

FUNCTIONAL ASTHMA SEVERITY AND IMPULSIVE BEHAVIOUR
IN 6 AND 7 YEAR-OLD CHILDREN

A dissertation
submitted in partial fulfilment of
the requirements for the Degree
of
Master of Education (Child and Family Psychology)
in the University of Canterbury
by
Eeuwe Schuckard

University of Canterbury, New Zealand

September 2007

TABLE OF CONTENTS

ABSTRACT	9
CHAPTER 1	10
INTRODUCTION	10
Childhood Asthma: Context and Implications.....	11
Externalising Behaviour Problems: Context and Implications.....	14
Impulsivity Among Children with Asthma.....	16
CHAPTER 2.....	18
LITERATURE REVIEW	18
Externalising Behaviour Problems: Conceptualisation.....	19
Childhood Asthma: Conceptualisation.....	21
The Relationship between Asthma and Externalising Behaviour Problems.....	24
Impulsivity: Conceptualisation	34
Parent Reported Behavioural Impulsivity and Childhood Asthma.....	37
Laboratory Performance Based Measures of Behavioural Impulsivity	39
Focus of the Present Study.....	44
CHAPTER 3.....	46
METHODOLOGY	46
<i>Ethical Considerations</i>	46
<i>Sampling and Participation Rate</i>	47
<i>Participant Recruitment</i>	51
<i>Measures</i>	52
Asthma Severity Measures.....	52
Impulsivity Measures	53
Questionnaire.....	56

Additional Data Gathered During the Study	60
<i>Settings</i>	61
<i>Statistical Analyses</i>	62
CHAPTER THREE	64
RESULTS	64
Demographic Characteristics of Study Sample	64
Functional Asthma Severity and Two Choice Paradigm Small/Immediate Reward Choices.....	66
Response Pattern Differences During the TCP	67
Functional Asthma Severity Groups and Two Choice Paradigm Small/Immediate Reward Choices	70
TCP Test Performance, Asthma Medication Use and Computer Experience	71
TCP Test Performance and Parental Education.....	72
Functional Asthma Severity and CPRS-R Subscale Scores	73
TCP Reward Choices and CPRS-R Subscale Scores	77
Asthma Medication Use and CPRS-R Scores	79
Positive Behaviour and Functional Asthma Severity	80
Positive Behaviour and Impulsivity	81
Gender Differences	82
CHAPTER 4	86
DISCUSSION.....	86
Asthma and Impulsivity.....	86
Asthma Medication and Impulsivity.....	89
Confounding Factors of TCP Reward Choices	90
Agreement Between Impulsivity Measures	93
Children's Understanding of the TCP	91
Children's Positive Behaviours and Functional Asthma Severity	95
Positive Behaviours and Impulsivity.....	96
Gender Differences	97

Strengths of the Study.....	98
Limitations.....	99
Implications for Practice	103
Suggestion for Further Research	103
Conclusion	104
REFERENCES	105
APPENDICES.....	116
<i>Appendix A. Ethics Approval</i>	<i>116</i>
<i>Appendix B. Parent and Child Information Sheet.....</i>	<i>118</i>
<i>Appendix C. Parent and Child Consent Form.....</i>	<i>121</i>
<i>Appendix D. ISACC Questionnaire Items</i>	<i>123</i>
<i>Appendix E. Comparison of the Asthma Functional Severity Scale and the Adapted Version Used in the Current Study.....</i>	<i>128</i>
<i>Appendix F. Two Choice Paradigm Training Procedure</i>	<i>132</i>
<i>Appendix G. Conners' Parent Rating Scale - Revised Hyperactive-Impulsive, Conners' Global Index: Restless-Impulsivity and the DSM-IV Hyperactive-Impulsive Subscale Items.....</i>	<i>139</i>
<i>Appendix H. Supplementary Strengths Checklist Items of the Assessment Checklist for Children</i>	<i>143</i>
<i>Appendix I. Positive Behaviour Scale Items.....</i>	<i>145</i>
<i>Appendix J. TCP Response Choice Patterns</i>	<i>147</i>

LIST OF TABLES

Table 1. <i>Functional Asthma Severity Group Distribution of the Study Sampling Frame</i>	49
Table 2. <i>Functional Asthma Severity Group Distribution of the Study Sample</i>	50
Table 3. <i>Demographic Characteristics of Study Sample</i>	65
Table 4. <i>Score Comparison Between Five Respondents Who Chose the Fewest Small/Immediate Rewards and Those Who Chose the Most</i>	68
Table 5. <i>Maternal Education of Children Who Chose the Fewest and Most Small/Immediate Rewards</i>	69
Table 6. <i>Paternal Education of Children Who Chose the Fewest and Most Small/Immediate Rewards During the TCP</i>	70
Table 7. <i>Number of Small/Immediate Reward Choices Made by Children in Different Functional Asthma Severity Groups</i>	71
Table 8. <i>Asthma Medication, Experience with Computer Games and the Number of TCP Small/Immediate Reward Choices</i>	72
Table 9. <i>Parental Education and Small/Immediate Reward Choices</i>	73
Table 10. <i>Functional Asthma Severity of Children with Clinically Significant and Insignificant CPRS-R Subscale Scores</i>	76
Table 11. <i>CPRS-R subscale Scores of Children in Different Functional Asthma Severity Groups</i>	77
Table 12. <i>Small/Immediate Reward Preference Among Children Scoring Clinically Significant and Non-Significant CPRS-R Subscale Scores</i>	78
Table 13. <i>Asthma Medication Use and CPRS-R Subscale Scores</i>	79

Table 14. <i>Positive Behaviour Scale Scores of Children in Different Functional Asthma Severity Categories</i>	81
Table 15. <i>Relationship Between Positive Behaviour Scale Scores and Impulsivity Measures</i>	82
Table 16. <i>Gender Differences Among the Measures Used During the Present Study</i>	83
Table 17. <i>Maternal Education Levels of Boys and Girls</i>	84
Table 18. <i>Paternal Education Levels of Boys and Girls</i>	84
Table 19. <i>Family Income of Boys and Girls</i>	85

LIST OF FIGURES

Figure 1. <i>Images Presented to Children During the TCP Computer task</i>	55
Figure 2. <i>Children's Preference for Small/Immediate Rewards and Functional Asthma Severity Scores</i>	66
Figure 3. <i>Children's CPRS-R Subscale Scores and Functional Asthma Severity Scores</i>	74

ACKNOWLEDGEMENTS

I would like to express my great appreciation to a number of support people without whom the completion of this dissertation would not have been possible:

- All children and their parents who were kind enough to participate in this research project;
- My Supervisors Dr Kathleen Liberty and Dr Michael Tarren-Sweeney, for all their support, knowledge, advice and guidance;
- Dr Philip Pattemore, a co-investigator in the Academic Achievement and Health in New Entrant Children in Christchurch Study (Children's Learning Study) and a paediatric respiratory specialist, for his continued work and comprehensive reviews of all the children in the study with asthma;
- The Asthma and Respiratory Foundation New Zealand (Inc.), the University of Canterbury and the University of Otago for funding the Academic Achievement and Health in New Entrant Children in Christchurch Study (Children's Learning Study);
- My family and friends for their never-ending support.

ABSTRACT

There is evidence that children with asthma exhibit more externalizing behaviour problems than other children. Impulsive behaviours can mark the onset and severity of externalizing behaviour problems. The present paper reports an exploratory examination of relationships between functional asthma severity and impulsivity in 6 and 7 year old children with asthma (N = 16). Participants with varying functional asthma severity were recruited at age 5 from a larger community study (the Children's Learning Study). Parents completed items from three subscales of the Connors' Parent Rating Scale-Revised (*CPRS-R*), the *Hyperactive-Impulsive, Connors' Global Index: Restless-Impulsive* and the *DSM-IV Hyperactive-Impulsive* subscales. Children completed the Two Choice Paradigm (TCP), a computer program measuring delay aversion type impulsive behaviours. Mean (SD) *CPRS-R Hyperactive-Impulsive, Connors' Global Index: Restless-Impulsive* and *DSM-IV Hyperactive-Impulsive* subscale scores were 59 (11), 56 (10) and 59 (10) respectively. There was no correlation between functional asthma severity and delay aversion or *CPRS-R* subscale scores and there was no evidence of a trend for such a relationship. Preliminary investigations conducted with a small sample of 6-7 year-old children with asthma thus suggest that functional asthma severity is not related to impulsivity.

CHAPTER 1

INTRODUCTION

Asthma is a chronic illness in which inflammation of the airway walls causes hyper-responsive mucous production and muscle tightening. These symptoms interfere with breathing ability and may impede activities such as sleep and exercise (Global Initiative for Asthma, 2006; National Asthma Education and Prevention Program, 1997). Symptoms of the illness can be particularly frequent early in the morning and at night (Global Initiative for Asthma, 2004); they include a shortness of breath, wheezing, coughing, chest tightness, increased respiratory rate and a runny nose without symptoms of a common cold, pneumonia and retraction (Kaugars, Klennert & Bender, 2004; Strunk, 2002). Factors that influence asthma onset and persistence are complex and varied, physiological factors such as bronchial hyper-responsiveness and allergic status interplay with environmental allergens to determine the initial onset and subsequent course of the illness (Kaugars, Klennert & Bender, 2004). Specific stimuli that may increase the risk of developing an asthma attack include “house dust mites, animals with fur, cockroaches, pollens, and moulds, occupational irritants, tobacco smoke, respiratory (viral) infections, exercise, strong emotional expressions, chemical irritants, and drugs (such as aspirin and beta blockers)” (Global Initiative for Asthma, 2006, pg. 4). Asthma has two components, airway inflammation, which is chronically present and asthma attacks, or periodic exacerbations of symptoms (Global Initiative for Asthma, 2006).

Childhood Asthma: Context and Implications

Important factors that determine the course and effects of asthma on children include the age at which symptoms first appear, the severity of these symptoms, family functioning and available coping resources (Klennert, Nelson, Price, Adinoff, Leung & Mrazek, 2001). Children who are most adversely affected by asthma often develop serious airway restriction before the age of 3 years (Mrazek, Schuman & Klennert, 1998). Their condition may be triggered and intensified by stressful family environments characterised by high levels of stress and parenting difficulties, which appear to reduce immune functioning and medication adherence (Mrazek, Klennert, Mrazek & Macey, 1991; Sandberg, Paton, Ahola, McCann, McGuinness, Hillary et al., 2000). Severe asthma appears particularly difficult for children to cope with due to its adverse effects on life style, sleep and emotional regulation (Klennert, McQuaid, McCormick, Adinoff & Bryant, 2000; Mrazek, Schuman & Klennert, 1998; Sandberg et al., 2000).

Childhood asthma was previously conceptualised as a psychosomatic illness where the stress of dysfunctional interactions between mother and child induced such symptoms (Klennert, McQuaid, McCormick, Adinoff & Bryant, 2000). However, a recent increase in the pathophysiological understanding of the illness has led to the withdrawal of this proposition. Instead, the illness is now conceptualised as a condition resulting from complex and reciprocal interactions between physiological and environmental factors.

Asthma is most common among children and its prevalence appears to be increasing among this population (Global Initiative for Asthma, 2006). New Zealand has the highest prevalence rate of asthma among children in the world; more than 25% of this population is affected, compared to

many other countries where prevalence rates are less than 5% (Shaw, 2006). An estimated 25% of New Zealand 6-7 year old children and 30% of 13-14 year olds are affected by asthma (Asher, Barry, Clayton, Crane, D'Souza, Ellwood et al., 2001) but these prevalence rates differ among ethnic groups. Prevalence rates among Maori, European and Pacific Island children are 28%, 32% and 22% respectively (Pattemore, Ellison-Loschmann, Asher, Barry, Clayton, Crane et al., 2004). Asthma prevalence rates of families who have emigrated to New Zealand from the Pacific Islands typically double within one generation (Global Initiative for Asthma, 2006).

The effects of asthma are apparent globally; it is estimated that 15 million disability-adjusted life years (DALYs), or the number of years of life lost due to a medical condition causing premature death or incapacitation, are lost every year, world-wide, due to asthma (Global Initiative for Asthma, 2004). This figure is similar to other chronic conditions such as schizophrenia, diabetes and cirrhosis of the liver, each accounting for 1% of DALYs lost throughout the world each year (Global Initiative for Asthma, 2004). A current estimate of the proportion of deaths attributable to asthma, of which many are preventable with proper long-term medical care, stand at 1 in every 250 deaths worldwide (Global Initiative for Asthma, 2004). Such figures are very concerning given the high proportion of children living in New Zealand who are affected by the illness.

European children in New Zealand visit the hospital more frequently due to asthma symptoms than Maori and Pacific Island children, however, hospital admission rates of the latter two ethnicities are increasing (Shaw, 2006). Such trends are concerning, frequent and lengthy hospital admissions, especially among young children, are a risk factor for negative psychological outcomes (Mrazek, Schuman & Klinnert, 1998). The increase in hospital admission rates among

Maori and Pacific Island children in New Zealand suggests that the adverse affects of asthma may be increasing among these two populations; a proposition supported by findings suggesting that Maori and Pacific Island children in New Zealand use asthma medication less effectively than European children (Shaw, 2006).

Effective medication use is an important facet of asthma symptom management, and has important implications for the effects of the illness. Medications include inhaled corticosteroids (ICS) and beta agonists (SABA), whose asthma symptom relief and prevention properties are especially important among children. However, when the medications are not used appropriately, asthma severity may increase, resulting in an increased risk of negative outcomes (Wamboldt, Fritz, Mansell, McQuaid & Klein, 1998). Ineffective symptom management may coincide with other factors such as dysfunctional and unsupportive family environments (Kaugars, Klinnert & Bender, 2004). The combination of such factors may potentially lead to frequent hospitalizations, reduced quality of life, increased stress, behaviour problems or even death.

Asthma related medication use, hospital visits and lost productivity contribute to the substantial economic cost of the illness in New Zealand. The Pharmaceutical Management Agency of New Zealand (PHARMAC) reported having spent 60 million dollars on asthma medication during 2002-2003 (Shaw, 2006). Children with asthma spent approximately 10,000 days in hospital during the year 2000 and made 12,000 visits to hospital emergency departments at an average cost of \$250 per visit (Shaw, 2006). A French study of the effects of childhood asthma, found that over a 12 month period, 30% of parents with asthmatic children lost days at work due to their

child's condition; 13% of parents reported a loss of more than 5 work days (Laforest, Yin, Sazonov Kocivar, Pacheco, Dickson, Gormand et al., 2004).

Externalising Behaviour Problems: Context and Implications

The substantial implications of asthma are not limited to its direct effects. A review of literature investigating the psychological implications of asthma among children has found that children with asthma are more likely to exhibit behaviour problems than the rest of the population (McQuaid, Kopel & Nassau, 2001). The relationship between the illness and difficult behaviours appears strongest among severe cases of asthma (Wamboldt, Fritz, Mansell, McQuaid & Klein, 1998). The term "behaviour problems" encompasses patterns of behaviours that are either categorically maladaptive or occur with such intensity or frequency that they become maladaptive. The term is generally used in relation to internalizing and externalising behaviour problems, or problems "mainly within the self" and "conflicts with other people and with their expectations for the child" (Achenbach & Rescorla, 2000, Pg. 13).

Externalising behaviour problems include; disobedience, frequent frustration, fighting, selfishness and stubborn behaviours (Achenbach & Rescorla, 2000). Behaviours may also include restlessness, hyperactivity, distractibility and impulsiveness (Conners, 1997). Almost all young people display such behaviours at some time during their development (Mash & Barkely, 2003). However, when such displays are markedly different from the rest of the population and become difficult for parents and teachers to manage, they become clinically significant.

Externalising behaviour problems are very common among children and remain the most common reason for referral to mental health services (Carr, 2006). In North America, the strain of delinquent and disruptive antisocial behaviours on the educational, criminal justice, health and mental health systems make it the most costly of all mental health problems (Cohen, Miller & Rossman, 1994). Some externalizing behaviour difficulties such as argumentativeness, angry outbursts, frequent loss of temper and refusal to comply with adult rules or instructions are often exhibited by young children (Mash & Wolfe, 2001). However, under some environmental contexts such as inconsistent and harsh parenting practices, externalising behaviour problems exhibited by many young children may intensify. Under such circumstances, children may become aggressive and deceitful, damage property, violate established rules and steal (American Psychiatric Association, 2000).

Externalising behaviour problems appear to develop differently between boys and girls. Boys appear more likely to exhibit overt destructive behaviours, while girls are more likely to engage in covert aggressive behaviours (Mash & Wolfe, 2001). Girls who display serious externalising behaviour problems appear to present antisocial behaviours that are more severe than boys once they have been referred to psychiatric services (Waschbusch, 2002). Girls with co-morbid hyperactivity, impulsivity, inattention and conduct problems display higher severity ratings, lower verbal aptitude scores on intelligence tests and increased negative adjustment with peers (Waschbusch, 2002). There are very few studies investigating outcomes of girls who display such behaviours; however, it appears that externalizing behaviour problems among this population are likely to develop into the internalising type over time (Mash & Wolfe, 2001). Boys who continue

to exhibit externalizing behaviour problems during childhood are more likely to continue with similar behaviours (Mash & Wolfe, 2001).

Externalising behaviour difficulties exhibited by many children do not typically intensify; 25% of children with oppositional behaviours abstain from such behaviours entirely over time and 50% do not intensify in severity (Mash & Wolfe, 2001). Therefore, the frequent exhibition of externalising behaviour problems is a pronounced developmental variation but does not necessarily signify the presence of behaviours that will continue to escalate and develop into serious delinquency over time (Mash & Wolfe, 2001). According to the review of research conducted by McQuaid, Kopel, and Nassau (2001), children with asthma are more likely to exhibit disobedience, angry outbursts, stubbornness and temper tantrums compared to children without asthma. However, the extent of such behaviours among this population is rarely markedly different from the rest of the population (Klennert, McQuaid, McCormick, Adinoff & Bryant, 2000). Therefore, even though children with asthma may exhibit more externalising behaviour problems than those without asthma, it is unlikely that this population is at increased risk of developing delinquency or conduct-disordered behaviours.

Impulsivity Among Children with Asthma

To examine the relationship between asthma and externalising behaviour problems, the current study sought to investigate whether asthma severity was related to levels of impulsivity exhibited by children. Children with externalising behaviour difficulties consistently show elevated levels of impulsive behaviours (Avila, Cuenca, Felix, Parcet & Miranda, 2004; Olson, Schilling & Bates, 1999; Snyder, Prichard, Schrepferman, Patrick & Stoolmiller, 2004; Toupin, Dery, Pauze,

Mercier & Fortin, 2000; Waschbusch, 2002; White, Moffitt, Caspi, Bartusch, Needles & Stouthamer-Loeber, 1994). Frequent displays of inappropriate impulsive behaviours also predict the onset of externalising behaviour problems (Snyder, Prichard, Schrepferman, Patrick & Stoolmiller, 2004) and their chronic long term persistence (Waschbusch, 2002).

Impulsivity is related to externalising behaviour problems because the complex circumstances found during social interactions are made even more difficult when learned behaviours are unable to be inhibited and delays are difficult to endure (Snyder, Prichard, Schrepferman, Patrick & Stoolmiller, 2004). Impulsive behaviours may include a greater motivation for small rewards made available quickly rather than those that are larger provided after a delay; it may also signify acting before consequences have been taken into account; acting before a situation is understood; or, an overactive cognitive tempo leading to heightened arousal (Dougherty, Mathias, Marsh & Jagar, 2005). The investigation of asthma severity and impulsive behaviours is important because the relationship between the two variables will clarify whether impulsive behaviours may be responsible for the link between asthma and externalising behaviour problems. The research will also clarify whether children with severe asthma are at an increased risk of developing chronic and severe externalising behaviour problems.

CHAPTER 2

LITERATURE REVIEW

The increasing number of children affected by asthma is concerning, given the link between the illness and difficult to manage behaviours. McQuaid, Kopel and Nassau (2001) conducted a substantial meta-analysis of 26 studies which used the behavioural adjustment data of 5,000 children. Of the studies included by McQuaid, Kopel and Nassau (2001), 19 conducted between 1975 and 2001 studied externalising behaviour problems among children with asthma.

Externalising behaviour problem differences between children with and without asthma yielded an effect size of 0.4, a difference substantially smaller than the 0.73 effect size generated by measures of internalising behaviour problems (McQuaid, Kopel & Nassau, 2001).

McQuaid, Kopel, and Nassau (2001) found that differences between parental ratings of child externalising behaviour problems increased when healthy children were compared to children with increasingly severe asthma. Effect-sizes of $d = 0.14$, 0.25 and 0.48 were detected between healthy children and children with mild, moderate, and severe asthma severity. These results suggest that there may be a relationship between asthma severity and externalizing behaviour problems. The authors proposed that parental stress may increase with intensifying child asthma severity and consequently, parenting difficulties may arise as the child's illness symptoms become increasingly difficult to manage. Other factors such as poverty, family stress and general living conditions may also contribute to the relationship because these factors all contribute to the development and intensification of asthma and behavioural difficulties (McQuaid, Kopel & Nassau, 2001). These propositions, however, could not be verified during the meta-analysis by McQuaid, Kopel and Nassau (2001) because the reviewed studies did not specifically investigate

the role of these factors in the relationship between asthma and externalizing behaviour difficulties.

Externalising Behaviour Problems: Conceptualisation

The meta-analysis by McQuaid, Kopel and Nassau (2001) suggests that children with asthma may exhibit more overactive and defiant actions or withdrawn and anxious behaviours than children without the illness. Such difficulties can be conceptualised on a continuum of behaviour problems spanning from internalising, anxious and withdrawn, to externalising, overactive and defiant manifestations of coping difficulties (Achenbach & Rescorla, 2000). In this dissertation, only the externalising end of this continuum will be discussed. Specific behaviours encompassed by this construct include “acting out”, “disruptive”, and “undercontrolled” behaviours (Mash & Barkely, 2003) and destructiveness, deceitful behaviour, truancy, temper tantrums, argumentativeness, defiance, harassment of others, frequent frustration and negative affect, anger, resentment, spite and vindictiveness (American Psychiatric Association, 2000).

Many models have been proposed to conceptualise externalising behaviour problems to ensure that universal terminology is used during the research of such behaviours. Many researchers use the clinical criteria of the diagnostic labels “oppositional defiant disorder (ODD)”, “conduct disorder (CD)” and “attention deficit/hyperactivity disorder (ADHD)” defined by the *Diagnostic and Statistical Manual of Mental Disorders-IV-Text Revision (DSM-IV TR)* (American Psychiatric Association, 2000) to conceptualise externalising behaviour problems. These psychological and psychiatric based diagnostic labels are based on the continuum of destructive versus non-destructive and overt versus covert behaviours (American Psychiatric Association,

2000). The *DSM-IV TR* provides clear criteria to define clinically significant psychological problems, ensuring consistent working definitions in the literature (American Psychiatric Association, 2000). However, the externalising behaviour problems displayed by some children with asthma are often not severe enough to be considered clinically significant (Klennert, McQuaid, McCormick, Adinoff & Bryant, 2000). Therefore, the diagnostic criteria of the *DSM-IV TR* may not detect the types of behaviour problems exhibited by some children with asthma.

The externalising and internalising behaviour continuum presented by Achenbach and Rescorla (2000) may prove more useful to describe the behaviours presented by some children with asthma. This continuum was developed using extensive research investigating children's behavioural and emotional problems with multivariate analysis (Achenbach & Rescorla, 2000). The externalising end of this continuum represents conflict with other people (behaviours that are overt), whereas the internalising end of the spectrum encompasses behaviours that are mostly internal (Klennert, Nelson, Price, Adinoff, Leung & Mrazek, 2001). This model puts externalising behaviour problems in the context of various oppositional, aggressive, hyperactive, withdrawn and anxious type behavioural presentations and conceptualises each of the behaviours on their own continuum of severity. Therefore, because the behaviour problems continuum presented by Achenbach and Rescorla, (2000) accounts for both the type and severity of individual behaviour problems, it is more useful during the investigation of difficult to manage behaviours among children with asthma than the *DSM-IV TR*, which only provides categorical symptom descriptions.

Childhood Asthma: Conceptualisation

Like externalising behaviour problems, asthma is also a highly variable construct that is difficult to define. The illness is generally defined as a condition where the walls along the airway are inflamed, making them sensitive to stimuli and causing irritation to the airways (National Asthma Education and Prevention Program, 1997). The definition of asthma has changed frequently since its symptom cluster became accepted as an illness during the 1960s. Definition changes led to important developments of asthma treatment and understanding. The original definition during the 1960s focused on the episodic occurrence of airway obstruction, and consequently, treatment was focused on remediation of the immediate symptoms rather than their prevention (Szeffler, 2002). This was achieved with some success after the drug epinephrine became widely available. During the 1970s, the definition of the illness changed as more research emerged describing its development. As a result, treatment progressed towards preventative management of bronchospasms, rather than their mere relief (Szeffler, 2002). During the 1990s the definition of asthma changed again with the development of bronchoscopy and endobronchial biopsy, diagnostic methods that showed the airways of those with asthma to be inflamed (Szeffler, 2002). This led to the definition of asthma as a chronic illness, which required management rather than a cure (Szeffler, 2002).

At present, the criteria for what constitutes a diagnosable case of asthma remains contested among clinicians, and many important questions regarding which symptoms fall under its diagnostic criteria continue to generate debate. Conceptual and procedural disagreement among asthma researchers may lead to inconsistent diagnostic procedures and criteria to determine asthma status of study populations. Attempts to establish universal definitions are in progress, the

Guidelines for the Diagnosis and Management of Asthma (National Asthma Education and Prevention Program, 1997) suggest that the presence of chronic inflammation of the airways, signified by the presence of wheezing, breathlessness, chest tightness, and coughing, are the most relevant diagnostic criteria. However, there are important diagnostic complexities related to this definition, including which symptoms constitute inflammation and when wheezing becomes asthma (Szeffler, 2002).

The applicability of symptoms implicated with chronic inflammation of the airways to the definition of asthma, particularly during the diagnosis of young children, is limited, given that airway obstruction is not exclusive to asthma (Strunk, 2002). Airway obstruction is an important diagnostic symptom to many other illnesses that belong to a cluster called the “reactive airway diseases”. Illnesses under this category include bronchopulmonary dysplasia, sinusitis, aspiration (that is, reflux, direct and foreign body aspiration), cystic fibrosis, anatomic abnormality (for example, vascular ring, mediastinal mass), cardiac abnormalities associated with congestive heart failure, tuberculosis, bronchiolitis and pertussis (Strunk, 2002). According to Strunk, (2002), a valid diagnosis procedure of asthma is a process in which other airway obstructing conditions are ruled out using chest radiographies, video fluoroscopies, computed tomographies, sweat chloride tests, allergy skin test procedures and parent interviews examining the presence of snoring while the child is asleep (Strunk, 2002), before an official diagnosis is made.

Such procedures are especially important when diagnosing young children, as this group of patients is not yet capable of accurately describing illness symptoms to a clinician (Strunk, 2002). Currently, the most common asthma diagnostic procedure in children three years or younger

involves chest radiography, sweat chloride testing and skin allergy testing (Strunk, 2002). The most frequently used measure is the chest radiograph, which is only able to rule out conditions involving the chest, while video fluoroscopy and computed tomography are rarely used (Strunk, 2002). Current difficulties during the diagnosis of asthma in young children need to be addressed, as the disproportionately high prevalence among this age group may be a diagnostic artefact (Szeffler, 2002).

The bleak outlook of Strunk (2002) on current asthma diagnosis procedures also applies to its treatment and management. Chronic inflammation of the airways is the treated symptom of choice among practitioners, despite the conceptual complexities associated with this construct (Strunk, 2002). Investigating the time of onset and the mechanisms underlying progression and persistence of asthma symptoms during attacks may be especially difficult. Szeffler (2002) provides a more optimistic outlook, suggesting that current diagnostic practices and management of asthma in young children have become increasingly refined with the development of “bronchoscopy, endobronchial biopsy, bronchoalveolar lavage, and induced sputum” (Szeffler, 2002, p. 549) which are systems of diagnosis not mentioned by Strunk, (2002). Despite such improvements in diagnosis procedures, the specific criteria prescribed for the illness diagnosis still appear to vary. Inconsistent working definitions are especially problematic when seeking to determine the relationship between asthma and psychological functioning in children and adolescents because similar definitions may be used to describe different airway irritation and restriction symptoms (Klinnert, McQuaid, McCormick, Adinoff & Bryant, 2000).

Variations in the assessment of asthma are apparent when its severity is quantified. Asthma severity is defined by the frequency and severity of attacks, the child's response to treatment and the impact of symptoms on activity (Klennert, McQuaid, McCormick, Adinoff & Bryant, 2000). For example, a child with confirmed asthma whose breathing is regularly restricted by airway irritation and whose symptoms restrict physical movement, sleep and speech is considered to display asthma symptoms more severe than a child whose breathing is rarely restricted and whose symptoms do not restrict physical movement, sleep and speech. In addition, the level of control children have over their symptoms are used to determine severity (Klennert, McQuaid, McCormick, Adinoff & Bryant, 2000). For instance, children who continue to display symptoms despite taking medication are more severely affected than those whose medication reduces symptom intensity (Klennert, McQuaid, McCormick, Adinoff & Bryant, 2000). There are two main conceptualisations of asthma severity, physiological load and functional impact (Wamboldt, Fritz, Mansell, McQuaid & Klein, 1998). The physiological load of asthma refers to the intensity and frequency of its symptoms, while functional asthma impact is how much of an impact the illness has on the child's everyday functioning.

The Relationship between Asthma and Externalising Behaviour Problems

The functional effects of asthma are related to behaviour problems to a greater extent than the physiological load (Wamboldt, Fritz, Mansell, McQuaid & Klein, 1998). This suggests that rather than the asthma symptoms, it is the effects of asthma on the everyday lives of children that play the most important role in the relationship between asthma and behaviour problems (Wamboldt, Fritz, Mansell, McQuaid & Klein, 1998). However, MacLean, Perrin, Gortmaker and Pierre, (1992) suggest that a functional aspect of asthma severity such as days missed from school, will

correlate with behaviour problems to a greater extent than the number of acute asthma attacks because children who are rarely at school are also expected to have a greater number of behaviour problems. Therefore, functional asthma severity may be related to externalizing behaviour problems because the impact of symptoms on children's lives determines the difficulty of coping with the illness and factors associated with the functional impact of the illness are also associated with the onset of behaviour difficulties.

Another important factor implicated in the relationship between asthma and externalizing behaviour difficulties is whether symptoms are acute or chronic. The distinction is important given that chronic symptoms appear more difficult for children to cope with and consequently, mark a greater number of behaviour problems. For instance, Mrazek, Schuman and Klinnert (1998) found that in a sample of 150 children, those with asthma onset before the age of 3 years yielded a greater number of behaviour problems at ages 3, 4, and 6 than children with asthma onset between the ages of 3-6 ($p > 0.05$). Therefore, the early development of asthma and the stressors associated with their chronic presence may put children at particular risk of developing behaviour problems.

Another factor to complicate the investigation of a potential relationship between asthma severity and behaviour problems is the documented side effects of asthma medication. Consistent use of medications such as prednisone and theophylline are important for successfully managing asthma and its symptoms (Bender & Milgrom, 1995). However, concerns have been raised over the possible side effects of taking asthma medications including impaired memory, mood, motorskills, attention, school adaptation; and hyperactivity, irritability, lethargy and sadness

(Milgrom & Bender, 1993a; , 1993b). A comprehensive literature review conducted by Bender and Milgrom (1995), concluded that there was little conclusive evidence to suggest that asthma medications such as prednisone and theophylline were directly responsible for externalising behaviour problems such as hyperactivity and irritability in children.

Two placebo-controlled and randomized protocol studies were conducted to investigate the effects of theophylline. During both the open label (Bender, Lerner, Ikle, Comer & Szeffler, 1991) and closed label studies (Bender & Milgrom, 1992), children taking theophylline as opposed to placebo's displayed slightly enhanced memory and attention but a slightly increased level of hand tremors and anxiety. These differences were statistically significant, though their clinical significance was minimal. During the open label phase of the study, parents of children taking theophylline as opposed to a placebo reported more hyperactivity and conduct problems than did parents of children taking the placebo, however, parental reports did not differ during the closed label study. Other studies, including those testing as many as 21 psychological variables (Schlieper, Alcock, Beaudry, Feldman & Leikin, 1991), have yielded similar results, (Bender & Milgrom, 1995).

Findings regarding the effects of prednisone, a type of corticosteroid, were different to those of theophylline. Children taking prednisone may display higher rates of mood, attention and memory problems, however, such effects are no longer detected 24-48 hours after taking the medication (Milgrom & Bender, 1993a). The effect of prednisone on children's behaviour and emotional states does not appear to be causal or linear (Bender & Milgrom, 1995). Populations most at risk of adverse effects include children with previous emotional and behaviour

difficulties and girls, however, relatively few studies support such findings and neither group has consistently shown adverse reactions to prednisone during clinical trials (Bender & Milgrom, 1995). Another literature review of the effects of corticosteroids conducted by Stuart, Segal and Keady, (2005) made similar conclusions to Bender & Milgrom (1995), suggesting that the evidence for adverse psychological side effects of corticosteroid use is very limited and no specific risk factors have yet been identified that consistently mark children at increased risk of negative side effects.

Studies of corticosteroids and their side effects on mood, memory and attention have rarely detected clinically significant results despite statistically significant differences between treatment and placebo groups (Bender & Milgrom, 1995). Concerns regarding the exacerbations of previous psychiatric symptoms among adults after long-term use were disproven after dose/response trials showed that such side effects could be prevented with prednisone doses under 40mg (Milgrom & Bender, 1993a). This conclusion was supported by Stuart, Segal and Keady, (2005) who suggest that high doses of corticosteroid medications increase the likelihood of negative psychological effects, however, dose response effects remain unclear with extensive individual differences shown in the side effects. The impact of theophylline and prednisone appear to be minimal provided the correct dosage is taken. Children with a history of emotional difficulties and females may be at risk of adverse affects to prednisone but as yet, changes in mood, memory and attention have not been systematically detected among these populations (Bender & Milgrom, 1995).

Research investigating the effects of asthma on children and the potential impact of asthma medication is often complicated by a lack of agreement between informants (Klennert, McQuaid, McCormick, Adinoff & Bryant, 2000). The use of retrospective parent-reports may be responsible for low informant agreement in some studies as event perception may change over time (Klennert, McQuaid, McCormick, Adinoff & Bryant, 2000; Mrazek, Schuman & Klennert, 1998). For example, during a study of the behavioural and emotional adjustment of 103 children with varying degrees of physiological asthma severity, maternal Child Behaviour Checklist (CBCL) (Achenbach & Rescorla, 2000) ratings of children with asthma were higher than those without asthma (difference significant at $p < 0.05$) (Klennert, McQuaid, McCormick, Adinoff & Bryant, 2000). However, externalising behaviour problem ratings of children with and without asthma obtained by trained clinicians during child interviews and observations did not differ at a statistically significant level (child interview, $p < 0.58$; child observation, $p = 0.22$) (Klennert, McQuaid, McCormick, Adinoff & Bryant, 2000).

The relationship between physiological asthma severity and behaviour problems also changed depending on the informant during the study by Klennert, McQuaid, McCormick, Adinoff and Bryant (2000). Asthma severity ratings were correlated with observer- but not parent-reports of behavioural and emotional adjustment. Parent-rated child emotional and behavioural adjustment, as measured by CBCL broadband scales, yielded insignificant correlations with child asthma severity ($r < 0.07$, ns), suggesting that illness severity was not related to increased coping difficulties as reported by parents. However, clinician rated problem behaviours during semi-structured interviews were positively correlated with asthma severity ($r = 0.23$, $p < 0.05$). This finding illustrates perception differences between informants of children's externalising

behaviour problems. Wamboldt, Fritz, Mansell, McQuaid and Klein (1998) suggest that Parent's own perceptions of their health and their socio-economic status (SES) can affect how they rate their child's behaviours. Other factors such as parental psychosocial stress, social support and family psychological functioning are also related to parental perceptions of behaviour problems in their child (Bender, Annett, Iklé, DuHamel, Rand & Strunk, 2000; Calam, Gregg, Simpson, Simpson, Woodcock & Custovic, 2005; Kaugars, Klinnert & Bender, 2004).

Another methodological difficulty in research studies investigating the relationship of asthma to behaviour problems relates to the relatively small externalising behaviour problem differences of children with and without asthma. Recent research of psychological functioning among children with asthma has established that asthma severity may be linked to differences in emotional regulation in children (Klinnert, McQuaid, McCormick, Adinoff & Bryant, 2000), a construct implicated in the development of externalising behaviour problems (Cole, Zahn-Waxler, Fox, Usher & Welsh, 1996). Children's emotional regulation appears to decrease with increased asthma severity ($r = -.27, p < 0.02$); however, whether such a relationship is clinically significant has been questioned (Klinnert, McQuaid, McCormick, Adinoff & Bryant, 2000). Difficulties with emotional regulation in children with asthma may result in negative and conflicting interactions with others; however, these difficulties may not be severe enough to lead to clinically significant behaviour problems (Klinnert, McQuaid, McCormick, Adinoff & Bryant, 2000). Therefore, studies may not detect externalising behaviour difficulties in children with asthma because they are not of a detectable intensity.

Family functioning is an important factor determining how asthma affects children. The onset of physical illness such as asthma in some children is likely to place strain on their parents, which, if not managed appropriately, may lead to stress within the family system. Such stress may increase asthma severity because it impedes parents efforts to manage their children's medication compliance and symptom management (Kaugars, Klennert & Bender, 2004). A study conducted by Wamboldt, Weintraub, Krafchick and Wamboldt (1996) found that there were higher rates of psychopathology in family members of 62 adolescents with severe asthma than in the family members of a control group without asthma. The elevated prevalence rates of antisocial personality disorder (male relatives, $p = 0.000$; female relatives, $p = 0.003$) and substance abuse (male relatives, $p = 0.000$; female relatives, p not significant) in the family members of hospitalised adolescents may suggest that severe cases of the illness are related to family dysfunction (Wamboldt, Weintraub, Krafchick & Wamboldt, 1996). The results of Wamboldt, Weintraub, Krafchick, and Wamboldt (1996) must be interpreted with caution because the prevalence rates of psychopathology among adolescents with severe asthma were compared with prevalence estimates made 10 years before their study.

The findings of Wamboldt, Weintraub, Krafchick, and Wamboldt (1996) may support the proposition that children with asthma have higher rates of difficult to manage behaviours because the illness is more frequent among families in which certain members are affected by psychological disorders; consequently they may be less likely to employ effective parenting practices (Wamboldt, Weintraub, Krafchick & Wamboldt, 1996). These research findings may also suggest that rather than similar environmental factors contributing to the higher rates of externalising behaviour problems in children with asthma, similar underlying genetic

mechanisms may also be responsible, a notion supported by findings that show higher rates of familial psychopathology among adolescents with severe asthma (Wamboldt, Fritz, Mansell, McQuaid & Klein, 1998).

The possibility that similar underlying genetic mechanisms are responsible for the development of both behaviour problems and asthma onset in children may explain why it is still unclear whether psychological difficulties occur before or after asthma onset in some children. Research has illustrated that behaviour problems may precede asthma (Calam, Gregg, Simpson, Simpson, Woodcock & Custovic, 2005) or develop after illness onset (Mrazek, Schuman & Klinnert, 1998). Illness severity and time of onset is likely to be related to difficult child behaviours through complex, dynamic and reciprocal relationships implicating many factors (Calam, Gregg, Simpson, Simpson, Woodcock & Custovic, 2005). Such reciprocal relationships are illustrated by findings that show that children with severe asthma have greater difficulties with psychological adjustment, which in turn intensify their asthma severity (McQuaid, Kopel & Nassau, 2001). The complexity of the relationship between asthma and behaviour problems is also made evident by maternal smoking when the child is three, which is not only associated with the onset of respiratory problems, but also the development of ADHD and other behaviour difficulties (Calam, Gregg, Simpson, Simpson, Woodcock & Custovic, 2005). Other variables that appear to affect the relationship between asthma and behaviour problems include the child's age when asthma symptoms first appear, the severity of these symptoms, and whether the child is hospitalised and for how long (Mrazek, Schuman & Klinnert, 1998).

Some researchers have described the underlying mechanisms that may link asthma and behaviour problems; however, most describe the relationship between asthma and internalising rather than externalising type behaviour problems. One model proposes that factors affecting children's ability to cope with chronic illness play a more major role in determining the psychological consequences than the severity of the condition (Wamboldt, Fritz, Mansell, McQuaid & Klein, 1998). Such factors include the child's intellectual ability and self-concept, family cohesion, family psychological functioning and the emotional state of the child's mother (Bender, Annett, Iklé, DuHamel, Rand & Strunk, 2000; Lavigne & Faier-Routman, 1993). Another theory suggests that children with asthma may have greater difficulties with adjustment because they have a greater number of stressors associated with chronic illness than other children. Children appear to be more at risk of developing behaviour difficulties when they are diagnosed with asthma before they are 3-years-old, possibly because they do not yet have the coping abilities necessary to deal with the asthma-related stressors (Mrazek, Schuman & Klinnert, 1998).

If the child is able to successfully cope with asthma symptoms, however, then the condition may help increase resilience (McQuaid, Kopel & Nassau, 2001). This is illustrated by the curve-linear relationship between asthma severity and behaviour problems (Perrin, MacLean & Perrin, 1989). This curve shows that children with severe and mild asthma may have the highest rates of behaviour problems, while children with moderate asthma have the lowest. Therefore, there may be other important factors affecting children's ability to cope with asthma than just its direct symptoms. For instance, the extent to which parents are able to support their child with asthma may be an important determinant of illness impact. Asthmatic children with high genetic vulnerability are likely to receive more effective support from their parents than children with a

low genetic vulnerability, potentially because of their parents' higher likelihood of having had to manage asthma symptoms themselves (Calam, Gregg, Simpson, Morris, Woodcock & Custovic, 2003). Parents of children with few asthma symptoms may be less likely to have had asthma themselves and are therefore not able to provide the same level of support as parents with the illness. Such decreased support may leave children with more coping difficulties than children with moderate asthma severity who are more likely to have parents who have experienced the illness. Children with severe symptoms, however, may be affected to such an extent that, even if their parents are able to give them the necessary support, coping is made extremely difficult (Calam, Gregg, Simpson, Morris, Woodcock & Custovic, 2003).

Another possibility may be that severe asthma develops because of an inability to cope with the illness's symptoms, rather than a genetic predisposition to severe symptoms. Factors related to an inability to cope may also in turn be responsible for the development of behaviour difficulties. Repetti, Taylor and Seeman (2002) suggest that family circumstances are the main catalyst for both severe asthma and the development of behaviour difficulties. Many families whose interactions are characterised by coercion may make it difficult for the child to manage asthma symptoms. Such family interactions may also lead to the development of psychological difficulties within the child.

These theories would appear to explain the development of both externalising and internalising behaviour problems among children with asthma, but they have been constructed from findings which only support a link within the internalising domain. The study by Calam et al. (2003), however, used a measure of externalising behaviour problems. Calam et al. (2003) suggest that

parents of children with asthma may have more sympathy for their child than parents of children without the illness. This may allow the child to make demands on the parents and, should they be rejected, the resulting argument may cause the child to develop an asthma attack. When the parents notice the child developing breathing difficulties, they may give in to the demands to ensure that the symptoms do not progress any further. As a result, children learn that their parents will concede to their demands with the onset of an asthma attack and the resulting loss of parental authority may increase the amount of difficult behaviours exhibited by the child (Calam, Gregg, Simpson, Morris, Woodcock & Custovic, 2003).

Impulsivity: Conceptualisation

This current study seeks to add to the body of literature describing the relationship between asthma and externalising behaviour difficulties by investigating impulsivity among children with the illness. Impulsivity impedes the ability of children to deal with complex situations such as those found during peer interactions, activities requiring sustained attention and situations requiring self-control. High levels of impulsivity mark an increased risk of externalising behavioural difficulties among young children (Snyder, Prichard, Schrepferman, Patrick & Stoolmiller, 2004). Once such behaviour problems are established, they are also more likely to persist and intensify among children with impulse control difficulties (Moffitt, 1993).

Investigating impulsive behaviours exhibited by children with varying degrees of asthma severity may identify whether this construct is implicated in the relationship between the illness and externalising behaviour difficulties. Such an investigation may also clarify whether varying degrees of asthma severity act as a risk factor for the intensification of such behaviour difficulties.

Children with impulse control difficulties find inhibiting their initial reactions to environmental stimuli difficult and are less likely to contemplate the implications of their actions before carrying them out (Mash & Wolfe, 2001). Impulse control difficulties may also impair children's ability to change learned behaviours, and consequently, they may find adapting to complex and varied situational demands difficult (Mash & Wolfe, 2001). Difficulties inhibiting learned behaviours and a lack of future insight may make co-operative play difficult because waiting, taking turns and adapting interaction styles to suit different circumstances are actions requiring self-control, insight and adaptability.

Impulsivity is a complex and multifaceted construct spanning across personality, cognitive and behavioural domains. Behavioural impulsivity, a term first coined by Gray, Owen, Davis and Tsaltas (1983), is an overactive approach system to environmental stimuli characterised by deficiencies in inhibiting motor movement and a limited ability to resist or delay gratification and temptation. Cognitive impulsivity was the term used to describe mental control, otherwise known as executive functioning. Executive functioning affects the ability to engage in complex mental processes such as using sustained attention and keeping mentally occupied for long periods of time (White, Moffitt, Caspi, Bartusch, Needles & Stouthamer-Loeber, 1994). Impulsivity on the personality domain is the enduring style of relating to the world characterised by acting without thinking and difficulties with waiting for and delaying gratification. Third party reports and performance task measures are used to quantify behavioural impulsivity ratings, self-reports are used for the personality domain and performance tasks are used to measure cognitive impulsivity (White, Moffitt, Caspi, Bartusch, Needles & Stouthamer-Loeber, 1994).

Behavioural impulsivity is most closely related to externalizing behaviour problems out of the three impulsivity domains. White and colleagues (1994) investigated the various factors of impulsivity and their relationship with externalising behaviour problems by applying a series of factor analyses to data collected from a sample of 400 adolescents (mean age of 10 years) using a wide array of behavioural, cognitive and personality based impulsivity measures. Half of the boys participating in the study of White and colleagues (1994) were deemed to be at risk of developing delinquent behaviours based on parent-, teacher- and self-report ratings. The other half of the recruited sample was a control group randomly selected from local schools. White and colleagues (1994) found that the risk of developing delinquency at age 10 and 13 among the boys participating in their study was most strongly related to measures of behavioural impulsivity. Impulsivity measures that loaded on the behavioural domain consisted entirely of parent and observer reports of motor restlessness, impatience, impersistence and behaviour under-control. These constructs were measured using video-taped observations coded according to descriptions of impulsive behaviour devised by Lynam, Moffitt, White and Caspi, (1991); the California Child Q-Set (Caspi, Block, Block, Klopp, Lynam, Moffitt et al., 1992); and items taken from the CBCL (Achenbach & Edelbrock, 1983) and an adapted version of the Self-Report Delinquency (Elliot, Huszina & Ageton, 1985) scale. Scores obtained with these measures yielded statistically significant differences between children in the stable delinquency, mild externalising behaviour problems and stable non-delinquency groups ($p = 0.001$). White et al. (1994) also found that behavioural impulsivity among 10-13 year-old boys was related to the severity of externalising behaviour problems. Children with mild externalizing behaviour problems received behavioural

impulsivity scores that were 1 SD above the stable non-delinquents, and children with stable delinquency scored 2 SDs above stable non-delinquents.

Parent Reported Behavioural Impulsivity and Childhood Asthma

The *Conners' Parent Rating Scale - Revised (CPRS-R)* developed by Conners, Sitarenios, Parker, and Epstein (1998), is a parent report questionnaire that assesses child impulsivity. The questionnaire is suitable for children and adolescents aged 3-17 and has been used to assess behaviour problems including those attributable to impulse inhibition difficulties. The psychometric properties of the *CPRS-R* were assessed using data collected from a large community based sample ($n = 8000+$) of parents, teachers, children, and adolescents throughout the United States and Canada from 1993-1996 (Conners, 1997). Factor analyses were used to identify items that either loaded onto more than one factor with a correlation greater than 0.30 or those that loaded onto factors below 0.30 correlations. These were removed from the questionnaire. Reliability of the *CPRS-R* subscale scores ranged from 0.75 to 0.94 among males and 0.75 and 0.93 among females aged 8-17 years old, suggesting that scores on the various subscales of the *CPRS-R* remain stable over time (Conners, Sitarenios, Parker & Epstein, 1998). The *CPRS-R* includes subscales that measure behaviour problems across externalizing and internalizing domains. The subscales were developed using factor analyses applied to statements describing difficult child behaviours, including those attributed to impulsivity. Three subscales measure impulsive behaviour: a) *Hyperactive-Impulsive* subscale, b) *Conners' Global Index: Restless Impulsive* subscale and c) *DSM-IV: Hyperactive-Impulsive* subscale. The *Hyperactive-Impulsive* subscale quantifies difficulties sitting still, concentrating on the same task over time, restlessness and impulsiveness. The *Global Index: Restless Impulsive* quantifies restlessness,

impulsivity and inattentiveness. The *DSM-IV: Hyperactive-Impulsive* subscale quantifies behaviours that constitute diagnostic criteria for hyperactive-impulsive type ADHD.

An earlier version of the *CPRS-R*, the *Conners' Parent Rating Scale (CPRS)* (Conners, 1990) was used during a French study of 92 children with asthma (Vila, Nollet-Clemencon, de Blic, Mouren-Simmeoni & Scheinmann, 1998). Six questionnaire subscales were included in the study, including the *Impulsivity* subscale. The aim of the study was to investigate the prevalence of psychopathology among children and adolescents with varying degrees of functional and physiological asthma severity. Children in mild, moderate and severe asthma severity categories did not yield statistically significant *CPRS Impulsivity* subscale score differences ($p = 0.215$). These results did not change when the three asthma severity categories were reduced to mild and severe. However, children with increasingly severe asthma did exhibit more hyperactive behaviours as measured by the *CPRS Hyperactivity Index* subscale ($p = 0.062$) and a statistically significant difference was found between children with mild and severe asthma severity ($p < 0.05$). All of the children participating in the study with severe asthma were taking oral corticosteroids (Vila, Nollet-Clemencon, de Blic, Mouren-Simmeoni & Scheinmann, 1998). Therefore, the behaviours of children who were and were not taking asthma medication were unable to be compared during the study.

Vila, Nollet-Clemencon, de Blic, Mouren-Simmeoni, and Scheinmann, (1998) reported that increasing asthma severity may be associated with hyperactive but not impulsive behaviours. Investigating whether there is a relationship between asthma severity and the updated *CPRS-R* impulsivity subscales will contribute to those findings. In addition, no studies as of yet have

investigated impulsivity among children with asthma using laboratory tasks of impulsivity. These tasks could supplement information gained from parent reports.

Laboratory Performance Based Measures of Behavioural Impulsivity

Most research using laboratory tasks to measure behavioural impulsivity have been conducted with children diagnosed with ADHD, a population with significant difficulties inhibiting behaviours and enduring delays (Mash & Wolfe, 2001). Sonuga-Barke, Dalen, and Remington, (2003) compared response inhibition and delay aversion in 156 children aged 3-5.5 years-old, to investigate whether the two constructs contributed independently to parent reports of hyperactive and impulsive behaviours. Health nurse and school teacher reports of behaviours representing ADHD were used to select and recruit 70% of the children; the other 30% of the sample was randomly selected from local primary and nursery schools. During the study, children's delay aversion and response inhibition was tested using the cookie delay task (Campbell, Szumowski, Ewing, Gluxk & Breaux, 1982) and the preschool choice delay task (Sonuga-Barke, Taylor, Sembi & Smith, 1992). Results of these measures were compared to parent reports of hyperactive and impulsive behaviours quantified using the Parent Account of Childhood Symptoms (Taylor, Sandberg & Thorley, 1991) scale and the Strengths and Difficulties Questionnaire (Goodman, 1997).

The cookie delay task (Campbell, Szumowski, Ewing, Gluxk & Breaux, 1982), was used during the study to measure response inhibition. The task involves a cookie being placed under one of three upturned transparent cups over eight consecutive trials. Experimenters raised their hands half way through delay periods ranging between 5-30 seconds, and clapped them together after a

set amount of time (Sonuga-Barke, Dalen & Remington, 2003). Children were instructed to take the cookie only after experimenters had clapped their hands. Children's approach behaviours toward the cookies were coded as *not inhibited* when children took the cookie before researchers clapped their hands; *partially inhibited* when children reached for the cookies but did not take them; and *fully inhibited* when children did not reach for the cookie at all.

The preschool choice delay task (Sonuga-Barke, Taylor, Sembi & Smith, 1992) was used during the study to measure delay aversion. During this task, children were seated in front of a computer screen and asked to make 22 choices between large-delayed rewards, or small-immediate rewards. Choice options were presented on the computer screen as two teddy bears holding one or two balloons. Teddy bears holding two balloons (large-delayed reward) were placed in the background of the presented image, and teddy bears holding one balloon (small-immediate reward) were placed on the foreground. Depth cues were provided by drawings of paths leading to each teddy bear and reward magnitude was represented by the number of balloons each teddy bear held. After a child selected one teddy bear using a mouse pointer, the teddy bear would walk to the foreground and release the balloon(s) they were holding. Teddy bears in the background with two balloons took longer to walk to the foreground (17 seconds) than teddy bears closer to the foreground (1 second) who were holding one balloon.

In the findings from the study, children with an increased number of parent reported externalising behaviour problems representing ADHD, had difficulties inhibiting their behaviours and enduring delays during the two tasks (Sonuga-Barke, Dalen & Remington, 2003). They were more likely to take the cookies placed under upturned cups before experimenters clapped their

hands ($r = -0.40, p < 0.01$), and were more likely to choose teddy bears holding one balloon ($r = -0.46, p < 0.01$) (Sonuga-Barke, Dalen & Remington, 2003).

Solanto, Abikoff, Sonuga-Barke, Schachar, Logan, Wigal and colleagues (2001) investigated the same behavioural impulsivity constructs in 106 children aged 7–10. Of these children, 77 met criteria for ADHD and 29 did not. Solanto and colleagues (2001) used computer programs to measure both response inhibition and delay aversion. The Stop Signal Task (Schachar & Logan, 1990) was used to measure response inhibition and the Delay Aversion Paradigm (Sonuga-Barke, Taylor, Sembi & Smith, 1992) was used to measure delay aversion.

The Choice Delay Task, a measure of delay aversion, involved children making 20 choices between two rectangles presented on the screen of a computer. One rectangle was green and had “1 Point” written on it, the other was blue and had “2 Points” written on it. Each square was associated with a different delay, the “2 Points” square made participants wait 30 seconds before receiving the respective number of points, and the “1 Point” square made participants wait for 2 seconds before receiving the respective number of points. Participants were instructed that each point earned could be exchanged for a nickel at the end of the task. The results obtained by Solanto and colleagues (2001) with the Choice Delay Task were the same as those of Sonuga-Barke, Dalen and Remington (2003) who used the cookie delay task. The number of small/soon rewards chosen during the Two Choice Task differentiated children who met criteria for ADHD and those who did not ($p < 0.001$). The number of small/soon reward choices during the Choice Delay Task also correlated significantly with classroom observations of interference with activities ($r = -0.375$, significant at $p < 0.01$), gross motor overactivity ($r = -0.355$, significant at p

< 0.01), behaviours representing ADHD ($r = -0.280$, significant at $p < 0.05$) and physical aggression ($r = -0.395$, significant at $p < 0.01$).

The Stop Signal Task used during the study conducted by Solanto and colleagues (2001) was used to measure response inhibition. The task consists of two parts; the first part involves the presentation of a series of “X”s and “O”s on the screen of a computer during 1000 msec intervals. Instructions are given to participants to press “X” and “Y” keys on a computer keyboard corresponding with the letters they see on the screen in front of them. Each of the 32 trials are followed by a wait interval and a fixation interval. The wait interval presents a blank screen for 1500 msec and the fixation interval presents a small cross in the centre of the screen for 500msec signalling the onset of the next trial. The second part of the task is the same as the first with one exception; during 33% of randomly selected trials, an auditory signal is presented to participants signalling they are to refrain from pushing the “X” and “Y” computer keys. Auditory signals were presented 100, 250, 350, 500 msec after the target stimulus onset. The efficiency with which participants were able to inhibit their responses differentiated children who met criteria for ADHD and those who did not ($p < 0.001$). Children who exhibited disruptive and aggressive behaviours during a classroom observation found inhibiting their responses during the Stop Signal Task difficult, with respective correlations of $r = 0.30$ ($p < 0.05$) and $r = 0.31$ ($p < 0.05$).

Dougherty, Mathias, Marsh and Jagar (2005) devised a series of computer administered behavioural impulsivity measures testing response inhibition and delay aversion. The measures are similar to those used in previous studies, for instance, the Two Choice Paradigm and the GoStop Paradigm developed by Dougherty, Mathias, Marsh and Jagar (2005) is similar to the

Choice Delay task and the Stop Signal Task used by Solanto et al. (2001). However, the computer measures developed by Dougherty, Mathias, Marsh and Jagar (2005) are unique in that they allow the easy manipulation of various test variables, for instance the Two Choice Paradigm allows the manipulation of delay duration and reward size. Dougherty, Mathias, Marsh and Jagar (2005) also devised another computer program to measure response inhibition called the Single Key Impulsivity Paradigm. This task involves participants pushing the button of a mouse to earn points; the longer they wait between each push the more points appear on a counter presented to them on a computer screen.

None of the impulsivity measures devised by Dougherty, Bjork, Harper, Marsh, Moeller, Mathias and colleagues (2003) have been applied to young children. However, the Two Choice Paradigm (TCP) and the Single Key Impulsivity Paradigm (SKIP) have been applied to twenty-two 13–17 year-old adolescents with disruptive behaviour disorders and 22 controls without behaviour problems (Dougherty et al., 2003). The TCP presents participants with two shapes on the screen of a computer, one circle and one square. During the study conducted by Dougherty, Bjork, Harper, Marsh, Moeller, Mathias and colleagues (2003) participants were given a 5c coin after a delay of 5 seconds (small/immediate reward) when they selected a circle, and 15c after a 15 second delay (large/delayed reward) when the square was selected. The disruptive adolescents did not show a greater preference for short delay choices than controls ($p = 0.420$). The p value increased to 0.580 when the scores were corrected for intellectual ability, suggesting this was a strong reward choice confounder during the task (Dougherty et al., 2003). During the SKIP, participants push a button to earn points: the longer the delay between each push, the more points they are awarded. The delay between each button push during the SKIP yielded a statistically

significant difference between adolescents with and without disruptive behaviour problems ($p = 0.04$). The SKIP performance differences between the two groups remained statistically significant when intellectual ability was controlled for suggesting that of the two reward-orientated tasks, the SKIP was a better marker of externalising behaviour difficulties than the TCP.

Sonuga-Barke (2002) suggests that two choice tasks such as the TCP have a smaller response inhibition load than response inhibition tasks such as the SKIP; subjects choosing between small/immediate and large/delayed rewards do not have to delay their actions to receive the larger reward. They make the original choice but do not have to inhibit their responses while waiting. Adolescents with disruptive behaviour disorders appear to find the response inhibition component of tasks such as the SKIP more difficult than the delay component of the TCP (Dougherty et al., 2003; Sonuga-Barke, 2002). Even though the SKIP is a useful tool to investigate response inhibition among older children, it may be too difficult for younger children because the reward/delay paradigms during the task are not overt. Therefore, the TCP is the best-suited measure of behavioural impulsivity for use with young children.

Focus of the Present Study

The focus of the present study was to investigate whether there was a relationship between asthma severity and impulsivity. The study intends to overcome previous research shortcomings by focusing on specific asthma and impulsivity sub-constructs, the delay avoidance aspect of impulsivity and the functional aspect of asthma severity. This study also sought to investigate whether there was a relationship between delay aversion impulsivity and parental ratings of child

impulsive behaviours by investigating whether an increased preference for small/ immediate rewards during the TCP resulted in increased parent reported impulsive behaviour problems.

To investigate the relationship between asthma and delay aversion type impulsivity with 6-year-old children with asthma, the present study had the following research aim: To investigate whether there was a relationship between functional asthma severity and impulsivity among 6 and 7 year-old children with asthma displaying varying degrees functional asthma severity.

CHAPTER 3

METHODOLOGY

Ethical Considerations

Before participant recruitment and data collection began for the current study, ethical approval of the proposed procedures was sought and obtained from The University of Canterbury Human Ethics Committee. All procedures employed during the current study were deemed ethically appropriate by the committee. A copy of the University of Canterbury Human Ethics Committee's letter of approval is included in appendix A.

Participants were well informed of the data collection procedures before consent was acquired. The introductory letter and the consent form encouraged parents to talk with their children before offering to participate in the study. If children were not able to write their name, their parents were asked to do this for them. One of the study's aims was to collect data of children's delay aversion with a computer task. To ensure children were informed about participating in the study, the researcher discussed the computer task with them before beginning the procedure. When the child displayed an understanding about the computer task including the right to withdraw from participation at any time, the researcher asked if they wanted to play the computer game, if the child said "yes", the researcher commenced with the task. The researcher used a simple and clear communication style to ensure parents and children understood data collection procedures.

Sampling and Participation Rate

The aim of the current study was to recruit 20 children with varying degrees of functional asthma severity from the CLS. This number was thought to be achievable given the scope of a dissertation. The CLS is an epidemiological cohort study investigating the relationships between health, social development and academic achievement in 298 five-year-old children during their first year at school. The study is funded by the Asthma and Respiratory Foundation of New Zealand, the University of Canterbury and the University of Otago. Children who had just begun attending school at 5 years and 0 months beginning in mid-2005, were recruited from eight randomly selected schools stratified by decile. Children whose first language was not English, Maori or a Pacific Island language, children entering school at an older age and those who received “Ongoing and Reviewable Resourcing Schemes” (ORRS) were excluded from the CLS. Recruitment of 5 year old children began in mid 2005, continued throughout 2006 and concluded in March, 2007.

Asthma status and its functional severity were the variables used to select participants from the CLS for the present study. To assess the asthma and/or wheeze status of 5 year old children, the CLS first acquired parent reports of children’s symptoms using questionnaire items taken from the International Study of Asthma and Allergies in Childhood (ISAAC) (Asher, Keil, Anderson, Beasley, Crane, Martinez et al., 1995). Then, after consent was obtained from parents, families’ general practitioners (GP) were contacted to gain further information about children’s asthma and wheeze symptoms. The collected information was then reviewed by a paediatric respiratory specialist, who categorised children according to their asthma and/or wheeze status. Children who displayed asthmatic symptoms were classified as having “current” asthma and/or wheeze.

Using an adaptation of the Asthma Functional Severity Scale (AFSS) (Rosier, Bishop, Nolan, Robertson, Carlin & Phelan, 1994), the researcher of the current study estimated functional asthma severity of all 30 children participating in the CLS who had turned 6 years of age and were categorized by the respiratory specialist with “current” asthma and/or wheeze at 5 years of age. These 30 children represented the study sampling frame. The researcher was blind to the identity of participants when the calculations were made.

To ensure children with a wide range of functional asthma severities participated in the current study, the categorical classifications presented by Rosier and colleagues (1995) were used to recruit children with varying functional severities. These categories of functional severity were constructed by Rosier and colleagues (1994) using the item response theory of the partial credit model and ranged between *low*, *mild*, *moderate* and *severe*. According to Rosier’s severity classifications, 53% of the 30 children had low functional asthma severity, 26.6% had mild severity, 13.3% had moderate severity, and 6.6% had functional impairments in the severe range. The distribution of functional asthma severity in this sample was similar to that of the 1,267 children participating in the study conducted by Rosier and colleagues (1994). Children with AFSS scores in the *low* range made up 47.4% of their sample, 29.9% were in the *mild* range, 18.3% were in the *moderate* range and 4.4% were in the *severe* range. This data is presented in table 1.

Table 1. *Functional Asthma Severity Group Distribution of the Study Sampling Frame*

Functional Severity Classification		N	Percent of Study Sampling Frame (Percent of Rosier's Participants)
Low	(Scores of 0-4)	16	53% (47.4%)
Mild	(Scores of 5-8)	8	26.6% (29.9%)
Moderate	(Scores of 9-14)	4	13.3% (18.3%)
Severe	(Scores of 15-22)	2	6.6% (4.4%)

Utilizing the calculated functional asthma severity scores, research supervisors of the current study selected children with *mild*, *moderate* and *severe* functional asthma severity and created a list of names. To ensure a range of severity scores, all 14 children identified in the sampling frame with a functional severity score of 5 or greater were selected by the research supervisors for recruitment. This included a further 4 children with *moderate* or *severe* asthma who were not in the original 30, but who had completed their 6 year assessment in the interim. Children who had a functional asthma severity score below 5 were randomly selected from the *low* group using a random number system.

The names and contact details of 24 children in total and their parents were given to the researcher who was blind to the functional asthma severity rating of each child. The researcher then attempted to contact the parents of each of the 24 identified children. Research supervisors replaced children not willing or unable to participate with others who had similar AFSS scores. Of the 24 families: 4 (20%) were unable to be contacted by the researcher, 17 (70.8%) were

willing to participate and 3 (12.5%) were not willing. One child chose to discontinue participation, leaving the data collected from 16 (66.67%) participants usable for analysis.

The functional asthma severity of the 16 children participating in this study, estimated by the adaptation of the Asthma Functional Severity Scale (AFSS) (Rosier, Bishop, Nolan, Robertson, Carlin & Phelan, 1994), ranged from 0-15 out of a possible 0-24. All severity increments were equally represented by 6.3% of the total sample with exception of 0, 3 and 10 severity scores. Severities of 1, 7, 8, 11, 12 and 13 and those above 15 were not represented in the current sample. Children who scored 0 functional severity made up 25.0% of the sample, 18.8% scored 3 and 12.5% scored 10. According to the functional asthma severity categories established by Rosier et al., (1994), 56.25% of the 16 children participating in the current study had *low* functional asthma severity, 13.5% had *mild* asthma severity, 25% had *moderate* asthma severity and 6.25% had *severe* asthma severity. These results have been presented in table 2.

Table 2. *Functional Asthma Severity Group Distribution of the Study Sample*

Functional Severity Classification	N	Percent of Study Sample
Low	9	56.25%
Mild	2	13.50%
Moderate	4	25.00%
Severe	1	6.25%

Participant Recruitment

To recruit parents and their children, the researcher telephoned parents and gave them a brief introduction about the data collection procedures. They were then asked if they would be interested in receiving further information about participating in the study. If parents wanted further information, a letter of introduction containing all information about the data collection procedures, a consent form and pre-paid envelope were sent to them. The letter of introduction covered all relevant details of the study including; details of the computer task administered to children and the monetary rewards offered as incentive, the negotiability of the monetary reward, the parent questionnaire and the contact details of the investigators involved in the study. A copy of the information sheet is included in appendix B.

Three days later, parents were telephoned again in case they had any further questions about the introductory material. If parents and their children wanted to participate, they were asked to either send a signed consent form back to the CLS in a pre-paid envelope, or to have the form ready when the researcher visited them to collect the data. The consent form presented seven aspects of participating in the study; including; the right to withdraw at any time and the data collection procedures. A copy of the consent form is included in appendix C. Unless parents allowed the researcher to collect the consent form when collecting the data, parents were rung again by telephone when their forms arrived at the CLS by mail. A time was then arranged to collect the data.

Measures

Asthma Severity Measures

Functional asthma severity was calculated from data previously recorded by the CLS. The CLS acquired parent reports of children's asthma symptoms using two structured interviews including standardized questions taken from the International Study of Asthma and Allergies (ISAAC). These questionnaire items are included in Appendix D. The ISAAC study stemmed from a pre-existing research initiative from Auckland, New Zealand, that sought to standardize data collection methods during asthma related epidemiological data collection. This initiative began in 1989 with the development of a standardized questionnaire designed to provide data regarding asthma prevalence in the United Kingdom, New Zealand, and Australia. The standardization effort by the ISAAC study is now a collaborative endeavor from international researchers, including New Zealand, seeking to assist the progression of studies investigating the mechanisms underlying asthma, allergic rhinitis and eczema prevalence by developing and promoting a standardized questionnaire (Steering Committee of the International Study of Asthma and Allergies in Childhood, 2007).

Asthma severity was calculated by applying an adapted version of Asthma Functional Severity Scale (Rosier, Bishop, Nolan, Robertson, Carlin & Phelan, 1994) to the ISAAC questionnaire data collected by the CLS. The AFSS (Rosier, Bishop, Nolan, Robertson, Carlin & Phelan, 1994) is a parent report, six-item questionnaire measuring the functional aspects of asthma severity among children aged 8-16 years. The questionnaire items measure four components of functional asthma severity; the frequency of asthmatic episodes and airway restriction symptoms between such episodes, the extent of impairment during asthma attacks and the impact of airway

restriction on the child's daily functioning between episodes (Rosier, Bishop, Nolan, Robertson, Carlin & Phelan, 1994). The AFSS uses a 4 point scale to attribute a degree of functional severity to each of the four measured domains, with lower scores suggesting milder functional asthma severity than higher scores. The psychometric properties of the AFSS were analyzed using 9,192 Australian children aged between 8-16 years; the scale showed good reliability and validity (Cronbach's $\alpha=0.89$) (Rosier, Bishop, Nolan, Robertson, Carlin & Phelan, 1994). The applicable age range of the questionnaire was not clearly specified by the authors but Rutishauser, Sawyer, & Bowes, (1998) interpret Rosier's relevant age range specification of "school age" to include children between 5-15 years old.

An adapted version of the AFSS was used during the current study to allow its application to the ISAAC questionnaire items used by the CLS. Differences between the original AFSS and the adapted one used by the CLS are included in Appendix E. Using the adapted AFSS, functional asthma severity scores were calculated without the need for technical lung function tests, physical exams, or blood tests. The researcher calculated a functional asthma severity score for each of the 30 children in the CLS classified as having current asthma and/or wheeze. The overall functional asthma severity scores ranged between 0-24; higher scores suggest a greater illness impact on general activities than lower scores.

Impulsivity Measures

Two measures of impulsivity were used during the current study; a computer task measuring behavioural and reward orientated facets of impulsivity called the Two Choice Paradigm (TCP) (Dougherty, Mathias, Marsh & Jagar, 2005), and a parent report questionnaire of children's

impulsive behaviours. The TCP is part of a computerized impulsivity measurement package supplied by Donald M. Dougherty of the University of Ohio, where participants choose between receiving a large reward presented after a long delay or a small reward given after a short delay.

During each trial of the TCP, participants choose between two cards presented on the screen of a laptop computer, one with a square on it, the other with a circle. After a training session familiarizing participants with the reward/delay paradigms of each shape, each trial consists of selecting the shape by clicking on one of the cards with a computer mouse. Each participant completes 30 TCP trials. When a shape is selected, it turns grey and the other card disappears for a short period signalling that the participant must wait. When the selected card flashes, it is once again clicked on and a reward is presented.

During the current research project, if the child had originally clicked on the square, they would be awarded 20 cents/points after a 10 second delay, while the circle provided 10 cents/points after a 2 second delay. After each trial, a 10c or 20c coin was placed next to the computer in the child's view and the total amount they had earned was displayed above the two shapes on the computer screen. This task was repeated 10 times during the training round and 30 times during the testing trials, over a period of 2:00 - 6:00 minutes depending on the shapes chosen by the child. At the end of the task, the money earned during the task was given to the child. The screens presented to the child at each stage of the task are presented in figure 1.

Figure 1. *Images Presented to Children During the TCP Computer task*

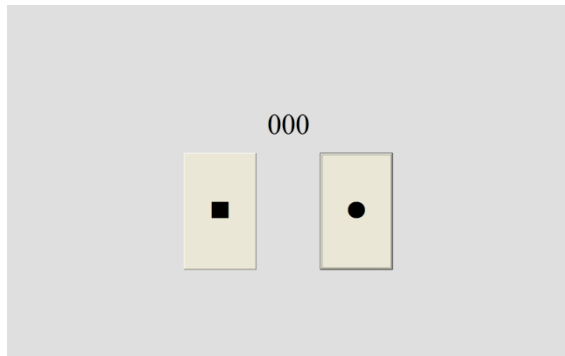


Image presented to the participant before a shape had been selected .

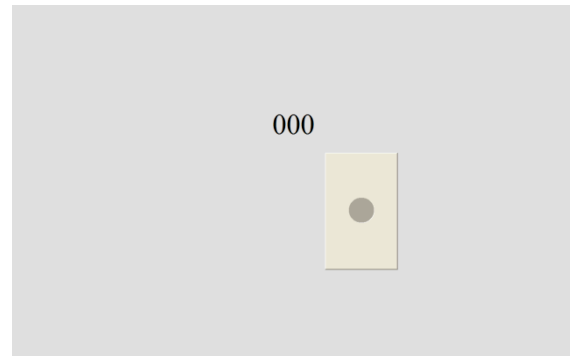


Image presented to the participant after a circle had been selected.

Previous research using the TCP or similar computer programs employed different delay/reward ratios. Dougherty et al., (2003), who studied adolescents between the ages of 13 and 17 years, used 5 cent rewards (American currency) after a 5 second delay and 15 cents after a 15 second delay. Solanto et al., (2001) studied children aged between 7 and 10 years old. This study constructed a task slightly different from the TCP. A screen with one green square labelled 1 point and a blue square labelled 2 points was presented to participants during each trial. After selecting a shape with a computer mouse, the participant was awarded the relevant points. Each point earned could be traded for a nickel at the end of the task. The delay for 1 point was 2 seconds and the delay for 2 points was 30 seconds. A pilot study conducted by Solanto et al., (2001) found that these parameters yielded the greatest differences between children with only ADHD and those who also had difficulties with aggressive behaviours. During the current study, the same 2 second delay was utilized for the smaller reward, 10 cents (New Zealand currency). However, rather than a 30 second delay, a 10 second delay eliciting a 20 cent reward was used. This ensured that the difference between the two time spans remained substantial without the

long wait times. The delay periods of Dougherty et al., (2003), could not be utilized during this study because a delay period equal in quantity to the amount of money received would have made the task too long and tedious for 6-7 year old children.

To ensure children understood the procedures, they were coached through 10 training trials by the researcher. During the ten training trials, the first five presented only a circle, and the last five displayed only squares. An extensive series of instructions was given to children ensuring they understood the procedure. The training procedure is outlined in appendix F. When the training trials ended, the researcher asked the child a series of questions to ensure they understood the procedures. If the child gave the wrong answer to any of the questions, the correct answer would be discussed with them before moving to the next question. Then, when all questions were answered, those they got wrong would be asked again until all the questions were answered correctly. The children were then asked whether they had any further questions before they completed the 30 testing trials. When the procedure was finished, the parent was asked to complete the questionnaire.

Questionnaire

A Questionnaire was used during the current study to acquire further information about children's impulsive and adaptive behaviours. Parental ratings of impulsive behaviour were used to gain further information about children's impulsivity and to provide comparative data for that obtained by the TCP. Parental ratings of positive and adaptive child behaviours were collected for two reasons; to ensure parents would not only reflect on the difficult behaviours exhibited by their children and to investigate their relationship with functional asthma severity and

impulsivity. The questionnaire used in the current study was constructed from individual subscale items of three other questionnaires; the Conners' Parent Rating Scale – Revised (*CPRS-R*) (Conners, 1997), a 10 item short form version of the Positive Behaviour Scale (Hofferth, 1998) and the Supplementary Strengths Checklist of the Assessment Checklist for Children (SSC-ACC) (Tarren-Sweeney, 2007). *CPRS-R* subscale items were used to record parent ratings of children's impulsivity and the Positive Behaviour Scale and the SSC-ACC items were used to ensure parents did not only reflect on their children's difficult behaviours.

The Conners' parent Rating Scale (*CPRS-R*) (Conners, 1997) is a comprehensive parent, teacher or adolescent report checklist of child and adolescent behaviour problems, with an emphasis on attention deficit hyperactivity disorder (ADHD) (Conners, Sitarenios, Parker & Epstein, 1998). The questionnaire quantifies a series of behaviours often exhibited by children with externalising behaviour problems and is suitable for children and adolescents aged 3-17. Substantial portions of the questionnaire's items quantify behaviours frequently exhibited by children diagnosed with ADHD, including those that are hyperactive and impulsive (Conners, 1997). Three *CPRS-R* subscales measure two impulsivity constructs, hyperactive-impulsive and restless-impulsive behaviours. Parental perceptions of children's behaviours could be compared to the data of over 8000 parents, teachers and children collected by Conners' (1997).

Six *CPRS-R* (Conners, 1997) subscales were included in the questionnaire used during this study; the *Hyperactive-Impulsive*; *Conners' ADHD Index*; *Conners' Global Index: Restless-Impulsive*; *Conners' Global Index: Total*; *DSM IV Inattentive*; and *DSM-IV Hyperactive-Impulsive* subscales. However, only the *Hyperactive-Impulsive*; *Conners' Global Index: Restless-*

Impulsivity; and the *DSM-IV Hyperactive-Impulsive* subscale items were used for statistical analysis because they specifically measured impulsive and other associated behaviours. The *CPRS-R* subscale items included in the questionnaire used during this study are included in appendix G. Items of each *CPRS-R* subscale are rated by parents or teachers on a four point scale ranging from 0 to 3 or, “NOT TRUE AT ALL (seldom, never)” to “VERY MUCH TRUE (often, very frequent)”. Children’s raw subscale scores are then converted to T-scores, allowing their comparison to the same reference values obtained by Conners (1997). The T-score distribution has a mean of 50 and a standard deviation of 10.

Questionnaire items of children’s positive behaviours were included in the questionnaire to ensure parents reflected on both the positive and difficult behaviours exhibited by their children. Due to the exploratory nature of this study, the positive behaviour questionnaire results were also used to identify whether increased impulsivity identified by the TCP and *CPRS-R* subscales and increased functional asthma severity coincided with decreased adaptive behaviours. During this study the SSC-ACC (Tarren-Sweeney, 2007) and 10 item short form version of the Positive Behaviour Scale (Hofferth, 1998) were used to assess positive and adaptive behaviours exhibited by children with asthma.

The ACC is a carer-report psychiatric rating scale, measuring behaviours, emotional states, traits, and manners of relating to others (Tarren-Sweeney, 2007). It was developed to measure a range of problems not adequately covered by other standardized instruments. Recently, a number of additional items were written for the ACC, measuring converse *strengths*. This strengths scale was included in the present study questionnaire. The ACC has good content, construct and

factorial validity, as well as internal reliability, matching or exceeding that of other standardized checklists (Tarren-Sweeney, 2007). However, the strengths scale is a research instrument that has yet to be validated. The questionnaire items are listed in appendix H.

Another scale of adaptive child behaviour, a 10 item adaptation of the Positive Behaviour Scale (Hofferth, 1998) was also included in the questionnaire so scores obtained by the SSC-ACC could be compared to those obtained by a scale measuring similar constructs. The Positive Behavior Scale (Epps, Park, Huston & Ripke, 2003) is a parent report questionnaire designed to measure the well-being of children aged between 2-12. The original scale consisted of 25 items, divided into 3 subscales; social competence and sensitivity, compliance and self-control, and autonomy. The scale also measures obedience, persistence, and self esteem. Questionnaire items are rated on a five-point-scale, ranging from “never” to “all of the time”, by parents or teachers who each answer slightly different questionnaire items. The Positive Behavior Scale was adapted to a 10 item version during the Panel Study of Income Dynamics (PSID) study (Hofferth, 1998). This adaptation of the Positive Behavior Scale (Hofferth, 1998) used the “Social Competence” and “Compliance” subscales of the original.

The standard Positive Behaviour Scale (Epps, Park, Huston & Ripke, 2003) was tested for internal consistency, using the alpha level of the questionnaire items. Internal consistency of the questionnaire was 0.79, above the adequate threshold of 0.70 (Epps, Park, Huston & Ripke, 2003). The correlation among raters was low, with a total correlation of 0.19 between parents and teachers for the total positive behaviours measured. The stability of total positive behaviours over time was moderate over a 3-year period, with a correlation of 0.51 among parents. Among

teachers the stability was slightly lower at 0.42, however, teachers had frequently changed schools over the 3 year period. The adapted 10 item Positive Behavior Scale (Hofferth, 1998) appears to have good validity; total positive behaviours rated by parents mark decreased problem behaviours and externalising behaviours (correlation of -0.59) on other behaviour problem measures (Gresham & Elliot, 1987). The correlation of positive and problem behaviours among teacher ratings were lower at -0.23. The questionnaire items utilized during the current study are listed appendix I.

Additional Data Gathered During the Study

During the current study, further data were gathered regarding the time children spent on computers or other digital entertainment devices, and whether they had taken any asthma medication that day. It was possible that children who spent more time on the computer found the computer task easier than those who did not (Dahl, White, Weihe, Sorensen, Letz, Hudnell et al., 1996). Asthma medication taken during the day may also have had an impact on how children performed during the TCP and parental ratings of impulsive behaviour (Bender & Milgrom, 1995). Due to the potential confounding properties of these two variables, parents were asked how often their child was on the computer, Play-Station, X-Box or other digital device during the week and whether children had taken any asthma medication that day. Children who were on the computer once a week or more were classified as spending time on digital devices, and those who were less than once a week were classified as not spending time on such devices. Data was also collected on demographic variables of children, such as age, gender, relationship with parents, parental education and ethnicity, as these factors may implicate this study's measures. Children's relationship with their parents are important because this has an impact on children's

development and behaviour (Pilowsky, 1995) and it may also be related to parental responses to asthma management, as well as environmental conditions associated with asthma (Halfon, Mendonca & Berkowitz, 1995). Data of parental education was also gathered as this factor is correlated with children's intellectual ability (Scarr, Weinberg & Waldman, 1993). Children's intellectual ability has been found to confound their performance during computerised measures of impulsivity (Dougherty et al., 2003; White, Moffitt, Caspi, Bartusch, Needles & Stouthamer-Loeber, 1994).

Settings

During the present study, data on children's impulsivity was collected at their home. Sessions were scheduled for after school, weekends, or school holidays. This ensured that the utilized procedures had minimal effects on the child's routine. Data collection involved children completing a task on a laptop computer, the Two Choice Paradigm (TCP) (Dougherty, Mathias, Marsh & Jagar, 2005), and parents filling in a questionnaire. During the computer task, children were seated either on a chair at the dining room table or on some occasions at a coffee table in their living rooms. The researcher sat at an arm's length next to the child and laptop computer. Distracting environmental stimuli were minimized during the procedure; parents turned off televisions and siblings were asked to remain quiet throughout the computer task. During the procedure, parents were seated next to the child or they would continue with their routines in adjacent rooms. After the computer task, parents were asked to fill in a questionnaire about their children's impulsive and positive behaviours.

Statistical Analyses

Collation and statistical analyses of the data gathered during the present study were conducted using the *Statistical Package for Social Sciences* (SPSS). Across all analyses conducted during the study, p values of < 0.05 were taken to indicate statistically significant relationships between variables and distribution differences between participant groups. A series of bivariate correlations were conducted to investigate whether there was a relationship between children's functional asthma severity, impulsivity and positive behaviours. Scores obtained with the Asthma Functional Severity Scale (Rosier, Bishop, Nolan, Robertson, Carlin & Phelan, 1994) were correlated with the number of small/immediate reward choices made during the TCP and scores obtained with the *CPRS-R* (Conners, 1997), *APBS* (Hofferth, 1998) and *SSC-ACC* (Tarren-Sweeney, 2007). Another series of bivariate correlations were conducted to investigate whether there was relationship between children's impulsive behaviours and positive behaviour scores. Scores obtained with both measures of impulsive behaviour were correlated with those obtained using the two positive behaviour questionnaires.

A series of Mann-Whitney U tests were conducted to investigate whether groups of children taking asthma medication made different reward choices during the TCP, or received different parent rated impulsivity and positive behaviour scores. The Mann-Whitney U test is a non-parametric equivalent to the t -test statistic. Due to the small sample size of this study, groups were too small to compare mean scores, and consequently, non-parametric statistics were used rather than their parametric counterparts.

Another series of Mann-Whitney U tests were conducted to investigate whether the two gender groups made different reward choices during the TCP or received different *CPRS-R*, APBS and SSC-ACC scores. In addition, Mann Whittney U tests were used to investigate whether the TCP reward choices of children with parents who had not completed high school and those who had attended tertiary education differed. The test was also used to investigate whether *CPRS-R*, APBS and SSC-ACC scores of children who chose small/immediate rewards during seven or less of the thirty TCP trials differed to those who chose small/immediate rewards during eight or more of the trials.

A series of Kruskal-Wallis H tests were conducted to investigate whether groups of children in the *low*, *mild*, *moderate* and *severe* functional asthma severity categories (Rosier, Bishop, Nolan, Robertson, Carlin & Phelan, 1994) made different reward choices during the TCP, or received different *CPRS-R*, APBS and SSC-ACC scores. The Kruskal-Wallis H test is a non-parametric equivalent to the ANOVA statistic.

The ninth set of analyses were conducted to investigate whether TCP response style was related to any of the other measured variables. A series of Mann-Whitney U tests were conducted comparing measure outcomes between children who chose small/immediate rewards on or less than 7 of the 30 TCP trials and children who chose small/immediate rewards more than 7 times. A chi-squared analysis was also conducted to compare functional asthma severity group distribution between the two TCP response groups and another two to compare the parental education distribution between the two response groups.

CHAPTER THREE

RESULTS

Demographic Characteristics of Study Sample

Of the 16 children recruited to the study, nine were girls (56.3%) and seven were boys (43.8). Fourteen children were age 6 (87.5%) and two children were age 7 (12.5%). All but one of the children lived with both their biological parents while the remaining child lived with one biological parent. Results of the Social Trends Report (Monitoring and Research Team, 2003) were used during this study to investigate how well the recruited sample represented the Christchurch population. Demographic data collected by the Monitoring-and-Research-Team (2003) showed that 67.25% of Christchurch families with children consisted of two parents with one or more children and 32.74% consisted of one parent and one or more children. During the current study, children living with both their parents were over-represented and children living with one parent were under-represented.

Of the 12 parents willing to disclose their income, 15.4% were in the second income quintile, 53.8% were in the third quintile, and 30% were in the fourth quintile. The Christchurch census conducted in 2003 found that of families with children, 13.8% were in the second income quintile, 20.2% were in the third quintile and 17.3% were in the fourth quintile (Monitoring and Research Team, 2003). Families in first and fifth income quintiles were not represented in this study while the second and third income quintiles were over represented.

Of the 16 parents participating in the current study, 14 (87.5%) classified themselves as New Zealand European, 1 (6.3%) as New Zealand Maori, 1 (6.3%) as New Zealand Pacific Islander. The 2003 Christchurch census found that 87% of people living in Christchurch classified themselves as New Zealand European, 6.9% as New Zealand Maori, 2.4% as New Zealand Pacific Islander and 0.6% as other. Therefore ethnic populations in Christchurch are well represented with exception of the Asian community who make up 5.5% of the Christchurch population (Monitoring and Research Team, 2003) but are not represented in the current study sample. Demographic information of this study's participants is presented in table 3.

Table 3. *Demographic Characteristics of Study Sample*

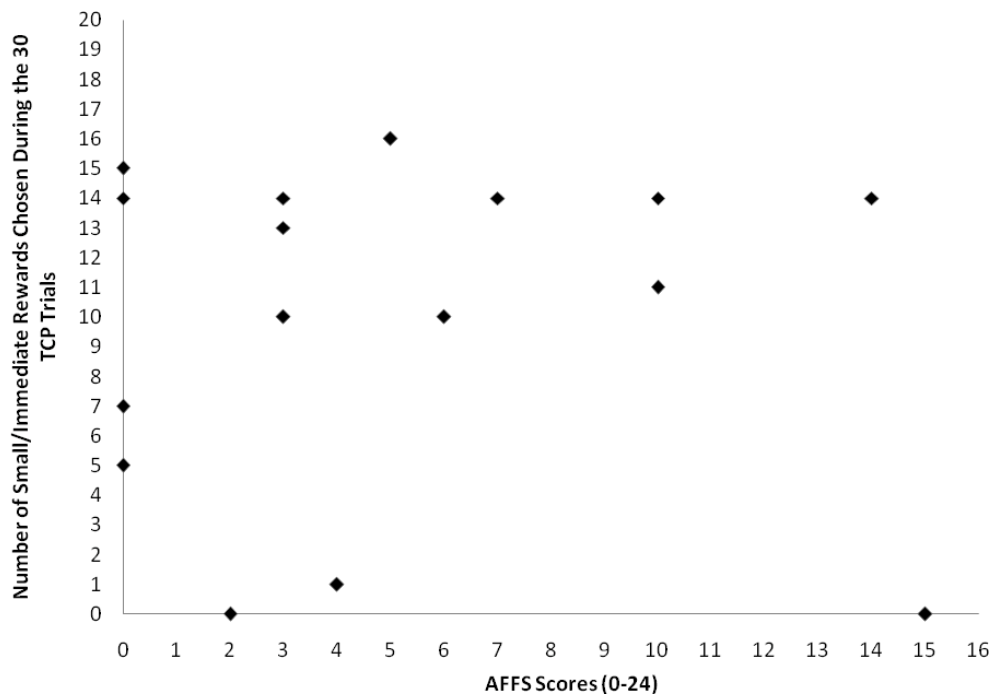
Demographic Characteristic	Number (%) (n = 16)
Living Situation	
Living With Both Biological Parents (67.3)*	15 (93.8)
Living With One Biological and One Step Parent (32.74)*	1 (6.25)
Annual Family Income	
Quintile 2 (13.8)*	2 (12.5)
Quintile 3(20.2)*	7 (43.8)
Quintile 4 (17.3)*	4 (25.0)
Unspecified	3 (18.8)
Ethnicity	
New Zealand European (87)*	14 (87.5)
New Zealand Maori (6.9)*	1 (6.25)
New Zealand Pacific Islander (2.4)*	1 (6.25)

*Note. *Christchurch percentage of total family incomes in each quintile. Christchurch City Council (2003) Christchurch Social Trends Report 2003*

Functional Asthma Severity and Two Choice Paradigm Small/Immediate Reward Choices

The main objective of the present study was to investigate whether there was a relationship between functional asthma severity and impulsivity among 6-7 year-old children. One measure of impulsivity was the Two Choice Paradigm (TCP), a computer task that quantifies delay aversion by measuring the number of small/immediate rewards chosen during 30 trials. The mean number of small/immediate reward choices children made during the 30 TCP trials was 9.88 (SD = 5.57). To investigate whether there was a relationship between functional asthma severity and delay aversion, the number of small/immediate rewards chosen during the 30 TCP trials were graphed and correlated with children's AFSS scores. Figure 2 shows the distribution of delay avoidant scores among children with varying degrees of functional asthma severity.

Figure 2. *Children's Preference for Small/Immediate Rewards and Functional Asthma Severity Scores*



The number of delay avoidant responses during the 30 TCP trials varied substantially across the functional asthma severity spectrum. Of the participating children, 10 (62.5%) chose small/immediate rewards on 10-15 of the 30 TCP trials. This group of participants yielded *mild* to *moderate* functional asthma severity scores of 0 – 14 on the AFSS (Rosier, Bishop, Nolan, Robertson, Carlin & Phelan, 1994). Three of the participants (18.75%) chose small/immediate rewards on less than two of the thirty TCP trials. This group of children showed considerable functional asthma severity variation, yielding AFSS scores of 2, 4 and 14. These results suggest that during the 30 TCP trials, most children chose 10-15 small/immediate rewards, while a small group chose 0-1 small/immediate rewards.

To assess whether there was a relationship between functional asthma severity at age 6-7 and a preference for small/immediate rewards, a bivariate Pearson correlation with a two-tailed test of statistical significance was conducted. Functional asthma severity did not correlate with the number of small/immediate rewards chosen during the 30 TCP trials at a statistically significant level ($r = -0.03$, $p = 0.92$). This result suggests that functional asthma severity is not related to the number of delay avoidant responses chosen during the TCP.

Response Pattern Differences During the TCP

TCP response data showed that children's reward choices became increasingly random as they chose more small/immediate rewards. A series of graphs showing children's response patterns have been included in appendix J. A series of Mann-Whitney U tests were conducted to investigate whether groups of children who chose 7 or fewer small/immediate rewards during the 30 TCP trials scored differently across any other measured variable compared to children who

chose more than 7. This number of small/immediate rewards chosen during the TCP differentiated the five children who chose the least small/immediate rewards from the other eleven who chose the most. Results shown in table 4 indicate that none of the mean AFSS, *CPRS-R* subscale, APBS or SSC-ACC rank scores differed at a statistically significant level between the groups of children who chose small/immediate rewards on more and less than 7 of the 30 TCP trials.

Table 4. *Score Comparison Between Five Respondents Who Chose the Fewest Small/Immediate Rewards and Those Who Chose the Most*

Measure	TCP Reward Choice Group	N	Mean Rank	<i>U</i>	<i>p</i>
AFSS Scores	≤ 7 Small/Immediate Rewards	5	7.00	20.00	0.39
	> 7 Small/Immediate Rewards	11	9.18		
<i>CPRS-R</i> C T-scores	≤ 7 Small/Immediate Rewards	5	9.20	24.00	0.69
	> 7 Small/Immediate Rewards	11	8.18		
<i>CPRS-R</i> I T-scores	≤ 7 Small/Immediate Rewards	5	6.80	19.00	0.33
	> 7 Small/Immediate Rewards	11	9.27		
<i>CPRS-R</i> M T-scores	≤ 7 Small/Immediate Rewards	5	9.10	24.50	0.73
	> 7 Small/Immediate Rewards	11	8.23		
SSC-ACC Scores	≤ 7 Small/Immediate Rewards	5	9.50	22.50	0.57
	> 7 Small/Immediate Rewards	11	8.05		
APBS Scores	≤ 7 Small/Immediate Rewards	5	8.60	27.00	0.95
	> 7 Small/Immediate Rewards	11	8.45		

To investigate whether parental education differed between the five children who chose the fewest small/immediate rewards and the other eleven children who chose the most, two two-way Pearson's chi-squared analysis (χ^2) were conducted. Maternal and paternal education of the five

children who chose the fewest small/immediate rewards were compared to the parental education of the eleven children who chose the most. Table 5 is a contingency table showing the number of children in each of TCP response groups and their maternal level of education.

Table 5. *Maternal Education of Children Who Chose the Fewest and Most Small/Immediate Rewards*

	Attended High School (n = 9)	Attended Tertiary Education (n = 7)
The Least Small/Immediate Rewards (n = 5)	2	3
The most Small/Immediate Rewards (n = 11)	7	4

The chi-squared analysis did not show a statistically significant relationship between TCP response style and maternal education ($\chi^2 = 0.78$, $p = 0.38$). These results suggest that the maternal education of children who chose the fewest small/immediate rewards did not differ compared to those who chose the most.

Another chi-squared analysis was conducted to investigate whether the five children who chose the fewest small/immediate rewards had fathers with different levels of education compared to the eleven children who chose the most small/immediate rewards. Table 6 is a contingency table showing the number of children in each of TCP response groups and their paternal level of education.

Table 6. *Paternal Education of Children Who Chose the Fewest and Most Small/Immediate Rewards During the TCP*

	Attended High School (n = 9)	Attended Tertiary Education (n = 4)
The Least Small/Immediate Rewards (n = 5)	3	1
The Most Small/Immediate Rewards (n = 11)	6	3

The chi-squared analysis did not show statistically significant parental education distribution differences between children who chose the fewest small/immediate rewards during TCP and those who chose the most ($\chi^2 = 0.09$, $p = 0.76$). This result showed that children's TCP performance was not related to their fathers' level of education.

Functional Asthma Severity Groups and Two Choice Paradigm Small/Immediate Reward Choices

To investigate whether the mean number of small/immediate TCP reward choices made by groups of children with varying functional asthma severities differed, a Kruskal-Wallis H test was conducted (the non-parametric equivalent of a one-way ANOVA). Severity increments used during this analysis were established by Rosier et al., (1994) who classified functional asthma scores of 0-4 as *low* functional asthma severity, 5-8 as *mild*, 9-14 as *moderate* and above 14 as *severe*. Only one child received an AFSS score in the *severe* range and consequently the

moderate and *severe* groups were combined to form the “moderate/severe” group. Table 7 shows that the number of small/immediate rewards chosen during the TCP by groups of children with varying degrees of functional asthma severity did not differ at a statistically significant level ($H = 2.69, p = 0.26$).

Table 7. *Number of Small/Immediate Reward Choices Made by Children in Different Functional Asthma Severity Groups*

Functional Severity	N	Mean Rank	H	<i>p</i>
Low	9	6.83	2.69	0.26
Mild	3	11.00		
Moderate/Severe	4	10.38		
Total	16			

TCP Test Performance, Asthma Medication Use and Computer Experience

Two variables that may have confounded children’s responses during the TCP were whether asthma medication had been taken on the day of testing and the amount of time spent on computers or other digital entertainment devices. To investigate whether these two variables marked different delay aversion responses during the TCP, two Mann-Whitney *U* tests were conducted. One of the tests assessed whether children spending time on computers more than once a week chose a different number of small/immediate rewards during the TCP than those spending time on computers less than once a week. Another compared the number of small/immediate reward choices made by children who had versus had not taken asthma medication on the day of testing.

Of the 16 children participating in the current study, three (18.75%) had taken asthma medication on the day of testing, one child (6.7%) had taken a preventative dose of Beclazone, another had taken 50mg of Flixotide and another had taken 200mg of Pulmicort. All three asthma medications were corticosteroids. The results are shown in table 8. Neither time spent on computers nor asthma medication use were related to small/immediate reward choices during the TCP.

Table 8. *Asthma Medication, Experience with Computer Games and the Number of TCP Small/Immediate Reward Choices*

Asthma medication status and computer experience status	N	Mean Rank	<i>U</i>	<i>p</i>
Asthma Medication taken on the day of testing	3	11.17	11.50	0.27
No asthma medication taken on the day of testing	13	7.88		
Is on the computer or other device more than once a week	9	7.89	26.00	0.55
Is on the computer or other device less than once a week	7	9.29		

TCP Test Performance and Parental Education

Another potential confounder of TCP test performance may have been parental education. Two Mann-Whitney *U* tests were conducted to investigate whether maternal and paternal education marked children's TCP reward choice differences. The mean small/immediate reward choice

ranks of children with parents who had attended high school and tertiary education were compared. Results are illustrated in Table 9. Neither maternal nor paternal education marked statistically significant mean TCP reward choice rank score differences of children.

Table 9. *Parental Education and Small/Immediate Reward Choices*

Parental Gender	Parental Education	N	Mean Rank	<i>U</i>	<i>p</i>
Paternal	Attended High School	10	7.30	18.00	0.77
	Attended Tertiary Education	4	8.00		
Maternal	Attended High School	9	9.22	25.00	0.48
	Attended Tertiary Education	7	7.57		

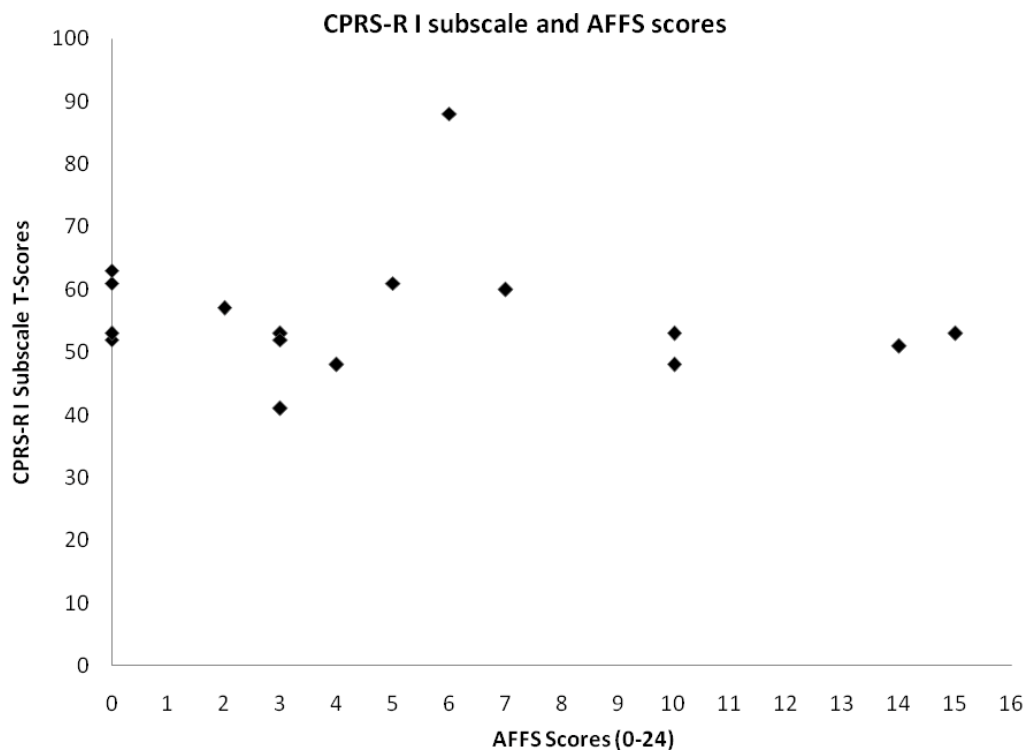
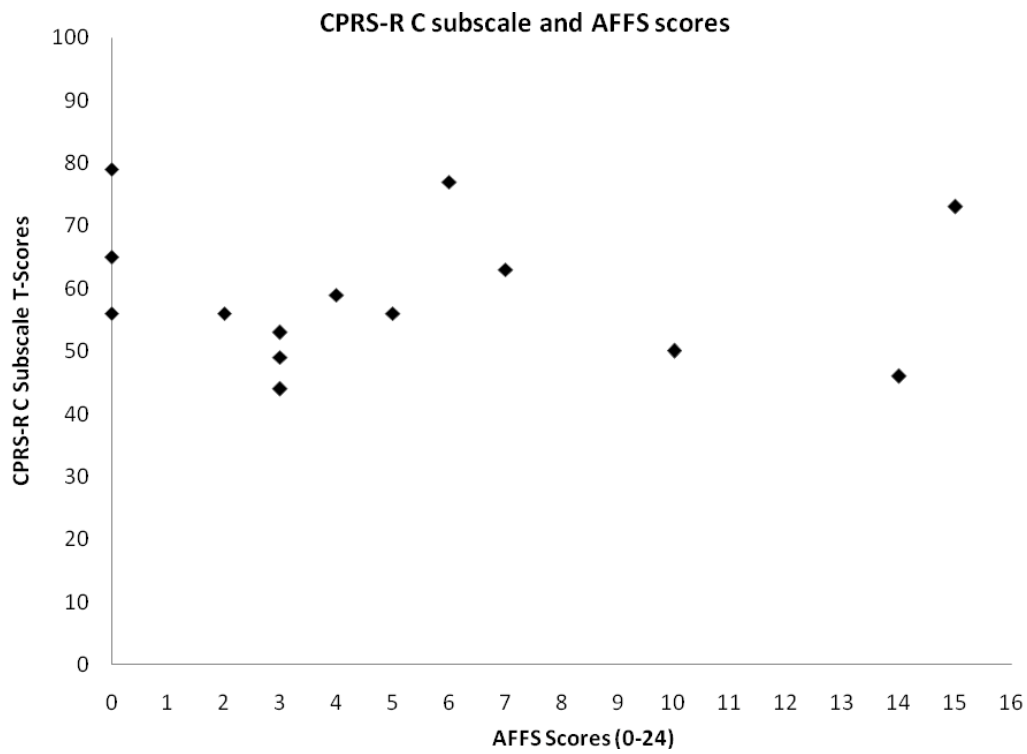
Functional Asthma Severity and CPRS-R Subscale Scores

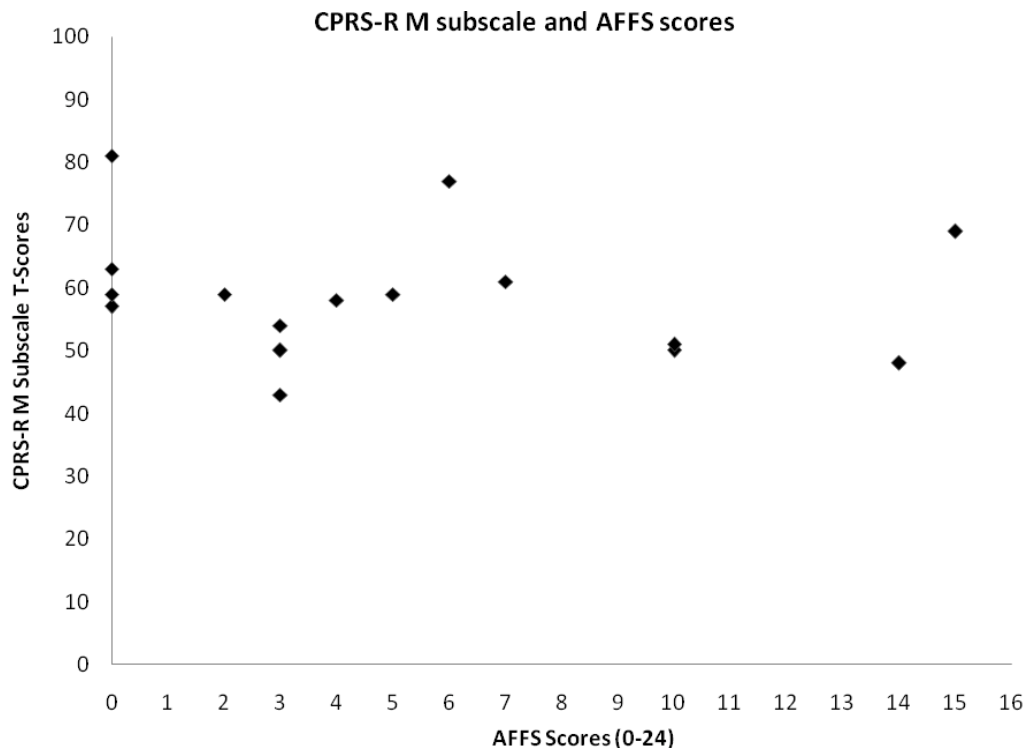
Children's mean T-scores on the *CPRS-R Hyperactive-impulsive* (subscale C), *Conners' Global Index: Restless Impulsive* (subscale I) and the *DSM-IV: and Hyperactive-Impulsive* (subscale M), subscales were 58.81 (SD = 10.73), 55.87 (SD = 10.28) and 55.69 (SD = 10.20) respectively.

These results suggest that the average C subscale T-scores of children participating in this study were above population norms by almost one standard deviation, whereas for the other subscales, scores were elevated by half a standard deviation.

To investigate whether there was a relationship between children's functional asthma severity and impulsivity, *CPRS-R* subscale T-scores were plotted against their AFSS scores, and correlations were calculated. Figure 3 shows the distribution of *CPRS-R* subscale T-scores among children with varying degrees of functional asthma severity.

Figure 3. *Children's CPRS-R Subscale Scores and Functional Asthma Severity Scores*





AFSS scores and *CPRS-R Hyperactive-Impulsive; Conners' Global Index: Restless-Impulsive*; and *DSM-IV: Hyperactive-Impulsive* subscale T-scores yielded statistically insignificant correlations of $r = 0.07$ ($p = 0.80$), $r = 0.23$ ($p = 0.40$) and $r = 0.02$ ($p = 0.95$) respectively. Cohen (1988) suggests that correlations of 0.10 – 0.29 be treated as small.

Mann-Whitney U tests were used to investigate whether mean AFSS rank scores of children yielding clinically significant and insignificant *CPRS-R* subscale T-scores differed. *CPRS-R* standardised T-scores are categorized as clinically significant when they are markedly different from population norms established by Conners (1997). Two T-score cut-offs were used, 60 and

65. A T-score of 60 was the least stringent of the two, marking *mildly* atypical behaviours while a T-score of 65, a more stringent criteria, marked *moderately* atypical behaviour (Conners, 1997).

The Mann-Whitney *U* tests for each of the *CPRS-R* subscales are listed in table 10. Results suggest that mean AFSS rank scores of children yielding clinically significant and insignificant *CPRS-R* subscale scores did not differ at a statistically significant level.

Table 10. *Functional Asthma Severity of Children with Clinically Significant and Insignificant CPRS-R Subscale Scores*

Clinical Significance of Groups	N (N =16)	Mean Rank	<i>U</i>	<i>p</i>
C Clinically Significant (≥ 61)	6 (37.5%)	7.93	27.50	0.67
C Clinically Insignificant(<61)	10 (62.5%)	8.94		
C Clinically Significant (≥ 66)	3 (19%)	8.38	23.50	0.95
C Clinically Insignificant (<66)	13 (81%)	8.54		
I Clinically Significant (≥ 61)	5 (31%)	8.80	26.00	0.86
I Clinically Insignificant (<61)	11 (69%)	8.36		
I Clinically Significant (≥ 66)	1 (6.25%)	16.00	0.00	0.10
I Clinically Insignificant (<66)	15 (93.75%)	8.00		
M Clinically Significant (≥ 61)	5 (31.25%)	6.83	20.00	0.27
M Clinically Insignificant (<61)	11 (68.75%)	9.50		
M Clinically Significant (≥ 66)	3 (19%)	8.38	23.50	0.95
M Clinically Insignificant (<66)	13 (81%)	8.54		

To investigate whether *low*, *mild* and *moderate/severe* functional asthma severity groups yielded different *CPRS-R Hyperactive-Impulsive*; *Conners' Global Index: Restless-Impulsive*; and *DSM-*

IV: Hyperactive-Impulsive subscale T-scores, three Kruskal-Wallis *H* tests were conducted. Table 11 shows that functional asthma severity groups did not yield statistically significant mean *CPRS-R* subscale rank score differences. This result suggests that functional asthma severity is not related to the presence of clinically significant versus normal levels of parent-reported externalising behaviours.

Table 11. *CPRS-R subscale Scores of Children in Different Functional Asthma Severity Groups*

Measure	Severity Groups	N	Mean Rank	<i>H</i>	<i>p</i>
C t-score	Low	9	8.56	1.38	0.50
	Mild	3	6.00		
	Moderate/Severe	4	10.25		
I t-score	Low	9	8.22	0.23	0.89
	Mild	3	9.67		
	Moderate/Severe	4	8.25		
M t-score	Low	9	8.83	1.10	0.58
	Mild	3	6.00		
	Moderate/Severe	4	9.63		

TCP Reward Choices and CPRS-R Subscale Scores

The relationship between scores obtained with both impulsivity measures were investigated to determine whether their respective constructs were related. The number of small/immediate rewards chosen during the 30 TCP trials and *CPRS-R* subscale T-scores were compared using three bivariate correlations. The number of small/immediate reward choices of children during the TCP were not related to *CPRS-R Hyperactive-Impulsive*; *Conners' Global Index*:

Restless-Impulsive; and *DSM-IV: Hyperactive-Impulsive* subscale T-scores at a statistically significant level with respective correlations of $r = 0.02$ ($p = 0.94$), $r = 0.25$ ($p = 0.36$), $r = -0.01$ ($p = 0.99$).

To investigate whether the number of small/immediate rewards chosen during the TCP differed between children with clinically significant and insignificant *CPRS-R* subscale T-scores, a series of Mann-Whitney *U* tests were conducted. Results in table 12 show that mean TCP reward choice rank scores did not differ between the groups at a statistically significant level.

Table 12. *Small/Immediate Reward Preference Among Children Scoring Clinically Significant and Non-Significant CPRS-R Subscale Scores*

Clinical Significance of Groups	N	Mean Rank	<i>U</i>	<i>p</i>
C Clin. Sig. (≥ 61)	7 (43.75%)	9.29	26.00	0.55
C Clin. Insig. (< 61)	9 (56.25%)	7.89		
C Clin. Sig. (≥ 66)	4 (25.00%)	9.38	20.50	0.66
C Clin. Insig. (< 66)	12 (75.00%)	8.21		
I Clin. Sig. (≥ 61)	5 (31.00%)	8.90	25.50	0.82
I Clin. Insig. (< 61)	11 (69.00%)	8.32		
I Clin. Sig. (≥ 66)	1 (6.25%)	11.50	4.50	0.50
I Clin. Insig. (< 66)	15 (93.75%)	8.30		
M Clin. Sig. (≥ 61)	6 (37.50%)	8.92	27.50	0.78
M Clin. Insig. (< 61)	10 (62.50%)	8.25		
M Clin. Sig. (≥ 66)	4 (25.00%)	9.38	20.50	0.66
M Clin. Insig. (< 66)	12 (75.00%)	8.21		

Asthma Medication Use and CPRS-R Scores

To investigate whether taking asthma medication marked different *CPRS-R* subscale T-scores, three Mann-Whitney *U* tests were conducted. Mean rank *CPRS-R* subscale T-scores of children who had and had not taken medication on the day of testing were compared. The results listed in table 13 suggest that mean *CPRS-R* subscale rank scores did not differ at a statistically significant level between children who had and had not taken asthma medication.

Table 13. *Asthma Medication Use and CPRS-R Subscale Scores*

<i>CPRS-R</i> subscale	Asthma Medication	N	Mean Rank	<i>U</i>	<i>p</i>
C	Yes	3	9.17	17.50	0.79
	No	13	8.35		
I	Yes	3	10.17	15.50	0.49
	No	13	8.12		
M	Yes	3	9.33	17.00	0.74
	No	13	8.31		

All three children who had taken medication on the day of testing had clinically significant *CPRS-R Hyperactive-Impulsive*; *Conners' Global Index: Restless-Impulsive*; and *DSM-IV: Hyperactive-Impulsive* subscale T-scores over 60. Therefore, even though no statistically significant differences were detected between children who had and had not taken asthma medication on the day of testing, this finding warrants further investigation with a larger sample.

Positive Behaviour and Functional Asthma Severity

Two bivariate correlations were conducted to investigate whether there was a relationship between children's AFSS scores and two measures of positive behaviour, namely, the APBS (Hofferth, 1998) and SSC-ACC (Tarren-Sweeney, 2007). Neither the APBS nor the SSC-ACC yielded a statistically significant relationship with children's AFSS scores with respective correlations co-efficients of $r = 0.31$ ($p = 0.24$) and $r = -0.03$ ($p = 0.91$).

Despite the lack of statistical significance, increasing APBS scores did mark slight AFSS score increases during this study with a correlation of $r = 0.31$ ($p = 0.24$). These results suggest that increasing functional asthma severity may mark adaptive and positive behaviour increases as measured by the APBS among a larger sample of children.

To investigate whether children in different functional asthma severity categories scored different positive behaviour measure scores, two Kruskal-Wallis H tests were conducted. Mean APBS and SSC-ACC score ranks of children in *low*, *mild*, *moderate/severe* functional asthma severity groups were compared. Results listed below in table 14 show that mean APBS and SSC-ACC rank scores did not differ at a statistically significant level between the functional asthma severity groups.

Table 14. *Positive Behaviour Scale Scores of Children in Different Functional Asthma Severity Categories*

Measure	Asthma Severity Category	N	Mean Rank	<i>U</i>	<i>p</i>
APBS	Low	9	7.06	2.00	0.37
	Mild	3	9.83		
	Moderate/Severe	4	10.75		
SSC-ACC	Low	9	7.94	0.29	0.87
	Mild	3	9.17		
	Moderate/Severe	4	9.25		

Positive Behaviour and Impulsivity

To investigate whether there was a relationship between adaptive and impulsive behaviours, scores obtained with the TCP and *CPRS-R* were compared to those obtained with the APBS and SSC-ACC. Four bivariate correlations were calculated for each positive behaviour scale, three to compare scores obtained with each of the *CPRS-R* subscales, and one to compare TCP reward choices. The results listed in table 15 below show that neither of the two positive behaviour scale scores yielded statistically significant correlations with the two impulsivity measures.

Table 15. *Relationship Between Positive Behaviour Scale Scores and Impulsivity Measures*

Statistic	APBS scores		SSC-ACC scores	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
number of small/immediate reward choices	0.06	0.83	-0.02	0.95
C-T scores	-0.25	0.35	0.09	0.74
I T-scores	-0.38	0.15	0.33	0.22
M T-scores	-0.32	0.23	0.08	0.76

Increased positive behaviours as measured by the APBS had small inverse correlations with *CPRS-R Hyperactive-Impulsive* (subscale C), $r = -0.25$ ($p = 0.35$); *Conners' Global Index: Restless-Impulsive* (subscale I), $r = -0.38$ ($p = 0.15$); and *DSM-IV: Hyperactive-Impulsive* (subscale M), $r = -0.32$ ($p = 0.23$) subscale scores, though not at a statistically significant level. SSC-ACC scores yielded a small, statistically insignificant, correlation with *CPRS-R Conners' Global Index: Restless-Impulsive* subscale scores, $r = 0.33$ ($p = 0.22$). This relationship may suggest that increased parent reported impulsive behaviours on the *CPRS-R Conners' Global Index: Restless-Impulsive* subscale were also related to a greater number of parent observed positive behaviours. Neither APBS nor SSC-ACC scores were related to the number of small/immediate rewards chosen during the TCP at a statistically significant level.

Gender Differences

To investigate the role of gender across the variables measured during this study, a series of Mann-Whitney *U* tests were conducted to establish whether girls and boys yielded different scores across the various measures utilized during the current study. Mean *CPRS-R Hyperactive-*

Impulsive; Conners' Global Index: Restless-Impulsive; and DSM-IV: Hyperactive-Impulsive subscale and ABPS rank scores of girls differed at a statistically significant level to those of boys. These results suggest that girls participating in this study may have exhibited a greater number of impulsive behaviours and fewer positive behaviours compared to boys. These results are listed in table 16.

Table 16. *Gender Differences Among the Measures Used During the Present Study*

Measure	Male (N = 7)	Female (N = 9)	<i>U</i>	<i>p</i>
	Mean Rank	Mean Rank		
AFSS	8.50	8.50	31.50	1.00
TCP (small/immediate)	5.36	10.94	9.50	0.02*
Conners' C	5.36	10.94	9.50	0.02*
Conners' I	5.14	11.11	8.00	0.01*
Conners' M	5.14	11.11	8.00	0.01*
APBS	11.36	6.28	11.50	0.03*
SSC-ACC	8.61	8.61	30.50	0.92

*Note. *p = 0.05 significance level (two-tailed)*

A series of analysis were conducted to investigate whether there were any demographic differences between the two gender groups that may have accounted for the gender differences. A chi-squared analysis was conducted comparing parental educational backgrounds between the two gender groups. Table 17 is a contingency table showing the distribution of children among gender and maternal education groups.

Table 17. *Maternal Education Levels of Boys and Girls*

	Attended High School (n = 9)	Attended Tertiary Education (n = 7)
Girls (n = 9)	5	4
Boys (n = 7)	4	3

The chi-squared analysis did not show a statistically significant relationship between children's gender and maternal education ($\chi^2 = 0.00$, $p = 0.95$). Paternal education was also compared between the two gender groups. Table 18 is a contingency table showing the distribution of children among gender and Paternal education groups.

Table 18. *Paternal Education Levels of Boys and Girls*

	Attended High School (n = 9)	Attended Tertiary Education (n = 4)
Girls (n = 9)	5	2
Boys (n = 7)	4	2

The chi-squared analysis did not show a statistically significant relationship between children's gender and paternal education ($\chi^2 = 0.03$, $p = 0.85$). To investigate whether family income may have differed between the two gender groups, a chi-squared analysis was conducted to investigate whether the family income of girls and boys differed. Table 19 is a contingency table showing the distribution of children among gender and family income groups.

Table 19. *Family Income of Boys and Girls*

	2 nd Income Quintile (n = 2)	3 rd Income Quintile (n = 7)	4 th Income Quintile (n = 4)
Girls (n = 9)	2	4	2
Boys (n = 7)	0	3	2

The chi-squared analysis did not show statistically significant distribution differences, $\chi^2 = 1.53$, $p = 0.47$, between children's gender and family income. None of the chi-squared analyses detected any demographic differences that may have explained the gender differences observed during this study.

CHAPTER 4

DISCUSSION

The aim of the current study was to investigate whether functional asthma severity among six-year-old children was related to impulsive behaviour. Children with asthma appear to be at increased risk of developing externalising behaviour problems compared to those without asthma (McQuaid, Kopel & Nassau, 2001). This risk may increase among those with greater asthma severity (McQuaid, Kopel & Nassau, 2001). During this study, impulsive behaviours were investigated among children with asthma because such behaviours have previously been found to mark an increased likelihood of chronic and intensifying externalising behaviour problems (Moffitt, 1993; Snyder, Prichard, Schrepferman, Patrick & Stoolmiller, 2004).

Asthma and Impulsivity

The present study found no relationship between functional asthma severity and delay aversion, a behavioural sub-construct of impulsivity. The study may have lacked statistical power to detect such a difference. However, the absence of a relationship may also be due to the measure used. The current study used the TCP (Dougherty, Mathias, Marsh & Jagar, 2005) to measure delay aversion among children with asthma. This computer task was recently developed and had not yet been applied to young children before this study.

The lack of a relationship between delay aversion and functional asthma severity during this study may support the results of Klennert, McQuaid, McCormick, Adinoff, & Bryant (2000), who

found that increased asthma severity only marked small and clinically insignificant externalising behaviour problem increases among children. A relationship between functional asthma severity and delay aversion would only be expected if increased asthma severity marked consistent clinically significant externalizing behaviour problems. Alternately, the results may suggest that the TCP is an invalid measure of delay aversion in 6-7 year-old children with asthma, possibly because children do not understand the task or because their motivation toward the rewards are not equal.

Impulsivity was also measured with parent reports of impulsive behaviours, quantified during this study with the *CPRS-R Hyperactive-Impulsive*, *Conners' Global Index: Restless Impulsive* and *DSM-IV: Hyperactive-Impulsive* subscales. No statistically significant relationships were detected between children's functional asthma severity and parent reports of impulsivity during this study, however, the *Conners' Global Index: Restless Impulsive* subscale yielded a small correlation with children's AFSS scores ($r = 0.23, p = 0.40$). This result suggests that increasing functional asthma severity in 6-7 year-old children may mark a slightly increased number of parent observed inattentive, distracted, impulsive and restless behaviours as well as fidgeting, frustration and disturbing of other children (Conners, 1997). Chance alone may have accounted for the trend because none of the other impulsivity measures yielded a similar relationship with functional asthma severity. This needs to be examined with a larger sample.

Another reason for the trend may have been that asthma severity was quantified according to its functional impact during this study. Functional asthma severity marks difficult behaviours among children more consistently than physiological severity (Wamboldt, Fritz, Mansell, McQuaid &

Klein, 1998) because the impact of illness on children's daily functioning encompass a greater number of factors related to behaviour problems compared to organic symptoms (MacLean, Perrin, Gortmaker & Pierre, 1992). The adapted version of the Asthma Functional Severity Scale (Rosier, Bishop, Nolan, Robertson, Carlin & Phelan, 1994) used during this study quantified asthma severity according to its effects on children's sleep, play, speech and sport. The role of family functioning and children's coping skills may be just as important to these severity constructs as children's physiological asthma symptoms (Wamboldt, Weintraub, Krafchick & Wamboldt, 1996). In addition, family functioning and coping skills are also related to externalizing behaviour problems (Mash & Wolfe, 2001). Therefore, the relationship between *CPRS-R Conners' Global Index: Restless Impulsive* subscale scores and functional asthma severity during this study may have been due to factors related to both externalizing behaviour problems and the functional impact of asthma.

Groups of children whose functional asthma severity was categorised as *low*, *mild*, and *moderate/severe* did not show statistically significant TCP reward choice or have parent reported *CPRS-R* subscale score differences. Despite the sample size limitations of this study and the measurement of functional rather than physiological asthma severity, the results obtained were comparable to those of Vila, Nollet-Clemencon, de Blic, Mouren-Simmeoni, and Scheinmann (1998) who investigated whether children's physiological asthma severity categories marked behaviour problems, including impulsivity. Vila, Nollet-Clemencon, de Blic, Mouren-Simmeoni, and Scheinmann (1998) found that in 92 children aged 8-17, impulsivity ratings obtained with the Conners' Parent Rating Scale (*CPRS*) (Conners, 1997) *Impulsivity* ($p = 0.22$) subscale did not

differ at a statistically significant level between groups of children with *intermittent and mild persistent*; *moderate persistent*; and *severe persistent* physiological asthma severity.

Asthma severity was measured during the study of Vila, Nollet-Clemencon, de Blic, Mouren-Simmeoni, and Scheinmann (1998) according to the number and intensity of symptoms displayed by children during the preceding week, the number of asthma symptoms during the night over the preceding month, peak expiratory flow and the amount of medication taken to manage symptoms. Results of the current study add to those of Vila, Nollet-Clemencon, de Blic, Mouren-Simmeoni, and Scheinmann (1998) with the replication of their findings across the functional asthma severity spectrum. The combined results suggest that neither the physiological nor the functional impact of asthma symptoms is related to parent reports of impulsivity.

Asthma Medication and Impulsivity

No statistically significant TCP reward choice or *CPRS-R* subscale score differences were detected between children who had and had not taken asthma medication on the day of testing. However, all three children taking asthma medications yielded clinically significant *CPRS-R Hyperactive-Impulsive*, *DSM-IV: Hyperactive-Impulsive* and *Conners' Global Index: Restless Impulsive* subscale T-scores above 60, suggesting mildly atypical and possibly clinically significant behaviour problems (Conners, 1997). Of the 16 children participating in the current study; three (18.75%) had taken asthma medication on the day of testing, one child (6.7%) had taken a preventative dose of Beclazone, one had taken 50mg of Flixotide and another had taken 200mg of Pulmicort. All three asthma medications were corticosteroids.

When corticosteroid side effects on mood, memory and attention are detected, they are rarely of clinical significance despite statistically significant differences between treatment and placebo groups (Bender & Milgrom, 1995). Due to the small number of children taking corticosteroids in the present study, the results obtained are not likely to be representative of the population of children taking corticosteroids. Further research investigating impulsivity among children who take corticosteroids with larger samples needs to be conducted.

Confounding Factors of TCP Reward Choices

A potential confounding factor of children's TCP performance was how much time they spent on computers. Familiarity with computer games may influence reward choices because Dahl et al. (1996) found that children who frequently played on digital entertainment devices performed better during computer tasks measuring impulsivity than those who rarely played. Results of the current study suggest that computer game experience was not related to TCP reward choices at a statistically significant level. The disparate results regarding the role of computer games found during this study and that conducted by Dahl and colleagues (1996) may be due to the differing environments in which children completed the computer tasks. Children participating in the study of Dahl et al. (1996) completed computer tasks in a single laboratory room, free of distracting stimuli. Children participating in the current study completed the TCP at their homes often with siblings around them engaged in activities that may have been distracting. Therefore, environmental stimuli that may have distracted children or made the choice delays easier to endure potentially confounded delay aversion differences during this study. Another reason that reward choice differences were not detected may have been because the threshold used to mark children's computer game experience was whether they spent time on computers more or less

than once a week. This distinction may not have been sensitive to the differences of children who were adept with computers and digital entertainment devices and those who were not.

Children's Understanding of the TCP

During the current study, informal observations of children's reward choices during the TCP suggested that they were based on their motivation toward the monetary rewards, not delay aversion. It was apparent during administration of the TCP that children's reward choices appeared to depend on an understanding of money. Children who were excited about receiving coins during the task appeared to choose fewer small/immediate rewards than children who appeared impartial to the monetary reward. The value of the coins to children may have been experiential; those motivated by the money may have had more experience buying goods and consequently had a better understanding of its value. Therefore, data collected with the TCP may have been invalid because motivation induced by the sight of coins may not have been equal for all children and consequently, the findings may be an indication of the varying motivational gradient of money rather than varying endurance of delay in obtaining money.

Another reason some children appeared more motivated toward the monetary reward than others may have been due to their understanding of the task. Some children may not have understood the task despite giving the impression they did. Children were coached through 10 TCP training trials and were asked a series of questions afterwards to ensure they understood how the reward and delay paradigms were related to each other. All children but one answered these questions correctly, suggesting they understood how the TCP worked. The child who answered one of these questions incorrectly the first time, answered correctly the second time. Despite indicating an

understanding of the TCP some children may not have understood the relationship between the reward and delay parameters of the task because reward choice patterns of many children appeared random. Their reward choices would often be the opposite of those selected on previous trials. The reward choice patterns of five children who chose very few small/immediate rewards indicated an understanding of the task because their choices were consistent. Reward choice pattern differences between the five children who chose the fewest small/immediate rewards and the other eleven who chose the most may suggest that choices were not based on delay aversion, but were due to their understanding of the task. Another explanation for the reward choice consistency differences between the groups may be that children who chose more small/immediate rewards were unwilling to endure the longer delay over multiple trials, suggesting they had greater delay aversion.

Children who find inhibiting impulses difficult may also find learning at school difficult (Cohen, DuRant & Cook, 1988), a potential indicator of their ability to learn how the TCP works. Parent reported impulsivity of the five children who chose the fewest number of small/immediate rewards did not differ from the other eleven children who chose the most. During the current study, parent reported impulsivity did not support the hypothesis that children who chose more small/immediate rewards did not understand the TCP. The eleven children who chose the most small/immediate rewards did not yield statistically significant *CPRS-R* subscale score differences compared to children who chose the fewest small/immediate rewards.

The level of parental education is another potential marker of children's understanding of the TCP. Parental education may be linked to children's understanding of the TCP because parents

with higher levels of education may provide children with more learning opportunities compared to parents with little education. Parental education is related to child intellectual ability (Scarr, Weinberg & Waldman, 1993) and intellectual ability is related to children's performance during computerized measures of impulsivity (White, Moffitt, Caspi, Bartusch, Needles & Stouthamer-Loeber, 1994). Two chi-squared analyses showed that the number of small/immediate rewards chosen during the TCP did not differ between children of parents who had attended high school and children of parents who had attended tertiary education. Parental education may not be a strong enough marker of children's intellectual ability to be related to TCP reward choices. In addition, the sample size of this study may not have been large enough to detect reward choice differences between children of parents with different educational backgrounds, especially given that paternal education data of three families were missing

Agreement Between Impulsivity Measures

The number of small/immediate reward choices children made during the TCP yielded statistically insignificant correlations with their *CPRS-R Hyperactive-impulsive*, *Conners' Global Index: Restless Impulsive* and *DSM-IV: Hyperactive-Impulsive* subscale scores. However, a small though statistically insignificant correlation was detected between TCP reward choices and *CPRS-R Conners' Global Index: Restless Impulsive* subscale scores ($r = 0.23, p = 0.40$), potentially suggesting that a greater number of parent observed inattentive, distracted, impulsive and restless behaviours (Conners, 1997) may mark a greater preference for small/immediate, or delay avoidant, reward choices during the TCP. It is likely that the lack of statistically significant correlations between the measures was due to the different impulsivity constructs that each instrument was designed to measure. The CPRS-R subscales used during this study were

constructed to measure parent reported hyperactive, impulsive, restless and ADHD type behaviours of children, whereas the TCP was specifically constructed to measure the delay aversion sub-construct of impulsivity.

The lack of statistically significant relationships between impulsivity measures was also apparent when the numbers of small/immediate rewards chosen by children with clinically significant and insignificant CPRS-R subscale scores were compared. *Children* with clinically significant parent reported impulsivity scores did not choose a greater number of small/immediate rewards during the TCP compared to children with clinically insignificant impulsivity scores. This result fits with the proposition that elevated impulsive behaviours, as measured by laboratory tasks, have only been detected in children with severe externalising behaviour problems (Snyder, Prichard, Schrepferman, Patrick & Stoolmiller, 2004; Toupin, Dery, Pauze, Mercier & Fortin, 2000; Waschbusch, 2002). Previous findings suggest that only within clinical populations are persons with increased aggression likely to choose more delay avoidant responses during the TCP than persons without aggression difficulties (Cherek, Moeller, Schnapp & Dougherty, 1997; Dougherty et al., 2003; Sonuga-Barke, 2002). Therefore, children in this study who received clinically significant *CPRS-R* subscale scores would have also needed aggression difficulties in order to belong to populations with a greater preference for small/immediate rewards. The relationship between asthma and externalising behaviour problems such as aggressive displays does not appear to be a strong one (McQuaid, Kopel & Nassau, 2001) and therefore it was not surprising that children participating in this study with clinically significant *CPRS-R* subscale scores did not have a greater preference for small/immediate rewards.

Children's Positive Behaviours and Functional Asthma Severity

No statistically significant relationships were detected during the current study between positive behaviours and asthma. A small correlation was detected between AFSS and Adapted Positive Behaviour Scale scores ($r = 0.31, p = 0.24$) suggesting that children's parent rated positive and adaptive behaviours may have increased with increasing functional asthma severity. There was no evidence for such a relationship between AFSS and Supplementary Strengths Checklist of the Assessment Checklist for Children (SSC-ACC) scores. The disparate results between the APBS and SSC-ACC may be due to the populations that each questionnaire was designed to assess. The APBS was constructed to investigate children's positive behaviours across community populations (Hofferth, 1998), whereas the SSC-ACC was designed to assess the positive behaviours of children in care (personal communication with author, Tarren-Sweeney, 2007). Children in care are more likely to exhibit behavioural and emotional disturbance (Deater-Deckard & Plomin, 1999) which may suggest less frequent displays of adaptive and positive behaviours. The adaptive behaviours of children in care may also not be the same as those of other children.

SSC-ACC scores obtained during the current study showed a ceiling effect, which may also be due to the fact that the instrument was designed to measure positive behaviours among children in care. Positive behaviours of children in care may not be as developed as positive behaviours of children in the general population and consequently, all children participating in the current study but one received SSC-ACC scores between 35-42 out of a possible 42, while APBS scores ranged between 25-50 out of a possible 50.

The positive correlation detected between children's ABPS scores and functional asthma severity was surprising. Increased functional asthma severity is likely to suggest coping difficulties in children with asthma because the measure quantifies symptom impact on daily functioning. The finding may support the proposition that asthma increases the number of circumstances where children can learn coping skills (McQuaid, Kopel & Nassau, 2001). Another interpretation of the results may be that children with increased functional asthma severity are more likely to have parents with the illness, and consequently, are given more effective assistance with their illness symptoms (Calam, Gregg, Simpson, Morris, Woodcock & Custovic, 2003). The resulting coping skills developed by children may have been measured by the APBS with its reference to cheerfulness, curiosity, compliance, and self-reliance (Hofferth, 1998).

Positive Behaviours and Impulsivity

No statistically significant relationships were detected during the study between impulsivity and parent rated positive behaviours. However, small insignificant correlations were detected between APBS scores and *CPRS-R Hyperactive-Impulsive*, $r = -0.27$ ($p = 0.32$); *Conners' Global Index: Restless-Impulsive*, $r = -0.34$ ($p = 0.19$); and *DSM-IV: Hyperactive-Impulsive*, $r = -0.31$ ($p = 0.25$) subscale scores. These findings are supported by a previous study assessing the impact of Welfare to Work Programs in the United States on children's wellbeing (National Evaluation of Welfare to Work Strategies, 2005). The study also found that parent reported externalizing behaviour problems among children, as measured by the Behaviour Problem Index (Peterson & Zill, 1986), was inversely related to APBS scores ($r = -.29$, $p < .001$). Because both the *CPRS-R* and the APBS are designed to assess behaviours among the general population, increased parent

observed difficult impulsive behaviours are likely to coincide with a decreased number of observed positive behaviours.

The SSC-ACC yielded a small statistically insignificant correlation with the *CPRS-R Conners' Global Index: Restless-Impulsive*, $r = 0.33$ ($p = 0.22$) subscale scores suggesting that increased parent reported positive behaviours may have marked increased parent rated impulsivity. This result was surprising and may have been due to chance. None of the other *CPRS-R* subscale scores or the number of small/immediate reward choices of children were related to children's SSC-ACC scores.

Gender Differences

Girls participating in the current study chose more small/immediate rewards during the TCIP and received lower APBS scores compared to boys. It is possible that these results were due to chance or a small sample size because no statistically significant parental education or family income distribution differences were detected between boys and girls that may have accounted for such findings. The results were especially surprising given that externalising behaviour problems are 3 to 4 times as common among boys compared to girls and such difficulties develop earlier among boys and are more persistent (Keenan, Loeber & Green, 1999; Zoccolillo, 1993). In addition, girls are more likely to display behaviour problems on the internalizing rather than externalising end of the spectrum (Mash & Wolfe, 2001). The gender differences detected during this study may suggest that the sample was not representative of children with asthma. To test whether the gender differences found during this study were due to chance, further research studies utilizing larger sample sizes are needed.

Strengths of the Study

One of the main strengths of this study was the use of both a computer task and parent report questionnaire to gain information of children's impulsivity. Given that only one computerized measure of impulsivity was utilized during the current study, it was important to investigate whether increased delay avoidance during the task was in fact related to overt signs of impulsivity. Both the *CPRS-R* and the TCP measure different facets of impulsive behaviour; the TCP was designed to specifically measure delay aversion, while the *CPRS-R* subscales were designed to measure parent observed impulsive and hyperactive behaviours. It was also important to collect information with the *CPRS-R* to ensure that more than one specific impulsiveness construct was measured in children with asthma.

Another strength of the study was that constructs were conceptualized in accordance with specific definitions. Previous research has used broad-band conceptualizations of asthma and impulsivity despite the measurement of specific sub-constructs (Avila, Cuenca, Felix, Parcet & Miranda, 2004; Klinnert, McQuaid, McCormick, Adinoff & Bryant, 2000; Mrazek, Schuman & Klinnert, 1998; White, Moffitt, Caspi, Bartusch, Needles & Stouthamer-Loeber, 1994). Such disparities between conceptualisation and measurement of asthma and impulsivity may be partly responsible for the inconsistent findings regarding their relationship with behaviour problems. During this study, delay aversion and parent observed impulsive behaviours were the specific impulsivity constructs and asthma was conceptualized and quantified according to its functional impact.

Another strength of the study was the instructional material devised to help children understand the TCP. The instructions read out to children were developed to be used together with the training trials of the TCP and appeared to successfully teach them the reward/delay paradigms associated with their choices. At the end of the instruction procedure, children were asked a series of questions that tested their understanding of the reward/delay paradigms of their choices. All but one of the children participating in this study answered these questions correctly. Another strength of the study was that the questionnaire filled in by parents started and finished with positive behaviour items. This ensured that parents did not only reflect on their children's difficult to manage behaviours, but also their positive behaviours. Having positive behaviour items at the end of the questionnaire also ensured that parents finished participating after having reflected positively on their children.

Limitations

Results of this study must be considered in the light of its limitations. The study had insufficient statistical power to address the research questions adequately. With exception of TCP small/immediate reward choice and *CPRS-R* subscale score differences between the two gender groups, no statistically significant correlations or group differences were detected during the study. The small sample size also meant that children participating in the study may not have represented their respective populations.

A number of this study's limitations arose from the use of the TCP with the 6-7 year-old children. Informal observations suggest that the motivational value of coins offered as incentive during the TCP were not the same for all children. Some children appeared highly motivated by the

monetary rewards whereas others did not. Those who appeared highly motivated by the coins selected very few small/immediate rewards while those who did not appear motivated by the coins appeared to make random reward choices. An important assumption of the TCP is that all children are equally motivated by the rewards offered during the task and this does not appear to have been the case. A factor that may have made some children impartial to receiving the monetary reward was that they found it difficult to grasp the value of the coins given to them. Both 10c and 20c piece coins were offered as incentive during the TCP. Children may have found it easier to understand this monetary incentive if only one type of coin was used. Instead of a 20c reward being offered after a large/delayed reward choice, children should have been given two 10c pieces. This may have made conceptualising the quantity of money easier, especially amongst children who had little experience with its spending.

There were also a number limitations, both procedural and environmental, during the application of the TCP that may have led to inconsistent delay periods between children. One of the procedural limitations was how money was delivered to children during the TCP. During the first three computer task administrations, coins received were presented immediately after the child had made a reward choice. This had the effect of reducing waiting times for children because their attention could be redirected toward this event. This error became apparent after the first three TCP procedures had been administered and afterwards, coins were presented to children after the delay to ensure they endured the entire specified delay. This inconsistency may have invalidated data collected from the first three children, as their reward/delay paradigms were different to those of children taking the TCP later.

An environmental limitation that may have led to inconsistent reward delays between children may have been that the TCP was administered in their homes. Some of the home environments contained more distracters than others. Most children completed the computer task shortly after having come home from school. In some households, many siblings were engaged in leisure time activities within the vicinity, whereas in others, there were very few distracting stimuli. Such differing environments may have influenced delay/reward choices during the TCP because for some children delays meant having to wait in a quiet room with very few distracting stimuli, while for others it meant they could divert their attention from the computer task to the activities engaged in by siblings. The delay would have been more difficult in a room devoid of external stimuli than a room where siblings were engaged in interesting activities.

A procedural limitation during the TCP may have made it difficult for children to understand how their reward choices affected the length of the task. Children were not given any means with which to monitor their progress through the TCP. Therefore, it may have been difficult for children to understand the relationship between the delays associated with their choices and the total length of the task. The study conducted by Solanto et al., (2001) used a grid to show the child how many trials were left. The grid was placed next to the child, and with each trial, a counter was moved one position closer to the final trial. During the present study, some children asked how many trials were left during the TCP. The researcher answered such questions, however a grid showing the amount of trials left would have given children a better indication of how their choices influenced the length of the task.

Other limitations of the study included the use of an adapted version of Rosier's Asthma Functional Severity Scale (Rosier, Bishop, Nolan, Robertson, Carlin & Phelan, 1994) which had not yet been tested for validity or reliability. The validity and reliability of such a scale is very important for two reasons. First, the reliability of a measure gives an indication of whether its measured constructs are quantified systematically over a large sample. Second, a measure's validity indicates how well it taps into its respective construct. Even though the original Asthma Functional Severity Scale (Rosier, Bishop, Nolan, Robertson, Carlin & Phelan, 1994) had good psychometric properties, its adaptation to the current study may have rendered it invalid and unreliable.

Another limitation of the study was how children were dispersed across functional asthma severity categories. Children were dispersed across the functional asthma severity spectrum in about the same proportion as established by Rosier et al. (1994), although only one child participating in the study received a score in the *severe* range. The curve linear relationship between asthma severity and behaviour problems found by Perrin, MacLean, and Perrin (1989) shows that the full asthma severity spectrum must be represented before a sample is valid because factors associated with asthma may vary across the illness severity spectrum.

Finally, findings of this study may have been limited due to demographic factors. Children living with two biological parents whose family income fell in the third and fourth income quintiles were over-represented in the study sample while children living with one biological parent whose income was in the first and fifth quintiles were under-represented. The Asian community was not represented in the study sample nor were children living with temporary or foster caregivers.

Implications for Practice

The implications of the current study for practice are very limited given the scope of this exploratory analysis. Trends detected during the current study suggest that functional asthma severity was not related to delay aversion or parent reported impulsive behaviour. Further research is needed to investigate whether there is a relationship between externalising behaviour problems and delay aversion, however, potentially the TCP may be used as a screening tool for children's risk of intensifying externalising behaviour problems. A possible confounding factor informally observed during the TCP application was that children appeared to respond differently to incentives offered during the computer task; some children were highly motivated by the coins they received whereas others appeared impartial. Trends found during the current study may suggest that reward choice consistency marks children's motivation toward rewards offered during the TCP. Before the computer task can be used as valid assessment tool, further research is needed to determine the role of children's reward incentive on their reward choices. If a standardized procedure is developed for administration of the TCP and systems are developed to ensure children have equal motivation toward the rewards, it may prove a useful tool with which to assess children's delay aversion. However, findings of the present study suggest that the TCP procedure is not valid for 6-7 year-old children.

Suggestion for Further Research

Both asthma and impulsivity are highly complex constructs and only recently has research of these factors become systematic. Standardized physiological and functional asthma severity test

batteries are now being used to investigate the illness and its implications. The measurement of impulsivity has undergone a similar transformation, with the development of specific test batteries that measure specific and well defined constructs across the personality, behavioural and cognitive domains of this complex construct. Given these developments in asthma and impulsivity research, it is important to investigate whether these factors are related in case some children with asthma are at particular risk of intensifying behaviour problems. Further research is also needed to determine whether factors other than delay aversion determine children's reward choices, especially in young children. It is in this population that the measure is likely to be of most value, because potentially it could be used as a screening tool for intensifying and severe behaviour problems.

Conclusion

The current study was an exploratory analysis seeking to investigate whether there was a relationship between asthma and impulsivity. Impulsivity is important to investigate in children with asthma because it is a risk factor for intensifying externalising behaviour problems in children with established oppositional and defiant behaviours (Moffitt, 1993; Snyder, Prichard, Schrepferman, Patrick & Stoolmiller, 2004). Given that children with asthma are more likely to exhibit externalising behaviour problems and such behaviours intensify with increasing asthma severity (McQuaid, Kopel & Nassau, 2001), investigating risk factors that may increase the likelihood of intensifying behaviour problems is important. Results of the current study, despite limitations due to small sample size, showed that functional asthma severity among a small group of 6-7 year old children was not related to either computer task or parent reported measures of impulsivity.

REFERENCES

- Achenbach, T. M. & Edelbrock, C. S. (1983). *Manual for the Child Behavior Checklist and Revised Child Behavior Profile*. Burlington, VT: University of Vermont, Research Center for Children, Youth, & Families.
- Achenbach, T. M. & Rescorla, L. A. (2000). *Manual for the ASEBA Preschool Forms & Profiles*. Burlington, VT: University of Vermont, Research Center for Children, Youth, & Families.
- American Psychiatric Association. (2000). *Diagnostic and Statistical Manual of Mental Disorders*. Fourth Edition, Text Revision. Washington, DC, American Psychiatric Association.
- Asher, M. I., Barry, D., Clayton, T., Crane, J., D'Souza, W., Ellwood, P., Ford, R. P., Mackay, R., Mitchell, E. A., Moyes, C., Pattemore, P., Pearce, N. & Stewart, A. W. (2001). The burden of symptoms of asthma, allergic rhinoconjunctivitis and atopic eczema in children and adolescents in six New Zealand centres: ISAAC Phase One. *New Zealand Medical Journal*, 114(1128), 114-120.
- Asher, M. I., Keil, U., Anderson, H. R., Beasley, R., Crane, J., Martinez, F., Mitchell, F., Mitchell, E. A., Pearce, N., Sibbald, B., Stewart, A. W., Strachan, D., Weiland, S. K. & Williams, H. C. (1995). International study of asthma and allergies in childhood (ISAAC): rationale and methods. *European Respiratory Journal*, 8, 483-491.
- Avila, C., Cuenca, I., Felix, V., Parcet, M. A. & Miranda, A. (2004). Measuring impulsivity in school-aged boys and examining its relationship with ADHD and ODD ratings. *Journal of Abnormal Child Psychology*, 32(3), 295-304.

- Bender, B. & Milgrom, H. (1995). Neuropsychiatric effects of medication for allergic diseases. *Journal of Allergy and Clinical Immunology*, 95, 523-528.
- Bender, B. G., Annett, R. D., Iklé, D., DuHamel, T. R., Rand, C. & Strunk, R. C. (2000). Relationship between disease and psychological adaptation in children in the Childhood Asthma Management Program and their families. *Archives of Pediatric & Adolescent Medicine*, 154, 706-713.
- Bender, B. G., Lerner, L., Ikle, D., Comer, C. & Szeffler, S. J. (1991). Psychological change associated with theophylline treatment of asthmatic children: a six month study. *Pediatric Pulmonology*, 11(3), 223-242.
- Bender, B. G. & Milgrom, H. (1992). Theophylline-induced behavior change in children: an objective evaluation of parents' perceptions. *Journal of the American Medical Association*, 267, 2621-2624.
- Calam, R., Gregg, L., Simpson, A., Simpson, B., Woodcock, A. & Custovic, A. (2005). Behavior problems antecede the development of wheeze in childhood: A birth cohort study. *American Journal of Respiratory and Critical Care Medicine*, 171(4), 323-327.
- Calam, R., Gregg, L., Simpson, B., Morris, J., Woodcock, A. & Custovic, A. (2003). Childhood asthma, behavior problems, and family functioning. *Journal of Allergy and Clinical Immunology*, 112(3), 499-504.
- Campbell, S. B., Szumowski, E. K., Ewing, L. J., Gluxk, D. S. & Breaux, A. M. (1982). A multi-dimensional assessment of parent-identified behavior problem toddlers. *Journal of Abnormal Child Psychology*, 10(4), 569-592.
- Carr, A. (2006). *Child and Adolescent Clinical Psychology* (2 ed.). New York: Routledge.

- Caspi, A., Block, J., Block, J. H., Klopp, B., Lynam, D., Moffitt, T. E. & Stouthamer-Loeber, M. (1992). A "common language" version of the California Child Q-Set for personality assessment. *Psychological Bulletin*, 4, 512-523.
- Cherek, D. R., Moeller, F. G., Schnapp, W. & Dougherty, D. M. (1997). Studies of violent and nonviolent male parolees: I. Laboratory and psychometric measurements of aggression. *Biological Psychiatry*, 41(5), 514-522.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, New Jersey: L. Erlbaum Associates.
- Cohen, M. A., DuRant, R. H. & Cook, C. (1988). The Conners Teacher Rating Scale: Effects of age, sex, and race with special education children. *Psychology in the Schools*, 26, 195-202.
- Cohen, M. A., Miller, T. R. & Rossman, S. B. (1994). *The costs and consequences of violent behavior in the United States* (Vol. 4). Washington DC: National Academy Press.
- Cole, P. M., Zahn-Waxler, C., Fox, N. A., Usher, B. A. & Welsh, J. D. (1996). Individual differences in emotion regulation and behavior problems in preschool children. *Journal of Abnormal Psychology*, 105(4), 518-529.
- Conners, C. K. (1997). *Conners' Rating Scales-Revised*. Toronto: Multi-Health Systems Inc.
- Conners, C. K. (1990). *Manual for Conners' Rating Scales*. Toronto: Multi-Health Systems Inc.
- Conners, C. K., Sitarenios, G., Parker, J. D. & Epstein, J. N. (1998). The revised *Conners' Parent Rating Scale (CPRS-R)*: Factor structure, reliability, and criterion validity. *Journal of Abnormal Child Psychology*, 26(4), 257-268.

- Dahl, R., White, R. F., Weihe, P., Sorensen, N., Letz, R., Hudnell, H. K., Otto, D. A. & Grandjean, P. (1996). Feasibility and validity of three computer-assisted neurobehavioral tests in 7-year-old children. *Neurotoxicology Teratology* 18(4), 413-419.
- Deater-Deckard, K. & Plomin, R. (1999). An adoption study of the etiology of teacher and parent reports of externalizing behavior problems in middle childhood. *Child Development*, 70(1), 144-154.
- Dougherty, D. M., Bjork, J. M., Harper, R. A., Marsh, D. M., Moeller, F. G., Mathias, C. W. & Swann, A. C. (2003). Behavioral impulsivity paradigms: a comparison in hospitalized adolescents with disruptive behavior disorders. *Journal of Child Psychology and Psychiatry*, 44(8), 1145-1157.
- Dougherty, D. M., Mathias, C. W., Marsh, D. M. & Jagar, A. A. (2005). Laboratory behavioral measures of impulsivity. *Behavioral Research Methods*, 37(1), 82-90.
- Elliot, D. S., Huszinga, D. & Ageton, S. S. (1985). *Explaining delinquency and drug use*. Beverley Hills, California: Sage.
- Epps, R. S., Park, E. S. E., Huston, c. A. & Ripke, M. (2003, March 12-13). Psychometric Analyses of the Postive Behavior Scale in the new Hope Project and the Panel Study of income Dynamics. *Child Trends Conference on Positive Outcomes*, from <http://www.childtrends.org/Files/>
- Global Initiative for Asthma. (2004). *Global Burden of Asthma*. Wellington & Southampton: Medical Research Institute of New Zealand & University of Southampton, United Kingdom.

- Global Initiative for Asthma. (2006). Pocket Guide for Asthma Prevention and Management in Children. Medical Communications Resources, Inc. from <http://www.ginasthma.org/Guidelineitem.asp??l1=2&l2=1&intId=37>
- Goodman, R. (1997). The Strengths and Difficulties Questionnaire: a research note. *Journal of Child Psychology and Psychiatry*, 38, 581-586.
- Gray, J. A., Owen, S., Davis, N. & Tsaltas, E. (1983). Psychological and physiological relations between anxiety and impulsivity. In M. Zuckerman (Ed.), *The biological basis of sensation seeking, impulsivity and anxiety*. Hillsdale: Erlbaum.
- Gresham, F. M. & Elliot, S. N. (1987). The relationship between adaptive behavior and social skills: issues of definition and assessment. *The Journal of Special Education*, 21(1), 167-181.
- Halfon, N., Mendonca, A. & Berkowitz, G. (1995). Health status of children in foster care. The experience of the Center for the Vulnerable Child. *Archives of Pediatric and Adolescent Medicine*, 149(4), 386-392.
- Hofferth, S. L. (1998). *Report on 1997 data collection for the PSID child development supplement*: Michigan Institute for Social Research.
- Kaugars, A. S., Klinnert, M. D. & Bender, B. G. (2004). Family influences on pediatric asthma. *Journal of Pediatric Psychology*, 29(7), 475-491.
- Keenan, K., Loeber, R. & Green, S. (1999). Conduct disorder in girls: A review of the literature. *Clinical Child and Family Psychology Review*, 2, 3-19, 2, 3-19.
- Klinnert, M. D., McQuaid, E. L., McCormick, D., Adinoff, A. D. & Bryant, N. E. (2000). A multimethod assessment of behavioral and emotional adjustment in children with asthma. *Journal of Pediatric Psychology*, 25(1), 35-46.

- Klennert, M. D., Nelson, H. S., Price, M. R., Adinoff, A. D., Leung, D. Y. & Mrazek, D. A. (2001). Onset and persistence of childhood asthma: Predictors from infancy. *Pediatrics*, 108(4), 69-77.
- Laforest, L., Yin, D., Sazonov Kocevar, V., Pacheco, Y., Dickson, N., Gormand, F. & Van Ganse, E. (2004). Association between asthma control in children and loss of workdays by caregivers. *Annals of Allergy, Asthma and Immunology*, 93(3), 265-271.
- Lavigne, J. V. & Faier-Routman, J. (1993). Correlates of psychological adjustment to pediatric physical disorders: A meta-analytic review and comparison with existing models. *Journal of Development and Behavioral Pediatrics*, 14(2), 117-123.
- Lynam, D., Moffitt, T. E., White, J. L. & Caspi, A. (1991). *Reliability and validity of videotape-rated impulsivity dimensions*. Madison, Wisconsin: University of Wisconsin.
- MacLean, W. E., Jr., Perrin, J. M., Gortmaker, S. & Pierre, C. B. (1992). Psychological adjustment of children with asthma: Effects of illness severity and recent stressful life events. *Journal of Pediatric Psychology*, 17(2), 159-171.
- Mash, J. E. & Barkely, R. A. (2003). *Child Psychopathology* (2 ed.). New York: The Guilford Press.
- Mash, J. E. & Wolfe, A. D. (2001). *Abnormal Child Psychology* (Vol. 2). Belmont: Wadsworth Thomson Learning.
- McQuaid, E. L., Kopel, S. J. & Nassau, J. H. (2001). Behavioral adjustment in children with asthma: a meta-analysis. *Journal of Development and Behavioral Pediatrics*, 22(6), 430-439.
- Milgrom, H. & Bender, B. G. (1993a). Psychologic side effects of therapy with corticosteroids. *American Review of Respiratory Disorders*, 147(2), 471-473.

- Milgrom, H. & Bender, B. G. (1993b). Current issues in the use of theophylline. *American Review of Respiratory Disorders*, 147(6 Part 2), 33-39.
- Moffitt, T. E. (1993). Adolescence-limited and life-course-persistent antisocial behavior: A developmental taxonomy. *Psychological Review*, 100(4), 674-701.
- Monitoring-and-Research-Team. (2003). *Christchurch City Social Trends Report 2003: Prepared for the Long Term Council Community Plan*. Retrieved 12-06-2007. from <http://www.ccc.govt.nz/reports/2003/SocialTrendsReport/>.
- Monitoring and Research Team. (2003). *Christchurch City Social Trends Report 2003: Prepared for the Long Term Council Community Plan*. Retrieved 12-06-2007. from <http://www.ccc.govt.nz/reports/2003/SocialTrendsReport/>.
- Mrazek, D. A., Klinnert, M. D., Mrazek, P. & Macey, T. (1991). Early asthma onset: consideration of parenting issues. *Journal of American Academy of Child and Adolescent Psychiatry*, 30(2), 277-282.
- Mrazek, D. A., Schuman, W. B. & Klinnert, M. (1998). Early asthma onset: risk of emotional and behavioral difficulties. *Journal of Child Psychology and Psychiatry*, 39(2), 247-254.
- National Asthma Education and Prevention Program. (1997). Expert Panel Report 2. Clinical Practice Guidelines. Guidelines for the Diagnosis and Management of Asthma: Rockville, MD: US Department of Health and Human Services, Public Health Service, National Institutes of Health; National Heart, Lung and blood Institute.
- National Evaluation of Welfare to Work Strategies. (2005). Impact on young children and their families 2-years after enrollment. *National Evaluation of Welfare-to-Work Strategies*, from <http://aspe.hhs.gov/hsp/NEWS/child-outcomes/ch2.htm>

- Olson, S. L., Schilling, E. M. & Bates, J. E. (1999). Measurement of impulsivity: construct coherence, longitudinal stability, and relationship with externalizing problems in middle childhood and adolescence. *Journal of Abnormal Child Psychology*, 27(2), 151-165.
- Pattemore, P. K., Ellison-Loschmann, L., Asher, M. I., Barry, D. M., Clayton, T. O., Crane, J., D'Souza, W. J., Ellwood, P., Ford, R. P., Mackay, R. J., Mitchell, E. A., Moyes, C., Pearce, N. & Stewart, A. W. (2004). Asthma prevalence in European, Maori, and Pacific children in New Zealand: ISAAC study. *Pediatric Pulmonology*, 37(5), 433-442.
- Perrin, J. M., MacLean, W. E., Jr. & Perrin, C. E. (1989). Parental perception of health status and psychologic adjustment of children with asthma. *Pediatrics*, 83(1), 26-30.
- Peterson, J. L. & Zill, N. (1986). Marital disruption, parent-child relationships, and behavior programs in children. *Journal of Marriage and Family*, 48, 295-307.
- Pilowsky, D. (1995). Psychopathology among children placed in family foster care. *Journal of Psychiatric Services*, 46(9), 906-910.
- Repetti, R. L., Taylor, S. E. & Seeman, T. E. (2002). Risky families: family social environments and the mental and physical health of offspring. *Psychological Bulletin*, 128(2), 330-366.
- Rosier, M. J., Bishop, J., Nolan, T., Robertson, C. F., Carlin, J. B. & Phelan, P. D. (1994). Measurement of functional severity of asthma in children. *American Journal of Respiratory and Critical Care Medicine*, 149(6), 1434-1441.
- Rutishauser, C., Sawyer, S. M. & Bowes, G. (1998). Quality-of-life assessment in children and adolescents with asthma. *European Respiratory Journal*, 12(2), 486-494.
- Sandberg, S., Paton, J. Y., Ahola, S., McCann, D. C., McGuinness, D., Hillary, C. R. & Oja, H. (2000). The role of acute and chronic stress in asthma attacks in children. *The Lancet*, 356(9234), 982-987.

- Scarr, S., Weinberg, A. R. & Waldman, D. I. (1993). IQ correlations in transracial adoptive families. *Intelligence*, 17, 541-555.
- Schachar, R. & Logan, G. D. (1990). Impulsivity and inhibitory control in normal development and childhood psychopathology. *Developmental Psychology*, 26(5), 710-720.
- Schlieper, A., Alcock, D., Beaudry, P., Feldman, W. & Leikin, L. (1991). Effect of therapeutic plasma concentrations theophylline on behavior, cognitive processing, and affect in children asthma. *Journal of Pediatrics*, 118(3), 449-455.
- Shaw, I. (2006). Chapter 13: Asthma. In I. Asher & C. Byrnes (Eds.), *Trying to Catch our Breath* Wellington: The Asthma and Respiratory Foundation of NZ (Inc.).
- Snyder, J., Prichard, J., Schrepferman, L., Patrick, M. R. & Stoolmiller, M. (2004). Child impulsiveness-inattention, early peer experiences, and the development of early onset conduct problems. *Journal of Abnormal Child Psychology*, 32(6), 579-594.
- Solanto, M. V., Abikoff, H., Sonuga-Barke, E., Schachar, R., Logan, G. D., Wigal, T., Hechtman, L., Hinshaw, S. & Turkel, E. (2001). The ecological validity of delay aversion and response inhibition as measures of impulsivity in AD/HD: a supplement to the NIMH multimodal treatment study of AD/HD. *Journal of Abnormal Child Psychology*, 29(3), 215-228.
- Sonuga-Barke, E. J. (2002). Psychological heterogeneity in AD/HD: A dual pathway model of behaviour and cognition. *Behavioral Brain Research*, 130(1-2), 29-36.
- Sonuga-Barke, E. J., Dalen, L. & Remington, B. (2003). Do executive deficits and delay aversion make independent contributions to preschool attention-deficit/hyperactivity disorder symptoms? *American Academy of Child and Adolescent Psychiatry*, 42(11), 1335-1342.

- Sonuga-Barke, E. J., Taylor, E., Sembi, S. & Smith, J. (1992). Hyperactivity and delay aversion-
I. The effect of delay on choice. *Journal of Child Psychology and Psychiatry*, 33(2), 387-398.
- Steering Committee of the International Study of Asthma and Allergies in Childhood. (2007).
International Study of Asthma and Allergies in Childhood [Electronic Version]. Retrieved
1st of June, 2007 from www.isaac.auckland.ac.nz.
- Strunk, R. C. (2002). Defining asthma in the preschool-aged child. *Pediatrics*, 109(2 Suppl),
357-361.
- Stuart, F. A., Segal, T. Y. & Keady, S. (2005). Adverse psychological effects of corticosteroids in
children and adolescents. *Archives of Disease in Childhood*, 90, 500-506.
- Szefer, S. J. (2002). The natural history of asthma and early intervention. *Journal of Allergy and
Clinical Immunology*, 109(6 Suppl), S549-553.
- Tarren-Sweeney, M. (2007). The Assessment Checklist for Children - ACC: A behavioral rating
scale for children in foster, kinship and residential care. *Children and Youth Services
Review*, 29, 672-691.
- Taylor, E., Sandberg, S. & Thorley, G. G. (1991). *The epidemiology of childhood hyperactivity*.
Oxford, England: Oxford University Press.
- Toupin, J., Dery, M., Pauze, R., Mercier, H. & Fortin, L. (2000). Cognitive and familial
contributions to conduct disorder in children. *Journal of Child Psychology and
Psychiatry*, 41(3), 333-344.
- Vila, G., Nollet-Clemencon, C., de Blic, J., Mouren-Simmeoni, M.-C. & Scheinmann, P. (1998).
Asthma severity and psychopathology in a tertiary care department for children and
adolescents. *European Child & Adolescent Psychiatry*, 7, 137-144.

- Wamboldt, M. Z., Fritz, G., Mansell, A., McQuaid, E. L. & Klein, R. B. (1998). Relationship of asthma severity and psychological problems in children. *Journal of the American Academy of Child and Adolescent Psychiatry*, 37(9), 943-950.
- Wamboldt, M. Z., Weintraub, P., Krafchick, D. & Wamboldt, F. S. (1996). Psychiatric family history in adolescents with severe asthma. *Journal of the American Academy of Child and Adolescent Psychiatry*, 35(8), 1042-1049.
- Waschbusch, D. A. (2002). A meta-analytic examination of comorbid hyperactive-impulsive-attention problems and conduct problems. *Psychological Bulletin*, 128(1), 118-150.
- White, J. L., Moffitt, T. E., Caspi, A., Bartusch, D. J., Needles, D. J. & Stouthamer-Loeber, M. (1994). Measuring impulsivity and examining its relationship to delinquency. *Journal of Abnormal Psychology*, 103(2), 192-205.
- Zoccolillo, M. (1993). Gender and the development of conduct disorder. *Development and Psychopathology*, 5, 65-78.

APPENDICES

Appendix A. Ethics Approval

Dear Eeuwe

The Human Ethics Committee have considered and approved your recent application; please see letter attached. A hard copy of this letter will be sent to you at the School of Education.

Regards,

Deborah

Mrs Deborah Wekking

HEC Secretary

Eeuwe Schuckard
School of Education
UNIVERSITY OF CANTERBURY

Dear Eeuwe

The Human Ethics Committee advises that your research proposal “The relationship between asthma and impulsive behaviour in 5-6 year old children.” has been considered and approved. However, this approval is subject to the amendments you outlined in your email of 27 March 2007.

Yours sincerely

Dr Michael Grimshaw
Chair, Human Ethics Committee

Appendix B. Parent and Child Information Sheet

University of Canterbury

**School of Education Studies and Human Development
Child and Family Psychology**

Child Future Orientated Behaviour and Asthma

Information for Parents/Caregivers and Children to Participate in a Research Study

“Child future orientated behaviour and asthma”

Dear <Parent's Name>

I am writing to you because of your involvement in the Christchurch Children's Learning Study. My name is Eeuwe Schuckard and as part of the requirements toward my Masters of Education, I am inviting you to participate in my research project; “Child future orientated behaviour and asthma”. This project consists of a questionnaire which explores some aspects of your child's behaviour, and a computer activity for your child which explores their future orientated decision making.

The information gained from this project seeks to add to the Children's Learning Study. It is carried out by myself under the supervision of Dr Kathleen Liberty, and Dr Michael Tarren-Sweeney, at University of Canterbury, School of Education Studies and Human Development,. Both Dr Liberty and Dr Tarren-Sweeney will be please to discuss any concerns you may have about participation in the project, and may be contacted on 3642545 (Kathleen) or 3642987 (Michael).

This project will involve parents filling in a questionnaire and <Child's Name> completing a short computer activity (parents can watch this). Participation will take approximately 15-30 minutes but you may stop participation at any time and information will be discarded if you wish. The questionnaire will ask questions about your experience with difficult and positive behaviours displayed by your child. Your child will be asked to partake in a short computer activity allowing him/her to earn a small sum of money (between \$2.00 and \$6.00) by selecting shapes on the screen of a laptop computer with a computer mouse. Each shape will reward him/her with a certain sum of money that he/she may collect at the end of the computer task. The money offered to your child during the computer exercise is to help make the process more enjoyable. If you are unhappy with your child receiving money during the computer task then please let the researcher know. Procedures can be changed so that the money is given to you during the computer task and passed to your child later. Some other form of reward such as lollies may also be used should you find this more appropriate.

Before the child begins with the computer task, I will ask whether he/she “has used any asthma medication today”, and, if so, “what time this was”. I will make sure that you are present when this is asked in case your opinion differs with your child. After the completion of the questionnaire and the computer task, I will ask you whether you have any further questions and whether there is any other information you think may be relevant to my study.

With your consent, I will also collect some of the information you have provided to the Children's Learning Study. All the collected information including your responses to the questionnaire will remain confidential. Parents and children who have chosen to participate will be given a code number and only myself and the project supervisors will know the participant codes. Information from the questionnaire and the computer tasks will be coded into a computer using a number. The information provided will be summarized with the information from other participants. The information will be used in my research dissertation, and may be written up for publication. However, your participation and the collected information will be confidential. All the questionnaire and computer task data will be locked away in cabinets and shredded after the research paper has been written.

PLEASE TURN TO THE NEXT PAGE

University of Canterbury
School of Education Studies and Human Development
Child and Family Psychology

The project has been reviewed and approved by the University of Canterbury Human Ethics Committee
The Questionnaire and the computer task have no known risks associated with them. All information that is collected will be done with great care for you and your child so that no one is upset.

If you want to know more about the study, either now or at a later date, please feel free to contact

Euwe Schuckard;	Cell Number:	021922326
	E-Mail:	esc18@canterbury.ac.nz
Dr Kathleen Liberty;	Phone Number:	364 2545
	E-Mail:	kathleen.liberty@canterbury.ac.nz

I sincerely appreciate your interest and assistance in my project.

Yours Sincerely

Euwe Schuckard.

University of Canterbury
School of Education Studies and Human Development
Child and Family Psychology

Appendix C. Parent and Child Consent Form

Child Future Orientated Behaviour and Asthma

Parent/Caregiver and Child Consent Form

I have read and understood the description of the above project. On this basis I agree to participate as a subject in the project, and I consent to publication of the results of the project with the understanding that anonymity will be preserved. I understand also that I may at any time withdraw from the project, including withdrawal of any information I have provided.

I agree to complete the Questionnaire asking about my child's behaviours **YES/NO**

I have spoken with my child about the computer task where he/she will be required to select shapes on the screen of a laptop computer, with a computer mouse. I understand that the money offered to my child during the computer task may be changed to something else. **YES/NO**

I am confident my child understands what the computer task will involve and that he/she is willing to participate **YES/NO**

The researcher may use the information I have provided to the Children's Learning Study for his study **YES/NO**

I understand that my child and I may withdraw from the study at any time and have our information removed should we wish **YES/NO**

I am willing to have the confidential data of myself and my child stored and disposed of as described **YES/NO**

I am willing to have this information shared with the Children's Learning Study **YES/NO**

MY CHILD AND I CONSENT TO TAKE PART IN THIS STUDY

Parent/s or Caregiver/s Name (Please Print): _____

Childs/s Name (Please Print): _____

Signature of the Parent/s or Caregiver/s _____ **Date** _____

Signature of the Child _____ **Date** _____

Contact Details:

Researcher: Eeuwe Schuckard

Phone: 021922326

Email: esc18@student.canterbury.ac.nz

Supervisors:

Dr Kathleen Liberty: kathleen.liberty@canterbury.ac.nz

Dr Michael Tarren-Sweeney: Michaeltarren-sweeney@canterbury.ac.nz

Appendix D. ISACC Questionnaire Items

Q.15. ISAAC Questions

Wheezing/Asthma

15-1. Has {SC} ever had wheezing or whistling in the chest? Yes [1] No [2]

If Yes: ensure ask for permission to contact their physician

If yes to 15-1b

15-1c. How many attacks of wheezing has {SC} had in the past 12 months?

None 1 to 3 4 to 12 More than 12

15-2. Has {SC} woken up with shortness of breath at any time in the past 12 months?

Yes [1] No [2]

If Yes: ensure ask for permission to contact their physician

15-3 Has {SC}’s sleep ever been disturbed due to wheezing? Yes [1] No [2]

If yes: ensure ask for permission to contact their physician

15-4. Has {SC}’s sleep ever been disturbed due to wheezing? Yes [1] No [2]

If yes: ensure ask for permission to contact their physician

If yes to 15-4

15-4b. In the last 12 months? Yes [1] No [2]

If Yes to 15-4b

15-4c. How often, on average, has {SC}’s sleep been disturbed due to wheezing in the last 12 months?

- ☐ Less than 1 night per 6 months
- ☐ Less than 1 night per 3 months
- ☐ Less than 1 night per 1 months
- ☐ Less than 1 night per fortnight
- ☐ 1-2 nights per week
- ☐ 3-5 nights per week
- ☐ Most, if yes how many times per night? ____

15-5. Has your child's speech ever been affected by wheezing? Yes [1] No [2]

If yes to 15-5

15-5b. In the last 12 months? Yes [1] No [2]

If Yes: ensure ask for permission to contact their physician

15-5c. Has wheezing ever been severe enough to limit your child's speech to only one or two words at a time between breaths in the last 12 months? Yes [1] No [2]

If yes to 15-5c

15-5d. How often has {SC}'s speech been limited to only 1-2 words? ____

15-6. Has your child's chest ever sounded wheezy during or after exercise? Yes [1] No [2]

If yes: ensure ask for permission to contact their physician

If yes to 15-6

15-6b. In the last 12 months? Yes [1] No [2]

If the parent has answered yes to any wheezing questions, please make sure this is consistent to Q15-1. You may need to re-ask Q15-1

15-7. Has your child had a dry cough at night, apart from a cough associated with a cold or chest infection?

If yes to 15-7

15-7b. In the past 12 months? Yes [1] No [2]

15-8. Has {SC} ever had asthma? Yes [1] No [2]

If yes: ensure ask for permission to contact their physician

If yes to 15-8

15-8b. In the last 12 months? Yes [1] No [2]

If yes 15-8b.

15-8c. During which months?

January	May	September
February	June	October
March	July	November
April	August	December

If yes to 15-8

15-8d. Have you seen a doctor about your child's asthma? Yes [1] No [1]

If no to 15-8d (haven't seen their doctor about asthma)

15-8e. Why does the parent suspect {SC} has asthma? When did the parent first suspect asthma (age)?

15-9. Has {SC} ever had any of the following: wheezy bronchitis; viral wheeze; reactive airway disease or other chest diagnoses? Yes [1] No [2]

If yes: ensure ask for permission to contact their physician

If yes to 15-9

15-9b. In the last 12 months? Yes [1] No [2]

If yes to 15-9b

15-9c. During which months?

January	May	September
February	June	October
March	July	November
April	August	December

15-9d. Have you seen a doctor about your child's wheezy bronchitis/viral wheeze; reactive airway disease or other chest diagnoses? Yes [1] No [2]

If yes: ensure ask for permission to contact their physician

If no to 15-9d

15-9e. Why does the parent suspect {SC} has wheezy bronchitis or reactive airway disease? When did the parent first suspect wheezy bronchitis/viral wheeze; reactive airway disease or other chest diagnoses (age)?

If Yes to any of 15-1, 15-2, 15-3, 15-4, 15-5b, 15-6, 15-8, 15-9, 15-9d, ask for permission to contact physician. Please circle which above questions the parent answered ‘yes’ to. Otherwise please proceed to section 15-18.

Procedure to obtain consent to contact physician.

Say: “We would like your permission to contact the doctor(s) you have seen about {SC}’s asthma/ wheezy bronchitis/ viral wheeze/ reactive airway disease/ other chest diagnoses. You do not have to give us permission to contact your doctor in order to participate in the study.”

Give parent Physician Letter and Report dated 15-2-2005. Read aloud the letter and report with parent/caregiver so that they are clear as to what is being asked of the doctor. Go through Parent/Caregiver Consent to Contact Family Physician FORM dated 15-2-2005. If parent consents and signs form, obtain Doctor Name & Contact information and record it here and on the Physician Letter and Report Form dated 15-2-2005.

Note: If permission is not obtained, go to question 15-10

Physician Name and Contact details.

Is this your present doctor? Yes No No doctor at present

If no, repeat permission to contact physician procedures for the current doctor or any other doctors who have seen the child and may have relevant medical information on file.

Present Doctor: Name and Contact Information

Other doctors(s): name and contact information.

Appendix E. Comparison of the Asthma Functional Severity Scale and the Adapted Version
Used in the Current Study

<i>Asthma Functional Severity Scale (Rosier et. al., 1994)</i>	<i>Adaptation of the Asthma Severity Scale from CLS Items</i>
<p>(1). Some children have episodes only from time to time, and feel well between episodes. Other children, however, may feel wheezy or tight in the chest on most days, but also suffer from more severe episodes of asthma. In the last 12 months, how often did your child have episodes of wheezing, or wheezing which was more troublesome than usual?</p> <p>Never 0</p> <p>Less than monthly 1</p> <p>Monthly 2</p> <p>Weekly 3</p> <p>Daily 4</p> <p>Don't know 5</p>	<p>Item 1. Frequency of wheeze attacks in the last 12 months?</p> <p>Q. 15-1c. None 0</p> <p>1 to 3 1</p> <p>4 to 12 2</p> <p>More than 12 3</p> <p>If Q. 15-11a + b + c = 0 or 1</p> <p>More than 12 4</p> <p>If Q. 15-11a + b + c > 1</p>
<p>(2). In the last 12 months, how often did your child wake at night with cough or wheezing?</p> <p>Never 0</p> <p>Only with episodes 1</p> <p>Less than 1 night/week 2</p> <p>1-3 nights/week 3</p> <p>Most nights 4</p> <p>Don't know -</p>	<p>Item 2. Frequency of disturbed sleep due to wheeze in the last 12 months? (Q.15-4 or 15-4b, 15-4c)</p> <p>Never 0</p> <p>Less than 1 night/month</p> <p>(Includes 1 night/3 and 6 months) 1</p> <p>Less than 1 night/fortnight 2</p> <p>1-2 nights/week 3</p> <p>More than 3 nights/week 4</p> <p>(includes 3-5 nights, and most nights)</p>

<i>Asthma Functional Severity Scale (Rosier et. al., 1994)</i>	<i>Adaptation of the Asthma Severity Scale from CLS Items</i>		
3). In the last 12 months, how often was your child's wheezing troublesome first thing in the morning?	Item 3. Frequency of morning wheeze and asthma symptoms (Q.15-11a)		
Never 0	Never	0	
Only with episodes 1	1–2 per month	2	
Less than 1 morning/week 2	1–2 per week	3	
1–3 mornings/week 3	Every day	4	
Most mornings 4			
Don't know -			
(4). In the last 12 months has your child had an attack which has been severe enough to limit speech to only one or two words at a time between breaths?	Item 4. Speech affected by wheeze		
No 0	Never	0	(Q.15-5 = No)
Yes 4	Prior to last 12 months	1	(Q.15-5 = Yes, 15-5b = No)
Don't know -	Affected in the last 12 months	2	(Q.15-5 = Yes, 15-5c = No)
	Limited to two words	4	

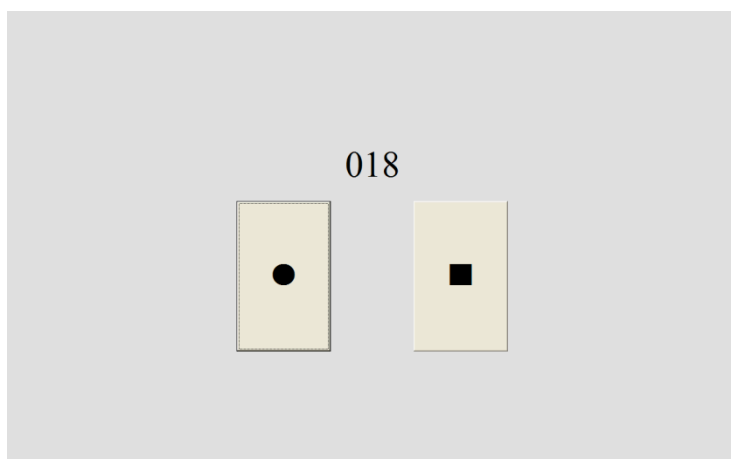
<i>Asthma Functional Severity Scale (Rosier et. al., 1994)</i>	<i>Adaptation of the Asthma Severity Scale from CLS Items</i>
<p>(5). In the last 12 months, how often were your child's activities affected or limited by cough, wheeze or shortness of breath while he/she was at home or playing with other children?</p> <p>Never 0</p> <p>Less often than monthly 1</p> <p>Monthly 2</p> <p>Weekly 3</p> <p>Daily 4</p> <p>Don't know -</p> <p>(6). In the last 12 months, how often were your child's sporting* activities at school affected by or limited by cough, wheeze or shortness of breath?</p> <p>Never 0</p> <p>Less often than monthly 1</p> <p>Monthly 2</p> <p>Weekly 3</p> <p>Daily 4</p> <p>Don't know -</p>	<p>Item 5. Wheeze during or following exercise</p> <p>Never 0 (Q. 15-6 = No)</p> <p>Prior to last 12 months 2 (Q. 15-6 = Yes, 15-6b = No)</p> <p>Affected in last 12 months 4 (Q. 15-6b = Yes)</p> <p>Item 6. Symptoms triggered by exertion (Q15-11d)</p> <p>Rarely 0</p> <p>Exercise or sports 1</p> <p>Hills, stairs, active play 2</p> <p>Exercise/sports + hills/stairs 3</p> <p>Exercise/sports + hills/stairs + walking on the flat 4</p> <p>TOTAL : /24</p>
TOTAL : /24	TOTAL: /24

Appendix F. Two Choice Paradigm Training Procedure

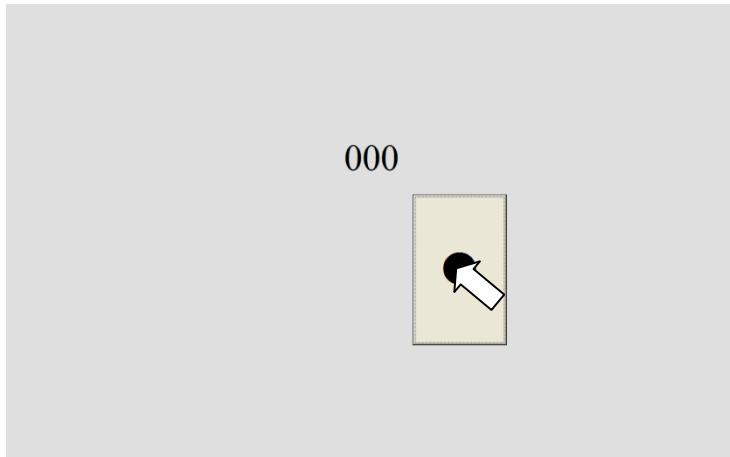
Children participating in the research will be asked to do a computerized task called the Two Choice Paradigm. It presents a choice between a large reward given after a long delay and a small reward given after a short delay.

As the picture below illustrates, with the presentation of each trial, the child is to choose between the square should he/she want a large reward (10 cents per trial) and the circle for the small reward (20 cents per trial) as shown in figure 1. The shape chosen by the child is selected with the computer's mouse. By clicking on either the square or the circle, the chosen shape becomes grey and the other shape disappears. The selected shape stays grey for 2 seconds if the circle is selected and 10 seconds if the square is selected during which the child has to wait. After this delay, the selected shape changes to black and begins to flash. The child clicks on the flashing shape to earn the monetary reward with the relevant coin being placed next to the computer after each trial, and the total amount earned being displayed above the two shapes on the computer screen. This task is repeated 10 times for the training round and 30 times during the testing trials, over a period of 2:00 minutes and 6:00 minutes depending on which shapes are chosen by the child. At the end of the task, the child receives the monetary reward they have earned.

During the Two Choice Paradigm, money serves as a motivator for the child to choose either an immediate or delayed reward. However, the possibility exists that parents find the child accepting money from the researcher inappropriate. In such cases, another form of reward will be negotiated with the caregiver or the process by which the child receives the money may be modified. As long as the reward acts as a motivator for the child and can be offered or presented immediately after each choice is made, the motivating effect will be similar to money. The payment must be dividable into a large and small amount so the child has a choice between a large delayed reward and one that is small and immediate. Should a payment method other than money be used, it must be ensured that it is comparable to currency. For instance, if lollies are used than they must all be the same type so the child's motivation revolves around the amount rather than the type.



At the beginning of the task the following picture is presented to the child on a laminated card;



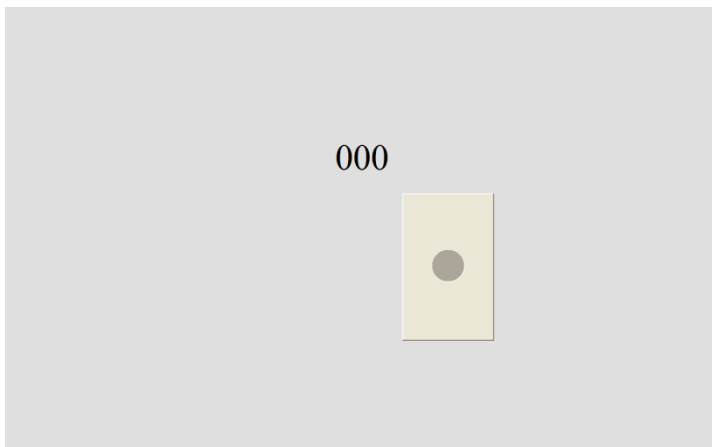
instructions given to the child are as follows;

“we are going to do an activity on the computer that will allow you to earn some money. The most you can earn is \$6.00 and the least you can earn is \$3.00.

I will read out the following from a laminated card;

“In this task, you’ll be clicking on shapes to earn money. You’ll have several chances to move the mouse’s arrow (I will point to the arrow on the card) onto a shape on the screen to add points to your counter (I will point to the three 0’s above the square). The first part of this task will be a practice session. During the practice, first you’ll see a circle appear on the screen (I will point to the circle on front of the card). When this happens, move the mouse’s arrow over the circle and click the left mouse button one time”

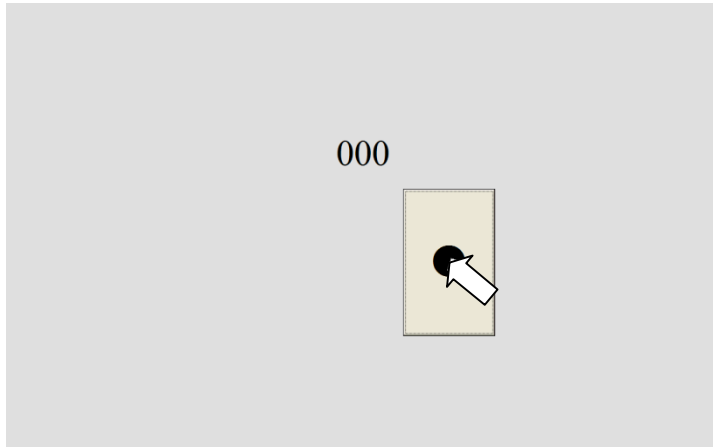
Next this picture will be shown on a laminated card;



While presenting it I will say to the child;

“When you click on the circle, the color will fade for a little while (I will point out the difference between the colours of the two cards)

Next, this picture will be presented on a laminated card;



While presenting it I will say to the child;

“When this happens, you wait until the circle starts to blink, then click the mouse arrow on the circle once more.”

“The circle will disappear and 10 cents will be added to your counter”

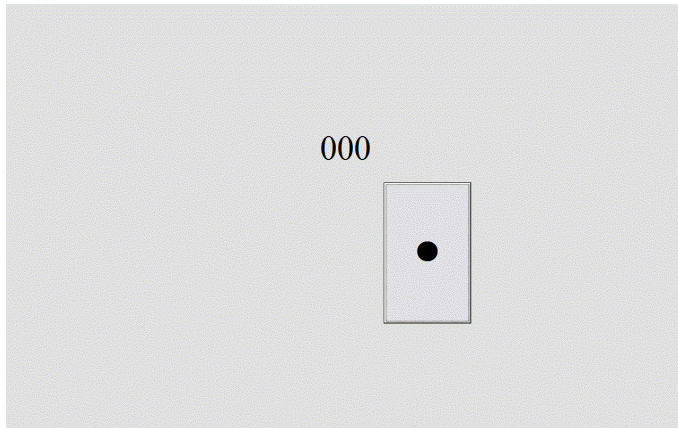
I will then motion towards the computer screen and mouse while saying “Now lets try this on the computer”

The task will start with this screen



I will say to the child “click on the grey button” while pointing toward the grey button below “Ready to Begin”

The child will be presented with a screen which looks like this;



I will say to the child “When you click on the circle, the color will fade for a little while, click on the circle now”

“well done, notice how the color is now grey whereas before it was black?”

“now you wait until the circle starts to blink”

I will wait with the child until the circle starts to blink and I will then say

“See how its blinking? Now you can click the circle again to collect your money”

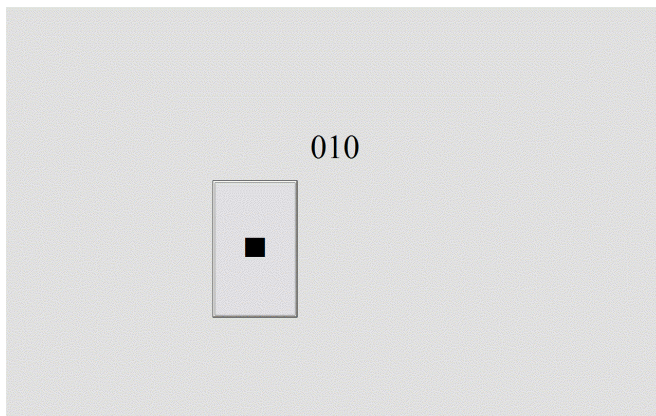
I will wait for the child to click on the flashing circle

When the score has been credited I will point to it and say

“See here? you have gained 10 cents, well done, lets try this again”

This process is to repeat five times, by which time the child will hopefully understand the process.

After the five trials with the circles the shape will change to a square



When this occurs I will say,

“Look, the shape is now a square, you click on the square the same way you clicked on the circle, have another go, click on the square”

When the child clicks on the square and it has faded to grey, I will say; “good”

“There are two differences between circles, which you clicked on before, and the square, what you have just clicked on”

“First, when you click on the square, you will have to wait longer before you can collect your money then if you click on the circle”

“Secondly, when you click on the square, you get more money compared to when you click on the circle”

When the square begins to flash I will say, “now click again and collect your money.”

“When you click on the circle you get 10 cents, when you click on the square you get 20 cents”

“Just remember, when you click on the circle you only have to wait a short time but you only get 10 cents, when you click on the square you have to wait for longer but you get 20 cents”

“Now lets try the next one”

When the child has clicked on the square I will say,

“Notice how you have to wait longer with this square, then you did with the circles?”

When the child has clicked to collect their money I will say

“see how you also get more points when you click on the square, you got 20 cents, whereas if you had clicked on a circle you would have only got 10 cents”

After the child has completed 5 trials containing squares this screen will appear again.

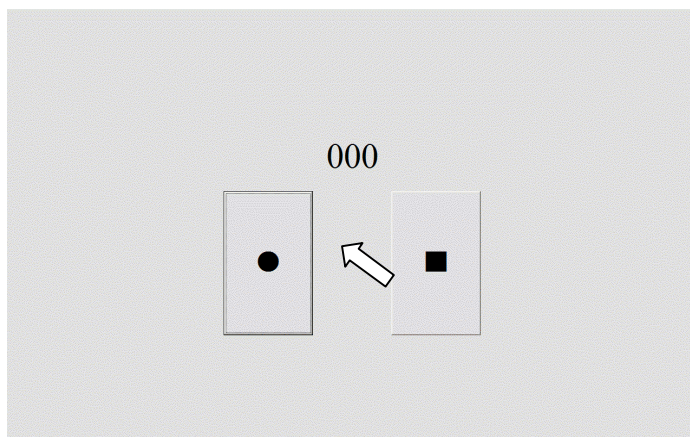
Ready to Begin

[Click here to Start or Press Button to Begin](#)

When it appears I will say, “well done, it looks like you understand what to do”

“Now its going to be a little bit different, instead of only having one square or circle appear on the screen at a time, you are going to see both a square and a circle on the screen, it will look like this”

I will show the child a queue card which looks like this



“Now you must decide which shape you want to click on, remember if you click on the circle, you will only have to wait a short time, but you only get 10 cents”

“If you choose the square, you have to wait a longer period of time, but you get 20 cents”

“you can take as long as want, and if you have any questions don’t hesitate to ask me, do you have any questions?”

“I will now ask you some questions to make sure that you have understood how this activity works, OK?”

I will ask the following questions

“which shape makes you have to wait the longest, the circle, or the square?”

“Which shape gives you the least amount of money, the circle or the square?”

“which shape makes you wait the shortest, the circle or the square?”

“Which shape gives you the most money when you click on it, the circle or the square?”

“How long do you get to decide which shape you want to pick?”

When the child answers these questions correctly I will say;

“Excellent, you have listened very well and you understand what I have told you”

“When you are ready to begin, click with the mouse on the grey button and you may finish playing this game”

“I will put the money that you earn next to the computer after you select each shape,”

EITHER “you can have the money that you earned while playing this game when you finish”.

OR “I will give the money you have earned to your mum/dad when you have finished”. Remember, the amount of money you have earned so far is shown on the counter at the top of the screen. Have fun”

“If you have any questions, don’t hesitate to ask me”

Once the child understands the procedures I will let him/her finish the computer task without interrupting. I will make sure that they are not distracted during the task by ensuring that anyone around him/her is quiet and that there are not any visual distracters in their peripheral field of view.

Appendix G. *Conners' Parent Rating Scale - Revised* Hyperactive-Impulsive, Conners' Global

Index: Restless-Impulsivity and the DSM-IV Hyperactive-Impulsive Subscale Items

Below are a number of common problems that children have. Please rate each item according to your child's behaviour in the last month. For each item, ask yourself "How much of a problem has this been in the last month?", and circle the best answer for each one. If none, not at all, seldom or very infrequently, you would circle 0. If very much true, or it occurs very often or frequently, you would circle 3. You would circle 1 or 2 for ratings in between. Please respond to all the items.

	QUESTIONS	NOT TRUE AT ALL (never, seldom)	JUST A LITTLE TRUE (occasionally)	PRETTY MUCH TRUE (Often, quite a bit)	VERY MUCH TRUE (Very Often, Very Frequent)
2	difficulty doing or completing homework	0	1	2	3
3	Is always "on the go" or acts as if driven by a motor	0	1	2	3
9	Avoids, expresses reluctance about, or has difficulties with engaging in tasks that require sustained mental effort (such as schoolwork or homework)	0	1	2	3
10	Has difficulty sustaining attention in tasks or play activities	0	1	2	3
12	Fails to complete assignments	0	1	2	3
13	Hard to control in malls or while grocery shopping	0	1	2	3
18	Restless or overactive	0	1	2	3
19	Has trouble concentrating in class	0	1	2	3
20	Does not seem to listen to what is being said to him/her	0	1	2	3
22	Needs close supervision to get through assignments	0	1	2	3
23	Runs about or climbs excessively in situation where it	0	1	2	3

QUESTIONS		NOT TRUE AT ALL (never, seldom)	JUST A LITTLE TRUE (occasionally)	PRETTY MUCH TRUE (Often, quite a bit)	VERY MUCH TRUE (Very Often, Very Frequent)
is inappropriate					
28	Excitable, impulsive	0	1	2	3
29	Does not follow through on instruction and fails to finish schoolwork, chores or duties in the workplace (not due to oppositional behaviour or failure to understand instructions).	0	1	2	3
30	Has difficulty organizing tasks and activities	0	1	2	3
32	Restless in the “squirmy sense”	0	1	2	3
37	Fails to finish things he/she starts	0	1	2	3
39	Talks excessively	0	1	2	3
41	fails to give close attention to details or makes careless mistakes in schoolwork, work or other activities	0	1	2	3
42	Has a difficulty waiting in lines or awaiting turn in games or group situations	0	1	2	3
49	Interrupts or intrudes on others (e.g. butts into others’ conversations or games)	0	1	2	3
50	Forgetful in daily activities	0	1	2	3
51	Cannot grasp arithmetic	0	1	2	3
52	Will run around between mouthfuls during meals	0	1	2	3
55	Fidgets with hands or feet or	0	1	2	3

QUESTIONS		NOT TRUE AT ALL (never, seldom)	JUST A LITTLE TRUE (occasionally)	PRETTY MUCH TRUE (Often, quite a bit)	VERY MUCH TRUE (Very Often, Very Frequent)
squirms in seat					
59	Has difficulty playing or engaging in leisure activities in quietly	0	1	2	3
62	Fidgeting	0	1	2	3
66	Disturbs other children	0	1	2	3
68	Demands must be met immediately – easily frustrated	0	1	2	3
71	Loses things necessary for tasks or activities (e.g. school assignments, pencils, books, tools or toys)	0	1	2	3
74	Spelling is poor	0	1	2	3
76	Leaves seat in classroom or in other situation in which remaining seated is expected	0	1	2	3
79	Easily distracted by extraneous stimuli	0	1	2	3
80	Blurts out answers to questions before the questions have been completed	0	1	2	3

Appendix H. Supplementary Strengths Checklist Items of the Assessment Checklist for
Children

For each statement, circle the number that best describes your child in the last four to six months

	0=Never	1=Rarely	2=Sometimes	3=mostly
Acts his/her age (not too grown up, or immature)	0	1	2	3
Comfortable with being looked after by adults (e.g. not excessively independent, doesn't try to 'parent' his/her caregivers, lets adults care for his/her younger siblings)	0	1	2	3
Cries when hurt	0	1	2	3
Genuinely sorry if he hurts someone's feelings	0	1	2	3
Has a regular appetite	0	1	2	3
Is affectionate towards family or caregivers	0	1	2	3
Says when feelings are hurt	0	1	2	3
Says when he is hurt or experiencing pain	0	1	2	3
Seems carefree (without concerns or worries)	0	1	2	3
Seems secure	0	1	2	3
Sensible with strangers (appropriately wary, not overfamiliar)	0	1	2	3
Stands up for him/herself	0	1	2	3
Tolerates others receiving attention or praise	0	1	2	3
Trusts the people he feels closes to (e.g. family or friends)	0	1	2	3

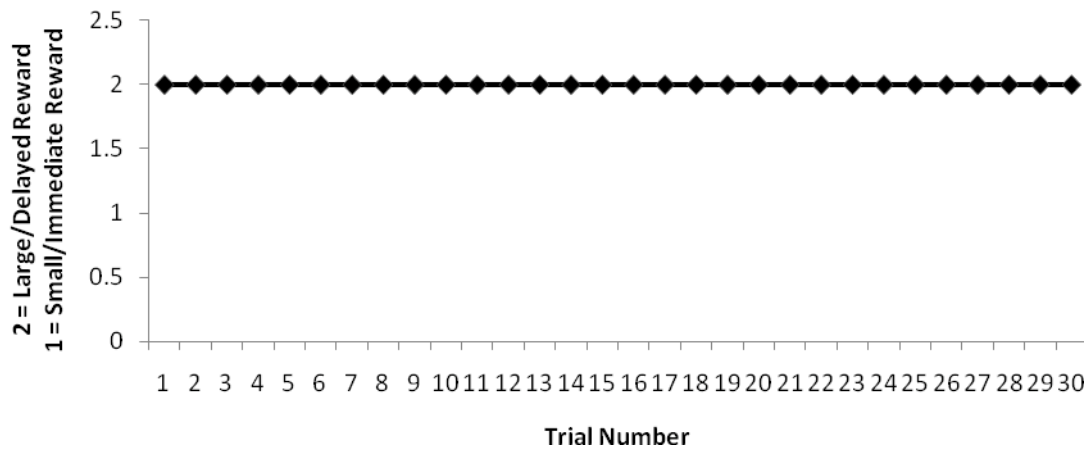
Appendix I. Positive Behaviour Scale Items

Thinking about the (SC), please tell me how much each statement applies to (SC) on a scale from 1-5, where: **1** means “not at all like your child,” and **5** means “totally like your child”
2, 3 and 4 are somewhere in between.

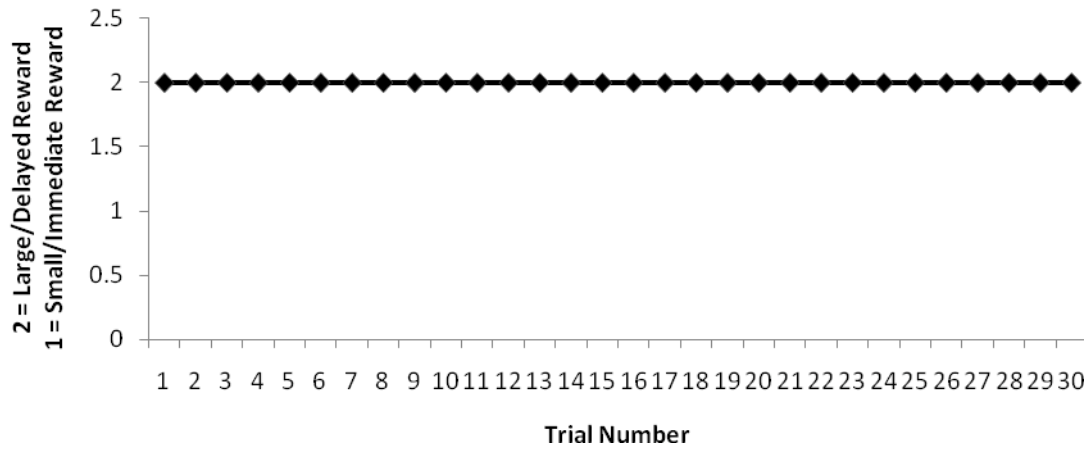
Statement	[1]	[2]	[3]	[4]	[5]	Other/don't know/refuse
	not at all like your child				totally like your child	
a. Is cheerful and happy	1	2	3	4	5	
b. Waits (his/her) turn in games and other activities	1	2	3	4	5	
c. Does neat, careful work for a child their age (or likes to be organized).	1	2	3	4	5	
d. Is curious and exploring, likes new experiences	1	2	3	4	5	
e. Thinks before (he/she) acts, is not impulsive.	1	2	3	4	5	
f. Gets along well with other people (his/her) age	1	2	3	4	5	
g. Usually does what you tell (him/her) to do	1	2	3	4	5	
h. Can get over being upset quickly	1	2	3	4	5	
i. Is admired and well-liked by other children (his/her) age	1	2	3	4	5	
j. Tries to do things for (himself/herself), is self-reliant	1	2	3	4	5	

Appendix J. TCP Response Choice Patterns

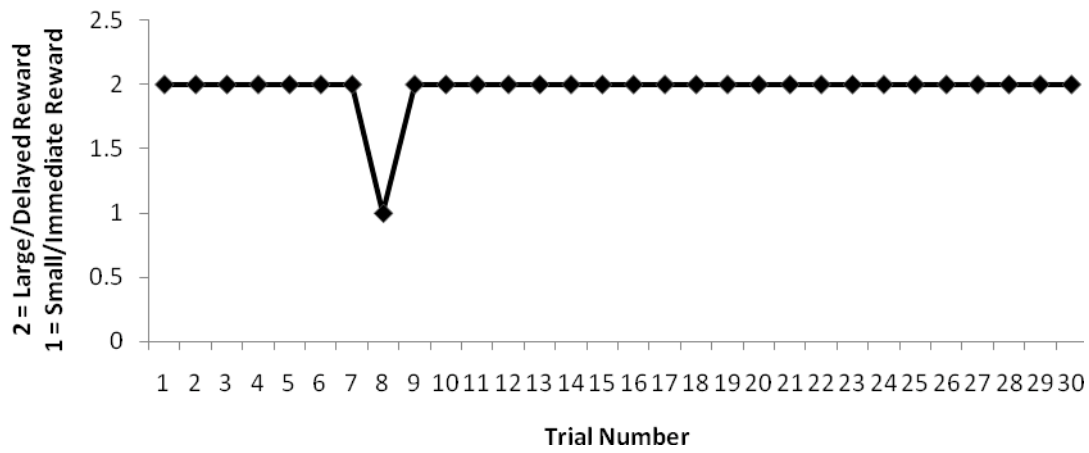
Response Pattern Data: Participant 7



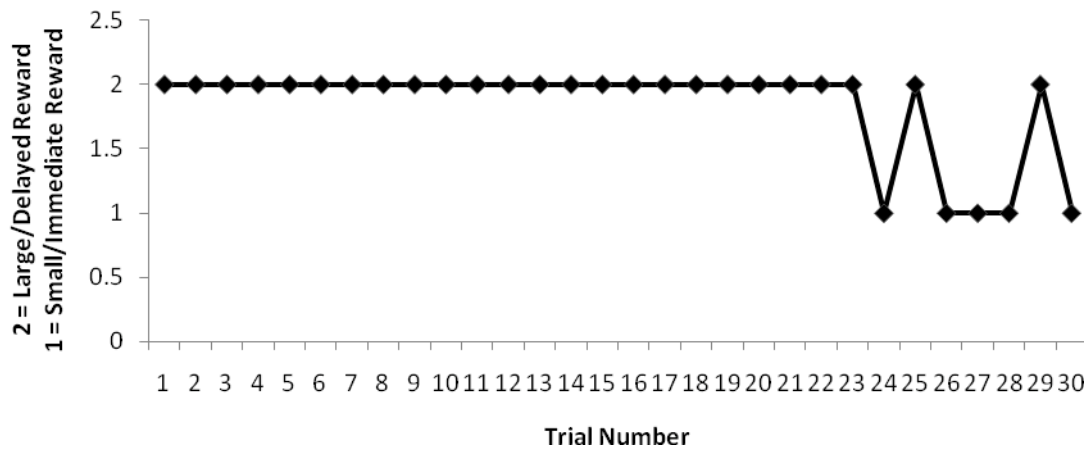
Response Pattern Data: Participant 11



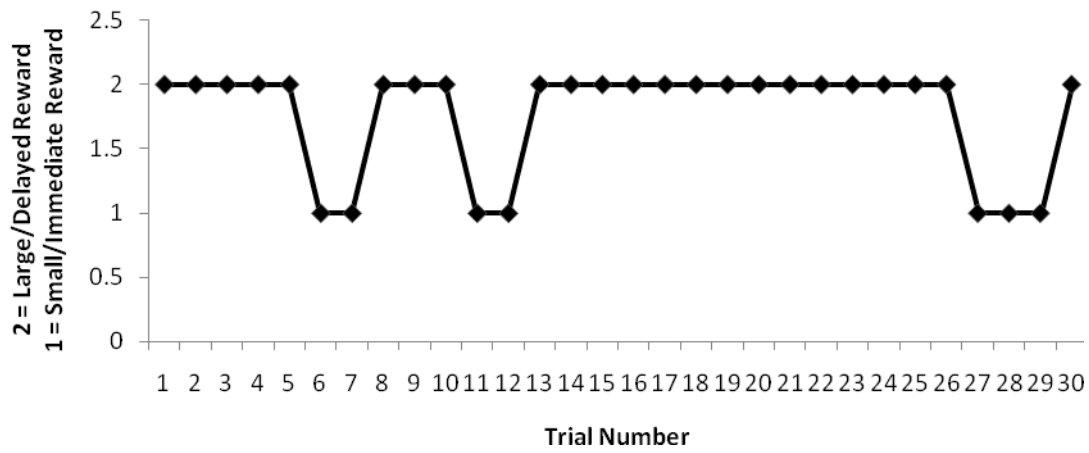
Response Pattern Data: Participant 22



Response Pattern Data: Participant 13



Response Pattern Data: Participant 2



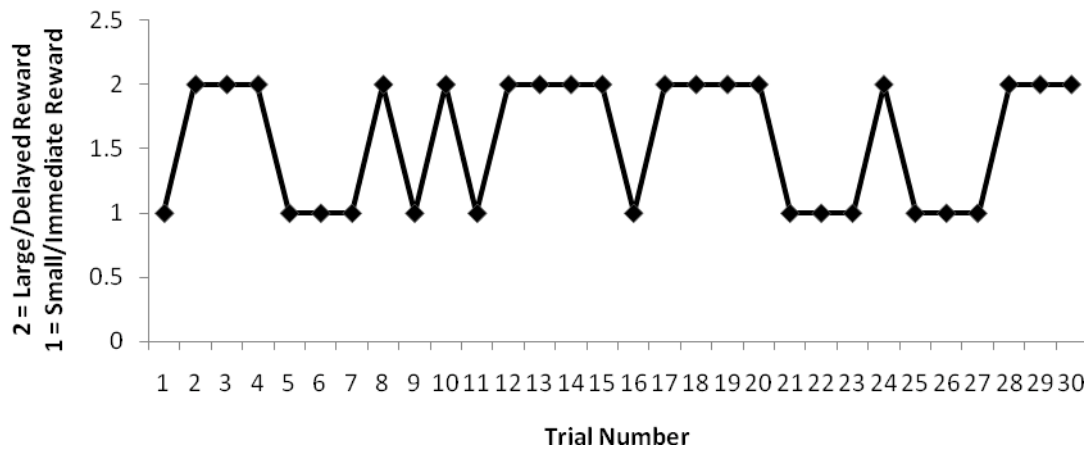
Response Pattern Data: Participant 20



Response Pattern Data: Participant 3



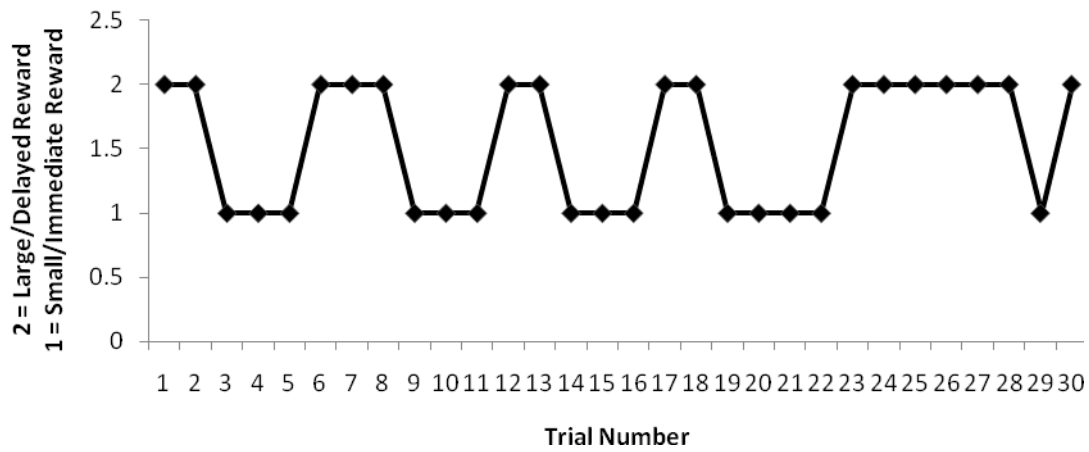
Response Pattern Data: Participant 15



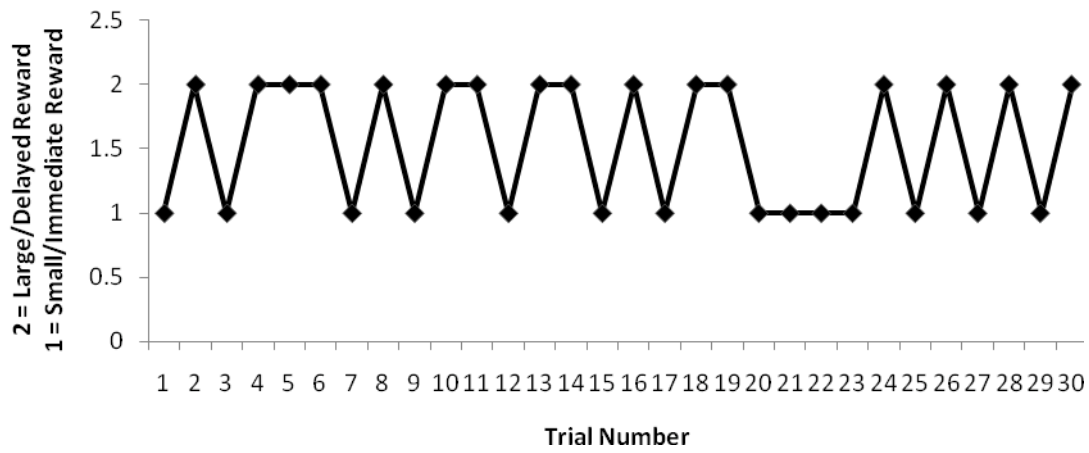
Response Pattern Data: Participant 4



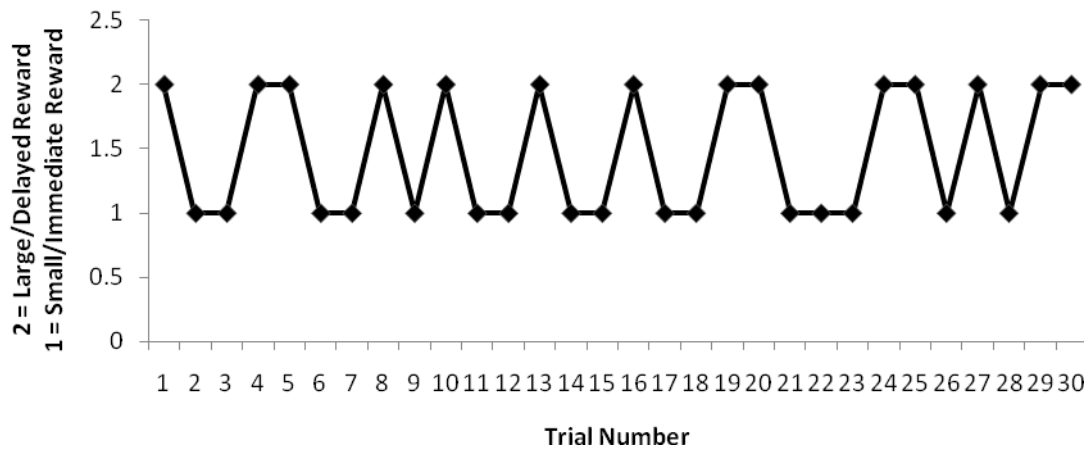
Response Pattern Data: Participant 16



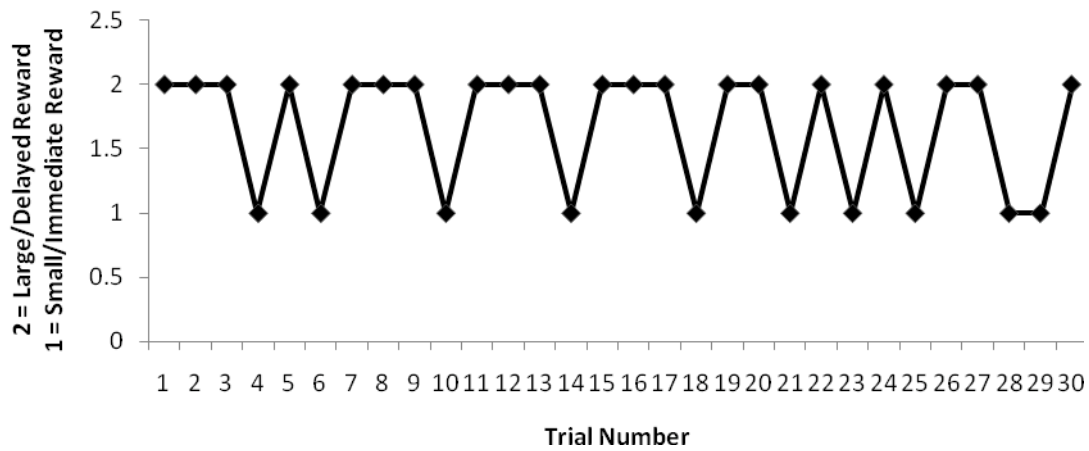
Response Pattern Data: Participant 1



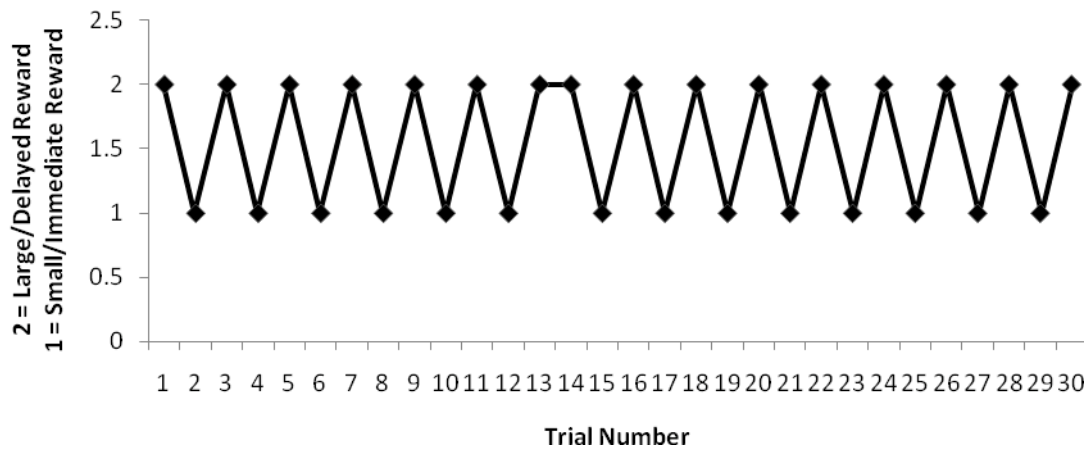
Response Pattern Data: Participant 8



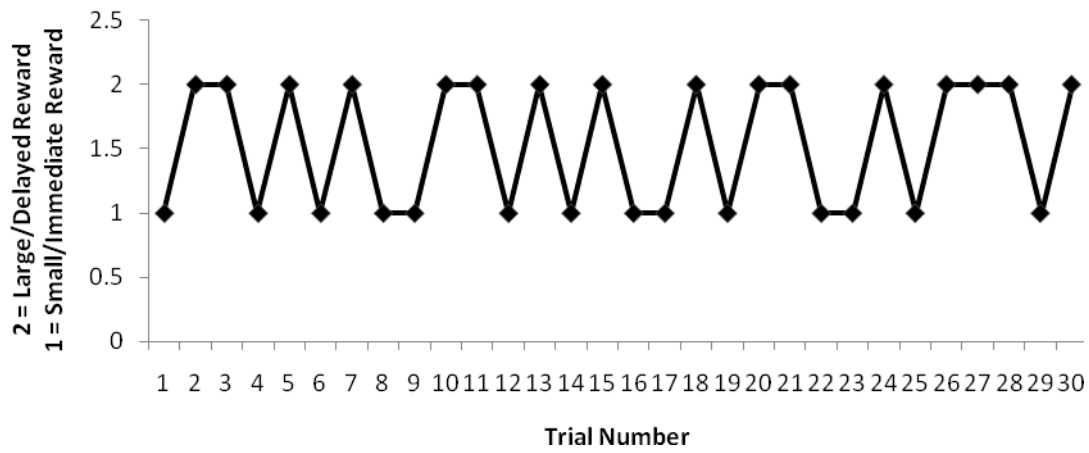
Response Pattern Data: Participant 10



Response Pattern Data: Participant 9



Response Pattern Data: Participant 12



Response Pattern Data: Participant 5

