of attentional bias towards delay, in the ADHD group, however, given other positive findings, this could to be due to methodological limitations. There were findings suggestive of an interpretive bias towards delay in ADHD and oppositional groups. These findings partially support Sonuga-Barke's (2001) delay aversion theory, which suggests that delay is of high motivational significance to children with ADHD. Yet further investigation is needed to explore the specificity of delay aversion, as it also seems to be of importance to children with oppositional problems. Further to this, findings from this study indicate that the motivational significance of delay may be primarily related to anger/annoyance rather than anxiety in children with ADHD. The findings are

limited however by lack of data supporting the validity or reliability of these techniques, suggesting that further replication and piloting needs to be carried out.

If children with ADHD are more likely to interpret situations as involving delay, this may be more likely to lead to emotional and behavioural patterns related to delay, which were noted in this study as being: frustration, boredom, disruption and displacement. Whilst the immediate effect of disruption and displacement is to reduce the perception of delay, employment of these behaviours could in turn lead to task disengagement and goals in a situation being delayed, thus reinforcing their original bias. This suggestion indicates a role for interpretational biases in the maintenance of behaviours associated with the symptoms of ADHD. The clinical implication of this is that targeting biased interpretations of delay may reduce these emotional and behavioural outcomes. If however, further studies continued to find that ADHD children were not more biased towards selecting inappropriate responses to delay, despite interpreting delay more often, yet continued to behave inappropriately, this may represent a skill deficit in enacting appropriate responses, suggesting that therapeutic intervention may be better targeted at skills training.

These findings, although preliminary and exploratory, suggest that investigating delay aversion in ADHD using an information processing framework may provide further information about the underlying mechanisms of this disorder, factors that relate to its maintenance, and areas which may be useful to target in it's treatment.

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## *Tables*

***Table 1:*** **Means for Age, IQ, Basic Reading and RCMAS scores (standard deviation in brackets)**

| | CONTROL (n23) | ADHD (n26) | COMORBID (n24) | OPPOSITIONAL (n12) |
|---|---|---|---|---|
| AGE IN MONTHS | 117.13 (8.81) | 120.85 (14.3) | 128.08 (12.43) | 134.5 (12.25) |
| ESTIMATED FULL SCALE IQ | 104.87(12.27) | 100.92 (16.67) | 93.85 (10.83) | 88.75 (11.29) |
| WORD SCORE | 100.48 (14.41) | 99.46 (14.58) | 89.67 (12.19) | 91.67 (9.49) |
| RCMAS TOTAL SCORE | 47.17 (10.26) | 52.77 (12.78) | 54.86 (10.64) | 47.83 (7.83) |
| PHYSIOLOGICAL SUBSCALE | 8.78 (2.66) | 10.42 (3.87) | 10.75 (3.34) | 10.08 (2.81) |
| WORRY SUBSCALE | 8.91 (2.57) | 9.81 (3.96) | 10.42 (3.13) | 7.75 (2.49) |
| SOCIAL SUBSCALE | 8.57 (3.04) | 10.58 (2.74) | 11.29 (3.43) | 9.5 (2.39) |
| LIE SUBSCALE | 10.04 (2.25) | 8.88 (3.02) | 7.67 (2.68) | 8.67 (2.15) |

***Table 2:*** **Means and Standard Deviations for performance on the SDQ (standard deviation in brackets, total number of participants recruited to each group in italics)**

| | CONTROL *23* | | ADHD *26* | | COMORBID *24* | | OPPOSITIONAL *12* | |
|---|---|---|---|---|---|---|---|---|
| | Parents (n21) | Teachers (n16) | Parents (n24) | Teachers (n21) | Parents (n21) | Teachers (n23) | Parents (n12) | Teachers (n10) |
| TOTAL DIFFICULTIES | 5.24 (3.49) | 5.5 (3.78) | 24.42 (5.76) | 14.9 (7.28) | 27.38 (4.67) | 19.96 (5.97) | 18.75 (4.31) | 18.5 (5.58) |
| PROSOCIAL | 8.9 (1.09) | 7.36 (1.86) | 6.92 (1.84) | 9.52 (6.7) | 5.05 (2.25) | 5.74 (3.84) | 6.5 (1.78) | 4.9 (2.07) |
| HYPERACTIVITY | 2.95 (1.69) | 3.0 (1.93) | 9.04 (1.4) | 6.57 (2.89) | 9.24 (1.14) | 8.08 (2.23) | 6.67 (2.61) | 6.2 (3.26) |
| EMOTIONAL | 1.0 (1.79) | 1.13 (1.63) | 5.25 (2.66) | 2.33 (2.22) | 5.9 (2.3) | 3.43 (2.4) | 2.83 (1.95) | 3.5 (2.68) |
| CONDUCT | 0.57 (0.87) | 0.44 (0.73) | 5.29 (2.31) | 2.19 (1.99) | 6.81 (1.69) | 4.43 (2.43) | 4.92 (2.06) | 5.6 (1.5) |
| PEER PROBLEMS | 0.76 (1.04) | 0.94 (1.39) | 4.83 (2.06) | 3.8 (2.8) | 5.43 (2.44) | 4.0 (2.34) | 4.33 (1.72) | 3.2 (2.04) |

*Table 3:* **Mean response times in dot probe experiment (standard deviation in brackets)**

| GRP | DELAY | | | | SOCIAL THREAT | | | | PHYSICAL THREAT | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *TL 1* | | TL 2 | | TL 1 | | TL 2 | | TL 1 | | TL 2 | |
| | PP 1 | PP 2 | PP 1 | PP 2 | PP 1 | PP 2 | PP 1 | PP 2 | PP 1 | PP 2 | PP 1 | PP 2 |
| CN (n 21) | 628.72 (228.56) | 631.56 (232.34) | 606.25 (219.87) | 622.32 (222.17) | 610.97 (187.57) | 629.59 (234.63) | 600.46 (192.93) | 585.46 (183.84) | 606.13 (201.36) | 600.32 (210.34) | 596.48 (174.11) | 616.66 (227.57) |
| AD (n 23) | 669.45 (294.27) | 699.06 (314.53) | 670.92 (304.41) | 752.92 (361.29) | 750.19 (382.78) | 695.24 (299.46) | 656.44 (308.50) | 677.09 (254.15) | 666.95 (326.16) | 701.65 (266.72) | 690.75 (361.90) | 699.40 (322.44) |
| CM (n 17) | 681.45 (330.75) | 701.99 (347.57) | 640.31 (288.88) | 630.48 (268.20) | 633.66 (264.31) | 663.74 (298.58) | 639.92 (274.61) | 612.19 (259.57) | 673.67 (312.05) | 653.16 (310.09) | 611.92 (238.41) | 574.12 (177.30) |
| OP (n10) | 539.38 (222.80) | 556.84 (265.62) | 532.20 (247.26) | 597.25 (316.21) | 554.14 (201.98) | 584.76 (224.17) | 534.52 (216.51) | 570.60 (241.64) | 523.64 (186.03) | 597.84 (257.43) | 510.48 (226.03) | 558.07 (203.12) |

Key: CN= control , AD= ADHD, CM=comorbid, OP= oppositional,

TL1= target word location top of the screen, TL2= target word location bottom of the screen,

PP1= probe position top of the screen, PP2= probe position bottom of the screen

***Table 4:*** **Mean attentional bias indices, and standard deviations for dot probe experiment (standard deviation in brackets)**

| Group | Word Type | | |
|---|---|---|---|
| | Delay | Social Threat | Physical Threat |
| Control (n21) | -13.33 (65.97) | 16.85 (45.40) | -7.01 (63.70) |
| ADHD (n23) | -23.79 (104.41) | -32.74 (63.81) | 5.21 (96.63) |
| Comorbid (n17) | 19.88 (64.59) | 31.41 (66.29) | 10.23 (86.81) |
| Oppositional (n10) | -22.31 (94.71) | 8.38 (68.03) | 22.79 (111.51) |

***Table 5*** **Means and standard deviations of word ratings (standard deviation in brackets)**

| Group | Word Type | | | |
|---|---|---|---|---|
| | Neutral | Delay | Social Threat | Physical Threat |
| Control (n15) | 1.73 (0.40) | 2.02 (0.57) | 3.04 (0.96) | 4.1 (0.82) |
| ADHD (n22) | 2.10 (0.66) | 1.90 (0.71) | 3.49 (0.89) | 4.27 (0.81) |
| Comorbid (n24) | 1.93 (0.52) | 1.92 (0.71) | 3.50 (0.68) | 4.35 (0.70) |
| Oppositional (n11) | 2.01 (0.45) | 2.20 (0.67) | 3.18 (0.91) | 4.18 (0.68) |

Table 6 *Means and Standard deviations of the total number of generated and fixed choice interpretations which corresponded with construct for each group(standard deviation in brackets).*

| Response type | Diagnostic Group | Ambiguous Situation Type | | |
|---|---|---|---|---|
| | | Delay | Social Threat | Physical Threat |
| Generated | Control (n 11) | 1.91(0.94) | 2.21 (0.79) | 0.73 (0.65) |
| | ADHD (n 20) | 2.55 (0.51) | 1.85 (1.18) | 0.90 (0.72) |
| | Comorbid (n 19) | 2.42 (0.51) | 2.53 (0.61) | 0.58 (0.51) |
| | Oppositional (n 8) | 2.75 (0.46) | 2.25 (1.04) | 0.75 (0.71) |
| Fixed Choice | Control (n 14) | 2.07 (0.62) | 1.93 (0.83) | 1.21 (0.89) |
| | ADHD (n 22) | 2.32 (0.78) | 2.00 (0.93) | 1.09 (0.81) |
| | Comorbid (n 23) | 2.13 (0.76) | 2.13 (1.06) | 0.78 (0.80) |
| | Oppositional (n 12) | 2.08 (0.67) | 1.67 (1.23) | 0.75 (0.62) |

Table 7 *Means and standard deviations of the total number of emotions endorsed (standard deviation in brackets)*

| Ambiguous Situation Type | Feelings | Diagnostic Group | | | |
|---|---|---|---|---|---|
| | | Control (n14) | ADHD (n21) | Comorbid (n 23) | Oppositional (11) |
| Delay | Angry | 1.29(0.91) | 0.81(0.93) | 1.22 (0.95) | 1.09 (0.94) |
| | Anxious | 0.21 (0.43) | 0.01 (0.30) | 0.004(0.21) | 0.0 (0.0) |
| | Upset | 0.43 (0.65) | 0.38 (0.50) | 0.22 (0.60) | 0.01 (0.30) |
| | Okay | 0.71 (0.83) | 0.86 (1.01) | 1.17 (0.83) | 1.27 (0.79) |
| | Bored | 0.71 (0.99) | 0.86 (1.11) | 0.39 (0.58) | 0.45 (0.69) |
| | Embarrassed | 0.00 (0.00) | 0.01 (.030) | 0.004(0.21) | 0.00 (0.00) |
| Social Threat | Angry | 0.79 (0.89) | 0.90 (0.89) | 1.26 (1.00) | 0.82 (0.98) |
| | Anxious | 0.50 (0.52) | 0.43 (0.51) | 0.17 (0.39) | 0.01 (0.30) |
| | Upset | 1.07 (0.83) | 1.05 (0.80) | 0.96 (1.02) | 0.55 (0.69) |

| | | | | | |
|---|---|---|---|---|---|
| | Okay | 0.57 (0.85) | 0.52 (0.75) | 0.70 (0.93) | 1.18 (0.87) |
| | Bored | 0.00 (0.00) | 0.005(0.22) | 0.004(0.21) | 0.00 (0.00) |
| | Embarrassed | 0.14 (0.36) | 0.01 (0.30) | 0.00 (0.00) | 0.01 (0.30) |
| Physical Threat | Angry | 0.79 (0.80) | 0.57 (0.68) | 0.65 (0.57) | 0.55 (0.69) |
| | Anxious | 0.79 (0.98) | 0.66 (0.80) | 0.26 (0.45) | 0.45 (0.69) |
| | Upset | 0.29 (0.47) | 0.33 (0.48) | 0.30 (0.47) | 0.36 (0.50) |
| | Okay | 1.07 (0.83) | 1.10 (0.89) | 1.39 (0.89) | 1.36 (0.92) |
| | Bored | 0.00 (0.00) | 0.005(0.22) | 0.004(0.21) | 0.00 (0.00) |
| | Embarrassed | 0.00 (0.00) | 0.005(0.22) | 0.009(0.29) | 0.00 (0.00) |

Table 8 *Mean proportion of emotions endorsed for each scenario type given interpretation of delay or threat. (standard deviation in brackets)*

| | Feelings | Diagnostic Group | | | |
|---|---|---|---|---|---|
| | | Control (n14) | ADHD (n21) | Comorbid (n 23) | Oppositional (11) |
| Delay | Angry | 38.83(29.63) | 35.59 (38.02) | 44.17 (40.43) | 33.25 (36.92) |
| | Anxious | 9.67 (17.98) | 1.5 (7.03) | 2.17 (10.43) | 0.0 (0.0) |
| | Upset | 19.42 (25.48) | 13.55 (18.90) | 5.83 (19.30) | 4.17 (14.43) |
| | Okay | 15.25 (22.96) | 15.14 (31.66) | 21.70 (32.35) | 31.92 (38.57) |
| | Bored | 33.33 (38.92) | 42.45 (45.94) | 20.26 (32.15) | 26.42 (35.18) |
| | Embarrassed | 0.00 (0.00) | 2.27 (10.66) | 4.35 (20.85) | 0.00 (0.00) |
| Social Threat | Angry | 33.29 (37.26) | 46.70 (38.38) | 45.36 (33.48) | 28.43 (35.61) |
| | Anxious | 16.57 (21.43) | 16.50 (17.39) | 7.55 (17.21) | 0.00 (0.00) |
| | Upset | 54.56 (31.60) | 43.30 (30.72) | 47.00 (37.21) | 40.43 (35.88) |
| | Okay | 7.14 (18.90) | 0.00 (0.00) | 4.54 (15.07) | 4.71 (12.47) |
| | Bored | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) |
| | Embarrassed | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) | 14.29 (37.80) |
| Physical Threat | Angry | 21.43 (39.34) | 11.60 (19.24) | 31.73 (38.14) | 38.14 (48.83) |
| | Anxious | 57.14 (53.45) | 56.70 (43.89) | 30.27 (40.01) | 28.57 (48.80) |
| | Upset | 21.43 (39.34) | 15.00 (33.75) | 12.09 (21.17) | 19.00 (37.76) |
| | Okay | 0.00 (0.00) | 0.00 (0.00) | 4.55 (15.08) | 14.29 (37.80) |
| | Bored | 0.00 (0.00) | 10.00 (31.62) | 0.00 (0.00) | 0.00 (0.00) |
| | Embarrassed | 0.00 (0.00) | 10.00 (31.62) | 0.00 (0.00) | 0.00 (0.00) |

Table 9 *Means and standard deviations of the total number of responses endorsed for each group in each scenario type (standard deviation in brackets)*

| Situation Type | Responses | Control (n14) | ADHD (n22) | Comorbid (n 23) | Oppositional (12) |
|---|---|---|---|---|---|
| Delay | Wait | 1.29 (0.91) | 1.32 (0.95) | 0.70 (0.93) | 1.33 (1.23) |
| | Disruptive | 0.36 (0.63) | 0.68 (0.72) | 0.61 (0.78) | 0.17 (0.39) |
| | Displacement | 0.71 (0.83) | 0.59 (0.73) | 0.91 (1.12) | 0.67 (0.79) |
| | Pro –social | 0.36 (0.63) | 0.23 (0.43) | 0.43 (0.59) | 0.50 (0.52) |
| Social Threat | Pro-Social | 2.43 (0.65) | 1.19 (0.93) | 1.35 (0.98) | 1.5 (1.0) |
| | Aggressive | 0.21 (0.43) | 0.48 (0.87) | 0.91 (0.85) | 0.75 (0.87) |
| | Avoidant | 0.43 (0.51) | 1.24 (0.70) | 0.74 (0.81) | 0.75 (0.75) |
| Physical Threat | Pro-Social | 2.50 (0.76) | 1.86 (0.91) | 1.91 (0.90) | 1.83 (0.94) |
| | Aggressive | 0.14 (0.36) | 0.38 (0.59) | 0.52 (0.67) | 0.50 (0.67) |
| | Avoidant | 0.29 (0.61) | 0.57 (0.51) | 0.39 (0.50) | 0.58 (0.67) |

***Table 10*** **Proportion of responses endorsed given an interpretation of delay or threat (standard deviation in brackets)**

| Situation Type | Responses | Control (n14) | ADHD (n22) | Comorbid (n 23) | Oppositional (12) |
|---|---|---|---|---|---|
| Delay | Wait | 46.36 (34.73) | 37.86 (38.60) | 26.78 (38.86) | 40.25 (41.72) |
| | Disruptive | 11.86 (20.01) | 30.27 (33.63) | 19.57 (29.60) | 2.75 (9.52) |
| | Displacement | 23.79 (25.07) | 25.68 (31.57) | 31.13 (41.54) | 27.83 (29.67) |
| | Pro –social | 3.57 (13.36) | 1.50 (7.04) | 3.61 (12.23) | 13.83 (21.06) |
| Social Threat | Pro-Social | 73.08 (33.73) | 29.15 (34.16) | 34.95 (36.27) | 33.33 (44.13) |
| | Aggressive | 8.92 (17.42) | 19.15 (33.90) | 31.65 (30.59) | 35.11 (32.75) |
| | Avoidant | 20.46 (31.27) | 48.30 (29.63) | 30.75 (32.13) | 31.55 (30.65) |
| Physical Threat | Pro-Social | 50.00 (50.00) | 28.82 (42.25) | 9.5 (27.49) | 25.00 (46.29) |
| | Aggressive | 14.29 (37.80) | 22.73 (41.01) | 45.21 (45.97) | 45.88 (50.22) |
| | Avoidant | 28.57 (48.80) | 39.36 (43.64) | 23.79 (37.38) | 16.62 (35.61) |

# APPENDICES

# APPENDIX 1 –

# INSTRUCTIONS FOR CONTRIBUTORS

# JOURNAL OF CHILD PSYCHOLOGY AND PSYCHIATRY

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2. *Abstract*: The abstract should not exceed 300 words.
3. *Acronyms*: In order to aid readers, we encourage authors who are using acronyms for tests or abbreviations not in common usage to provide a list to be printed after the abstract.
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5. *Acknowledgements*: These should appear on a separate sheet at the end of the text of the paper, before the References.

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(a) *References in text.*

References in running text should be quoted as follows: Smith and Brown (1990), or (Smith, 1990), or (Smith, 1980, 1981a, b), or (Smith & Brown, 1982), or (Brown & Green, 1983; Smith, 1982).

For up to five authors, all surnames should be cited the first time the reference occurs, e.g. Smith, Brown, Green, Rosen, and Jones (1981) or (Smith, Brown, & Jones, 1981). Subsequent citations should use "et al." (not underlined and with no period after the "et"), e.g. Smith et al. (1981) or (Smith et al., 1981).

For six or more authors, cite only the surname of the first author followed by "et al." and the year for the first and subsequent citation. Note, however, that **all** authors are listed in the Reference List.

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Full references should be given at the end of the article in alphabetical order, and not in footnotes. **Double spacing** must be used.

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References to books should include the authors' surnames and initials, the full title of the book, the place of publication, the publisher's name and the year of publication.

References to articles, chapters and symposia contributions should be cited as per the examples below:

Kiernan, C. (1981). Sign language in autistic children. *Journal of Child Psychology and Psychiatry, 22,* 215–220.

Jacob, G. (1983a). Development of coordination in children. *Developmental Studies, 6,* 219–230.

Jacob, G. (1983b). Disorders of communication. *Journal of Clinical Studies, 20,* 60–65.

Thompson, A. (1981). *Early experience: The new evidence.* Oxford: Pergamon Press.

Jones, C. C., & Brown, A. (1981). Disorders of perception. In K. Thompson (Ed.), *Problems in early childhood* (pp. 23–84). Oxford: Pergamon Press.

Use Ed.(s) for Editor(s); ed. for edition; p.(pp.) for page(s); Vol. 2 for Volume 2.

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These should be constructed so as to be intelligible without reference to the text. The approximate location of figures and tables should be clearly indicated in the text. Figures will be reproduced directly from the author's original drawing and photographs, so it is essential that they be of professional standard. Computer generated figures must be laser printed. Illustrations for reproduction should normally be twice the final size required. Half-tones should be included only when essential, and they must be prepared on glossy paper and have good contrast. All photographs, charts and diagrams should be referred to as "Figures" and numbered consecutively in the order referred to in the text. Figure legends should be typed on a separate page.

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# APPENDIX 2

## DOT-PROBE - INSTRUCTIONS FOR PARTICIPANTS AND TARGET W0RDS

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Telephone +44 (0)23 8059 5000
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Email

29th August 2000

Claire Deacon
Department of Clinical Psychology
University of Southampton
Highfield
Southampton SO17 1BJ

Dear Claire,

**Re: Application for Ethical Approval**

I am writing to confirm you that your ethical application titled "Pilot study of words to be used in Dot Probe investigating attentional and attributional biases towards delay in children with ADHD" has been given approval by the department.

Should you require any further information, please do not hesitate in contacting me on (023) 80 593995.

Yours sincerely,

Kathryn Smith
Ethical Secretary

## INSTRUCTIONS FOR DOT PROBE

You are going to see words shown on the computer screen, two at a time. The words will appear one above the other in the middle of the screen. You must read the top word out aloud as soon as it appears. The words will disappear after about one second.

Then, a small cross will appear where the top word was, or where the bottom words as. When you see the cross, you must press a button as fast as you can – the top one if the cross appeared where the top word was, and the bottom on if the cross appears where the bottom word was. You must press as fast as you can because e the computer programme will time how long it takes you to press the button, but you must also be careful to press the right button, because the computer records whether you pressed the right button or not.

You will need to watch the screen carefully for about five minutes, some of the words you see will be repeated, But it's important to keep reading. So there are two things you have to do; 1) read the top word out aloud as soon as it appears, and 2) press the button as fast as you can after you have seen the cross.

Do you understand? Lets have a practice.

Target Words used in the dot probe

| DELAY | SOCIAL | PHYSICAL |
|---|---|---|
| Stop | Fool | Painful |
| Stay | Dumb | Hurt |
| Afterwards | Hated | Bleeding |
| Later | Stupid | Danger |
| Slow | Lonely | Injury |
| Halt | Teased | Death |

# APPENDIX 3

# SUMMARY OF PILOT STUDY INVESTIGATING DELAY WORDS

## Do Hyperactive Children Pay more attention to delays and waiting?
## Consent Form for Research Participants

**Information Sheet**

Dear Parent

I am Claire Deacon, a Trainee Clinical psychologist from the University of Southampton. I am requesting permission for your child to participate in a pilot study for my dissertation regarding how hyperactive children process delay information. As part of this dissertation I need to carry out a pilot study with randomly selected school children in order to develop a short list of words that children associate with delays or waiting. This study will take about five minutes and will involve me asking your child, in school, to rate a list of words for how much they are associated with waiting.

Personal information will not be released to or viewed by anyone other than researchers involved in this project. Results of this study will not include your name or any other identifying characteristics. Your child's participation is voluntary and you or they may withdraw your participation at any time. I will also be asking your child to consent verbally

If you have any questions now or later, or would like to find out the results of the pilot study, or the dissertation I am carrying out please contact me, Claire Deacon at University of Southampton tel: 02380 595331 email: clairedeaco@hotmail.uk. If you want your child to participate please return this form to your child's teacher as soon as possible. Thank you for your time and consideration,

Sincerely,

*Claire Deacon, Trainee Clinical Psychologist*

**Statement of Consent**

I _____ have read the above informed consent form.

I understand that I may withdraw my consent and discontinue my child's participation at any time without penalty or loss of benefit to myself. I understand that data collected as part of this research project will be treated confidentially, and that published results of this research project will maintain my confidentially. In signing this consent letter, I am not waiving my legal claims, rights, or remedies. A copy of this consent letter will be offered to me.

**(Circle Yes or No)**

I give consent to participate in the above study. Yes No

Signature Date

Name

I understand that if I have questions about my child's rights as a participant in this research, or if I feel that my child or I have been placed at risk, I can contact the Chair of the Ethics Committee, Department of Psychology, University of Southampton, Southampton, SO17 1BJ.

Phone: (02380) 59 2612.

Summary of Pilot Study Investigating Delay Words

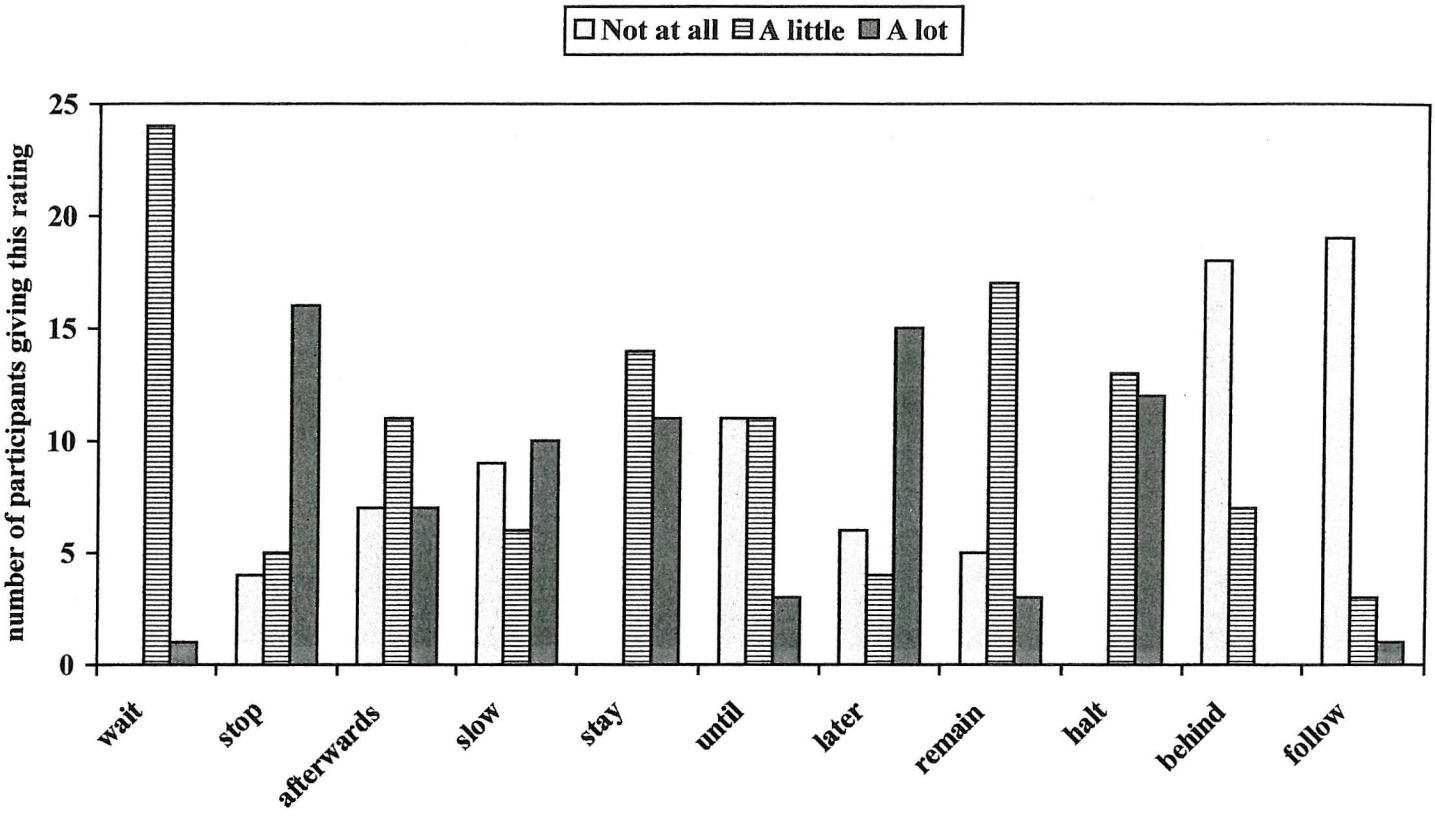
*Background*: Following from Sonuga-Barke, Hayes and Bareham (2001) acknowledgement of the limitations of their cues for delay I felt it wasn't clear whether all of the words used were related to delay, or how much children would equate them with waiting. However an effect had been found with these words on their dot-probe task, for the purposes of replication, given that I was changing dot-probe paradigm, I felt it was important not to introduce new cues. I therefore needed to find which of the cues were most related to having to wait.

*Aim*: To investigate which words used as delay cues in Sonuga-Barke, Hayes and Bareham's (2001) study were related to delay, or having to wait, in a normal population.

*Method*: Participants were 25 boys, aged between 8 and 12 years recruited through a local school and sports clubs. Information letters were sent home to parents, or handed out at the clubs. Children were seen in a quiet room to avoid distractions. First they were asked a question about listening as an ice breaker, and to get them used to the format of the question. Then they were told about situations that would involve waiting, and asked what they would be doing in those situations, this was to check they understood the concept of waiting. They were then asked to suggest some other situations they might have to wait in. Following this they were asked to rate the words used in Sonuga-Barke et.al.'s study (minus the word wrong, which was also used as a target word in the social threat category) for how much they would mean someone would want them to wait. Following this participants were thanked for taking part.

*Results:*

Figure 1. Total number of endorsements of how much the cue words related to waiting




The six most highly rated words: halt, stop, afterwards, stay, later, and slow were used for the Dot-probe task in the study.

Generated waiting situations

The participant's responses (reported verbatim) seemed to cluster into the following categories:

*Waiting for the teacher/other pupils*

To show my work, teacher to finish, to get on the computers, teacher marking other peoples work, to get in the IT room, other children to finish

*Going out to Play*

For the bell to go for play, going out to play, to go out, for break time,

*Transport*

For the bus, traffic jam (x2), in the car, at the bus stop, when the bus is late, for the traffic lights,

*Shopping*

At the shops (x2), for mum to finish shopping, in Tescoes, mum talking to friends at the shops,

*Food*

Dinner (x2), for my tea, food

*Miscellaneous*

Bed, Doctors, If people have been talking in line, Brothers on playstation and I want to play, Detention, For something to arrive, Dad to come home

Ambiguous situations for delay, and waiting/not waiting interpretations were developed for: waiting at school, waiting for mum, waiting for the bus.

# Verbal Script & Survey for Research Participants

My name's Claire I'm a university student, and I'm doing a project about whether certain words mean that you have to wait. I'd like to ask you a few questions if that's alright. It will take between five and ten minutes. You don't have to take part if you don't want to, and if you want to stop at any time, just tell me and that will be okay. Have you got any questions?

Okay, shall we start then?
To begin with I've got a couple of questions for you about what you might be doing in certain situations,
First of all, imagine that the teacher is telling a story, or the radio is on. In both of these situations what would you be doing? (Answer : listening)

Okay, now imagine that you have finished your work at school and everyone else is still working, or that you're standing in a queue. In both of these situations what would you be doing? (Answer: waiting)

In what other situations might you be waiting?

Okay, now I'm going to say some words, and I want you to tell me, if someone said these words to you how much they'd want you to wait, whether it would be not at all, a little or a lot. There are no right or wrong answers; I'm just interested in what you think. Is that okay?

So if someone said the word ( word from word list below) how much would they want you to wait? Not at all, a little or a lot?
*Continue with all words in word list.*

**Word List:**

| | **Not at all** | **A little** | **A lot** |
|---|---|---|---|
| **Wait** | | | |
| **Stop** | | | |
| **Afterwards** | | | |
| **Slow** | | | |
| **Stay** | | | |
| **Until** | | | |
| **Later** | | | |
| **Remain** | | | |
| **Halt** | | | |
| **Behind** | | | |
| **Follow** | | | |

Thank you very much for helping me, this has helped me with my project a lot.

# APPENDIX 4

# WORD-RATING SCALE,

# INSTRUCTIONS FOR PARTICIPANTS,

# AND COPYOF SCALE

## INSTRUCTIONS FOR WORD LIST

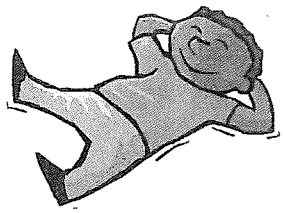
Now I've got a list of words for you, and I want you to tell me whether they're worrying words or calm words.

You can see on the top of the list, that there's a picture of a calm man, and a worried man, this is to help you remember.

If the words are really worrying score them as 5 by ticking in the five column here, if they're a bit worrying tick in the column under 3, and if they're really calm, tick in the column under the number 1.

Remember, there are no right or wrong answers, the best answer is the one you give. If you're not sure what the words mean, it's good to ask me, is that okay? Shall we start then?

(Put a star by any words, that the participant is unsure of)



**calm**

**worrying**

**1 2 3 4 5**

| | 1 | 2 | 3 | 4 | 5 | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Painful | | | | | | Coffee | | | | | |
| Halt | | | | | | Reach | | | | | |
| Sleep | | | | | | Hated | | | | | |
| Rope | | | | | | Give | | | | | |
| Mountain | | | | | | Hill | | | | | |
| Teased | | | | | | Injury | | | | | |
| Grass | | | | | | Road | | | | | |
| Background | | | | | | Hammer | | | | | |
| Stop | | | | | | Later | | | | | |
| Monkey | | | | | | Danger | | | | | |
| Lonely | | | | | | Juggle | | | | | |
| Hurt | | | | | | Trip | | | | | |
| Tree | | | | | | Stupid | | | | | |
| Dumb | | | | | | Death | | | | | |
| Afterwards | | | | | | Bottle | | | | | |
| Bleeding | | | | | | Fool | | | | | |
| Balloon | | | | | | Slow | | | | | |
| Stay | | | | | | Fill | | | | | |

# APPENDIX 5

# AMBIGUOUS SITUATIONS,

# INSTRUCTIONS FOR PARTICIPANTS,

# AND COPY OF INTERVIEW SCHEDULE

SITUATIONS

1.
You see the Head Teacher walking around the playground and she/he has been asking other children where you are.

WHAT DO YOU THINK IS MOST LIKELY TO HAVE HAPPENED? (Why do you think the head teacher is looking for you)

Which of the following explanations do you think is most likely?

a) She/he has a message for you
b) The headteacher thinks you have done something wrong and is angry.
c) She wants to tell you she has noticed you are working harder and that she is pleased
d) One of the other children has told the teachers something bad about you.

HOW ARE YOU FEELING?
WHAT WILL YOU DO ABOUT IT (What will you do now that you know that the head teacher is looking for you?)

2.
On the way to school you start to feel funny in the tummy.
WHAT DO YOU THINK IS MOST LIKELY TO HAVE HAPPENED? (why do you think you feel funny in the tummy?)

Which of the following explanations do you think is most likely?

a) There is something wrong with your stomach and you will need a really big operation
b) You ate some bad food and are going to be really sick at school.
c) You didn't have enough breakfast and should have a bit of your school lunch when you get to school.
d) It is okay and it will go away soon.

HOW WOULD YOU FEEL?
WHAT WILL YOU DO?

3.
You are at the shops with your mum, when you see her talking to someone.
WHAT DO YOU THINK IS MOST LIKELY TO BE HAPPENING?

Which of the following explanations do you think is most likely?

a) She has met up with a friend a she will be chatting for a while, you will have to wait for her.
b) Someone is asking her the time.
c) She is asking whereabouts something is.
d) She is talking to a shop assistant

HOW WILL YOU FEEL?
WHAT WILL YOU DO?

4.
You see a group of children from another class playing a great game. You walk over and want to join in and you hear them laughing.
WHAT DO YOU THINK IS MOST LIKELY TO HAPPEN NEXT?

Which of the following are most likely to happen next?

a) They are going to start looking at you and telling secrets about you.
b) They will soon ask you to join in.
c) One of them is likely to rush up and push you away.
d) They are going to notice you and smile

HOW WILL YOU FEEL?
WHAT WILL YOU DO?

5.
You want to use the computers at school, but they are already being used.
WHAT DO YOU THINK IS MOST LIKELY TO HAPPEN NEXT?

Which of the following is most likely to happen next?

a) The children using the computers are just finishing what they're doing and you will be able to use the computers straightaway.
b) The teacher will tell you you have to wait for a while.
c) The teacher will tell the other children to stop using the computer so that you can use it.
d) The children using the computer have fallen behind on their work, you will have to wait a long time until they're finished.

HOW WILL YOU FEEL?
WHAT WILL YOU DO?

6.
You are walking to a friends house and a big dog comes up.
WHAT DO YOU THINK IS MOST LIKELY TO HAVE HAPPENED? (Why do you think the big dog has come up to you?)

Which of the following explanations do you think is most likely?

a) The dog thinks you are a burglar and will chase you
b) The do is happy to have visitors and is saying hello
c) The dog doesn't know you and will probably bite you if you move
d) The dog is wagging his tail and wants a pat

HOW WILL YOU FEEL?
WHAT WILL YOU DO?

7.
Do you have a dog? If not pretend you do for the next situation.
It's Saturday and you're playing inside and your dog starts barking and growling
WHAT DO YOU THINK IS MOST LIKELY TO HAVE HAPPENED?
(Why do you think the dog is barking?)

Which of the following explanations do you think is most likely?

a) There is just another dog walking past
b) The cat is eating the dog's food
c) There is someone you don' t know trying to get into your house
d) The bike was left near the gate and someone is stealing it

HOW WILL YOU FEEL?
WHAT WILL YOU DO?

8,
You are showing your school project in front of the class and two pupils up the back are giggling
WHAT DO YOU THINK IS MOST LIKELY TO HAVE HAPPENED? (Why do you think they are giggling?)

Which of the following do you think is most likely?

a) They think the project is really dumb
b) They are being silly and tickling each other
c) Another kid is making funny faces at them.
d) There is a big stain on your uniform and they are laughing at you

HOW WILL YOU FEEL?
WHAT WILL YOU DO?

9.
You're at a bus stop and the bus hasn't arrived.
WHAT DO YOU THINK IS MOST LIKELY TO HAVE HAPPENED?
(why hasn't the bus arrived)

Which of the following explanations do you think is most likely?

a) You've just missed the bus and you'll have to wait a long time until the next one arrives
b) The bus is slightly late and will be here in a minute
c) You've arrived slightly early for the bus
d) The bus is stuck in a traffic jam and you will have to wait a long time for it to arrive.

HOW WILL YOU FEEL?
WHAT WILL YOU DO?

## INSTRUCTIONS FOR AMBIGUOUS SITUATIONS

Now I am going to tell you about some situations you might find yourself in and ask you what you would think about them.

For some of these situations you will have to imagine what it would be like, while others you may have already experienced or been in. The important thing is that you tell me what you would really think in that situation and what you would really do in that situation. Remember, this is not like an exam because there are no right or wrong answers, the best answer is the one that you give, okay, do you understand?

Sometimes when I say things you might not understand the meaning of something, or you might not be able to remember what I have said. It's okay to ask me to explain something and it's good to ask me to say things again.

Okay, you happy with all of that? Good, lets start then.

*While working with child:*
*-emphasise that you are a team, working together,*
*-On first item, explain clearly the part on 'explanations' :- "That's a really good answer (name), now I'm going to tell you some other kinds of answers or explanations, and all you have to do is pick which one you think is most likely.*
*-Praise the child regardless of type of answer*
*-If a child always keeps responding with the last item, check in case the child can not remember the earlier items, e.g. "how about I read those again and you can check to see if you don't prefer one of the other options".*

# APPENDIX 6

# FURTHER STATISTICAL ANALYSIS

Between group differences on the Parents SDQ: Results from MANOVA

| | DEPENDENT VARIABLE | DEGREES OF FREEDOM | ERROR | F | SIGNIFICANCE. |
|---|---|---|---|---|---|
| GROUP | total difficulties | 3 | 74 | 92.07 | .000 |
| | pro social | 3 | 74 | 16.44 | .000 |
| | hyperactivity | 3 | 74 | 67.03 | .000 |
| | emotional | 3 | 74 | 21.00 | .000 |
| | conduct | 3 | 74 | 46.02 | .000 |
| | peer problems | 3 | 74 | 25.36 | .000 |

Between group differences on the Teachers SDQ: Results from MANOVA

| | DEPENDENT VARIABLE | DEGREES FREEDOM | ERROR | F | SIGNIFICANCE |
|---|---|---|---|---|---|
| GROUP | Total *Difficulties* | 3 | 66 | 20.06 | .000 |
| | Prosocial | 3 | 66 | 3.61 | .018 |
| | Hyperactive | 3 | 66 | 12.76 | .000 |
| | Emotion | 3 | 66 | 4.02 | .011 |
| | Conduct | 3 | 66 | 21.69 | .000 |
| | Peer Problems | 3 | 66 | 6.66 | .001 |

Correlations between proportion of emotion type and response type endorsed for delay scenarios given an interpretation of delay on fixed choice.

| | Angry | Upset | Anxious | Okay | Bored | Embarrassed |
|---|---|---|---|---|---|---|
| Pro-social | -.007 | .221 | -.111 | -.073 | .002 | -.071 |
| Waiting | *-.231 | .049 | -.003 | **.306 | -.114 | .190 |
| Disruptive | **.402 | .217 | .016 | **-.323 | -.162 | -.122 |
| Displacement | -.051 | -.130 | -.098 | .024 | *.271 | .008 |

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

Correlations between proportion of emotion type and response type endorsed for social threat scenarios given an interpretation of social threat on fixed choice.

| | Angry | Upset | Anxious | Okay | Bored | Embarrassed |
|---|---|---|---|---|---|---|
| Prosocial Correlation Coefficient | -.089 | .151 | -.048 | -.043 | .165 | .067 |
| Avoidant Correlation Coefficient | -.017 | -.078 | .025 | -.047 | -.133 | .057 |
| Aggressive Correlation Coefficient | .206 | -.055 | .065 | .053 | -.100 | -.146 |

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

Correlations between proportion of emotion type and response type endorsed for Physical Threat Scenarios given an interpretation of physical threat on fixed choice.

| | Angry | Upset | Anxious | Okay | Bored | Embarrassed |
|---|---|---|---|---|---|---|
| Prosocial Correlation Coefficient | -.163 | .146 | .151 | -.143 | -.100 | -.100 |
| Avoidant Correlation Coefficient | -.032 | .005 | .096 | .281 | -.121 | .241 |
| Aggressive Correlation Coefficient | *.373 | .027 | -.242 | -.174 | -.121 | -.121 |

* Correlation is significant at the .05 level (2-tailed).
** Correlation is significant at the .01 level (2-tailed).

Spearman's rho, correlation coefficients and significance levels, between scores on separate tasks.

| | | Attentional Bias | | | Word List | | | | Generated Interpretations | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Delay | Social Threat | Physical Threat | Delay | Social Threat | Physical Threat | Neutral | Delay | Social Threat | Physical Threat |
| Attentional Bias Scores | Delay | 1.000 | .046 | .053 | .094 | .147 | .124 | -.200 | -.221 | .247 | .214 |
| | | . | (.701) | (.659) | (.468) | (.258) | (.335) | (.121) | (.111) | (.059) | (.106) |
| | Social threat | .046 | 1.000 | -.165 | .164 | -.081 | -.009 | -.002 | .089 | .023 | .080 |
| | | (.701) | . | (.168) | (.204) | (.536) | (.948) | (.986) | (.527) | (.862) | (.551) |
| | Physical Threat | .053 | -.165 | 1.000 | -.112 | -.095 | -.191 | -.058 | .008 | .198 | -.249 |
| | | (.659) | (.168) | . | (.386) | (.466) | (.138) | (.658) | (.954) | (.133) | (.060) |
| Wordlist Rating | Delay | .094 | .164 | -.112 | 1.000 | *.261 | *.257 | **.413 | -.030 | .145 | .056 |
| | | (.468) | (.204) | (.386) | . | (.019) | (.020) | (.000) | (.811) | (.212) | (.634) |
| | Social Threat | .147 | -.081 | -.095 | *.261 | 1.000 | **.502 | **.418 | -.232 | -.102 | .032 |
| | | (.258) | (.536) | (.466) | (.019) | . | (.000) | (.000) | (.065) | (.382) | (.785) |
| | Physical Threat | .124 | -.009 | -.191 | *.257 | **.502 | 1.000 | **.392 | -.002 | -.041 | .072 |
| | | (.335) | (.948) | (.138) | (.020) | (.000) | . | (.000) | (.988) | (.725) | (.540) |
| | Neutral | -.200 | -.002 | -.058 | **.413 | **.418 | **.392 | 1.000 | -.058 | .038 | .037 |
| | | (.121) | (.986) | (.658) | (.000) | (.000) | (.000) | . | (.648) | (.749) | (.756) |
| Generated Interpretations for ambiguous situations | Delay | -.221 | .089 | .008 | -.030 | -.232 | -.002 | -.058 | 1.000 | -.089 | -.044 |
| | | (.111) | (.527) | (.954) | (.811) | (.065) | (.988) | (.648) | . | (.479) | (.731) |
| | Social Threat | .247 | .023 | .198 | .145 | -.102 | -.041 | .038 | -.089 | 1.000 | .009 |
| | | (.059) | (.862) | (.133) | (.212) | (.382) | (.725) | (.749) | (.479) | . | (.937) |
| | Physical Threat | .214 | .080 | -.249 | .056 | .032 | .072 | .037 | -.044 | .009 | 1.000 |
| | | (.106) | (.551) | (.060) | (.634) | (.785) | (.540) | (.756) | (.731) | (.937) | . |

** Correlation is significant at the .01 level (2-tailed). * Correlation is significant at the .05 level (2-tailed).

Spearman's rho, correlation coefficients and significance levels, between scores on the RCMAS and attentional bias scores.

| | | rcmas (anxiety scale) total score | rcmas physiological | rcmas worry | rcmas social | rcmas lie |
|---|---|---|---|---|---|---|
| | Delay | .221 | .190 | .207 | .068 | -.114 |
| Attentional | | (.079) | (.132) | (.101) | (.593) | (.370) |
| Bias score | SocialT | .009 | .052 | -.012 | .023 | -.087 |
| | Threat | (.943) | (.684) | (.927) | (.858) | (.496) |
| | Physical | .078 | .108 | -.043 | .177 | -.215 |
| | Threat | (.540) | (.397) | (.737) | (.162) | (.088) |

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

Spearman's rho, correlation coefficients and significance levels, between scores on the RCMAS and ratings of words on calm-worrying scale

| | | rcmas (anxiety scale) total score | rcmas physiological | rcmas worry | rcmas social | rcmas lie |
|---|---|---|---|---|---|---|
| Wordlist | Delay | .026 | .115 | -.014 | -.076 | .100 |
| word type. | | (.819) | (.307) | (.899) | (.500) | (.375) |
| | Social | .201 | *.221 | .150 | .088 | .158 |
| | Threat | (.073) | (.049) | (.184) | (.436) | (.161) |
| | Physical | *.245 | **.315 | .197 | .048 | -.125 |
| | Threat | (.028) | (.004) | (.078) | (.670) | (.267) |

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

Spearman's rho, correlation coefficients and significance levels, between scores on the RCMAS and number of interpretations of delay or threat on ambiguous situoations

| | | rcmas (anxiety scale) total score | rcmas physiological | rcmas worry | rcmas social | rcmas lie |
|---|---|---|---|---|---|---|
| Generated Responses | Delay | -.177 | -.076 | *-.262 | -.071 | -.055 |
| | | (.158) | (.545) | (.035) | (.575) | (.662) |
| | Social Threat | *.245 | .178 | .205 | .206 | **-.311 |
| | | (.033) | (.123) | (.076) | (.074) | (.006) |
| | Physical Threat | .007 | -.042 | .106 | -.061 | -.082 |
| | | (.955) | (.719) | (.364) | (.603) | (.482) |
| Fixed Choice Responses | Delay | .215 | *.228 | .182 | .075 | **-.318 |
| | | (.058) | (.045) | (.110) | (.515) | (.005) |
| | Social Threat | **.349 | *.235 | *.226 | **.413 | *-.245 |
| | | (.002) | (.038) | (.046) | (.000) | (.031) |
| | Physical Threat | .127 | .020 | .151 | .090 | -.218 |
| | | (.268) | (.864) | (.188) | (.432) | (.056) |

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

# APPENDIX 7

# ETHICAL APPROVAL

SOUTHAMPTON & SOUTH WEST HANTS
JOINT LOCAL RESEARCH ETHICS COMMITTEE

Chairman: Dr Audrey Kermode

Administrator: Mrs Clair Wright
Trust Management Offices
Mailpoint 18
Southampton General Hospital
Tremona Road
Southampton
SO16 6YD

Tel: (023) 8079 4912
Fax: (023) 8079 8678

Ref: CPW/DBL

24th October 2000

Miss C Deacon
10 Greenhayes
Broadstone
Dorset BH18 8NA

Dear Miss Deacon

**Submission No:232/00 - Delay aversion & attentional & attributional style in children with attention deficit hyperactivity disorder.**

Following the conditional approval and in response to your letter dated 20th October 2000, I am pleased to confirm **full approval** having received all the amended paperwork as request in our conditional approval letter of 15th August 2000.

This approval was granted by the Chairman Dr Audrey Kermode and will be brought to the attention of the Committee at their meeting on 22nd November 2000.

This committee is fully compliant with the International Committee on Harmonisation/Good Clinical Practice (ICH) Guidelines for the Conduct of Trials involving the participation of human subjects as they relate to the responsibilities, composition, function, operations and records of an independent Ethics Committee/Independent Review Board. To this end it undertakes to adhere as far as is consistent with its Constitution, to the relevant clauses of the ICH Harmonised Tripartite Guideline for Good Clinical Practice, adopted by the Commission of the European Union on 17 January 1997.

Yours sincerely,

A R Kermode

**Clair Wright (Mrs)**
Research Ethics Administrator

POOLE HOSPITAL NHS TRUST

Our Ref : GPC.RCH.LREC 12/2001/S

27 January 2001

Miss Claire Deacon,
Trainee Clinical Psychologist
10 Greenhayes
Broadstone
Dorset BH18 8NA

Dear Miss Deacon

***Delay aversion and attentional and attributional style in children with Attention Deficit Hyperactivity Disorder***
LREC NO 12/01/S [must be quoted in all correspondence]

The East Dorset Local Research Ethics Committee met on 25 January 2001 to consider the above submission.

Ethical approval was granted. However, the Committee commented that you seem to be rather under resourced. They noted the very large and time consuming questionnaires and the large number of children that you are going to study in the three groups and it was felt that a total of 60 – 90 children which are needed for this study is going to be huge workload for you. Could you reassure us that the project will be a practical thing to start on.

Apart from this small point, we wish you success with the project which we thought was most interesting.

Kind regards.

***Please respond within 21 days.***

***Conditions of approval are set out in the attached sheet;***
***Protocol amendments should be precised and accompany all documentation;***
***Serious Adverse Events should be noted on the attached form and accompany the original documentation.***



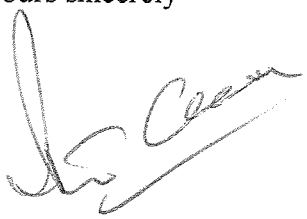
Longfleet Road
Poole, Dorset. BH15 2JB
Telephone: 01202 665511
www.poolehos.org

POOLE HOSPITAL
NHS TRUST

Present :

| | | | | |
|---|---|---|---|---|
| G P Clein | M Leggett | TJ Hamblin | B J Waltho | T Hollingberry |
| D Tory | S Kidman | R Day | S Wheeler | F Randall |

Yours sincerely



G P CLEIN
CHAIRMAN, East Dorset Local Research Ethics Committee



Longfleet Road
Poole, Dorset. BH15 2JB
Telephone: 01202 665511
www.poolehos.org

# APPENDIX 8

## CLINICAL GROUPS

## INFORMATION LETTERS AND CONSENT FORMS

Southampton Community Health Services NHS Trust

Child and Family Health Centre
Ashurst Hospital
Lyndhurst Road
Ashurst
Southampton SO40 7AR

Telephone: 023 8074 3000
Website: www.schs.org.uk

## TAKING PART IN RESEARCH

**Study Title: Do hyperactive children pay more attention to delay?**

Dear Parent,

I am a postgraduate student studying Clinical Psychology at the University of Southampton. As part of the course, I am carrying out a project investigating ways of assessing attentional style in children with ADHD and/or behavioural problems. You, and your child, are being invited to take part in this research project. Before you decide, it is important for you to understand why the research is being done and what it will involve. The following information may help you decide whether or not to take part. Please ask me if there is anything you do not understand or if you would like more information. Please take time to decide whether or not you wish to take part.

Consumers for Ethics in Research (CERES) publish a leaflet entitled 'Medical Research and You'. This leaflet gives more information about medical research and looks at some questions you may want to ask. A copy may be obtained from CERES, PO Box 1365, London N16 0BW.

Thank you for reading this,

**1. What is the purpose of the study?**
Some research has found that anxious children pay more attention to physical and social threat words and written situations than normal children. Investigations have also found that hyperactive children would prefer to minimise delay than to get a reward. Researchers suggest that hyperactive children dislike delay more than normal children, and will respond to delay words in the same way that anxious children respond to physical and social threat words. The aim of this research is to investigate the ways hyperactive children and/or behaviour problems respond to delay words and written delay situations, and find whether hyperactive children pay more attention to delay than normal children, and whether they dislike delay more than other children.

**3. Why has my child been chosen?**
He has been chosen because he has been identified by his doctor or keyworker at the hospital, or child and family guidance clinic, as being hyperactive and/or having behaviour problems.

**4. Who is organising the study?**
Claire Deacon, Trainee Clinical psychologist, studying at the University of Southampton, is organising the study as part of her training course.

**5. What will happen to me and my child if we decide to take part?**
If you decide to take part please fill in the enclosed consent form and questionnaire and return them in the pre-paid envelope. The research will acknowledge the receipt of these, and will then contact you to arrange an appointment with your child. You will also be asked permission to send your child's teacher a similar questionnaire to the one you have been asked to complete.

The researcher will carry out a short IQ and reading test and an anxiety test with your child, to help with understanding how he responds to the other assessments. Your child will then be asked to carry out a couple of tasks on a computer, he will also be asked to rate whether he thinks words from a list are good or bad words, and he will be asked some questions about situations in which he might experience a delay or a physical or social threat i.e. what he would think, what he would do.

In order for the research to be valid, it needs to be carried out when your child is not on medication for hyperactivity. Your child will need to stop taking medication for at least 12 hours before their appointment. If your child is taking Ritalin, or a similar medication, and you would like them to take part, the researcher will discuss this with your child's doctor.

**6. What are the possible benefits of taking part?**
The results from the IQ and reading assessments may be helpful to clinicians working with your child, but there may not be any direct benefit to your child in taking part in this study. However, we hope that the information obtained from the assessments in this study, may provide useful information about the attentional patterns of hyperactive children which will help us further understand ADHD and behavioural problems, and may help us to understand in the future what type of treatment programmes are helpful for these children.

**7. Confidentiality**
All information which is collected about your child will be kept strictly confidential within the child and family health services. Any information about your child which leaves the child and family health services will be anonymised so that your child cannot be recognised from it.

**8. What will happen to the results of the study?**
The overall results of the study will be written up and submitted to the training course in clinical psychology at the university of Southampton. If you would like a copy of this write up please contact Claire Deacon at the above address in September 2001.

**9.Who has reviewed this study?**
Southampton and South West Hampshire Local Research Ethics committee has reviewed this study.

**10. Contact for further information.**
If you require further information please contact Claire Deacon on the above telephone number.

Thank you for you time and consideration. If you wish to take part in this study please keep this information sheet, and sign and return the consent form, and your completed questionnaire in the enclosed envelope to Claire Deacon at the above address. You will be given a copy of the signed consent form to keep.

Signed: Claire Deacon
Trainee Clinical Psychologist

Southampton Community Health Services NHS Trust

Child and Family Health Centre
Ashurst Hospital
Lyndhurst Road
Ashurst
Southampton SO40 7AR

Telephone: 023 8074 3000
Website: www.schs.org.uk

# CONSENT FORM

**Title of Project: Do hyperactive children pay more attention to delay?**

Name of Researcher: Claire Deacon

Please initial box

1. I confirm that I have read and understood the information sheet dated....Jan 01.... (version ...../...../.....) for the above study ☐

2. I understand that my participation, and the participation of my child, is voluntary and that we are free to withdraw at any time without our medical care or legal rights being affected. ☐

3. I agree for my child to take part in the above study . ☐

Name of Child _____

| _____ | _____ | _____ |
|---|---|---|
| Name of parent | date | signature |

| _____ | _____ | _____ |
|---|---|---|
| Name of researcher | date | signature |

Dorset HealthCare NHS Trust

**DEPARTMENT OF PSYCHOLOGICAL THERAPIES**

**Providers of Psychology, Psychotherapy, Counselling and Research Services**

The Chines, Herbert Hospital, Alumhurst Road, Westbourne, Bournemouth BH4 8EW
Telephone: (01202) 766422 Fax: (01202) 757192
E-mail: dopt.ac@virgin.net Website: http://freespace.virgin.net/dopt.ac/Index.htm

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# TAKING PART IN RESEARCH

**Study Title: Do hyperactive children pay more attention to delay?**

Dear Parent,

I am a postgraduate student studying Clinical Psychology at the University of Southampton. As part of the course, I am carrying out a project investigating ways of assessing attentional style in children with ADHD and conduct disorder. You, and your child, are being invited to take part in this research project. Before you decide, it is important for you to understand why the research is being done and what it will involve. The following information may help you decide whether or not to take part. Please ask me if there is anything you do not understand or if you would like more information. Please take time to decide whether or not you wish to take part.

Consumers for Ethics in Research (CERES) publish a leaflet entitled 'Medical Research and You'. This leaflet gives more information about medical research and looks at some questions you may want to ask. A copy may be obtained from CERES, PO Box 1365, London N16 0BW.

Thank you for reading this.

**1. What is the purpose of the study?**
Some research has found that anxious children pay more attention to physical and social threat words and written situations than normal children. Investigations have also found that hyperactive children would prefer to minimise delay than to get a reward. Researchers suggest that hyperactive children dislike delay more than normal children, and will respond to delay words in the same way that anxious children respond to physical and social threat words. The aim of this research is to investigate the ways hyperactive children and/or behaviour problems respond to delay words and written delay situations, and find whether hyperactive children pay more attention to delay than normal children, and whether they dislike delay more than other children.

**3. Why has my child been chosen?**
He has been chosen because he has been identified his doctor at the hospital, or child and family guidance clinic, as being hyperactive and/or having behaviour problems.

**4. Who is organising the study?**
Claire Deacon, Trainee Clinical psychologist, studying at the University of Southampton, is organising the study as part of her training course.

**5. What will happen to me and my child if we decide to take part?**
If you decide to take part please fill in the enclosed consent form and questionnaire and return them in the pre-paid envelope. The research will acknowledge the receipt of these, and will then contact you to arrange an appointment with your child. You will also be asked permission to send your child's teacher a similar questionnaire to the one you have been asked to complete.

The researcher will carry out a short IQ and reading test and an anxiety test with your child, to help with understanding how he responds to the other assessments. Your child will then be asked to carry out a couple of tasks on a computer, he will also be asked to rate whether he thinks words from a list are good or bad word, and he will be asked some questions about situations in which he might experience a delay or a physical or social threat i.e. what he would think, what he would do.

In order for the research to be valid, it needs to be carried out when your child is not on medication for hyperactivity. Your child will need to stop taking medication for 24 hours before their appointment. If your child is taking Ritalin, or a similar medication, and you would like them to take part, the researcher will discuss this with your child's doctor.

**6. What are the possible benefits of taking part?**
The results from the IQ and reading assessments may be helpful to clinicians working with your child, but there may not be any direct benefit to your child in taking part in this study. However, we hope that the information obtained from the assessments in this study, may provide useful information about the attentional patterns of hyperactive children which will help us further understand ADHD and behavioural problems, and may help us to understand in the future what type of treatment programmes are helpful for these children.
client's GP will be notified that the client will be taking part in the study.

**7. Confidentiality**
All information which is collected about your child will be kept strictly confidential within the child and family health services. Any information about your child which leaves the child and family health services will be anonymised so that your child cannot be recognised from it.

**8. What will happen to the results of the study?**
The overall results of the study will be written up and submitted to the training course in clinical psychology at the university of Southampton. If you would like a copy of this write up please contact Claire Deacon at the above address in September 2001.

**9.Who has reviewed this study?**
East Dorset Local Research Ethics committee has reviewed this study.

**10. Contact for further information.**
If you require further information please contact Claire Deacon on the above telephone number.

Thank you for you time and consideration. If you wish to take part in this study please keep this information sheet, and sign and return the consent form, and your completed questionnaire in the enclosed envelope to Claire Deacon at the above address. You will be given a copy of the signed consent form to keep.

Signed: Claire Deacon
Trainee Clinical Psychologist

Thank you for your time and consideration.

Dorset HealthCare NHS Trust

**DEPARTMENT OF PSYCHOLOGICAL THERAPIES**

**Providers of Psychology, Psychotherapy, Counselling and Research Services**

The Chines, Herbert Hospital, Alumhurst Road, Westbourne, Bournemouth BH4 8EW
Telephone: (01202) 766422 Fax: (01202) 757192
E-mail: dopt.ac@virgin.net Website: http://freespace.virgin.net/dopt.ac/Index.htm

Awarded for excellence

# CONSENT FORM

**Title of Project: Do hyperactive children pay more attention to delay?**

Name of Researcher: Claire Deacon

Please initial box

1. I confirm that I have read and understood the information sheet dated..... (version .....) for the above study ☐

2. I understand that my participation, and the participation of my child, is voluntary and that we are free to withdraw at any time without our medical care or legal rights being affected. ☐

3. I agree for my child to take part in the above study . ☐

Name of Child _____

| _____ | _____ | _____ |
|---|---|---|
| Name of parent | date | signature |

| _____ | _____ | _____ |
|---|---|---|
| Name of researcher | date | signature |

# APPENDIX 9

## NORMAL COMPARISON GROUP

## INFORMATION LETTER AND CONSENTFORM

Dorset HealthCare NHS Trust
DEPARTMENT OF PSYCHOLOGICAL THERAPIES
Providers of Psychology, Psychotherapy, Counselling and Research Services
Branksome Clinic, 51a Layton Road, Parkstone, Poole, Dorset, BH12 2BJ
Telephone: (01202) 735300 Fax: (01202) 734092
Website: http://freespace.virgin.net/dopt.ac/Index.htm
e-mail: branksome.clinic@virgin.net

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## TAKING PART IN RESEARCH

**Study Title: Do hyperactive children pay more attention to threat words and scenarios?**

Dear Parent,

I am a postgraduate student studying Clinical Psychology at the University of Southampton. As part of the course, I am carrying out a project investigating attentional style in children with hyperactivity and/or behaviour problems. **As part of this research I need a comparison group of children who do not have these difficulties. You, and your child, are being invited to take part in this research project as part of the comparison group.** Before you decide, it is important for you to understand why the research is being done and what it will involve. The following information may help you decide whether or not to take part. Please ask me if there is anything you do not understand or if you would like more information. Please take time to decide whether or not you wish to take part.

Consumers for Ethics in Research (CERES) publish a leaflet entitled 'Medical Research and You'. This leaflet gives more information about medical research and looks at some questions you may want to ask. A copy may be obtained from CERES, PO Box 1365, London N16 0BW.

Thank you for reading this,

**1. What is the purpose of the study?**
Some research has found that anxious children pay more attention to physical and social threat words and written situations than non-anxious children. Investigations have also found that hyperactive children would prefer to minimise delay than to get a reward. Researchers suggest that hyperactive children dislike delay more than normal children, and will respond to delay words in the same way that anxious children respond to physical and social threat words. The aim of this research is to investigate the ways children with hyperactivity and/or behaviour problems respond to delay words and written delay situations, and find whether hyperactive children pay more attention to delay than normal children, and whether they dislike delay more than other children.

**3. Why has my child been chosen?**
He has been chosen because he has been identified by his teacher as being suitable to take part in the comparison group because he **does not** experience hyperactivity, major behavioural problems or any other major clinical difficulties.

**4. Who is organising the study?**
Claire Deacon, Trainee Clinical psychologist, studying at the University of Southampton, is organising the study as part of her clinical training.

**5. What will happen to me and my child if we decide to take part?**
If you decide to take part please fill in the enclosed consent form and questionnaire and return them to your child's school. The researcher will acknowledge the receipt of these, and will then contact you/ your school to arrange an appointment with your child.

The researcher will carry out a short IQ and reading test and an anxiety test with your child, to help with understanding how he responds to the other assessments. Your child will then be asked to carry out a couple of tasks on a lap top computer, he will also be asked to rate whether he thinks words from a list are calm or worrying words, and he will be asked some questions about situations in which he might experience a delay or a physical or social threat i.e. what he would think, what he would do. The entire appointment will take between one and two hours.

**6. What are the possible benefits of taking part?**
There may not be any direct benefit to your child in taking part in this study. However, we hope that the information obtained from the assessments in this study, may provide useful information about the attentional patterns of hyperactive children which will help us further understand ADHD and behavioural problems, and may help us to understand in the future what type of treatment programmes are helpful for these children.

**7. Confidentiality**
All information which is collected about your child will be kept strictly confidential . Any information about your child will be anonymised so that your child cannot be recognised from it.

**8. What will happen to the results of the study?**
The overall results of the study will be written up and submitted to the training course in clinical psychology at the university of Southampton. If you would like a copy of this write up please contact Claire Deacon at the above address in September 2001.

**9.Who has reviewed this study?**
East Dorset Local Research Ethics committee has reviewed this study.

**10. Contact for further information.**
If you require further information please contact Claire Deacon on the above telephone number.

Thank you for you time and consideration. If you wish to take part in this study please keep this information sheet, and sign and return the consent form, and your completed questionnaire to your child's school.

Signed: Claire Deacon
Trainee Clinical Psychologist

Thank you for your time and consideration.

Dorset HealthCare NHS Trust

**DEPARTMENT OF PSYCHOLOGICAL THERAPIES**

Providers of Psychology, Psychotherapy, Counselling and Research Services

Branksome Clinic, 51a Layton Road, Parkstone, Poole, Dorset, BH12 2BJ
Telephone: (01202) 735300 Fax: (01202) 734092
Website: http://freespace.virgin.net/dopt.ac/Index.htm
e-mail: branksome.clinic@virgin.net

Awarded for excellence

# CONSENT FORM

**Title of Project: Do hyperactive children pay more attention to threat words and scenarios?**

Name of Researcher: Claire Deacon

Please initial box

1. I confirm that I have read and understood the information sheet dated.....*May 01*..... (version .....*02*.....) for the above study ☐

2. I understand that my participation, and the participation of my child, is voluntary and that we are free to withdraw at any time without our medical care or legal rights being affected. ☐

3. I agree for my child to take part in the above study . ☐

Please delete as appropriate

I would like my child to be seen during school / after school / at the weekend

If you would like your child to be seen out of school hours please could you include your telephone number so that I can contact you to arrange an appointment.

Telephone Number: _____

Name of Child _____

_____ _____ _____

Name of parent date signature