THE RELATIONSHIPS BETWEEN IMPULSIVITY, WEIGHT, EATING BEHAVIOUR AND PARENTAL FEEDING PRACTICES IN CHILDREN

by

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ABSTRACT

Previous research has indicated that impulsivity is associated with child weight, eating behaviour and some controlling feeding practices and that there are differences in these variables between children with high (including clinically elevated) and low impulsivity levels. Few of these studies have used a range of impulsivity measures to assess this multifaceted concept. This thesis aimed to explore these relationships and differences using a range of parent-report and behavioural impulsivity measures. Three samples of children (2-4-year-olds, 7-11-year-olds and 5-15-year-olds) and their parents participated in three studies. Analyses indicated that impulsivity was positively associated with child weight and snack intake (Chapters Three and Five). Links between impulsivity, restriction and pressure to eat were mixed (Chapters Three and Five). Parental monitoring moderated links between impulsivity and food approach behaviour; a lack of monitoring was detrimental to child eating behaviour (Chapter Three). Observations of mealtime behaviours of parent-child dyads in which children had high vs. low impulsivity levels showed that parents of children with high impulsivity levels used more pressure to eat, while their children made more requests for food (Chapter Four). Furthermore, impulsivity, dietary restraint and stress interacted in their effects over snack intake; children high in impulsivity and dietary restraint decreased their intake under stress, while children low in dietary restraint increased their intake under stress (Chapter Six). Finally, parents and their children with and without clinically elevated impulsivity levels differed in eating and feeding behaviours (Chapter Seven). Interesting gender differences emerged throughout and the implications of the results and limitations of the individual studies are discussed in each chapter.

For Mama, Daddy, Shanice and David
For your endless support

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CHAPTER ONE

LITERATURE REVIEW

1.1 Aims and overview of the literature review

This thesis explores the relationships between impulsivity, weight, eating behaviour and controlling parental feeding practices in children aged 2-15 years. The aim of this literature review is to highlight research that has addressed some of these factors in a range of age groups, while also highlighting the gaps in the literature that this thesis aims to address. The review will open by defining the concept of impulsivity, which is a key factor in each of the chapters within this thesis. This will be followed by a description of Attention Deficit Hyperactivity Disorder (ADHD), a disorder associated with elevated impulsivity levels, as well as an elaboration on different ways in which impulsivity can be measured. The remaining sections will outline research studies that have linked impulsivity and ADHD with child weight, eating behaviour (including stress-related eating behaviour) and the feeding practices of monitoring, restriction for health and weight control and pressure to eat.

1.2 Defining impulsivity

Before beginning to discuss the research that has found links between impulsivity, child weight, eating behaviour and parental feeding practices it is important to understand what impulsivity is. Impulsivity is a complex and multifaceted concept affected by a range of biological and environmental factors (Nederkoorn, Braet, Van Eijs, Tanghe, & Jansen, 2006; Whiteside & Lynam, 2001). Due to its complexity many different approaches to its definition and measurement exist (Evenden, 1999b), which has led to many issues around the comparability of outcomes in studies measuring impulsivity.

Impulsive behaviours of varying degrees are common and impulsivity is considered to be a stable personality trait; some aspects of impulsivity can also be affected by situational demands and circumstances. The concept of impulsivity has pervasive importance in psychology, playing a key role in the development and maintenance of psychopathologies, such as personality disorders (e.g. Borderline Personality Disorder) and impulse disorders (e.g. substance use, paraphillias, kleptomania, pyromania, gambling; Dawe & Loxton, 2004; Evenden, 1999a) and in theories of personality. All major personality theories have included impulsivity, as have theories of infant temperament that address earlier stages of personality development in children (Buss & Plomin, 1975; Cloninger, Svrakic, & Przybeck, 1993; Rothbart, Ahadi, & Evans, 2000; Tellegen & Waller, 2008; Zuckerman, Kuhlman, Thornquist, & Kiers, 1991).

Eysenck and Eysenck (1987) developed the three-factor model of personality and included impulsiveness (e.g. I usually think carefully before doing anything) as a component of the factor psychoticism, while including ‘venturesomeness’ and sensation-seeking (e.g. I sometimes like doing things that are a bit frightening) as components of the factor extraversion. Similarly, Costa and McCrae (1992) developed the five-factor model of personality consisting of the dimensions Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism. Each of these factors contains six facets; four facets on three of the dimensions measure impulsivity (impulsiveness [Neuroticism], excitement-seeking [Extraversion], selfdiscipline and deliberation [Conscientiousness]). A more detailed description of how impulsivity is integrated in different theories of personality is beyond the scope of this thesis. Nevertheless, looking at the three- and five-factor models of personality already highlights that although there is considerable overlap in how impulsivity is represented there are also important differences in how different theories conceptualize impulsivity. Consequently there is only a limited degree of agreement on impulsivity measurement based on different models (Dougherty, Mathias, Marsh, & Jagar, 2005; Solanto et al., 2001).

Although impulsivity is regarded as a relatively stable trait, there are also changes in impulsivity levels across the life-span (Green, Fry, & Myerson, 1994). Younger children (and older adults) generally display greater levels of impulsivity than older typically developing children and adults (Kochanska, Murray, & Harlan, 2000). This is likely to be due to the emergence of self-regulatory mechanisms, which limit the expression of impulsive behaviour, integrating information from cognitive processes, memory and language systems and attentional mechanisms (Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996; Rothbart, 1989). Factors such as early parent-child interactions, child temperament and cognitive development have a crucial impact on impulsivity and its expression (Kochanska et al.). In addition, there appear to be gender differences in the expression of impulsivity, with males being more impulsive than females in childhood (Kochanska et al.). Whether this gender difference persists into adulthood is unclear (Feingold, 1994).

For the purpose of this thesis and in line with previous research, impulsivity will be understood as a multifaceted construct, defined as a tendency to react fast, without planning or foresight to a range of internal and external stimuli (Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001). The concept is reflected in a wide range of behaviours such as rapid and rash decision-making and acting that takes place before all the relevant information has been received and possible consequences have been weighed up (e.g. Evenden, 1999b). It is characterised by inattention and a lack of perseverance as well as by sensation-seeking, risk-taking and being less sensitive to punishment (Moeller et al., 2001). Inhibitory control, the ability to stop responses that are no longer necessary/appropriate or in conflict with goals, is considered to be a key facet of impulsivity (Buss & Plomin, 1975; Logan, Schachar, & Tannock, 1997; Schachar & Logan, 1990). In addition to assessing inhibitory control, tasks used within this thesis will also measure the impulsivity facets of ability to delay gratification, sensitivity to reward and punishment, motor impulsivity and response speed. These facets were selected as they have most frequently been linked with child weight, eating behaviour and parental feeding practices in previous research. Although other facets such as a lack of planning or perseverance have also been studied in the literature, these were not assessed to minimise the testing time for children.

1.2.1 Clinically elevated impulsivity levels

Although impulsive behaviours are commonly displayed, excessive or clinically elevated levels of impulsivity that cause significant problems for the individual displaying them are linked with psychopathologies and disorders like ADHD (Evenden, 1999a). ADHD is one of the most common psychiatric childhood disorders, with a prevalence of around 5-10% (Polanczyk, Silva de Lima, Horta, Biederman, & Rohde, 2007; Scahill & Schwab-Stone, 2000). The disorder is more likely to affect males than females with a gender ratio of 3:1 (Hinshaw & Blachman, 2005). It is characterized by three core symptoms (Impulsivity, Hyperactivity and Inattention), which must emerge before the age of 7 years (National Institute of Health and Clinical Excellence [NICE], 2009). The disorder is divided into four subtypes (predominantly inattentive or hyperactive-impulsive, combined and not otherwise specified) depending on the prevalence of these symptoms (NICE, 2009). For a diagnosis to be made, any symptoms must cause difficulty in at least two different areas, such as the child's home and school environments (Dempsey, Dyehouse, & Schafer, 2011). Hence, the symptoms and additional features of ADHD and its diagnosis are linked with significant difficulties for the child's social and academic development, while also placing a significant burden on families and society in general.

Neuroimaging and electrophysiological studies have indicated that there are biological differences between children with and without ADHD, and genetic factors have been suggested as a potential underlying cause (Dubnov-Raz, Perry, & Berger, 2011). The symptoms of ADHD may persist into adulthood in up to 60% of cases, while they diminish over time in some (Biederman, Mick, & Faraone, 2000; Kessler et al., 2005). A variety of stimulant (e.g. Methylphenidate) and non-stimulant (e.g. Atomoxetine) medications for the management of the symptoms of ADHD are currently available, some of which have been linked with appetite suppression and weight reduction (Barkley, 2004; Swanson et al., 2007).

Interestingly, researchers have reported a high incidence of co-morbidities between ADHD and psychiatric disorders like Conduct Disorder (CD), Oppositional Defiant Disorder (ODD), anxiety, substance use and learning disorders (Pliszka, 2000). More recently eating disorders such as Bulimia Nervosa (BN) and Binge Eating Disorder (BED) have been linked with ADHD (Cortese, Bernardina, & Mouren, 2007; Mikami et al., 2008; Surman, Randall, & Biederman, 2006). Research has also indicated that children and adults with ADHD may have an elevated risk of becoming overweight and obese (Erhart et al., 2012; Holtkamp et al., 2004; Khalife et al., 2014).

1.2.2 Measuring impulsivity

A wide range of tools are used to measure impulsivity in children and adults. Firstly, there are self-report questionnaires such as the Barratt Impulsiveness Scale (Patton, Stanford, & Barratt, 1995), the Eysenck Impulsiveness Questionnaire (EIQ; Eysenck, Pearson, Eastings, & Allsopp, 1985) or the Impulsivity subscale of the Eysenck Junior Questionnaire (Eysenck, Easting, & Pearson, 1984), and the Behavioural Activation/Inhibition Scales (BAS/BIS; Carver & White, 1994), which can be used with adults and children who are mature enough to comprehend the questions. Unfortunately, self-report scales may not yield accurate representations of an individual's impulsivity, as they are susceptible to self-representation biases. Some individuals, especially those who are young or very impulsive may lack insight into how they act in different situations and how impulsive they actually are (Dougherty et al., 2005).

Secondly, parent- and teacher-report questionnaires such as the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997), the Conners' Parent Rating Scale (CPRS; Conners, Sitarenios, Parker, & Epstein, 1998), the Child Behaviour Checklist (CBCL; Achenbach & Edelbrock, 1991), the Disruptive Behavior Disorder rating scale (DBD; Pelham, Gagny, Greenslade, & Milich, 1992), the Temperament in Middle Childhood Questionnaire (TMCQ, Simonds & Rothbart, 2004), the Children's Behaviour Questionnaire (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001) or the Early Child Behaviour Questionnaire (ECBQ; Putnam, Gartstein, & Rothbart, 2006), have been developed. These questionnaires assess child behaviour or temperament in general and some include specific subscales that assess impulsivity in particular. These measures assess impulsivity in a variety of social contexts and reflect long-term behaviour patterns. The depth with which these scales assess impulsivity and the number of impulsivity facets they address varies widely. Responses on these measures may be subject to social desirability biases and to issues around the interpretation of individual items; they may therefore not provide a comprehensive picture of a child's impulsivity (Moeller et al., 2001).

Thirdly, a large number of behavioural impulsivity tasks exist. These tasks measure impulsivity facets such as the ability to delay gratification (e.g. Delay of Gratification and Snack Delay tasks), sensitivity to reward and punishment (Door Opening task), inhibitory control and response speed (Go/No-Go and Tower tasks, Stop Signal task, interference tasks), motor impulsivity (Line Walking and Circle Drawing tasks), and reflectivity (Matching Familiar Figures Test [MFFT]; Kagan, 1965). Motivational aspects and fatigue may affect performance on these tasks and children have to have the cognitive skills to understand and memorise the rules and instructions associated with these tasks. Unfortunately, behavioural impulsivity tasks do not take social aspects of impulsivity into account and do also not allow inferences of long-term patterns of behaviour (Moeller et al., 2001). They do, however, allow a relatively objective assessment of specific behavioural processes that are temporary or state-dependent (Thamotharan, Lange, Zale, Huffhines, & Fields, 2013).

Due to the multidimensional nature of impulsivity the results of individual impulsivity tasks and questionnaires often correlate poorly (Dougherty et al., 2005; Solanto et al., 2001). Ideally, studies exploring the concept of impulsivity should rely on a number of impulsivity measures that cover as many facets of impulsivity as feasible. Additionally, a multi-informant approach for research with children may provide a more comprehensive picture of behaviour than the reliance on parent-report or behavioural impulsivity measures alone. Despite this only few studies have used this approach to link impulsivity, weight and eating behaviour in children (e.g. Braet, Claus, Verbeken, & Van Vlierberghe, 2007; Nederkoorn et al., 2006).

While some of the outlined measures are sometimes used to distinguish between children with and without ADHD (e.g. SDQ, performance on the Go/No-Go task) a clinical diagnosis of the disorder is generally based on more thorough assessments of behaviour using specific questionnaires and rating scales (e.g. CPRS; Conners et al. 1998; ADHD Rating Scale; DuPaul et al., 1998) and standardised clinical interviews based on DSM and ICD criteria (e.g. Diagnostic Interview Schedule for Children: Costello, Edelbrock, & Costello, 1985; NICE, 2009). These are administered to and conducted with parents, teachers and children themselves to allow an insight into whether the symptoms cause significant difficulty for the child in more than one context (NICE). Observations of child behaviour or assessments of the child’s cognitive or developmental abilities may also be used.

1.3 The role of impulsivity in child weight and obesity risk

Childhood obesity and its complications are a major public health concern in the UK and across the developed world. The most recent Health Survey for England revealed that 28% of 2-15-year-olds were classed as overweight or obese, highlighting the importance of identifying the key mechanisms for the development and maintenance of overweight and obesity in children (Health Survey for England, 2012). Sedentary lifestyles and unhealthy diets undoubtedly play a key role in the development of obesity (Ebbeling, Pawlak, & Ludwig, 2002; Epstein, Paluch, Gordy, & Dorn, 2000). Nevertheless, other factors such as underlying impulsivity levels may also impact on overweight and obesity by affecting eating behaviour and other lifestyle choices (Braet, et al., 2007; Davis et al., 2007; Guerrieri, Nederkoorn, & Jansen, 2008a; Khalife et al., 2014).

1.3.1 Impulsivity and child weight

Research has indicated that impulsivity and child weight as well as the risk of becoming overweight or obese are linked (Batterink, Yokum, & Stice, 2010; Bruce et al., 2011; Van den Berg et al., 2011). Seeyave et al. (2009) carried out a prospective study into links between impulsivity and weight and reported that 4-year-olds who failed a delay of gratification task had a greater risk of developing overweight by age 11. Similarly, Graziano, Calkins, and Keane (2010) found that self-regulation skills measured at age 2 predicted BMI and obesity risk at ages 2 and 5.5; performance on a delay of gratification task specifically predicted obesity risk at age 5.5. This remained significant even when controlling for BMI at age 2. These findings suggest that problems with the ability to delay gratification may exist prior to the development of obesity and that problems with this facet of impulsivity in particular could lead to the development of problematic eating behaviours linked with weight gain.

Francis and Susman (2009), who explored self-regulation through self-control and delay of gratification tasks at age 3 and 5 years and tracked weight trajectories until children were aged 12 years, found similar results. Children whose performance on the two behavioural impulsivity measures indicated low self-regulation were heavier at all BMI measurement points and had the most rapid weight gain from age 3 to 12 years. Interestingly, gender-specific analyses showed that the interactive effects of self-regulation and weight gain remained marginally significant for girls but not boys. These findings highlight the need to take potential gender differences in the impulsivity-weight relationship into account.

Unfortunately, few studies have explored the links between impulsivity and child weight using a wider array of impulsivity tasks. All of the discussed studies assessed only individual impulsivity facets, making it impossible to assess whether specific facets of impulsivity may influence weight differently and whether certain facets may be more or less strongly linked with weight in children. A recent meta-analysis by Thamotharan et al. (2013) tried to address this issue by assessing whether the use of different types of impulsivity measures and the assessment of different facets affected whether or not links between impulsivity and weight could be established in 2-21-year-olds. Although their analysis revealed that overweight and obese participants were moderately more impulsive than their healthy weight peers, the authors also found that the way impulsivity was measured and the type of impulsivity facet that was assessed had an important impact on study outcomes. Behavioural impulsivity measures, rather than self-report measures, had greater effect sizes, while the impulsivity facets of decision-making and disinhibition had greater effect sizes than the facets inattention and overall impulsivity. Thamotharan et al.'s results highlight the importance of selecting a wide range of impulsivity measures to assess impulsivity in children and adolescents. The findings from this meta-analysis also allow reconciliation of literature that failed to report links between impulsivity and child weight (e.g. Tan & Holub, 2011).

1.3.2 Differences in impulsivity levels between obese and healthy weight children

In addition to links between impulsivity, weight and obesity risk, researchers have also reported that overweight/obese and healthy weight children differ in their performance on a range of impulsivity measures. Johnson, Parry, and Drabman (1978) showed that the ability to delay gratification in the context of food-stimuli compared to non-food stimuli was associated with skinfold thickness in children aged 6 to 11 years. Braet et al. (2007) used a multi-informant approach to compare healthy and overweight 10-18-year-olds on reflection impulsivity (the tendency to consider alternatives; Kagan, 1965), child self-report (validated interview schedule and Attention Control Scale; Derryberry & Reed, 2002) and parent-report (DBD; Pelham et al., 1992) measures of impulsivity. The authors found that overweight compared to healthy weight children were higher in reflection impulsivity. Additionally, overweight compared to healthy weight boys showed more impulsivity, hyperactivity and attention deficits as well as problems focusing their attention on self-report measures. These findings highlight the importance of considering gender differences when investigating differences in impulsivity and obesity risk. Due to the cross-sectional nature of this study it is unclear whether more impulsive children were more susceptible to become overweight or whether elevated impulsivity levels were the result of their weight. It is most likely that a combination of both pathways underlies these findings (Braet et al.).

The risk for overweight/obesity in children with and without ADHD. In addition to studies highlighting that overweight/obese children may have greater impulsivity levels than healthy weight peers, researchers have also found higher than expected rates of ADHD, a disorder associated with clinically elevated impulsivity levels, in obese children and adults accessing obesity treatment and psychiatric services (Agranat-Meged et al., 2005; Altfas, 2002; Dempsey et al., 2011). Agranat-Meged et al. assessed the co-morbidity between obesity and ADHD in a small sample of 8-17-year-olds (*N*=26), hospitalised for morbid obesity. Overall, 57.7% of the sample, a significantly larger proportion than in the general population, met the DSM-IV criteria for ADHD. While some children were diagnosed prior to study entry, many were only diagnosed once they entered the study, suggesting that obesity may mask ADHD symptoms, while the stigma associated with obesity may also distort the interpretation of some behaviours linked with ADHD. This methodological approach does, however, allow for biases in diagnosis. While this study is limited by the lack of a control group a large epidemiological study showed that overweight and obese 7-17-year-olds were twice as likely as healthy or underweight children to be diagnosed with ADHD (Erhart et al., 2012).

In addition, epidemiological and clinical research studies have shown that obesity rates are greater than expected in children with ADHD, even when controlling for a range of potential confounds such as gender, socio-economic status, dietary intake patterns, physical activity and concurrent psychiatric conditions (Curtin, Bandini, Perrin, Tybor, & Must, 2005; Holtkamp et al., 2004; Pagoto et al., 2009). In children not receiving stimulant medication to control the symptoms associated with the disorder, ADHD was linked with greater BMI and also with elevated body fat and increased abdominal girth (Ptacek, Kuzelova, Paclt, Zukov, & Fischer, 2009). Khalife et al. (2014) carried out a longitudinal study linking childhood ADHD symptoms, measured by teacher- and parent-reports on measures based on DSM-IV criteria, and obesity risk in a Finnish sample of children. ADHD symptoms at age 8 predicted obesity at age 16. There was no evidence for a reverse association in which obesity predicted ADHD symptomatology. Furthermore, Waring and Lapane (2008) carried out a large nationally representative study linking ADHD and BMI z-scores in the United States. Compared to children without ADHD, 5-17-year-olds diagnosed with ADHD by a healthcare professional, who were not receiving stimulant medication, had 1.5 times the odds of being overweight; those medicated had 1.6 times the odds of being underweight. Similar results were reported by Erhart et al. (2012), who carried out a large epidemiological study including 7-17-year-olds with ADHD in Germany. Children with ADHD (parent reports and DSM criteria) were found to be 1.7 times more likely to be overweight or obese than children without ADHD. Overall, these findings indicate that children without ADHD who do not receive medication to control the symptoms associated with ADHD are part of an at-risk group for the development of overweight and obesity (Waring & Lapane).

Not all studies have found links between ADHD and overweight in children (Biederman et al., 2003; Spencer et al., 1996). Dubnov-Raz et al. (2011) found that irrespective of medication status, there was no difference in BMI z-scores between 6-

16-year-olds diagnosed with ADHD by a healthcare professional and treated in an ADHD clinic and healthy controls during a 17-month follow-up period. Children with ADHD actually tended to have a lower risk for overweight and obesity. Similarly, Rojo, Ruiz, Dominguez, Calaf, and Livianos (2006) analysed the prevalence of self-reported ADHD characteristics measured by the Hyperactivity subscale of the SDQ (Goodman et al., 1998) in a large community sample of 13-15-year-olds as a function of their BMI. Rojo et al. found that there was no difference in the prevalence of ADHD characteristics by BMI. Nevertheless, in morbidly obese males there was a tendency for a greater number of ADHD characteristics (27.9%). While this study is seriously limited by the lack of sensitivity of the SDQ to detect ADHD characteristics, it does raise the question whether links between ADHD and overweight/obesity risk may be specific to populations accessing services such as psychiatric facilities and obesity clinics.

On balance, the evidence, especially from large epidemiological studies, suggests that there is a bi-directional link between ADHD and its characteristics and the risk for the development of overweight and obesity in paediatric populations. The mixed and contradictory results of individual studies are likely the result of methodological differences including the studies' settings, the stringency of inclusion/exclusion criteria, and variations in the control for potential covariates such as age, gender and socio-economic status (Egmond-Fröhlich, Widhalm, & de Zwaan, 2012).

1.3.3 Differences in impulsivity networks of healthy and overweight/obese children

In addition to differences in impulsivity levels measured behaviourally or through questionnaires, imaging studies have also shown functional abnormalities in networks associated with inhibitory control, motivation and the regulation of food intake in overweight and obese children (Batterink et al., 2010; Bruce et al., 2010). Batterink et al. reported an association between higher BMI, reduced activation in frontal inhibitory regions and increased activation in food reward regions in response to food pictures in healthy weight to obese female adolescents. These findings suggest an association between increased weight and hypofunctioning of inhibitory control regions and increased response to food rewards. It is impossible to determine whether these differences in brain activation lead to differences in eating behaviour and weight gain or whether weight gain may lead to changes in the activation of neural circuits. Longitudinal studies would help to elucidate causal pathways and may also provide useful guidance for the development of interventions targeting overweight and obesity in impulsive children (Bruce et al.).

1.3.4 The impact of impulsivity on obesity treatment outcomes for children

Impulsivity has also been found to impact on treatment outcomes for children participating in weight-reduction programmes. Nederkoorn et al. (2006) compared impulsivity levels in obese 10-15-year-olds in a residential setting and healthy weight controls, matched on age, gender and education. Impulsivity was assessed through the Door Opening and Stop Signal tasks as well as through child self-report (BIS/BAS; Carver & White, 1994) and teacher-report (DBD; Pelham et al., 1992) measures. In accordance with other studies they found that obese children in treatment were more sensitive to reward and had less inhibitory control than healthy weight controls. Crucially, those children with the lowest levels of inhibitory control measured by the Stop Signal task lost least weight in the treatment programme. This suggests that the inhibitory control facet of impulsivity measured by the Stop Signal task in particular may play an important role in the maintenance of obesity, also impacting negatively on treatment outcomes.

In contrast to findings by Nederkoorn et al. (2006), Pauli-Pott, Albayrak, Hebebrand, and Pott (2010) investigated the impact of the inhibitory control facet of impulsivity on the success of a 1-year outpatient weight-reduction programme. Age-appropriate Go/No-Go and interference tasks were used to assess inhibitory control in a sample of 7.5-15-year-olds. The authors found that inhibitory control did not impact on treatment success in younger children. In adolescents, however, impulsivity (fast and less accurate responding) was associated with treatment success. Children who were more impulsive lost more weight, while less impulsive children lost less weight or dropped out of the programme.

These contradictory findings are likely due to differences in the measurement of impulsivity. While Pauli-Pott et al. (2010) found that fast but less accurate responding predicted treatment success, Nederkoorn et al. (2006) found that the ability to inhibit a response to a signal was crucial to treatment success. These findings suggest that these aspects of impulsive behaviour may independently and contrastingly affect treatment outcomes. This highlights the complex interplay between individual impulsivity facets and the importance of assessing a wide range of facets to allow reliable inferences to be made about their influence on weight control and eating behaviour.

1.4 Eating behaviour and impulsivity

Eating behaviours displayed during childhood have an important impact on intake and weight throughout child- and adulthood. Research suggests that children and adults may engage in impulsive eating behaviours, which may be one explanatory factor for the link between impulsivity and weight (Graziano et al., 2010). In adults, impulsivity measured through self-report measures such as the BIS (Carver & White, 1994) and behavioural tasks (Go/No-Go task, Stop Signal task) has been linked with making poorer food choices, a disregard for healthy eating goals and a tendency for overeating (Guerrieri et al., 2007; Jasinska et al., 2012). Less is known about links between eating behaviours and impulsivity in younger children.

One questionnaire that is frequently used to measure eating behaviours and to identify eating styles in children as young as 3 years is the Children's Eating Behaviour Questionnaire (CEBQ), developed by Wardle, Guthrie, Sanderson, and Rapoport (2001). This 35-item scale allows the assessment of food approach behaviours such as food responsiveness, enjoyment of food, emotional overeating and the desire to drink as well as the assessment of food avoidance behaviours such as satiety responsiveness, slowness in eating, emotional undereating and food fussiness (Wardle et al.).

Food approach behaviours are generally associated with higher BMI z-scores, while food avoidance behaviours are related to lower BMI z-scores (Viana, Sinde & Saxton, 2008). To date only few studies have investigated whether impulsivity is linked with these eating behaviours. Van den Berg et al. (2011) investigated links between impulsivity and reward sensitivity, assessed by parent-report on the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (Colder, O'Connor, & Hawk, 2004), and overeating measured by the CEBQ (a combination of emotional overeating and food responsiveness subscales) in 6-13-year-olds. The authors found that impulsivity and reward sensitivity predicted overeating.

These findings are further supported by laboratory-based intake research. Guerrieri, Nederkoorn, and Jansen (2008b) found that children who were more sensitive to rewards, measured by the Door Opening task, tended to eat more calories from snacks than children lower in reward sensitivity. Importantly, variety significantly interacted with reward sensitivity; children who were more sensitive to rewards consumed a significantly greater amount of snack foods when these varied in colour, shape and texture than when they were monotonous. The impulsivity facet inhibitory control measured by the Stop Signal task did not show such effects, suggesting that reward sensitivity in particular may affect eating behaviour, especially if eating environments are characterised by variety.

1.4.1 Eating behaviour and ADHD

Research has suggested that ADHD may be linked with the development of problematic eating patterns (Erhart et al., 2012; Khalife et al., 2014; Waring & Lapane, 2008). In adults tendencies to eat in response to negative emotions or external stimuli have been linked with retrospective reports of childhood ADHD symptoms and BMI (Davis, Levitan, Smith, Tweed, & Curtis, 2006; Dempsey et al., 2011). In addition, disordered eating tendencies and binge eating seen in disorders such as Bulimia Nervosa (BN), Binge Eating Disorder (BED) and the binge/purge subtype of Anorexia Nervosa (AN) can be seen at higher than expected rates in individuals with ADHD (Cortese et al., 2007; Mattos et al., 2004; Surman et al., 2006). Biederman et al. (2007) carried out a 5-year prospective study into the risk of eating disorders in females aged 6 to 18 years, diagnosed with ADHD according to DSM-IV criteria. Compared to healthy controls, girls with ADHD were 3.6 times more likely to meet criteria for an eating disorder (BN/AN), while they were 5.6 times more likely to meet the criteria for BN specifically. Similarly, Mikami et al. (2008) found that female 6-12-year-olds with the combined subtype of ADHD were at greater risk for BN symptoms and body dissatisfaction over a 4 to 5 year follow-up period than girls with the inattentive subtype of ADHD or control group girls. ADHD and binge eating behaviours may have a common underlying cause such as a dysfunction in the dopaminergic reward system or alterations in brain derived neurotrophic factor (Cortese et al., 2007; Liu, Li, Yang, & Wang, 2008). Interestingly, binge eating may also contribute to symptoms of ADHD (Cortese et al.). Individuals with BN and abnormal eating behaviours may repeatedly and impulsively interrupt their activities to obtain food, which can lead to symptoms associated with ADHD, such as inattention, disorganization and restlessness (Cortese, Konofal, Yateman, Mouren, & Lecendreux, 2006). Researchers have also found higher levels of motor impulsivity in individuals with BN and the binge/purge subtype of AN, suggesting that this impulsivity facet may contribute to, or manifest as, impulsivity as seen in ADHD (Rosval et al., 2006).

Inhibitory control deficits could make individuals with ADHD less able to accurately monitor their intake, and may also lead to a faster food intake, and eating in the absence of physiological need (Smith, Williamson, Bray, & Ryan, 1999). Wilhelm et al. (2011) e.g. investigated the impact of ADHD according to DSM-IV criteria and overweight on snack intake during a laboratory-based breakfast procedure. Compared to healthy controls, 7-15-year-olds with ADHD overate at the beginning of the meal, while overweight children consumed more calories overall. Additionally, Erhart et al. (2012) found that children with ADHD were more likely to report a feeling of loss of control over eating and a tendency for food dominate their lives than children without ADHD.

The preference for immediate rather than delayed rewards also means that children with ADHD could be more prone to choosing unhealthy foods that are immediately available (e.g. fast-food) instead of choosing healthier food options that are associated with longer preparation times (home-cooked meals and healthy snacks; Bitsakou, Psychogiou, Thompson, & Sonuga-Barke, 2009; Erhart et al., 2012). Finally, problems around planning and attention could make adhering to regular intake patterns problematic for individuals with ADHD. It is likely that these factors facilitate problematic eating behaviours such as binge eating in adults and children with ADHD. Unfortunately, little is known about potential differences in satiety responsiveness, slowness in eating or the responsiveness to or enjoyment of food in children with and without ADHD. Nevertheless, an awareness of such differences could help to identify useful targets for interventions aimed at reducing the risk for the development of overweight over time.

Common psychopathological factors such as major depression, sleep disorders and excessive daytime sleepiness may also mediate the associations between ADHD and binge eating behaviours as well as weight gain as they significantly impact on dietary intake, leading to a greater intake of fats and carbohydrates, especially sugars (Biederman, Spencer, Monteaux, & Faraone, 2010; Blunden, Milte, & Sinn, 2011; Cortese et al., 2007; Cortese et al., 2008). Finally, ADHD may also impact on weight via physical activity. Khalife et al. (2014) found that physical activity mediated the link between ADHD symptoms and obesity in 7-8-year-olds. Additionally, Erhart et al. (2012) found that compared to children without ADHD, children with ADHD were more likely to report engaging in sedentary activities, such as playing computer games, for longer periods of time.

Overall, a variety of factors have been identified, which may underlie the link between ADHD and the risk for the development for overweight and obesity. Nevertheless, further research into potential differences in eating behaviours observable from an early age are necessary to allow the development of effective interventions targeting problematic eating tendencies in children with ADHD.

1.4.2 Emotional, external and restrained eating: links with impulsivity

In addition to parent-report measures of child eating behaviour and style there are self-report measures of eating style, which can be used with adults and older children. The Dutch Eating Behaviour Questionnaire (DEBQ; Van Strien, Frijters, Bergers, & Defares, 1986) and an age-adapted version of this Questionnaire (DEBQ-C; Van Strien & Oosterveld, 2008) allow a thorough assessment of emotional, external and restrained eating tendencies. The DEBQ-C consists of 20 items and allows measuring these eating styles in children as young as 7 years.

Studies have shown that emotional and external eating measured by the DEBQ-C are positively associated with self-reported impulsivity, measured by the EIQ (Eysenck et al., 1985) in 10-13-year-olds (Farrow, 2012). Similar results have been found in adult samples (Jasinska et al., 2012). These links indicate that more impulsive children and adults may be more susceptible to external cues of eating and also more likely to eat in response to negative emotions. These inferences are based on a small number of studies, emphasizing the need to further explore whether certain impulsivity facets may be particularly relevant to certain maladaptive eating behaviours in children. It has been suggested that high sensitivity to reward may predispose children to prefer palatable foods, high in fat and sugar, to bland or healthier options, and may encourage their consumption in the absence of physiological need (Davis et al., 2007).

Evidence concerning restrained eating and its links with impulsivity is mixed and comes mainly from the adult literature. Nederkoorn, Van Eijs, and Jansen (2004) measured dietary restraint using the Restraint Scale (Herman & Polivy, 1980) and impulsivity using the Eysenck Personality Profiler (Eysenck, Wilson, & Jackson, 1996), the BIS/BAS scales (Carver & White, 1994) and the Stop Signal task in a sample of female undergraduates. They found that restrained eaters tended to be more impulsive on most measures. Jasinska et al. (2012) also found a trend towards a positive association between dietary restraint measured by the DEBQ (Van Strien et al., 1986) and self-reported motor impulsivity measured by the BIS-11 (Patton et al., 1995) in a sample of undergraduate students. Leitch, Morgan, and Yeomans (2013) conversely found that dietary restraint measured by the restraint factor of the Three Factor Eating Questionnaire (TFEQ-R; Stunkard & Messick, 1985) was linked with lower levels of behavioural impulsivity assessed by a Go/No-Go task in a sample of healthy weight females. Restraint was, however, not related to a range of other self-report (BIS-11; Patton et al., 1995) and behavioural impulsivity measures (MFFT, Delay Discounting task, Balloon Analogue task). Similarly, Meule, Lukito, Vögele, and Kübler (2011) reported that female students who were high in restraint measured by the Restraint Scale (Herman & Polivy) performed less impulsively on a modified version of the Go/No-Go task.

Additionally, research has indicated that impulsivity and dietary restraint interact in their effect over intake in adults (Jansen et al., 2009; Van Koningsbruggen, Stroebe, & Aarts, 2013). Van Koningsbruggen et al. found that successful dieting was more likely to be achieved by students low in self-reported trait impulsiveness measured by the BIS-11 (Patton et al., 1995). Similarly, Jansen et al. reported that overeating in female restrained eaters, indicated by scores on the Restraint Scale (Herman & Polivy, 1980), was only observed if participants were also high in impulsivity measured by the Stop Signal task.

One reason for inconsistencies in links between impulsivity and dietary restraint may be differences in the measurement of dietary restraint. The restraint subscale of the DEBQ (Van Strien et al., 1986), the restraint factor of the TFEQ (Stunkard & Messick, 1985) and Herman and Polivy's (1980) Restraint Scale are all widely used tools to assess dietary restraint in adults and, if modified, in children. The Restraint Scale is a ten-item measure, which addresses questions on weight fluctuation over time, dieting and weight/eating behaviour concerns (Heatherton, Herman, Polivy, King, & McGree, 1988). It can successfully distinguish between dieters and non-dieters, but does not distinguish between the restriction of food and disinhibited eating behaviour (Stunkard & Messick, 1985). The restraint factor of the TFEQ consists of 21 items (including some of the Restraint Scale) and the restraint subscale of the DEBQ consists of ten items. While all three scales measure motivational aspects of dietary restraint, the Restraint Scale alone focuses on disinhibited eating tendencies, while the DEBQ and TFEQ restraint scales assess the actual restriction of intake (Laessle, Tuschl, Kotthaus, & Pirke, 1989). Hence, differences in outcomes of studies looking at links between impulsivity and dietary restraint and of the impact of impulsivity in combination with restraint on dietary intake are likely to be due to variations in the measurement of restraint and impulsivity (Laessle et al.).

1.5 Stress

One important factor that could potentially moderate the relationship between impulsivity and eating behaviour is stress. Stress is a state of actual or perceived threatened homeostasis caused by internal or external stressors (Chrousos & Gold, 1992). The behavioural and physiological changes that are associated with stress aim to reinstate the desired state of homeostasis (Chrousos, 2009). The stress response is mainly mediated through the stress system, situated in the central nervous system and in organs within the periphery. The key parts of the stress system in the Central Nervous System include the actions of hypothalamic corticotropin-releasing hormone (CRH), arginine vasopressin, alpha-melanocyte-stimulating hormone and beta-endorphine, and noradrenaline (Chrousos; Pervanidou & Chrousos, 2011). The key parts of the peripheral stress system include the hypothalamic-pituitary-adrenal axis regulated glucocorticoids, noradrenaline and adrenaline (Chrousos; Pervanidou & Chrousos). When an individual perceives a stressor, CRH, which stimulates the secretion of adrenocorticotropic hormone (ACTH) from the anterior pituitary, is released. The released ACTH stimulates the secretion of noradrenaline, corticosterone, and cortisol, a steroid and stress hormone that belongs to the family of glucocorticoids, from the adrenal cortex. Among other functions, cortisol leads to an increase in blood glucose through the process of glucogenesis, while also aiding the metabolism of fat and protein, providing the body with energy rapidly.

Overall, the stress response serves several different central and peripheral functions, such as the facilitation of the fight or flight response and increases in heart rate, blood pressure and metabolism (Chrousos, 2009). The stress response is eventually inhibited through central and peripheral counter-regulatory feedback loops. Following the stressor the released noradrenaline dissipates quickly, while the lingering cortisol aids the return of the body to a state of homeostasis (Carlson, 2006). A range of different processes facilitate this, one of them being an increase in appetite and intake to regain energy, especially from fat and sugar (Dallman et al., 2003). Nevertheless, in our modern environment acute stressors rarely evoke a fight or flight response in which a vast amount of calories are burnt, suggesting that acute stress could lead to the consumption of excess calories in the absence of physiological need, mediated through cortisol (Peeke & Chrousos, 1995).

1.5.1 Stress-related eating behaviour

The immediate physiological changes caused by acute stress are associated with decreased intake through the suppression of appetite and the shutdown of the digestive system. Chronic stress, however, is associated with a hypersecretion of glucocorticoids and the combination of elevated levels of glucocorticoids and insulin has been found to increase the drive for and ingestion of palatable “comfort foods”, while also leading to disturbances in the initiation and termination of mealtimes and weight regulation (Coderre, Vallega, Pilch, & Chipkin, 1996; Lambillotte, Gilon, &

Henquin, 1997; Rosmond, 2005). The physiological changes induced by mild to moderate chronic life stress and maladaptive learning and coping processes, such as comfort food ingestion, which acts as a powerful, positive reinforcer through immediate palatability and delayed post-ingestive consequences, seem crucially important for stress-related weight changes (Cota, Tschöp, Horvath, & Levine, 2006; Dallman, Pecoraro, & la Fleur, 2005; Gibson, 2006).

Research has indicated that a number of factors, such as gender, eating behaviours (e.g. dietary restraint) and body weight, may moderate the link between stress and intake. Females (Klein, Faraday, & Grunberg, 1996), restrained eaters (Wardle, Steptoe, Oliver, & Lipsey, 2000), and overweight individuals (McKenna, 1972; Pine, 1985) have generally been found to increase their intake in the face of mild chronic and acute stress. Conversely, the intake of males, healthy weight and unrestrained eaters tends to remain the same or to be reduced under similar conditions (Greeno & Wing, 1994; Grunberg & Straub, 1992; Roemmich, Wright, & Epstein, 2002). In addition to stress itself, an individual's physiological reactivity to a stressor has also been highlighted as a crucial factor which predicts whether stress will lead to increased, unaffected or decreased intake (Newman, O'Connor, & Conner, 2007). Epel, Lapidus, McEwen, and Brownell (2001) found that cortisol expression during high and low stress days predicted intake in premenopausal women; only those women who reacted to high stress with a high expression of cortisol increased their intake, especially of foods high in sugar and fat.

As highlighted, stress can have varying effects on intake and underlying eating behaviours have been shown to affect stress-related eating in children and adults. Wardle et al. (2000) assessed the relationships between work-related stress and dietary intake, while considering dietary restraint measured by the DEBQ in adults. Although high work-stress periods (greater number of hours worked) were associated with an increased intake, dietary restraint significantly moderated this relationship. Only those high in dietary restraint increased their intake during high compared to low stress periods; those low in dietary restraint did not differ in their energy intake across periods. Similar results have been reported by Roemmich et al. (2002), who assessed the impact of stress and dietary restraint on snack intake in 8-11-year-olds. These results suggest that dietary restraint is a crucial factor for stress-related increases in dietary intake in children and adults.

1.5.2 Stress, eating behaviour and impulsivity

Research has shown that impulsivity and eating behaviour as well as stress and eating behaviour are linked. In addition stress and impulsivity have also been found to be linked; experimental and clinical research has shown that high levels of different types of stress can have detrimental effects on task performance, self-control and the inhibition of pre-potent responses (response tendencies that are more likely to occur due to prior priming), favouring impulsive behaviour (Cohen, 1980; Muraven & Baumeister, 2000). Furthermore, studies have shown that impulsivity can mediate the impact of stress on smoking behaviour in adolescents (Fields, Collins, Leraas, & Reynolds, 2009), while it can also interact with stress, leading to more dangerous and harmful drinking patterns in adults (Fox, Bergquist, Gu, & Sinha, 2010). These findings give rise to the question whether stress and impulsivity may also interact to affect eating behaviour in children and adults.

Unfortunately, little research has investigated the interplay between impulsivity, stress and eating behaviour in adults. A series of studies into emotional distress/negative mood and impulse control in relation to snack intake were carried out by Tice, Bratslavsky, and Baumeister (2001). These studies revealed that emotional distress and low mood led to an increased intake of sweet and fatty snack foods by reducing impulse control in students. This effect was, however, only observed if individuals believed that they could change and improve their negative mood. These results suggest that negative moods and stress in general could lead to overeating by inhibiting long-term health and weight goals and favouring short-term goals related to emotion regulation and mood improvement.

In a related study Bekker, Van de Meerendonk, and Mollerus (2004) explored the effects of induced negative or neutral moods (easy vs. challenging quiz completion) and impulsivity measured through self-report (BIS-11; Patton et al., 1995) on emotional eating, measured by the DEBQ (Van Strien et al., 1986), in a sample of female college students. Self-reported impulsivity and emotional eating were positively associated and analyses indicated that the negative mood induction led to an increase in emotional eating. Importantly, there was a near significant trend for an interaction between impulsivity and mood (p=.08), suggesting that more (rather than less) impulsive individuals were more susceptible to the impact of negative mood on emotional eating. Emotional eating, especially under conditions of stress, may function as a means of reducing negative feelings associated with performance failure and may provide a distraction from negative emotions (Bekker et al.; Katzman, Weiss, & Wolchik, 1986). Unfortunately, Bekker et al. only relied on self-reported impulsivity and firmer conclusions about the involvement of particular impulsivity facets in stress-related eating behaviour cannot be drawn.

In contrast to these findings, Van Strien and Ouwens (2007) did not find interactive effects between eating-related impulsivity, measured by the Eating Disorders Inventory (Garner, 1991), and stress (anticipated speech delivery) on savoury snack intake in female students. As the stress manipulation was still intact when participants were given access to the snacks this may have inhibited intake. Additionally, impulsivity was measured through self-report using a measure relevant to eating disorders, which may not be general enough to capture facets of impulsivity associated with non-pathological eating behaviours. These results highlight the importance of the careful selection of impulsivity measures to ensure the comparability between studies assessing the interactive effects of impulsivity and stress in relation to eating behaviour.

To the best of the author's knowledge research has not yet addressed how impulsivity relates to eating behaviour in typically developing children under conditions of stress. Based on previous research on links between stress, eating behaviour and impulsivity, it is likely that children with poor impulse control compared to those with better impulse control will increase their intake of palatable snack foods when experiencing a stressful event. This association, however, is likely to be affected by underlying levels of dietary restraint. Research investigating these links is necessary to test these hypotheses and to provide a clearer picture of stress-related eating behaviour under consideration of impulsivity in children.

1.6 Controlling feeding practices and impulsivity

During early infancy and childhood the way feeding practices are used by caregivers in the context of mealtimes and snack intake crucially shapes a child's eating behaviour (Benton, 2004; Carper, Fisher, & Birch, 2000). A widely used tool to assess a range of parental feeding practices is the Comprehensive Feeding Practices Questionnaire (CFPQ), developed by Musher-Eizenman and Holub (2007) to assess parental feeding across settings. The scale has 12 factors, which assess controlling feeding practices such as restriction for weight control and health, pressure to eat and monitoring, non-nutritive feeding practices like the use of food as reward or for emotion regulation. It also measures child control in feeding and involvement, encouragement of balance and variety, food environment, parental modelling and teaching about nutrition. The scale is based on other measures of parental feeding behaviours such as the Child Feeding Questionnaire (CFQ; Birch et al., 2001) and the Preschooler Feeding Questionnaire (PFQ; Baughcum et al., 2001) but extends these measures by assessing restriction more adequately and by providing a more comprehensive picture of parental feeding in the context of mealtime and snack intake. The CFPQ has been used in ethnically and culturally diverse populations and has been linked with child weight and eating behaviour (Blissett & Bennett, 2012; Musher-Eizenman & Holub). Research suggests that parental feeding strategies do not just affect the development of specific eating behaviours in children but may also relate to and affect disinhibited eating and impulsivity, contributing to the success or failure of the inhibition of pre-potent responses in the context of food intake (Carper et al., 2000). The links between controlling feeding strategies (restriction for health and weight control, pressure to eat and monitoring) and child impulsivity have therefore received increasing attention and studies focusing on links between these factors will be outlined below.

1.6.1 Restriction

Restriction is a commonly used controlling feeding practice, which generally aims to limit the intake of unhealthy foods high in fat and sugar (Musher-Eizenman & Holub, 2007). Contrary to the intention with which it is used, research has shown that restriction is associated with poor self-regulation (Johnson & Birch, 1994), eating in the absence of hunger (Birch, Fisher, & Davison, 2003) and a reduced intake of healthy foods (Cullen et al., 2000; Fisher, Mitchell, Smiciklas Wright, & Birch, 2002). A number of studies have shown that there are links between impulsivity and parental restriction and that both factors may interact in their effects on weight gain and problematic eating behaviours. Tan and Holub (2011) investigated links between parental restriction for health and weight control and child inhibitory control using the CBQ (Rothbart et al., 2001) as well as parental beliefs about energy regulation in 3-9-year-olds. While restriction for weight control measures parent's intentions of limiting the child's intake to maintain or reduce weight, restriction for health measures the extent to which parents attempt to limit their child's intake of unhealthy foods (Musher-Eizenman & Holub). Tan and Holub found that parents who believed that their children were better at regulating their intake and who felt their children had better inhibitory control used less restriction for health. Neither self-regulation of intake nor inhibitory control, were related to restriction for weight. These findings indicate that parents may try to counteract the effects of impulsivity on eating behaviour through the use of feeding strategies, which may be more or less effective in controlling child weight and intake. Unfortunately, the authors relied on parent-reported inhibitory control only and did not assess other impulsivity facets. It would, however, be interesting to assess whether other child impulsivity facets are linked with parental restriction and whether associations between impulsivity and restriction for weight control emerge once these facets are taken into account.

In addition to relationships between impulsivity and restriction, Anzman and Birch (2009) found that poor impulse control and child-perceived parental restriction may interact, leading to more problematic weight outcomes than associated with restriction or impulsivity per se. Poorer inhibitory control measured by the CBQ (Rothbart et al., 2001) at age 7, was associated with greater weight gain over time. Females with poorer impulse control had higher BMIs at all measurement points (age 7, 11, 15) and were also at a greater risk of being classified as overweight. Interestingly, females with poorer inhibitory control, whose parents were perceived to use high levels of restriction, had the strongest negative association between inhibitory control and weight. These findings suggest that restriction may have particularly negative effects on eating behaviour in females with poor inhibitory control and that less intrusive controlling feeding practices like covert restriction or monitoring may have a more positive impact on eating behaviour.

Extending these findings to the context of a pre-school, Rollins, Loken, Savage, and Birch (2014) found that inhibitory control measured by the CBQ (Rothbart et al., 2001) and restriction interacted, leading to an increased intake of previously restricted snacks in the absence of hunger. Importantly, 3-5-year-olds with poorer inhibitory control abilities consumed more of the snacks following restriction than children with better inhibitory control, indicating that inhibitory control moderated the impact of restriction on intake. These findings indicate that restricting access to foods leads to problematic eating behaviours linked with long-term weight gain, especially in impulsive children and irrespective of eating context.

Although a number of studies have begun to explore links and interactive effects of parental restriction and impulsivity, little is still known about the impact of specific impulsivity facets in relation to the parental restriction of intake. Additionally, research has not yet explored whether there are differences in the effect of parental restriction on mealtime and snack intake in children with low vs. high/clinically elevated impulsivity levels.

1.6.2 Monitoring

Monitoring is a feeding practice that involves keeping track of the child's intake of less healthy foods, high in fat, sugar and salt (Musher-Eizenman & Holub, 2007). It is less intrusive than the overt restriction of food and has been found to have a positive impact on child intake. Klesges, Stein, Eck, Isbell, and Klesges (1991) found that 4-7-year-olds consumed fewer calories overall and made fewer non-nutritive food choices if they were aware that their parents were monitoring their intake.

Few studies have addressed potential links between parental monitoring and impulsivity. Farrow (2012) examined links between self-reported impulsivity measured by the EIP (Eysenck et al., 1985), eating behaviour measured by the DEBQ-C (Van Strien & Oosterveld, 2007) and child-perceived parental feeding practices in 10-13-year-olds. While emotional and external eating were both associated with greater impulsivity, parental monitoring significantly moderated the link between impulsivity and emotional eating. Impulsivity was positively linked with emotional eating when parents used low and average levels of monitoring, but the relationship was not significant if they used high levels of monitoring. These findings indicate that parental monitoring may have a protective effect on emotional eating in impulsive children. As this study only relied on self-reported impulsivity, more detailed investigations of links between parental monitoring and different impulsivity facets measured through a range of self/parent-report questionnaires and behavioural tasks would be interesting.

1.6.3 Pressure to eat

Like restriction, pressure to eat is a commonly used controlling feeding practice that aims to increase a child's intake of foods considered to be healthy (Musher-Eizenman & Holub, 2007). In addition to this, pressure to eat may be used to increase a child's intake overall, especially if the child is perceived to be underweight or a poor eater (Gregory, Paxton, & Brozovic, 2010). Research suggests that despite parents' intentions, pressure is negatively associated with fruit and vegetable consumption and general intake (Brown, Ogden, Vögele, & Gibson, 2008; Fisher et al., 2002; Galloway, Fiorito, Francis, & Birch, 2006; Patrick, Nicklas, Hughes, & Morales, 2005; Wardle et al., 2005). Instead this practice has been linked with the development of negative attitudes towards the food that the child is pressured to eat and with disturbed intake regulation (Carper et al., 2000; Galloway et al., 2006; Van Strien & Bazelier, 2007). To the best of the author's knowledge research has not yet explored potential links between pressure to eat and impulsivity.

It is possible that parents of children with and without clinically elevated impulsivity levels use more pressure during mealtimes to focus their child's attention on the mealtime and to encourage intake. Research assessing mealtime-related difficulties in ADHD has indicated that children with ADHD find it difficult to remain seated during mealtimes and may therefore spend less time eating, consuming fewer calories (Lickteig, Isaacs, Zahor, & Hodgens, 1999). Research exploring these potential links using a variety of measures of impulsivity and self-reported as well as objectively observed pressure to eat in the context of a mealtime is needed.

1.7 Brief critique of the reviewed literature

The majority of the studies discussed in this review have used a limited number of measures of impulsivity to assess this complex and multi-faceted concept. Many have used only one self- or parent-report measure of impulsivity, (e.g. Anzman & Birch, 2009; Graziano et al., 2010; Seeyave et al., 2009) while few have relied on a multi-informant approach to allow an insight into a child's impulsivity levels across a variety of situations and in different contexts (e.g. Braet et al., 2007; Nederkoorn et al., 2006). While this approach has allowed gaining an insight into links between impulsivity, weight, eating and feeding variables, self- or parent-reports are prone to bias (Moeller et al., 2001). In addition it remains questionable whether children and individuals high in impulsivity have the necessary insight into and awareness of their own impulsivity levels to allow an accurate assessment of this concept through self-report measures (Thamotharan et al., 2013).

A related limitation is the lack of comparability between studies due to the use of different self-, parent-report and behavioural impulsivity measures (Dougherty et al., 2005). Many differences in outcomes and the lack or presence of associations between impulsivity, weight, eating and feeding variables may be critically associated with differences in how impulsivity was measured. Additionally, differences in the measurement of variables such as dietary restraint may underlie variations in outcomes for impulsivity-related eating behaviour in adults (Laessle et al., 1989). Finally, self-reported parental feeding practices may be subject to social desirability biases and research has indicated that feeding behaviour assessed though questionnaires and naturalistic observations of feeding often show little overlap (Haycraft & Blissett, 2008).

Few of the reviewed studies included gender-specific analyses, especially with respect to impulsivity-related eating behaviour (Braet et al., 2007; Francis & Susman, 2009). As impulsivity levels tend to be greater in males than females this may lead to interesting differences in how eating behaviours and weight outcomes are affected. In females, who are more likely to be affected by eating pathologies than males, impulsivity may also influence the expression of problematic eating behaviours differently (Striegel-Moore et al., 2009). Finally, gender differences in the expression of impulsivity may affect the use of controlling feeding practices by parents.

Much research has addressed links between impulsivity and weight or eating behaviour in clinical populations (Braet et al., 2007; Agranat-Meged et al., 2005). It would however, be interesting to investigate how non-clinical levels of impulsivity affect eating behaviour, weight and feeding in community samples of children and their parents. Furthermore, although research has indicated that there may be differences in the obesity-risk of children with and without clinically elevated impulsivity levels such as seen in ADHD, little is still known about the underlying mechanism for this link (Khalife et al., 2014). Exploring differences in eating behaviour and parental feeding between children with and without ADHD may provide useful information that could help to explain this link.

1.8 Overall summary of the review and directions for this thesis

The reviewed research has highlighted links between impulsivity, child weight, eating behaviour and parental feeding practices. Longitudinal research has indicated that more impulsive children may be at greater risk for becoming overweight and obese (Graziano et al., 2010; Seeyave et al., 2009). Cross-sectional research has shown that obese children may be more impulsive than healthy weight children (e.g. Braet et al., 2007), that impulsivity influences treatment outcomes for obesity interventions (Nederkoorn et al., 2006; Pauli-Pott et al., 2010) and that there are functional differences in inhibitory control related brain regions of obese and healthy weight children (Batterink et al., 2010; Bruce et al., 2010). Research in children with ADHD has also revealed that clinically elevated impulsivity levels may put these children at greater risk for becoming overweight and obese (Agranat-Meged et al., 2005; Biederman et al., 2007; Khalife et al., 2014).

Impulsivity has been linked with the development of problematic eating behaviours, such as overeating, emotional, external and restrained eating; these are all linked with weight gain (Farrow, 2012; Guerrieri et al., 2008b; Nederkoorn, 2004; Van den Berg et al., 2011). Nevertheless, many of the discussed studies have only used single measures of impulsivity. This thesis will extend these findings by using more thorough approaches to the measurement of impulsivity, which will allow identification of the specific impulsivity facets that are particularly relevant to the development of a variety of eating behaviours linked with increases and decreases in children's BMI.

Additionally, impulsivity appears to influence how parents feed and the way parents feed in turn affects child weight (Anzman & Birch, 2009; Farrow, 2012; Tan & Holub, 2011). While these links have been partly explored for restriction and monitoring, research is yet to address links between impulsivity and pressure to eat in children with varying impulsivity levels. Generally, studies linking parental feeding and impulsivity are limited by the incomplete measurement of impulsivity and this thesis will aim to supplement the existing literature by measuring impulsivity more comprehensively. Furthermore, this thesis will explore gender differences further as it is likely that parents of females and males differ in their use of controlling feeding practices depending on their child's underlying impulsivity levels (Anzman & Birch).

In children with ADHD the development of problematic eating behaviours and disorders has also been reported (Biederman et al., 2007; Erhart et al., 2012; Khalife et al., 2014; Mikami et al., 2008; Waring & Lapane, 2008). Whether children with and without ADHD differ on a range of non-clinical eating behaviours measured by the CEBQ is yet to be assessed. Furthermore, little is known about how parents of children with ADHD feed their children. Insights into eating and feeding differences in children with and without ADHD and their parents may help to understand mechanism underlying the link between ADHD and obesity. This thesis will address these questions.

A final factor that is linked with overeating and weight gain is stress, which has not been linked with impulsivity in children. This thesis will explore whether interactive effects between impulsivity and stress in their impact over behaviours such as smoking and drinking can also be seen for eating behaviour in children.

1.9 Aims of this thesis

The primary aim of this thesis is to explore relationships between impulsivity, child weight, eating behaviour and parental feeding practices and differences in these variables in children with high and low levels of impulsivity, using a variety of measures to capture a number of impulsivity facets (see Figure 1.1). Secondary aims include an exploration of the moderating effects of parental feeding on links between impulsivity, weight and eating behaviour. Additionally, the potential impact of stress on the relationship between eating behaviour and impulsivity will be assessed. Differences in weight, eating behaviour and parental feeding practices in children without and with clinically elevated impulsivity levels as indicated by the presence of a diagnosis of ADHD will be investigated. Where possible, gender differences will be explored.

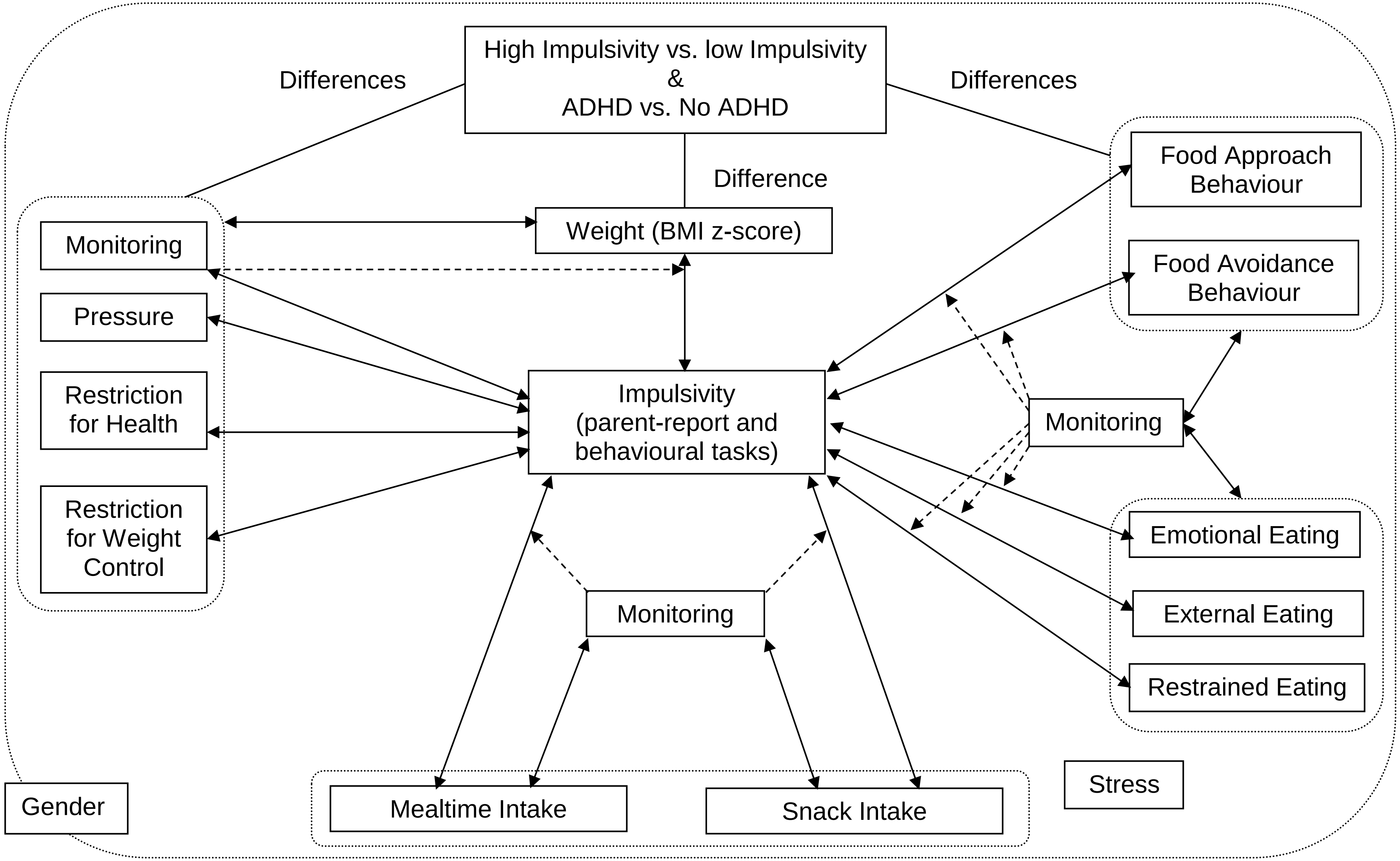

High Impulsivity vs. low Impulsivity
&
ADHD vs. No ADHD
Differences
Differences
Difference
Weight (BMI z-score)
Monitoring
Pressure
Restriction for Health
Restriction for Weight Control
Impulsivity (parent-report and behavioural tasks)
Food Approach Behaviour
Food Avoidance Behaviour
Monitoring
Emotional Eating
External Eating
Restrained Eating
Monitoring
Mealtime Intake
Snack Intake
Stress
Gender

Figure 1.1. Model of relationships between impulsivity, child weight, eating behaviour and parental feeding practices to be explored in this thesis (solid arrows). This model also highlights potential moderating effects of parental feeding on the relationship between impulsivity and weight and of monitoring on the relationship between impulsivity and eating behaviour (dashed arrows). Finally, potential interactions of impulsivity, restrained eating and stress in their effects on snack intake are highlighted (dotted arrows). Explorations of differences in weight, eating and feeding in children with high vs. low impulsivity levels and ADHD vs. no ADHD are noted and the exploration of gender effects is also indicated in this model (Differences). The parental feeding practices monitoring, pressure to eat and restriction for health and weight control address parent factors, while impulsivity, weight, intake, stress and eating behaviour variables address child factors.

CHAPTER TWO

GENERAL METHODOLOGY

2.1 Introduction

This chapter aims to outline the methodologies used in this thesis. The research designs of the three individual projects will be explained, the samples will be described and the procedures will be highlighted. The measures used in this thesis will be detailed and an overview of the data analysis strategy will be provided.

2.2 Research design

As highlighted in the literature review, little research has addressed links between child impulsivity, eating behaviour and parental feeding practices using a range of different parent-report impulsivity measures and impulsivity tasks. In addition, the impact of stress on the link between impulsivity and eating behaviour has not been explored. To expand the existing knowledge on links between childhood impulsivity, eating behaviour and parental feeding practices the present thesis used a range of age-appropriate impulsivity tasks and parent-report measures to explore links in children of different age groups. The use of impulsivity tasks in addition to parent-report measures aimed to provide a more complete picture of a child's impulsivity profile, while also allowing insights into impulsivity facets that may be particularly linked with certain aspects of child eating or parental feeding behaviour.

For this thesis data were collected from three samples of children and their parents. For the majority of studies discussed within this thesis parents and children were invited to the Infant and Child Laboratory (ICL) at the University of Birmingham. This setting was chosen to keep the circumstances of testing consistent across participants. Initially links between parent-reported impulsivity and impulsivity task performance and weight, eating behaviour and parental feeding practices were explored in children aged 2 to 4 years and 7 to 11 years (Chapters Three and Five). In addition observations of parent-child mealtime interactions were conducted on a subset of families of 2-4-year-olds to explore potential differences in interactions due to variations in parent-perceived impulsivity (Chapter Four). Furthermore, experimental methods were used to explore the impact of stress on eating behaviour in 7-11-year-olds (Chapter Six). Finally, little is known about differences in eating behaviour in children with and without clinically elevated impulsivity levels as seen in Attention Deficit Hyperactivity Disorder (ADHD). An online survey, completed by parents of 5-15-year-olds, with and without a formal diagnosis of ADHD, was therefore carried out to explore potential differences in child weight, eating behaviour and parental feeding practices (Chapter Seven). Although this approach has limitations it provides a first step towards an investigation of the mechanisms underlying the proposed link between ADHD and the risk for weight gain and obesity in children.

2.3 Research samples

After ethical permission was obtained from the ethical review board at the University of Birmingham, participants were recruited from nurseries, toddler groups and schools in and around Birmingham. Parents of children in suitable age-ranges were also recruited from the ICL database, which contains information on families in which parents have indicated an interest in research participation at the University of Birmingham. Additionally, participants were recruited through adverts placed in *Families* magazine, on the *netmums* website, on parenting websites and forums, and through *Facebook* groups and other social media platforms. These recruitment techniques apply to all samples recruited for the studies included in this thesis. Participation in all three studies was voluntary and therefore the results of the studies presented within this thesis may be affected by a self-selection bias. A wide range of means of recruitment, were employed to increase the range of socio-economic and ethnic backgrounds of participating families.

Study one (Chapter Three) included 95 parent-child dyads, who visited the ICL. Children (41 females) were aged 2 to 4 years. Ninety-three mealtimes were made up of mother-child dyads, while the remaining two mealtimes were made up of father-child dyads.

Mealtime observations were conducted on a subset of 36 parent-child dyads participating in study one and already described in Chapter Three. The children with the highest (*n*=18) and lowest (*n*=18) parent-reported impulsivity scores were selected and their mealtimes were analysed (Chapter Four).

Study two (Chapters Five and Six) included 50 children and their parents, who visited the ICL twice. Children (28 females) were aged 7 to 11 years. Forty-eight questionnaire packs were completed by children's mothers, while two were completed by fathers. Chapter Five focused on links between impulsivity, eating behaviour and parental feeding strategies, while Chapter Six focused on the interactive effects of impulsivity, dietary restraint and stress affecting snack intake.

Study three (Chapter Seven) explored potential differences in weight, eating behaviour and the use of parental feeding practices in children with and without ADHD aged 5 to 15 years. The chapter included data on 105 children (61 diagnosed with ADHD, 43 females) and their parents (99 mothers). Parents provided information on their child's impulsivity levels, ADHD diagnosis, weight, eating behaviour and their own use of controlling feeding practices.

2.4 Procedures

Parents and children aged 2 to 4 years, participating in studies described in Chapters Three and Four were recruited through the ICL database and from nurseries and toddler groups in and around Birmingham, UK (see Appendix A-1 for posters and leaflets left at nurseries and toddler groups). Recruitment took place between April 2012 and March 2013. Participants for these studies were recruited as part of a larger on-going study looking at successful novel food introductions in toddlers.

Parents and children aged 7 to 11 years, participating in studies described in Chapters Five and Six were recruited through the ICL database, from schools in and around Birmingham, UK (see Appendix A-2 for leaflets given to children and their parents) and through an advert in the parent magazine *Families*, which is delivered in and around Birmingham, UK (see Appendix A-3 for the magazine advert). The recruitment for this study took place between September 2012 and August 2013.

Parents of children with and without ADHD aged 5 to 15 years, participating in the study described in Chapter Seven were recruited through parenting websites, ADHD forums and Facebook as well as other social media such as the University of Birmingham's e-newsletter and twitter (see Appendix A-4 for adverts on social media platforms). Parents willing to participate were asked to follow a link to access the online survey. Recruitment for this study took place between November 2012 and April 2014.

2.5 Questionnaires

The results of the reliability analyses for the measures used within this thesis will be presented in the relevant chapter on the first occurrence of each measure. Table 2.1 provides an overview of which questionnaires, behavioural tasks and additional assessments were used in which chapter. More information on each of the measures can be seen in the subsequent sections.

Table 2.1

Overview of the standardised questionnaire measures and behavioural impulsivity tasks administered to parents and children participating in each of the three studies. This information is further broken down by the number of chapters the measure/task is relevant to.

	Study one *N*=95		Study two *N*=50		Study three *N*=105
	Chapter Three	Chapter Four *n*=36	Chapter Five	Chapter Six	Chapter Seven
Questionnaires					
Children's Eating Behaviour Questionnaire	X		X		X
Dutch Eating Behaviour Questionnaire-Child version			X	X	
Comprehensive Feeding Practices Questionnaire	X		X		X
Early Childhood Behaviour Questionnaire	X	X			
Temperament in Middle Childhood Questionnaire			X	X	X
Conners' Parent Rating Scale			X	X	X
Strengths and Difficulties Questionnaire			X	X	X
Background information	X	X	X	X	X
ADHD and co-morbid disorders					X

	Study one *N*=95		Study two *N*=50		Study three *N*=105
	Chapter Three	Chapter Four *n*=36	Chapter Five	Chapter Six	Chapter Seven
Behavioural tasks					
Snack Delay task (Delay of gratification)	X				
Tower task (Inhibitory control)	X				
Line Walking task (Motor impulsivity)	X				
Go/No-Go Task (Response speed and inhibitory control)			X	X	
Door Opening Task (Sensitivity to reward and punishment)			X	X	
Delay Discounting Task (Delay of gratification)			X	X	
Circle Drawing Task (Motor impulsivity)			X	X	
Other assessments					
Mealtime intake	X				
Mealtime observation		X			
Snack session intake			X	X	
Stress/Control task				X	
Stress assessment: Visual analogue scale				X	
Stress assessment: Heart rate				X	
Picture rating scale: Hunger and satiety			X	X	

2.5.1 Measures of child eating behaviour and parental feeding practices

Children's Eating Behaviour Questionnaire (CEBQ; Wardle, Guthrie, Sanderson, & Rapoport, 2001 – see Appendix B-1). The CEBQ was used to assess parent-perceived child eating behaviour in Chapters Three, Five and Seven. The 35-item questionnaire consists of eight subscales: Food Responsiveness (five items, e.g. If allowed to, my child would eat too much.), Emotional Overeating (five items, e.g. My child eats more when worried.), Enjoyment of Food (four items, e.g. My child enjoys eating.), Desire to Drink (three items, e.g. If given the chance, my child would always be having a drink.), Satiety Responsiveness (five items, e.g. My child gets full up easily.), Slowness in Eating (four items, e.g. My child finishes his/her meal very quickly.), Emotional Undereating (three items, e.g. My child eats more when s/he is happy.), and Food Fussiness (six items, e.g. My child is difficult to please with meals.). All of the scale's items are phrased as statements, using a 5-point Likert scale ranging from 1 (*Never*) to 5 (*Always*). The four subscales Food Responsiveness, Enjoyment of Food, Desire to Drink, and Emotional Overeating can be combined into a subscale measuring Food Approach behaviour, which assesses a child's desire for, interest in and liking of food and drinks as well as a tendency to eat when experiencing negative emotions. The four subscales Satiety Responsiveness, Slowness in Eating, Emotional Undereating and Food Fussiness can be combined into a subscale measuring Food Avoidance behaviour, which assesses a child's intake speed, regulation abilities, food selectivity and tendency to avoid eating when experiencing negative emotions. To avoid an excessive number of analyses this thesis explored links between impulsivity and food approach and food avoidance behaviour rather than between the individual subscales. The CEBQ has high test-re-test reliability, has been successfully used to measure parent-perceived eating behaviour in children as young as 2 years, and has been linked with intake and BMI (Carnell & Wardle, 2007; Farrow & Blissett, 2012; Viana, Sinde, & Saxton, 2008). The scale's reliability and validity have been demonstrated and acceptable to excellent internal consistency scores for the individual subscales have previously been reported (Viana et al., 2008).

Dutch Eating Behaviour Questionnaire-Child version (DEBQ-C; Van Strien & Oosterfeld, 2008 – see Appendix B-2). The DEBQ-C assesses self-reported eating behaviour and eating styles in children aged 7-12 years and was used to assess self-perceived eating style in 7-11-year-olds in Chapters Five and Six. The scale consists of 20 items in question form, using a 3-point Likert scale ranging from 0 (*No*) to 2 (*Yes*). The scale is subdivided into three subscales, Emotional Eating (seven items, e.g. If you feel lonely do you feel like eating food?), External Eating (six items, e.g. Do you find it difficult to stay away from yummy food?) and Restrained Eating (seven items, e.g. Do you keep an eye on exactly what you eat?). Slight modifications of the original phrasing of individual items were made to ensure that the items were applicable and comprehendible for British children aged 7 years or older. The scale's reliability and validity have been demonstrated, and good internal consistency scores for the three subscales have previously been reported (Van Strien & Oosterfeld).

Comprehensive Feeding Practices Questionnaire (CFPQ; Musher-Eizenman & Holub, 2007 – see Appendix B-3). The CFPQ was used to assess the use of a range of parent self-reported feeding strategies in the context of a mealtime and snack intake in Chapters Three, Five and Seven. The 49-item scale consists of the following 12 subscales: Child Control (five items, e.g. Do you let your child eat whatever s/he wants?), Environment (four items, e.g. Most of the food I keep in the house is healthy.), Involvement (three items, e.g. I involve my child in planning family meals.), Encouraging Balance and Variety (four items, e.g. I encourage my child to eat a variety of foods.), Modelling (four items, e.g. I try to show enthusiasm about eating healthy foods.), Teaching about Nutrition (three items, e.g. I discuss with my child why it's important to eat healthy foods.), Monitoring (four items, e.g. How much do you keep track of the sweets [candy, ice cream, cake, pies, pastries] that your child eats?), Pressure (four items, e.g. If my child eats only a small helping, I try to get him/her to eat more.), Restriction for Health (four items, e.g. If I did not guide or regulate my child's eating, s/he would eat too much of his/her favourite foods.), Restriction for Weight Control (eight items, e.g. I encourage my child to eat less so he/she won't get fat.), Emotion Regulation (three items, e.g. When this child gets fussy, is giving him/her something to eat or drink the first thing you do?), and Food as Reward (three items, e.g. I withhold sweets/dessert from my child in response to bad behaviour). The scale's first 13 items are phrased as questions, using a 5-point Likert scale ranging from 1 (*Never*) to 5 (*Always*). The scale's remaining items (14-49) are phrased as statements, using a 5-point Likert scale ranging from 1 (*Disagree*) to 5 (*Agree*). For the purpose of this thesis specific emphasis was placed on the four controlling feeding strategies Monitoring, Pressure, and Restriction for Health and Weight Control, while the other subscales were disregarded. The reliability and validity of the scale have been demonstrated and its utility in samples of children as young as 2 years has been shown (Musher-Eizenman & Holub). Internal consistency scores for the selected subscales have ranged from acceptable to excellent (Musher-Eizenman, de Lauzon-Guillain, Holub, Leporc, & Charles, 2009).

2.5.2 Measures of child impulsivity and behaviour difficulties

Early Childhood Behaviour Questionnaire (ECBQ; Putnam, Gartstein, & Rothbart, 2006 – see Appendix B-4). The ECBQ is a parent-report measure consisting of 201 items measuring 18 aspects of temperament in children aged 1.5 to 3 years over the past two weeks. The 18 subscales measure Activity Levels/Energy, Attentional Focusing, Attentional Shifting, Cuddliness, Discomfort, Fear, Frustration, High Intensity Pleasure, Impulsivity, Inhibitory Control, Low Intensity Pleasure, Motor Activation, Perceptual Sensitivity, Positive Anticipation, Sadness, Shyness, Sociability and Soothability. The scale was used to assess impulsivity in the samples of children described in Chapters Three and Four and therefore only the items corresponding to the subscale Impulsivity (ten items, e.g. When offered a choice of activities, how often did your child decide what to do very quickly and go after it?) were selected. All items are written in question form using a seven point Likert scale ranging from 1 (*Never*) to 7 (*Always*); additionally there is a *Does not apply* response option for situations that children/parents have not previously experienced. The reliability and validity of the questionnaire have been demonstrated (Putnam et al.). Nevertheless, internal consistency scores for the Impulsivity subscale have previously been found to be poor (Casalin, Luyten, Vliegen, & Meurs, 2012; Putnam et al.). This may be due to the multidimensional aspect of impulsivity, and an inability of a scale with such few items, to capture the concept comprehensively. Nevertheless, this measure was selected as it can easily be administered to parents in a time-efficient manner. Additionally, the use of this subscale provided some theoretical continuity for the impulsivity measurement in older children participating in study three.

Temperament in Middle Childhood Questionnaire (TMCQ, version 3.0; Simonds & Rothbart, 2004 – see Appendix B-5). The TMCQ measures parent-perceived temperament over the last six months in children aged 7 to 10 years. The scale consists of 157 items in statement form, utilizing a 5-point Likert scale ranging from 1 (*Almost always untrue*) to 5 (*Almost always true*). Additionally, there is a *not applicable* response option for items addressing situations that children/parents have not previously experienced. Items are subdivided into 17 subscales addressing Activation Control, Activity Level, Affiliation, Anger/Frustration, Assertiveness/Dominance, Attention Focusing, Discomfort, Fantasy/Openness, Fear, High Intensity Pleasure, Impulsivity, Inhibitory Control, Low Intensity Pleasure, Perceptual Sensitivity, Sadness, Shyness, and Soothability/Falling Reactivity. The scale was selected to specifically assess impulsivity in the samples of children described in Chapters Five, Six and Seven and therefore only the 13 items of the Impulsivity subscale (e.g. My child grabs what s/he wants.) were selected. The TMCQ has good to moderate validity and reliability and the internal consistency of the impulsivity subscale has been found to be acceptable to excellent (Piazza, Bering, & Ingram, 2011; Simonds, 2006; Simonds & Rothbart).

Conners' Parent Rating Scale (CPRS-R [L]; Conners, Sitarenios, Parker, & Epstein, 1998 – see Appendix B-6). The revised, long version of the CPRS measures parents' perceptions of their children's behaviour problems over the past month. The scale consists of 80 items that are subdivided into 14 subscales assessing Oppositional Behaviour, Cognitive Problems, Hyperactivity-Impulsivity, Anxious Behaviour/Shyness, Perfectionism, Social Problems, and Psychosomatic Symptoms. The scale yields scores for the Conners' ADHD Index and the Conners' Global Index Total (made up of the Conners' Global Index: Restless-Impulsive and Emotional Lability). The scale also provides a DSM-IV Symptoms Subscales Total made up of the DSM-IV Inattentive and Hyperactive-Impulsive Subscales. Items are written in statement-form using a 4-point Likert scale ranging from 0 (*Not true at all*) to 3 (*Very much true*). For the purpose of this thesis the Hyperactivity subscale (nine items, e.g. Is always "on the go" or acts as if driven by a motor.) and the Conner's Global Index (CGI): Restless-Impulsive (seven items, e.g. Fails to finish things he/she starts.) were selected in Chapters Five, Six and Seven. The subscales of this measure were selected in addition to the TMCQ impulsivity measure to provide a broader assessment of parent-perceived, stable impulsivity. The scale's reliability and validity have been demonstrated and the subscales have been found to have good to excellent internal consistency (Conners et al.).

Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997 – see Appendix B-7). The SDQ is a parent-report measure that assesses children's overall functioning and behaviour difficulties during the past six months. The questionnaire consists of 25 items in statement form, using a 3-point Likert scale ranging from 0 (*Not true*) to 2 (*Certainly true*). The questionnaire contains five subscales, assessing Emotional Symptoms (five items, e.g. Often unhappy, downhearted or tearful.), Conduct Problems (five items, e.g. Often lies or cheats.), Hyperactivity (five items, e.g. Constantly fidgeting or squirming.), Peer Problems (five items, e.g. Rather solitary, tends to play alone.), and Prosocial behaviour (five items, e.g. Considerate of other people's feelings.). A Total Difficulties score can be calculated by adding the scores of the subscales Emotional Symptoms, Conduct Problems, Hyperactivity, and Peer problems. A Total Difficulties score in the range of 0 to 13 is considered to be normal, while a score of 14 to 16 is considered to be borderline. Scores ranging from 17 to 40 are considered to be abnormal, and may be indicative of the presence of underlying mental health disorders and behavioural difficulties. The scale has been shown to be valid, with excellent test-retest reliability and good internal consistency scores (Goodman; Goodman & Scott, 1999; Klasen et al., 2000; Smedje, Broman, Hetta, & Van Knorring, 1999). This measure was included to be aware of potential underlying behaviour difficulties in children described in Chapters Five, Six, and Seven.

2.5.3 Demographics and additional assessments (see Appendix B-8)

Background information. In all studies discussed within this thesis (Chapters Three, Four, Five, Six, and Seven), parents provided background information on themselves and on their children. Parents self-reported their own and their child's age, gender, family annual income and/or educational level as well as parent and child ethnicity. In studies one and two (Chapters Three, Four, Five and Six) mothers and children were measured and weighed by a trained researcher wearing light indoor clothing, without shoes. Where fathers visited the lab, mothers were contacted and their self-reported height and weight were recorded. In study three (Chapter

Seven) parents self-reported their own and their child's height and weight, as the online survey did not allow collecting this data directly. Potential self-report biases or incorrect reporting therefore have to be considered for these data. Maternal or parental (Chapter Seven only) BMIs and child BMI z-scores, adjusting for age and gender, were calculated. BMI z-scores were calculated by generating child BMI: weight (kg) divided by height (m) squared; BMIs were converted into z-scores taking age and gender into account, using the British Growth Reference (1990, revised in 1996).

ADHD and comorbid disorders. In Chapter Seven the presence or absence of a diagnosis of ADHD was established through parental reports of whether the child had previously been diagnosed with ADHD by a healthcare professional (Has your child been diagnosed with Attention Deficit Hyperactivity Disorder [ADHD]?). This approach and type of question has previously been used to establish the presence of a diagnosis of ADHD (e.g. Waring & Lapane, 2008). If parents indicated that their child had been diagnosed with ADHD, this question was followed up by questions on the subtype of ADHD and whether the child took any medication to manage the symptoms associated with ADHD. Additionally, parents provided information on child diagnoses of co-morbid disorders by a healthcare professional (Has your child been diagnosed with any other disorders (e.g. Conduct Disorder [CD], Oppositional Defiant Disorder [ODD], or any anxiety disorder)? If yes, please state which.) Finally, the presence of learning difficulties or developmental disorders was established through parent-report (Does your child have learning difficulties or developmental disorders? If yes, please state which).

2.6 Behavioural impulsivity measures

2.6.1 Snack Delay task (Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996)

This task was used to measure a child's ability to delay gratification and specifically a child's ability to delay retrieving a palatable snack in Chapter Three. A chocolate button was placed on the table in front of the child (approximately 18cm away from the child), within his/her reach. The child was asked to place his/her hands on the table and to wait to retrieve the snack until the researcher rang a bell. Children's abilities to delay were assessed over three trials with increasing waiting periods (10, 20 and 30 seconds). Halfway through each trial the researcher lifted the bell, which was resting on the table, but did not ring it. Coding of this task reflected the child's ability to delay the retrieval of the snack and behaviour was categorised as follows. 0=Child ate the snack prior to the researcher lifting the bell, 1=Child ate the snack after the researcher lifted the bell but before it was rung; 2=Child touched the bell or snack before the researcher lifted the bell; 3=Child touched the bell or snack after the researcher lifted the bell; 4=Child waited to retrieve the snack until the bell was rung. The task has previously been used to assess delay gratification in children as young as 2 years (Kochanska et al.). The task was slightly modified as the original task required covering the snack with a clear plastic cup. Nevertheless, pilot testing within our lab indicated that children were reluctant to touch the plastic cup and it was therefore removed in further testing. Higher scores achieved on the Snack Delay task are indicative of lower impulsivity levels and a child's better ability to delay gratification.

2.6.2 Tower task (Kochanska et al., 1996)

This task was used to assess a child's inhibitory control and ability to initiate and suppress activity to a signal in Chapter Three. Children were asked to build a tower with the researcher, using 21 wooden blocks. Initially, the researcher explained turn-taking to the child and demonstrated the process. While building the tower the researcher waited for explicit non-verbal or verbal signals from the child to take her turn (e.g. the child looking at the researcher, handing her a block or saying "it's your turn"). There were two trials. Data coding reflected the child's ability to take turns (total number of blocks * 100/ number of blocks placed by the child). A penalty was deducted (-5) if the child pushed the tower over prior to completion, while a merit was added (+5) if the child carefully removed blocks (e.g. to straighten up blocks that were already part of the Tower, to stabilise the Tower or to change the colour of the selected block). The task has previously been used to assess initiation and suppression of activity in children as young as 2 years (Kochanska et al.). Higher scores achieved on the Tower task are indicative of lower impulsivity levels and better inhibitory control.

2.6.3 Line Walking task (Kochanska et al., 1996)

In Chapter Three, this task was used to measure a child's motor impulsivity by measuring the ability to slow down. Children were asked to walk along a 1.8m long tape attached to the floor towards and away from the mother. The time children took to walk along the line during the two slow trials was recorded and averaged. The task has previously been used to assess the ability to slow down motor activity in children as young as 2 years (Kochanska et al.). Higher scores on the Line Walking task indicate lower levels of motor impulsivity.

2.6.4 Go/No-Go task (GNG task; Bezdjian, Baker, Lozano, & Raine, 2009)

The GNG task was used in Chapters Five and Six and measures the extent to which children are able to inhibit prepotent responses to non-food stimuli. Non-food stimuli were selected to avoid inhibitory carry-over effects from the GNG task affecting snack intake of children participating in study two. This computerised task involved the sequential presentation of a target stimulus (cartoon sun), requiring a key-press response, and a non-target (cartoon flower), requiring the inhibition of the key press response. A fixation cross, presented at the centre of the screen for 500ms at the beginning of each trial, was followed by the presentation of the target/non-target in the centre of the screen for 500ms. The inter-stimulus interval, consisting of a blank screen, lasted 1500ms. The task consisted of 12 practice trials and 100 experimental trials. The ratio between targets and non-targets was 3:1. Correct responses to targets were classed as hits, while the failure to respond to the target was classed as an error of omission or a miss. Finally, the failure to inhibit responses to non-targets was classed as an error of commission, while the absence of responding to non-targets was considered as a correct response. Errors of commission and the response speed to targets (Go trial reaction time [RT]) were recorded (dependent variables; DVs), with more errors (poor inhibitory control) and faster RTs (response speed) reflecting higher levels of impulsivity (Barkley, 1991; Halperin et al., 1991). The task lasted approximately four minutes and has previously been successfully used to measure impulsivity in children as young as 7.5 years

(Pauli-Pott, Albayrak, Hebebrand, & Pott, 2010). The data resulting from this task were cleaned; RTs below 150ms were removed as they were not classed as responses to the stimuli, but as accidental/chance responses. RTs, which were 2 *SDs* above the mean RT, were also removed as they were likely to reflect a child's distraction from the task.

2.6.5 Door Opening task (e.g. Nederkoorn, Braet, Van Eijs, Tanghe, & Jansen, 2006)

The Door Opening task was used in Chapters Five and Six and measures a child's sensitivity to reward and punishment. In this computerised task children could open up to 100 sequentially presented doors, through a key-press. Behind each door either a happy face, associated with winning a point or a sad face, associated with losing a point, was displayed. In each task block (a set of ten doors) the probability of finding a happy face reduced by 10%. There were no time constraints. Children automatically received ten points at the beginning of the task and were told that they could get one sticker for each point at the end of the task. Emphasis was placed on the fact that children could stop the task at any time to exchange their points for stickers. The number of doors opened (DV) was recorded as an indicator of reward sensitivity, with more impulsive children opening more doors than less impulsive, more punishment sensitive peers. The task lasted between four and eight minutes and has previously been successfully used to assess impulsivity in children as young as eight years (e.g. Guerrieri, Nederkoorn, & Jansen, 2008b; Matthys, Van Goozen, De Vries, Cohen-Kettenis, & Van Engeland, 1998; Nederkoorn et al.; Verbeken, Braet, Claus, Nederkoorn, & Oosterlaan, 2009).

2.6.6 Delay Discounting task (Johnson, Parry, & Drabman, 1978)

The Delay Discounting task was used in Chapters Five and Six and measures motivational aspects of impulsivity by assessing children's abilities to delay gratification (e.g. Johnson et al.). This computerised task involved the simultaneous presentation of two reward magnitudes (one star vs. two stars) on the left and right sides of the screen. Each trial was preceded by a centrally displayed fixation cross lasting 500ms. Children selected the preferred reward magnitude through a key press. While the small reward was always associated with the immediate reward selecting the larger reward was always associated with a 30 second delay before receiving the reward. The delay duration associated with each type of reward was indicated by its position on the screen; positioning of the reward in top half of screen equalled a delay of 30 seconds, while positioning of the reward in the bottom half of the screen equalled an immediate reward. Children received the reward (plastic counters) immediately or after the delay and were told that they could exchange their counters for a prize at the end of the session. More counters would equal a greater prize. The task consisted of four practice and 32 experimental trials and lasted between 3 and 16 minutes. The number of trials in which a larger delayed reward was selected was recorded (DV) and a greater number of delays was indicative of lower levels of impulsivity. Age-appropriate versions of delay gratification tasks have been used with children as young as 4 years (Mischel, Shoda, & Rodriguez, 1989).

2.6.7 Circle Drawing task (CDT; Bachorowski & Newman, 1990; Verbeken et al., 2009)

The CDT was used in Chapters Five and Six and measures a child's motor impulsivity and ability to inhibit an ongoing motor response. Performance on the task has previously been associated with impulsive behaviours and impulsivity-related disorders like ADHD (Avila, Cuenca, Felix, Parcet, & Miranda, 2004). Children were asked to trace the outline of a large circle (ø=50.8cm) printed onto a wooden square, with their index finger. A small line intersected the circle's top centre outline, indicating the start/finish point. The task consisted of two conditions; in the first condition children were asked to simply trace the circle's outline (neutral condition), while they were asked to trace the circle's outline as slowly as possible in the second condition (inhibition condition). The maximum time allocated for tracing the circle was 12 minutes for both conditions. Children were, however, not aware of this time limit. The tracing time during the inhibition condition was recorded (DV) and slower tracing was indicative of a better ability to inhibit an on-going motor response and lower motor impulsivity (Verbeken, et al.). This task has been used to measure motor impulsivity in children as young as 6 years (Avila et al.).

2.7 Observations

For a subset of parent-child dyads participating in study one a more detailed analysis of mealtime interactions was carried out (Chapter Four). An adaptation of the Family Mealtime Coding Scale developed by Haycraft and Blissett (2008) was used to code children's and parents' mealtime behaviours. Mealtime recordings were transcribed using InqScribe software (Version 2.2), which allows the simultaneous viewing and transcription of video recordings. In addition it allows the insertion of time codes, ensuring that durations of behaviours are recorded accurately. Child and parent vocalisations and actions were coded, yielding detailed representations of the mealtimes. Mealtime durations were also recorded. Children's mealtime behaviours were grouped into nine categories: Mouthful, Verbal Refusal, Physical Refusal, Food Request, Food Play, Fidgeting, Negative Vocalisation, and Out of Chair (occurrence and duration). Parental mealtime behaviours and feeding strategies were grouped into 16 categories: Mealtime Conversation, Mealtime Unrelated Conversation, Mealtime Termination, Comparison, Teaching, Bargaining, Restriction, Pressure (face, hand, plate), Verbal Pressure, Verbal Encouragement, Instruction (food-related), Praise (food-related), Reprimand and Restraint. Detailed descriptions and corresponding examples for all child and parent mealtime behaviours and feeding strategies can be seen in Chapter Four (Tables 4.1 and 4.2). An experienced researcher coded all occurrences of the described behaviours and durations of some behaviours that were observed during mealtimes. A trained, independent second observer coded a randomly selected subsample of four mealtime transcripts. The inter-rater reliability for the observation of the behaviours was calculated and can be seen in Chapter Four.

2.8 Food preparation, intake and recording

2.8.1 Mealtime

Parents and children participating in study one (Chapters Three and Four) each received a standardised meal. Children's meals consisted of half a ham or cheese sandwich (filling dependent on preference) made with white bread with added wheatgerm (approximately 120kcal or 125kcal respectively), 10g ready salted potato crisps (approximately 53kcal, Walkers Snack Food Ltd.), two chocolate-chip cookies (approximately 114kcal, Burtons Foods Ltd.), five milk-chocolate buttons (approximately 35kcal, Cadbury Plc.) and five green grapes (approximately 18kcal). Parents received a whole ham or cheese sandwich (filling dependent on preference; approximately 240kcal or 250kcal respectively). The meal also contained a novel fruit (as part of a larger study), which was either a whole dried date without the stone (approximately 23kcal), a tinned lychee without the stone (approximately 21kcal), or a quarter of a fresh fig (approximately 12kcal). Fruits were selected based on the absence of children's previous experience with them. For the purpose of this study all mealtimes were treated as fairly typical, containing mostly familiar foods and one unusual food. Differences between the consumption of familiar and unfamiliar foods will not be discussed within this thesis, but the data did not show any differences in overall calorie intake or parent/child mealtime behaviours by novel food type. All foods were weighed before and after mealtimes. Consumption in grams was converted into calories based on manufacturer guidelines and overall calorie intake was calculated. Water was available throughout mealtimes. Parents' and children's foods were presented on identical white, round porcelain plates (Ø=18cm).

2.8.2 Snack session

Children participating in study two (Chapters Five and Six) had access to six different sweet and savoury snack foods that varied in fat and sugar content during a 10-minute snack session. The foods consisted of 130g chocolate chip cookies (496kcal/100g), 300g Haribo Gold Bears (348kcal/100g), 70g salted crisps

(536kcal/100g), 90g salted pretzels (378kcal/100g), 280g green grapes (69kcal/100g) and 200g carrot sticks (35kcal/100g). The snack foods were weighed before and after the snack session using an electronic scale (Kern: EMB 600-2); the calories consumed for each snack food, as well as overall calorie intake were calculated using manufacturer information. Water was available throughout the snack session. Snack foods were presented in square, white plastic bowls (10 x 10cm).

2.8.3 Apparatus

Mealtimes and snack sessions were observed using a Sharp LCD TV (model specification: LC-19D1E-BK). Mealtimes were recorded using two remotely adjustable Sony cameras (model specification: EVI-D70), located in opposite corners of the observation room. Recordings were processed using an Extron MAV-Series and Picture-in-Picture Processor (model specification: PIP 422), which ensured that the parents' and children's mealtime interactions and children's snack session behaviours, could be observed and captured accurately. Mealtimes were written onto discs using a Sony DVD Recorder (model specification: RDR-HXD890) and were labelled with participant identification codes.

2.9 Stress and control tasks

2.9.1 Control task

Children participating in study two (Chapters Five and Six) completed a non-challenging maths game with the researcher; this task had no relevance to Chapter Five but was used as a non-stressful control task to compare the potential effects of a stressful task on snack intake in Chapter Six. The maths game consisted of mathematical problems below children's school grade, displayed on PowerPoint slides (one problem per slide) with response options (including the correct response) at the bottom of the slide (e.g. 1+1=? a:1, b:2, c:3). Children controlled the speed of the slides, were allowed to discuss responses with the researcher and received positive feedback for their responses.

2.9.2 Stress task

Children participating in study two (Chapters Five and Six) completed a stressful mental arithmetic test with the researcher; this task had no relevance to Chapter Five but was used as a stress task to assess the potential effects of a stress task compared to non-stressful control task on snack intake in Chapter Six. The stress task consisted of a mental arithmetic test with age-appropriate but challenging problems. Each problem consisted of three parts displayed on three separate PowerPoint slides (e.g., slide 1: 4*3; slide 2: +8; slide 3: -12; answer = ?). Children were instructed to look at all three slides before giving their answer and were given a practice problem before beginning the stress task. The first two slides were displayed for 2.5 seconds, while the third slide was displayed for 4 seconds. Children received positive and negative feedback from the researcher.

2.10 Assessments of stress and hunger/satiety

2.10.1 Stress assessment

Visual analogue scale. Children participating in study two (relevant to Chapter Six only) self-reported perceived stress using a 100mm visual analogue scale (VAS) with the anchors "*not stressed at all*" and "*extremely stressed*". Stress ratings made immediately before and after the stress and control tasks provided the key measurements. Self-reported stress reactivity was defined as the rating made immediately after a stress or a control task minus the rating made preceding a stress or a control task.

Heart rate. For children participating in study two (relevant to Chapter Six only) physiological stress was objectively assessed through the monitoring of heart rate (HR) using a wireless HR monitor (Model specification: Polar RS 400). The HR monitor consisted of an elastic strap with an electrode, which was fitted around the child's chest by the parent (accuracy of fitting was checked by the researcher). A wristwatch, which was worn by the child throughout the visit, recorded the HR at 5-second intervals. HR recordings were transferred to a computer for analysis after each testing session. The key HR measurement periods were baseline, the minute before stress task onset, and the seven minutes of the stress task. Reactivity was calculated as the average stress/control task HR minus the baseline HR.

2.10.2 Hunger and satiety assessment

For children participating in study two (Chapters Five and Six) hunger and satiety states were assessed through the newly developed Teddy Picture Rating Scale (PRS; Bennett & Blissett, 2014 – see Appendix B-9 for scale development).

The scale consists of five black and white cartoon bear silhouettes. Varying amounts of “food” are represented by black ovals in each bear’s stomach area, which increase in size proportionally as the amount of food consumed and the satiety of the bear increases. Each of the five bear silhouettes is accompanied by a label placed above the silhouette, which describes the bear’s level of hunger and satiety, starting from 1 (*very hungry*) to 5 (*not hungry at all/very full*). The scale was pilot-tested to ensure that it could be comprehended and used to reflect hunger and satiety by children of this age range (Bennett & Blissett).

2.11 General data analysis strategy

SPSS version 20 statistical software was used to analyse the data. Histograms were inspected and indicated that the majority of data were normally distributed. Initially, descriptive statistics for child impulsivity were calculated and potential gender differences were explored using independent samples *t*-tests or Chi-squared analyses. The impact of potential covariates like child age, BMI z-score, maternal/parent BMI and family annual income and/or parent education level on child impulsivity and on weight, eating and feeding variables was assessed. For all directional hypotheses one-tailed analyses were carried out, while for all non-directional hypotheses two-tailed analyses were applied. For all analyses involving large numbers of correlations a criterion alpha for significance of .01 was selected to account for multiple testing and to reduce the associated rise in the family-wise error rate (Chapters Three and Five).

In Chapters Three and Five Pearson’s correlations controlling for covariates where appropriate were carried out to examine hypothesized relationships between parent-reported impulsivity and child impulsivity task performance and weight, eating and feeding variables. These analyses were carried out for the sample overall and for females and males separately. Additionally, moderation analyses were carried out to assess if the feeding practice monitoring moderated the relationship between impulsivity and food approach and avoidance behaviour or mealtime intake. Finally, it was assessed if parental controlling feeding practices moderated the relationship between impulsivity and child weight.

In Chapter Four ANOVAs controlling for covariates as appropriate were carried out to examine potential differences in observed mealtime behaviours in a sample of children with high and low impulsivity levels and their parents. Due to small sample size gender analyses were not carried out.

Chapter Six focused on the potential impact of stress on the link between impulsivity and dietary restraint in relation to snack intake. A manipulation check assessing whether the stress task elevated self-reported and objectively measured stress in comparison to a control task was carried out. Interactive effects between impulsivity and dietary restraint under control conditions were assessed. Finally, split-plot ANOVAs, controlling for covariates where appropriate, were carried out to assess if task type, impulsivity and dietary restraint interacted in their effects over calorie intake from snacks. Due to small sample sizes gender analyses were not carried out.

In Chapter Seven between-subjects ANOVAs, controlling for covariates where appropriate, were carried out to assess differences in impulsivity, BMI z-score and eating behaviour in children with and without ADHD. Additionally, it was assessed whether parents of children with and without ADHD differed in their use of controlling feeding practices. These analyses were carried out for the sample overall and for the male and female subsamples separately.

CHAPTER THREE

IMPULSIVITY, EATING AND FEEDING BEHAVIOUR IN 2-4-YEAR-OLDS

3.1 Abstract

Research has highlighted links between impulsivity and weight in children and adults. Nevertheless, little is known about the nature of this link in very young children or about the underlying mechanism. The present study aimed to address this limitation by exploring relationships between impulsivity, weight, eating behaviour and parental controlling feeding practices in a sample of 95 2-4-year-olds. Impulsivity was assessed through parent-report and tasks measuring the impulsivity facets delay of gratification (Snack Delay task), motor impulsivity (Line Walking task) and inhibitory control (Tower task). Pearson's correlations demonstrated positive links between impulsivity, pressure and restriction for weight control, especially in the female subsample. Additionally, females greater in motor impulsivity were heavier. Furthermore, monitoring moderated the relationship between impulsivity and food approach behaviour, indicating that monitoring may protect more impulsive children from displaying problematic eating behaviours. No parental controlling feeding practices moderated the relationship between impulsivity and weight. The study's findings and limitations are discussed.

3.2 Introduction

Childhood obesity is a major health concern in the UK and around the world. Lifestyle factors like unhealthy diets and lack of appropriate levels of exercise have been highlighted as the critical factors underlying the obesity epidemic across the world (Ebbeling, Pawlak, & Ludwig, 2002; Epstein, Paluch, Gordy, & Dorn, 2000). Other factors such as impulsivity and inhibitory control have received increasing attention in a bid to identify some of the mechanisms underlying overeating and poor food choices (Braet, Claus, Verbeken, & Vlierberghe, 2007; Davis et al., 2007; Guerrieri, Nederkoorn, & Jansen, 2008a). Research has shown that impulsivity plays an important role in eating behaviour and weight regulation. Overweight adults and children have been found to be more impulsive than healthy weight individuals (Braet et al., 2007; Davis, Levitan, Muglia, Bewell, & Kennedy, 2004) and early inhibitory control abilities have been found to be predictive of later weight and risk for overweight (Graziano, Calkins, & Keane, 2010).

Seeyave et al. (2009) reported that 4-year-olds, who failed a delay of gratification task, were at a greater risk of being overweight by age 11. Graziano et al. (2010) similarly found that general self-regulation skills at age 2 predicted child BMI and obesity risk at ages 2 and 5.5. Inhibitory control/reward sensitivity measured by a delay of gratification task specifically predicted obesity risk at age 5.5 even when accounting for child BMI at age 2. These findings suggest that differences in self-regulation and inhibitory control may predate the development of obesity. Francis and Susman (2009) explored self-regulation through self-control and delay of gratification tasks at age 2 years and 5 years and tracked child weight until children were aged 12 years. More impulsive children were heavier at all BMI measurements and had the most rapid weight gain from age 3 to 12 years. Interestingly, gender-specific analyses showed a near-significant interaction between impulsivity and weight in females but not males, highlighting the need to take potential gender differences in the impulsivity-weight relationship into account and to explore them further. Unfortunately, previous studies have been limited by their narrow assessment of impulsivity and an assessment of a greater variety of impulsivity facets may indicate further associations and interactions.

Research has also highlighted differences in impulsivity levels between obese and healthy weight children. Braet et al. (2007) e.g. found that overweight 10-18-year-olds had poorer impulse control than healthy weight children on performance and self-report measures of impulsivity. Similarly, the success in weight reduction programs for children appears affected by underlying impulsivity levels (Nederkoorn, Braet, Van Eijs, Tanghe, & Jansen, 2006; Pauli-Pott, Albayrak, Hebebrand, & Pott, 2010). Nevertheless, some studies have failed to identify links between impulsivity and weight in children, which may be attributable to the measures that were used to assess impulsivity (e.g. Tan & Holub, 2011). A recent meta-analysis by Thamotharan, Lange, Zale, Huffhines, and Fields (2013) showed that behavioural, rather than self-report measures of impulsivity and measurements of the impulsivity facets of decision-making and disinhibition rather than of inattention and overall impulsivity, yielded greater effect sizes in studies linking impulsivity and weight in children. Their findings underline the importance of careful selection of impulsivity measures that assess a range of impulsivity facets.

Research suggests that children as well as adults display impulsive eating tendencies (Graziano et al., 2010). High sensitivity to reward, one facet of impulsivity, may predispose children to prefer palatable foods, high in fat and sugar to bland ones, and may encourage their consumption in the absence of physiological need (Davis et al., 2007). Findings from the adult literature suggest that impulsive individuals make poorer food choices and have a tendency to overeat (Guerrieri et al., 2007; Jasinska et al., 2012; Nederkoorn, Houben, Hofmann, Roefs, & Jansen, 2010). Furthermore, Guerrieri, Nederkoorn, and Jansen (2008b) reported that the variety of the food environment interacts with impulsivity leading to overeating in children. These findings indicate that impulsivity may make adults and children more prone to respond to negative emotional states and food-focused, varied environments by eating palatable foods.

The impact of impulsivity on eating behaviour in young children is influenced by caregivers who are responsible for their food environment and mealtime interactions (Patrick, Nicklas, Hughes, & Morales, 2005). Tan and Holub (2011) found that parents who believed their 3-9-year-olds to be better able to regulate their intake and who felt their children had better inhibitory control used less restriction for health but not weight. Anzman and Birch (2009) also found that poorer parent-reported inhibitory control at age 7 was associated with greater weight gain over time, with higher BMIs at all measurement points (age 7, 11, 15) and with greater risk for overweight in females. The association between impulsivity and weight was moderated by child-perceived parental restriction; females who had lower inhibitory control, and whose parents were perceived to use high levels of restriction, had the strongest negative association between inhibitory control and weight**.** Thus parental restriction appears particularly detrimental for weight regulation in impulsive females. Research has indicated that less intrusive controlling feeding practices like monitoring or covert restriction may have a more positive impact on eating behaviour (Farrow, 2012; Klesges, Stein, Eck, Isbell, & Klesges, 1991).

Overall, these findings indicate that impulsivity is related to eating behaviour from childhood to adulthood and that it can affect dietary intake and weight from an early age. Parents may try to counteract the effects of impulsivity through the use of feeding strategies, but their efficacy appears limited.

3.2.1 Aims and hypotheses

To address the identified gaps in the literature, this study aims to assess the relationship between impulsivity, measured through a range of behavioural and parent-report measures, child weight and intake. It is hypothesized that parent-reported impulsivity and impulsivity task performance will be associated. As previous studies have not addressed potential relationships between child eating behaviour and impulsivity in this age group, this study aimed to explore these hypothesised relationships but no directionality was inferred. Finally, this study aimed to explore relationships between impulsivity and parental controlling feeding practices. It was hypothesized that parental feeding and impulsivity would be associated; no directional hypotheses were made (see Figure 3.1). To explore the previously described moderating effect of monitoring on eating behaviour in a younger sample, the moderating effects of monitoring on the relationship between impulsivity and eating behaviour/intake were explored. The analyses were limited to exploring the impact of monitoring on eating behaviour, because monitoring in particular has been linked with positive eating outcomes in children and may therefore emerge as a useful tool to encourage healthy eating patterns in impulsive children. Previous research has also highlighted the moderating impact of restriction on the link between impulsivity and child weight and the impact of pressure and monitoring on child weight. It is possible that these controlling feeding practices will impact differently on child weight depending on underlying impulsivity levels. This study therefore aimed to explore the impact of controlling feeding practices on the impulsivity-weight relationship.

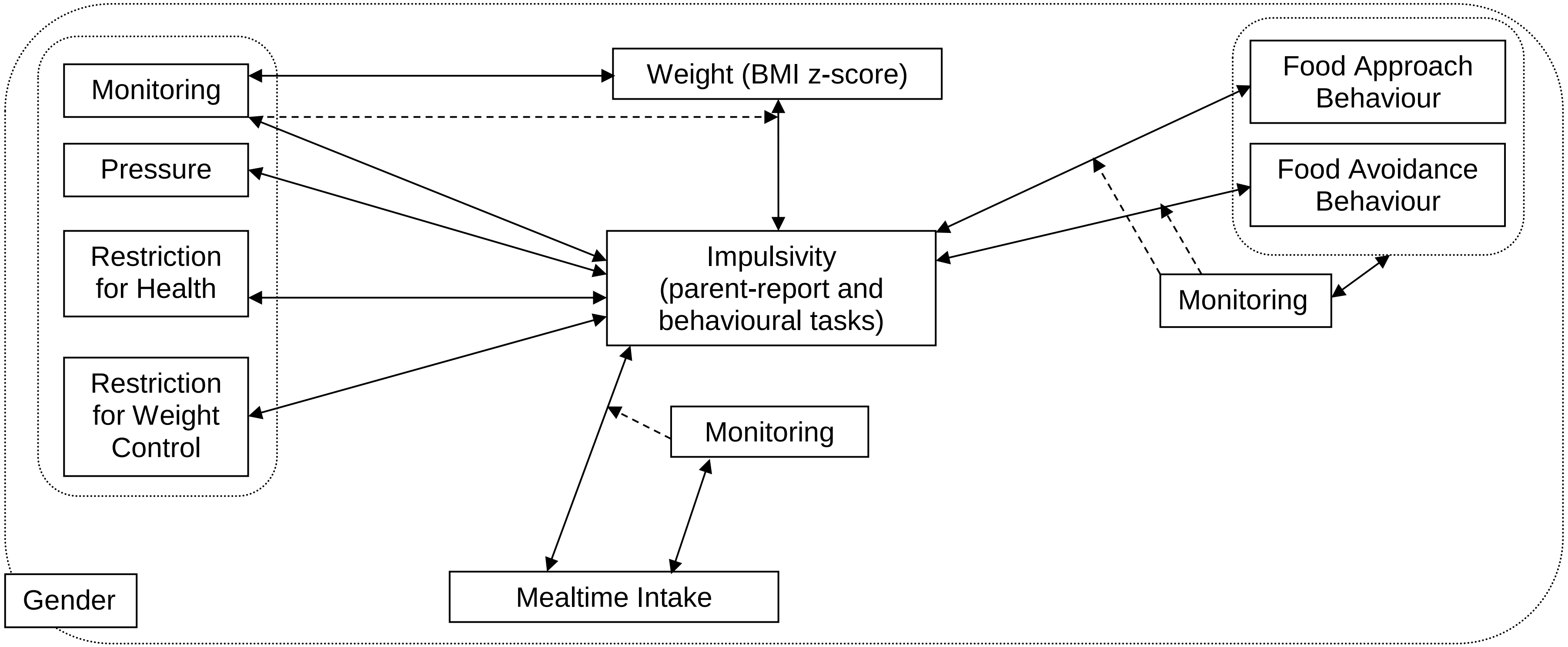


Figure 3.1. This model shows the relationships between impulsivity, weight, eating behaviour and controlling parental feeding practices to be explored in this chapter (solid arrows). Additionally, the moderating effects of monitoring on the relationship between impulsivity and eating behaviour and of controlling feeding on the relationship between impulsivity and child weight to be explored within this chapter are highlighted (dashed arrows). The parental feeding practices monitoring, pressure to eat and restriction for health and weight control address parent factors, while impulsivity, weight, mealtime intake and eating behaviour variables address child factors.

3.3 Method

3.3.1 Participants

Ninety-five parent-child dyads participated in this study. Parents and children were recruited through the Infant and Child laboratory (ICL) database, and from nurseries and toddler groups in and around central Birmingham, UK (see Appendix A-1 for posters/leaflets). Recruitment took place between April 2012 and March 2013. Participants for this study were recruited as part of a larger ongoing study on successful novel food introductions in toddlers. All parents who participated in this study were the primary caregivers of their children. Exclusion criteria included the presence of known food allergies, the presence of disorders affecting eating, current or recent major illness, diagnosed intellectual disabilities or impulsivity-related or anxiety disorders. Overall, 150 parents were contacted, with 95 participating in this study, resulting in an overall response rate of 63.3%. The sample's demographic characteristics can be seen in Table 3.1. There was a clear tendency for mothers rather than fathers to participate, with child gender being fairly balanced. Parents tended to be in their mid-thirties; children were around 2.5 years. Parents were slightly overweight overall, while children were healthy weight. The sample consisted of predominantly White/British families, from middle-class backgrounds.

3.3.2 Mealtimes

Mealtime recording. Mealtimes were observed and recorded (see Chapter Two, Section 2.8.3).

Mealtime foods and preparation. Parents and children each received a standardised meal served on white round plates (Ø=18cm). Meals consisted of a ham or cheese sandwich (half a sandwich for children), 10g ready salted potato crisps, two chocolate-chip cookies, five milk-chocolate buttons, five green grapes and one of three new fruits the child had not tried before (dried date, tinned lychee or fresh fig). Foods were weighed before and after mealtimes. Consumption in grams was converted into calories based on manufacturer guidelines and overall calorie intake was calculated (see Chapter Two, Section 2.8.1). Water was available throughout mealtimes.

3.3.3 Measures and procedure

All questionnaires were completed by the children's mothers. More detail on all measures can be found in Chapter Two (see Appendix B for the selected questionnaires).

Demographic information. Mothers provided information on their child's age and gender, their own age, household size and composition, ethnicity, their annual household income and level of education. Mothers and children were measured and weighed wearing light indoor clothing, without shoes. Where fathers attended (*n*=2) mothers were contacted and their self-reported height and weight were recorded. Maternal BMIs and child BMI z-scores adjusting for age and gender were calculated.

Children's Eating Behaviour Questionnaire (CEBQ; Wardle, Guthrie, Sanderson, & Rapoport, 2001). The CEBQ measures parent-reported Food

Approach and Food Avoidance behaviours displayed by children as young as 2 years. The Cronbach's alpha for the Food Approach subscale was .81 and the Cronbach's alpha for the Food Avoidance subscale was .85, indicating that both subscales had good internal consistency.

Comprehensive Feeding Practices Questionnaire (CFPQ; Musher-Eizenman & Holub, 2007). The CFPQ is a measure of parental feeding practices. This measure was used to assess the controlling feeding practices Monitoring, Pressure, Restriction for Weight Control and Restriction for Health. The Cronbach's alpha for Montoring was .85 and the alpha for Pressure was .72. The Cronbach's alphas for Restriction for Weight Control and Restriction for Health were .75 and .71, respectively, indicating that all subscales had good internal consistency.

Early Childhood Behaviour Questionnaire (ECBQ; Putnam, Gartstein, & Rothbart, 2006). The ECBQ measures child temperament and was used to assess parent-perceived child impulsivity. The Cronbach's alpha for the Impulsivity subscale was .77, indicating that the subscale had good internal consistency.

Snack Delay task. This task assesses a child's ability to delay gratification by waiting to retrieve a palatable snack (chocolate button) placed on the table within his/her reach. Children were asked to delay snack retrieval until a bell was rung over three trials with progressively longer waiting intervals (10, 20 and 30 seconds). Task coding reflected the child's ability to delay the retrieval of the snack. Higher scores indicated lower levels of impulsivity (better ability to delay gratification).

Tower task. This task measures a child's inhibitory control. During two trials children were asked to build a tower with the researcher, while taking turns. Data coding reflected the child's ability to take turns and to refrain from pushing the tower over/removing blocks carefully. Higher scores indicated lower levels of impulsivity (better inhibitory control).

Line Walking task. This task assesses a child's motor impulsivity. For this task children were asked to walk along a 1.8m long line without instruction (one trial) and while being told to walk as slowly as possible (two trials). The time children took to walk along the line during the two slow trials was recorded and averaged. Higher scores indicated slower walking and lower levels of motor impulsivity.

The procedures and data coding for the three behavioural tasks were adapted from Kochanska, Murray, Jacques, Koenig, and Vandegeest (1996).

Parents and children were greeted and invited into the large observation room at the ICL at the University of Birmingham. Initially, parents and children familiarised themselves with the surroundings, while the researcher explained the procedure and took informed consent of the parents. After being seated the researcher presented parents and children with their meals, exited the room and observed the mealtime from the adjacent observation room. At the end of the mealtime (signalled by parents pushing their own and their child's plates away), the researcher re-entered the room, removed the foods and gave the questionnaires to parents. Attending fathers (n=2) took the questionnaire home for completion by the mother; this was later returned by post. While parents completed the questionnaire, the researcher completed the behavioural tasks with the children in a corner of the room, but in proximity to the parent. Before debriefing, mothers and children were measured and weighed. Parents were reimbursed for their travel expenses (£10), while children received an age-appropriate toy for their participation. The Ethical Review Committee of the University of Birmingham approved this study (ERN 12-0465AP1).

3.3.4 Statistical analysis

SPSS version 20 statistical software was used to analyse the data. The selected criterion alpha for significance was .01 to account for multiple testing and to reduce the associated rise in the family-wise error rate. Histograms were inspected and indicated that the majority of data were normally distributed. Initially descriptive statistics for child impulsivity were calculated and potential gender differences were explored using independent samples *t*-tests. The impact of potential covariates like age, child BMI z-score, maternal BMI and family annual income on impulsivity, eating and feeding variables was assessed. Pearson's correlations controlling for covariates where appropriate were carried out to examine hypothesized relationships between parent-reported impulsivity and impulsivity task performance and child weight, eating and feeding variables. These analyses were carried out for the sample overall and for females and males separately. Finally, moderation analyses were carried out to assess if parental monitoring moderated the relationship between impulsivity and food approach or avoidance behaviours or mealtime intake. Additionally, it was assessed if parental controlling feeding practices moderated the relationship between impulsivity and child weight.

3.4 Results

3.4.1 Descriptive statistics

Demographic characteristics. Table 3.1 shows the demographic characteristics of the sample. Gender differences in child age and weight were assessed. Females were aged 23 to 45 months (*M*=29.54, *SD*=5.08) and males were aged 22 to 46 months (*M*=29.59, *SD*=5.78). A *t*-test indicated that there was no significant difference in age by gender (*t*(93)=-.05, *p*=.96). Female's BMI z-scores ranged from -5.24 to 3.61 (*M*=.39, *SD*=1.44) and male's BMI z-scores ranged from -1.53 to 3 (*M*=.3, *SD*=.95). A *t*-test indicated that there was no significant difference in BMI z-score by gender (*t*(91)=.36, *p*=.72).

Table 3.1

Demographic characteristics of the sample overall (N=95)

Variables	Parent Characteristics	Child Characteristics
Gender	93 female, 2 male	41 females, 54 males
Age, mean (*SD*)	35.42 (4.92) years	29.49 (5.43) months
Age range	26 – 54	22-46
BMI, mean (*SD*)	25.6 (5.62)	.34 (1.18)*
BMI range	18.1 – 45.86	-5.24-3.61*
Educational level	7.4% Professional/Doctorate (*n*=7)	
	28.4% Post-Graduate Qualification (*n*=27)	
	35.8% University graduate (*n*=34)	
	17.9% A-Levels (*n*=17)	
	1.1% Some secondary education (*n*=1)	
	2.1% Other (*n*=2)	
Family annual income	15.8% > £75000 (*n*=15)	
	10.5% £60-75000 (*n*=10)	
	22.1% £45-60000 (*n*=21)	
	27.4% £30-45000 (*n*=26)	
	21.1% £15-30000 (*n*=20)	
	3.2% < £15000 (*n*=3)	
Ethnicity	80% White British (*n*=76)	
	1.1% Black British (*n*=1)	
	10.5% Asian/Asian British (*n*=10)	
	2.1% Mixed (*n*=2)	
	6.3% Other (*n*=6)	

* For children BMIs (mean and *SD*) are adjusted for their age and gender (BMI z-scores).

Child impulsivity. Table 3.2 shows that parent-reported impulsivity and impulsivity task performance varied widely across children, suggesting that impulsivity levels in the current sample had a sufficient range to allow explorations of associations with eating and feeding variables. Additionally, Table 3.2 shows the number of children who completed the individual impulsivity tasks. The Snack Delay task was completed by the largest number of children (*n*=74), while the Line Walking task was completed by slightly fewer children (*n*=69); the Tower task was completed by the lowest number of children (*n*=62). Task completers and non-completers did not differ in age or gender (see Appendix C-1 for analyses).

T-tests were carried out to assess gender differences in parent-reported impulsivity and impulsivity task performance. These analyses indicated that there were no gender differences in parent-reported impulsivity ($t(93)=.25$, $p=.81$), Snack Delay task performance ($t(72)=.73$, $p=.47$), Line Walking task performance ($t(55.63)=-.87$, $p=.39$), or Tower task performance ($t(60)=.22$, $p=.82$).

Table 3.2

Children's scores on the parent-report measure of impulsivity and on the impulsivity tasks. Scores are presented for the sample overall and separately for females (n=41) and males (n=54)

		Mean (*SD*)	Min	Max	*N*
ECBQ Impulsivity	Overall	5 (0.83)	2.8	6.8	95
	Females	5.03 (0.82)	3	6.8	41
	Males	4.98 (0.84)	2.8	6.7	54
Snack Delay task	Overall	3.11 (1.2)	0	4	74
	Females	3.22 (1.29)	0	4	34
	Males	3.02 (1.12)	0	4	40
Line Walking task	Overall	5.68 (3.75)	1.41	25.11	69
	Females	5.27 (2.25)	2	11.44	31
	Males	6.01 (4.64)	1.41	25.11	38
Tower task	Overall	17.02 (2.81)	9	24.09	62
	Females	17.01 (3.27)	9	24.09	29
	Males	16.95 (2.37)	12.92	20.71	33

3.4.2 Covariates

Pearson's correlations were carried out to assess associations between the experimental variables (impulsivity, weight, eating behaviour, parental feeding) and confounding variables such as child age, BMI z-score, maternal BMI and family annual income. Based on previous research it was hypothesized that impulsivity would be associated with child age, and family annual income, while child BMI z-score would be associated with child age, maternal BMI and family annual income. It was also hypothesized that eating behaviour (food approach and avoidance) and mealtime intake would be associated with child age and BMI-z-score. Finally, it was hypothesised that parental feeding practices would be associated with child age and BMI z-score, maternal BMI and family annual income.

The analyses indicated that none of the potential confounds were associated with impulsivity, child BMI z-score or food approach or avoidance behaviour. Child age, but no other confounds, was positively associated with mealtime intake. Analyses evaluating links between mealtime intake and impulsivity therefore controlled for child age. None of the potential confounds were associated with the feeding practices restriction or monitoring, but pressure to eat was negatively associated with maternal BMI (see Table 3.3). Analyses evaluating links between pressure to eat and impulsivity therefore controlled for maternal BMI.

Table 3.3

Correlations between measures of interest and potential confounds

	Child BMI z-score	Child age	Maternal BMI	Annual Income
ECBQ Impulsivity	.01	-.19	.1	-.01
Snack Delay	.14	.14	-.03	-.04
Line Walking	.09	.13	-.04	.14
Tower	-.02	.19	-.04	-.2
Food Approach	-.05	-.19	.15	-.07
Food Avoidance	-.19	.12	-.05	.12
Mealtime Intake	-.04	.3*	-.15	.24
Monitoring	-.12	.02	.05	.05
Pressure	-.11	.06	-.29*	.26
Restriction Health	-.08	.05	.05	-.06
Restriction Weight	.03	.08	.08	-.09
Child BMI z-score	-	-.11	.06	-.12

**p*<.01

3.4.3 Impulsivity

Parent-reported impulsivity and impulsivity task performance. Firstly, it was assessed whether parent-reported impulsivity measured by the ECBQ was associated with children's performance on the three behavioural impulsivity tasks (Snack Delay, Line Walking, Tower). Pearson's correlations indicated that parent-reported impulsivity was not associated with impulsivity task performance for the sample overall, or for females and males separately (see Table 3.4).

Table 3.4

Correlations between parent-reported impulsivity and child impulsivity task performance

Measure		Snack Delay	Line Walking	Tower
ECBQ	Overall	-.22	-.07	-.25
Impulsivity	Females	-.27	.03	-.32
	Males	-.18	-.12	-.14

Individual impulsivity tasks. Secondly, it was examined whether children's performance on individual impulsivity tasks correlated. Pearson's correlations indicated that there were no relationships between the performances on individual impulsivity tasks for the sample overall, or for females and males separately (see Table 3.5).

Table 3.5

Intercorrelations between impulsivity task performances

Tasks		Line Walking	Tower
Snack Delay	Overall	.07	.27
	Females	-.04	.31
	Males	.14	.21
Line Walking	Overall		-.01
	Females		-.18
	Males		.14

3.4.4 Impulsivity and child weight

Parent-reported impulsivity and weight. Pearson's correlations assessed whether parent-reported impulsivity was associated with weight in general or with weight in females/males separately. These analyses indicated that impulsivity was not associated with BMI z-score for the sample overall ($r(93)=.01$, $p=.91$), for females ($r(41)=.01$, $p=.93$) or males ($r(52)=.01$, $p=.96$).

Impulsivity task performance and weight. Pearson's correlations were carried out to examine whether impulsivity task performance was associated with weight for the sample overall, and for females and males separately. These analyses indicated that there was a negative association between Line Walking task performance and BMI z-score for females, indicating that females with lower levels of motor impulsivity had lower BMI z-scores. There were no such relationships for males or for the sample overall (see Table 3.6).

Table 3.6

Correlations between impulsivity task performance and BMI z-score

		Snack Delay	Line Walking	Tower
Child BMI z-score	Overall	.14	.09	-.02
	Females	-.01	-.45*	.07
	Males	.31	.33	-.15

*$p=.01$

3.4.5 Impulsivity and child eating behaviour

Parent-reported impulsivity and eating behaviour. Pearson's correlations were carried out to assess whether parent-reported impulsivity was associated with food approach or avoidance behaviours. These analyses indicated that there were no relationships between eating behaviours and impulsivity for the sample overall or for females and males separately.

Furthermore, partial Pearson's correlations controlling for child age showed that there were no relationships between parent-reported impulsivity and mealtime intake for the sample overall or for females and males separately (see Table 3.7).

Table 3.7

Correlations between parent-reported impulsivity and eating behaviour

		Food Approach	Food Avoidance	Mealtime Intake+
ECBQ Impulsivity	Overall	.15	-.1	.02
	Female	.13	-.11	.16
	Male	.18	-.09	-.06

+ Controlling for child age

Impulsivity task performance and eating behaviour. Pearson's correlations were carried out to examine associations between impulsivity task performance and eating behaviour. These analyses indicated that there were no associations between Snack Delay, Line Walking or Tower task performance and food approach or avoidance behaviours for the sample overall or for females and males separately.

Furthermore, partial Pearson's correlations controlling for child age showed that there were no relationships between impulsivity task performance and intake for the sample overall or for females and males separately (see Table 3.8).

Table 3.8

Correlations between impulsivity task performance and eating behaviour

		Food Approach	Food Avoidance	Mealtime Intake+
Snack Delay	Overall	-.01	-.12	-.22
	Female	-.05	-.27	-.02
	Male	.06	-.01	-.34
Line Walking	Overall	.06	.24	-.05
	Female	-.24	.22	.13
	Male	.14	.27	-.12
Tower	Overall	.13	.03	.01
	Female	.11	-.07	-.01
	Male	.18	.14	.08

+ Controlling for child age

3.4.6 Impulsivity and controlling feeding practices

Parent-reported impulsivity and controlling feeding practices. Pearson's correlations (partial; controlling for maternal BMI on associations between impulsivity and pressure) were carried out to assess the relationships between impulsivity and the controlling feeding practices monitoring, pressure and restriction (health/weight). These analyses indicated that there was a positive relationship between pressure and impulsivity, suggesting that parents of more impulsive children used more pressure to eat. Gender specific analyses indicated that this association was mainly driven by females, not reaching significance in males. Restriction (health/weight) and monitoring were not associated with impulsivity (see Table 3.9).

Table 3.9

Correlations between parent-reported impulsivity and controlling feeding practices

		Monitoring	Pressure+	Restriction Health	Restriction Weight
ECBQ Impulsivity	Overall	-.13	.31*	.01	.05
	Female	-.03	.48*	.08	-.01
	Male	-.2	.17	-.04	.11

*p<.01, + controlling for maternal BMI

Impulsivity task performance and controlling feeding practices. Pearson's correlations (partial; controlling for maternal BMI on associations between impulsivity and pressure) were carried out to assess whether impulsivity task performance was associated with the controlling feeding practices monitoring, pressure and restriction (health/weight). These analyses indicated that Snack Delay task performance and Line Walking task performance were not associated with feeding practices. Tower task performance was positively associated with restriction for weight, reaching significance for females but not males. Parents of females who performed less impulsively on the Tower task reported using higher levels of restriction for weight control. Tower task performance was not associated with any other controlling feeding practices (see Table 3.10).

Table 3.10

Correlations between impulsivity task performance and controlling feeding practices

		Monitoring	Pressure+	Restriction Health	Restriction Weight
Snack Delay	Overall	.13	-.14	-.22	.05
	Female	.14	-.45	-.26	.25
	Male	.11	.24	-.16	-.11
Line Walking	Overall	.004	.31	.12	-.22
	Female	.11	.47	.37	-.16
	Male	-.03	.27	-.03	-.28
Tower	Overall	.08	-.14	.06	.34*
	Female	.1	-.27	.17	.61**
	Male	.06	.03	-.07	-.001

***p*<.001, **p*<.01, + controlling for maternal BMI

3.4.7 Moderating effects of parental monitoring on associations between impulsivity, eating behaviour and mealtime intake

Monitoring, eating behaviour and mealtime intake. Initially it was assessed whether monitoring was related to food approach or avoidance behaviours and mealtime intake. Analyses showed that there were no linear associations between monitoring, reported eating behaviour and measured intake (see Table 3.11).

Table 3.11

Correlations between monitoring and eating behaviour

		Food Approach	Food Avoidance	Mealtime Intake
Monitoring	Overall	-.01	.09	-.04
	Females	.16	.09	.01
	Males	-.11	.1	-.07

Moderating effects of monitoring. Analyses assessing the moderating effect of monitoring on the relationships between impulsivity and food approach and avoidance behaviour and mealtime intake were carried out (see Appendix C-2 for full description of all analyses). These indicated that parental monitoring moderated the relationship between parent-reported impulsivity and food approach behaviour in females only. The relationship was significant if monitoring was low (1 *SD* below mean: b=.34, *t*=1.6, *p*=.01), but not if parents reported using average (mean: b=.08, *t*=.88, *p*=.38) or high amounts of monitoring (1 *SD* above mean: b=-.19, *t*=-1.43, *p*=.16). The association between impulsivity and food approach behaviour in females was positive if monitoring was low (see Figure 3.2a).

Additionally, monitoring moderated the relationship between Line Walking task performance and food approach behaviour in the sample overall, and specifically in males. In males the relationship was significant if monitoring was low (1 *SD* below mean: b=.04, *t*=3.39, *p*=.002), but not if parents reported using average (mean: b=-.01, *t*=-.25, *p*=.8) or high amounts of monitoring (1 *SD* above mean: b=-.05, *t*=-1.34, *p*=.19). Males who responded more impulsively on the Line Walking task and walked faster were rated higher in food approach behaviour (see Figure 3.2b).

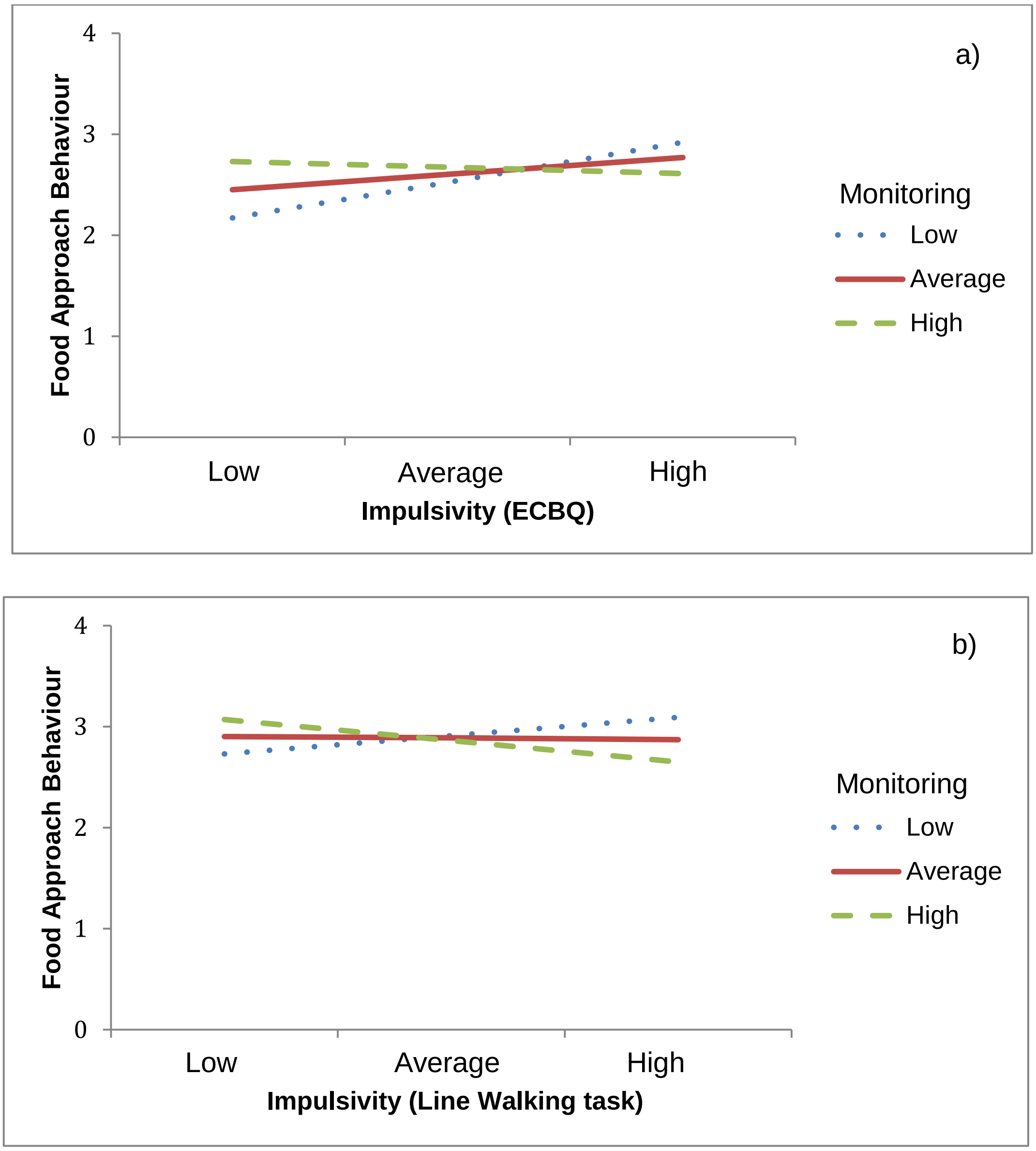


Figure 3.2. Plots of the moderating effects of monitoring on the relationship between parent-reported impulsivity and food approach behaviour in females (a) and on the relationship between Line Walking task performance and food approach behaviour in males (b).

3.4.8 Moderating effects of parental controlling feeding practices on associations between impulsivity and weight

Parental controlling feeding practices and weight. Analyses indicated that there were no associations between BMI z-score and any of the controlling feeding practices (see Table 3.12).

Table 3.12

Correlations between BMI z-score and parental controlling feeding practices

		Monitoring	Pressure	Restriction Health	Restriction Weight
Child BMI z-score	Overall	-.12	-.11	-.08	.03
	Female	-.08	-.19	-.12	.03
	Male	-.18	.02	.002	.04

Moderating effects of parental controlling feeding practices. There were no moderating effects of monitoring, pressure or restriction (health/weight) on the relationship between impulsivity and BMI z-score for the sample overall or for females and males separately (see Appendix C-3 for all analyses).

3.5 Discussion

The current study aimed to explore links between impulsivity, weight, eating behaviour and parental controlling feeding practices in a sample of 2-4-year-olds. Previous research in older children and adults has highlighted links between impulsivity and deficits in inhibitory control and weight (Braet et al., 2007; Graziano et al., 2010) and intake of palatable snack foods (Guerrieri et al., 2008b). Studies that have explored the potential relationships between impulsivity and child eating behaviour or parental controlling feeding practices in a sample of this age group are scarce. Overall, few associations between impulsivity, weight, eating behaviour and parental feeding were found in this age group. Associations between impulsivity and weight emerged only for females and associations between impulsivity and eating behaviour emerged only when moderating effects of the feeding practice monitoring were taken into account. Interesting relationships emerged for impulsivity and the controlling feeding practices pressure and restriction; these were observed most strongly in females. No moderating effects of any of the controlling feeding practices on the relationship between impulsivity and BMI z-score were observed (see Figure 3.3 for a visual representation of observed relationships).

It was hypothesized that impulsivity would be related to child weight. The hypothesis was partly confirmed as a relationship between impulsivity and weight was discovered in females. Females with higher levels of motor impulsivity, measured through the Line Walking task, had a higher BMI z-score. Females' performance on the Line Walking task and its association with weight may indicate an early tendency to act on impulse, which may become more problematic in later life when children have greater independent access to palatable snack foods.

Interestingly, there were no links between impulsivity and BMI z-score in males. Similar gender differences regarding the impact of impulsivity on weight have been reported by Francis and Susman (2009) who found a tendency for weight gain over time to interact with impulsivity levels in females, but not in males aged 3 to 12 years. The current study thus extends previous findings into a slightly younger and narrower age group. Francis and Susman suggest that earlier maturation in females may underlie this finding; an explanation, which cannot explain the gender effects in the current sample. Impulsivity levels did not differ between males and females and neither did the range of scores on the impulsivity measures, making it unlikely that the absence of correlations is due to range restriction in the male subsample. Nevertheless, associations between impulsivity and weight may emerge at a later age in males.

The lack of associations between weight and the ability to delay gratification measured by the Snack Delay task is surprising. Previous studies using delay of gratification tasks did report such relationships, especially with edible rewards, like those in the present study (Bonato & Boland, 1983; Bruce et al., 2011). Chocolate buttons were selected as the reward in the current study because they tend to be liked by children. As child liking of the reward was not formally measured, the possibility that liking may have affected associations between Snack Delay task performance and weight cannot be ruled out.

To address the possibility that the observed gender differences in impulsivity-weight links were due to underlying differences in eating behaviour, links between impulsivity and parent-reported eating behaviour and mealtime intake were explored. It was hypothesized that impulsivity would be related to food approach and avoidance behaviours as well as to mealtime intake. Contrary to these hypotheses there were no such associations between impulsivity and eating behaviour for the sample overall or when broken down by gender. Research in adults has suggested that impulsivity is associated with emotional overeating in response to negative mood and through this to increases in BMI (Davis, Strachan, & Berkson, 2004). Children in the current study did not experience a mood manipulation and were not distressed or upset during their visit at the lab, which may explain the lack of associations. Nevertheless, previous research has indicated that more impulsive children may have more difficulties in resisting highly palatable foods in general, making them more prone to eating in the absence of physiological need (Nederkoorn et al., 2006). The current findings are therefore surprising and suggest that, for 2-4-year-olds, pathways between impulsivity and eating behaviour may not be established yet or may only exist under conditions not tested by the current study (i.e. a negative mood manipulation, or absence of a caregiver). It is also possible that associations between impulsivity and eating behaviour were affected by the strong influence of parental feeding behaviours at this age. Parents do not just create their child's food environment by regulating the availability of foods in and outside of the home, but also control portion sizes and mealtime interactions that affect intake (Patrick et al., 2005).

To explore these possibilities further, potential relationships between impulsivity and parental controlling feeding practices were explored. In line with the hypotheses, parent-reported impulsivity was associated with pressure to eat in the sample overall, but specifically in females. This indicates that parents who perceive their daughters to be more impulsive also use more pressure to eat during mealtimes. It may be that more impulsive children are less focused during mealtimes and spend more time away from the table, thereby motivating their parents to use pressure to eat to increase mealtime focus and intake. Additionally, parents may be trying to encourage the intake of healthy rather than palatable but unhealthy foods by using pressure to eat (Birch et al., 2001). Previous research has indicated that contrary to parents' intentions this feeding practice can disrupt children's natural satiety responses, leading to overeating and weight gain over time, as well as to a dislike for foods that the child is pressured to eat (Galloway, Fiorito, Francis, & Birch, 2006; Van Strien & Bazelier, 2007). Detailed observations of mealtimes of children with high and low levels of impulsivity and their parents could allow insights into reasons for the observed association between impulsivity and pressure to eat.

Additionally, the results revealed that the inhibitory control facet of impulsivity was associated with restriction for weight control in the sample overall, and specifically in females. The results showed that parents of daughters who had poorer inhibitory control used less restriction to control their child's weight. This study is the first to report links between this type of restriction and behavioural impulsivity. The findings could reflect that parents perceive their restriction to have little positive impact on the eating behaviour of more impulsive children as they might be less responsive to parental requests and prohibitions (Tan & Holub, 2011). Research on the effects of restriction suggests that it can be linked with reduced intake, but can also lead to an increased preoccupation with the restricted foods (Ogden, Cordey, Cutler, & Thomas, 2013). Additionally, restriction has been linked with eating in the absence of hunger, especially in impulsive females, suggesting that it might lead to a vulnerability for overeating, especially if children have heightened impulsivity levels

(Anzman & Birch, 2009; Carper, Fisher, & Birch, 2000; Fisher & Birch, 1999). Alternatively, restriction for weight control may make children less impulsive. Recent studies have indicated that manipulations of impulsivity through inhibition tasks such as the Go/No-Go and stop-signal tasks can reduce impulsivity and also impact on eating behaviour; both tasks have been found to lead to a decrease in intake of palatable foods (Houben 2011; Houben & Jansen, 2011).

This study also explored potential moderating effects of monitoring on the relationship between impulsivity and eating behaviour. Similarly to findings by Farrow (2012), we found that monitoring moderated the relationship between impulsivity and food approach behaviour. The relationship was only observed when parents used low rather than average or high levels of monitoring. Interestingly this moderating effect of monitoring was found when impulsivity was measured through parent-report in females, but through the Line Walking task performance in males. The association between parent-reported and motor impulsivity and food approach behaviour was positive in females and males whose parents used low levels of monitoring. Our findings indicate that children high in stable, trait-like impulsivity (females) and motor impulsivity (males), whose parents monitor their intake less, may be more prone to display food approach behaviours that are associated with weight gain (Carnell & Wardle, 2007; Farrow & Blissett, 2012; Viana, Sinde, & Saxton, 2008). This is an interesting finding that deserves further investigation. Overall our findings further support the previously assumed positive effect of this controlling feeding practice on child eating behaviour in females and males (Klesges et al., 1991).

Contrary to findings in the literature we did not observe a moderating effect of controlling feeding practices on the relationship between impulsivity and child BMI z-score. Anzman and Birch (2009) found that higher levels of perceived restriction were associated with greater weight gain in females with low inhibitory control, a facet of impulsivity. The sample studied in Anzman and Birch's study was older than the sample in the current study and it may be that this moderating effect does not develop until later and in females only. Additionally, children in the study reported perceived restriction, whereas the current study relied on parent-reported controlling feeding practices.

As highlighted in previous research, parent-reported impulsivity and impulsivity task performance were not associated. Furthermore, performance scores on individual tasks were not related. This is likely to reflect the multifaceted nature of impulsivity and differences in the underlying impulsivity facets that were captured by each measure (Dougherty, Mathias, Marsh, & Jagar, 2005; Solanto et al., 2001). The observed differences in associations between parent-reported impulsivity and the individual impulsivity tasks and weight, eating and feeding variables highlight the merit of including a variety of tasks to capture impulsivity. Furthermore, the differences in associations by child gender that emerged from this research stress the value of carrying out gender analyses in future research exploring links between impulsivity and weight, eating and feeding variables.

This study has several limitations. Although the overall sample size was appropriate, sample sizes for the analyses by gender were small and a replication of our findings in larger female and male subsamples would be useful to validate these findings. Additionally, a large number of correlational analyses were conducted, which increased the family-wise error rate, and the potential for false positives. Adjusting the alpha level to .01 addressed this issue, but a more stringent cut-off for significance may have been desirable. Although the researcher attempted to engage all children in the impulsivity tasks, some children did not complete all tasks. Compliance was especially an issue for the Tower task, which was completed by the fewest children. Although this task was age-appropriate and has previously been used with children of this age group some children failed to grasp the concept of turn-taking (Kochanska et al., 1996). Importantly, there were no differences in age or gender between completers and non-completers for any of the behavioural tasks.

Our results suggest that the influence of impulsivity on weight, eating behaviour and parental feeding can mainly be detected in females at this age. Motor impulsivity was associated with elevations in females' weight, the inhibitory control facet of impulsivity was associated with less parental restriction for weight control and parent-perceived impulsivity was linked with more parental pressure to eat. This combination of factors may foster problematic eating patterns by overriding innate satiety mechanisms, without providing effective barriers to balance intake through monitoring or covert restriction. Parental monitoring, as previously suggested, emerged as an effective moderator of the relationship between food approach behaviour and parent-reported impulsivity, indicating that this feeding practice in particular may be protective against the influence of impulsivity on eating behaviour in females and males.

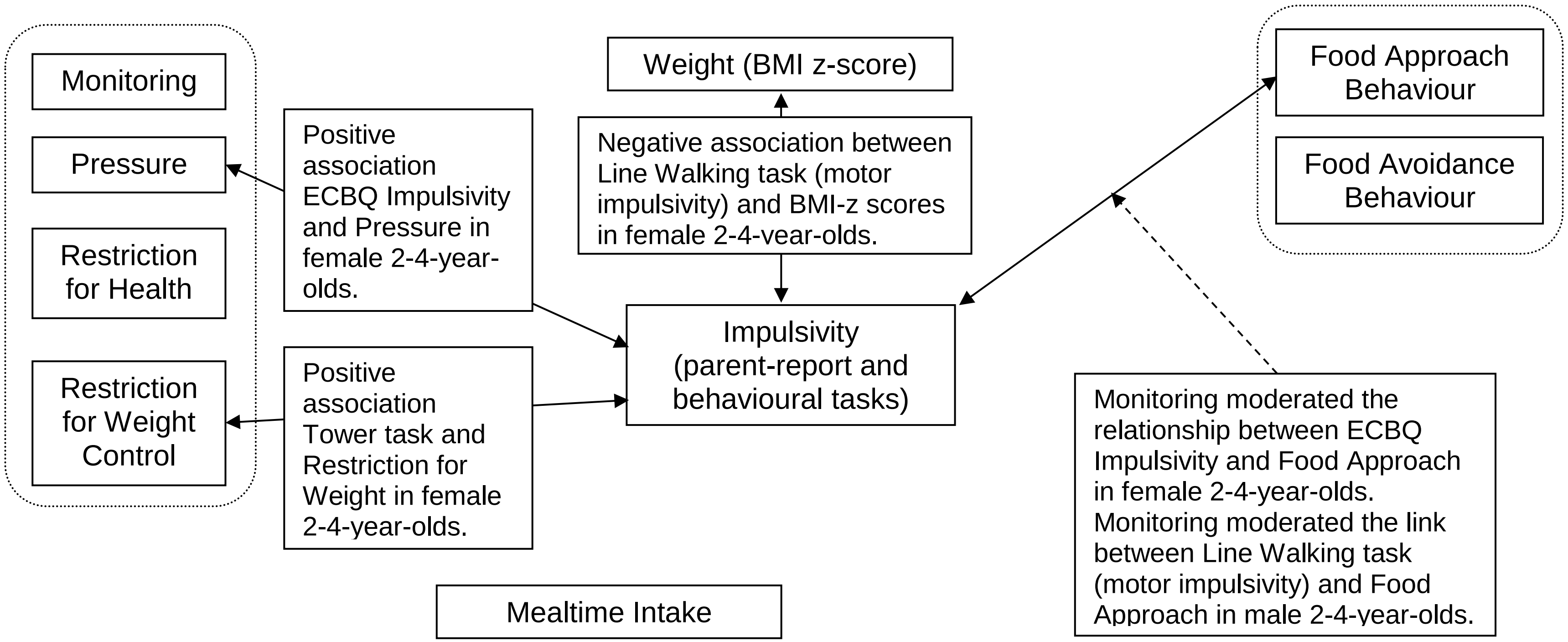


Figure 3.3. This model summarises the observed associations between impulsivity, weight, eating and feeding behaviour (solid arrows). The model also highlights the moderating effects of monitoring on the relationship between impulsivity and food approach behaviour observed in this chapter (dashed arrows). The absence of arrows indicates the lack of associations/moderations.

CHAPTER FOUR

MEALTIME INTERACTIONS AND IMPULSIVITY IN 2-4-YEAR-OLDS

4.1 Abstract

The impact of impulsivity on mealtime behaviours exhibited by children and their parents has received little attention. The current study aimed to explore mealtime behaviour differences in parents and children with low and high parent-reported impulsivity levels. Thirty-six parent-child dyads including 2-4-year-olds with low (*n*=18) and high (*n*=18) levels of impulsivity participated in this laboratory-based observational study and consumed a meal. Mealtimes were transcribed and coded. ANOVAs revealed that there were no differences in the number of disruptive mealtime behaviours displayed or the number of mouthfuls consumed by children with high and low levels of impulsivity. Children high in impulsivity made more requests for food than their less impulsive peers. Parents of children with high impulsivity levels used a greater number of instructing and pressuring strategies but made fewer reprimands. Parents of children high or low in impulsivity did not differ in their use of restriction and a range of other frequently used feeding behaviours. This study provides observational evidence for differences and similarities in the use of controlling feeding practices based on child impulsivity. The study's results and limitations are discussed

4.2 Introduction

Research has indicated that impulsivity and inhibitory control play an important role for child eating behaviour and weight regulation. Overweight and obese children and adults have been found to behave more impulsively and to have poorer inhibitory control abilities (Braet, Claus, Verbeken, & Vlierberghe, 2007; Davis, Levitan, Muglia, Bewell, & Kennedy, 2004). Similarly, early self-regulation skills in toddlers have been found to predict the risk for overweight and obesity in later childhood (Graziano, Calkins, & Keane, 2010). A range of factors such as a greater responsiveness to varied food environments (Guerrieri, Nederkoorn, & Jansen, 2007) and elevated reactivity to food cues have been proposed as possible mechanism underlying this link (e.g. Bruce et al., 2010). Environmental factors such as the availability, accessibility and variety of palatable, energy-rich foods undoubtedly play a role for a child’s obesity risk. Nevertheless, parent-child interactions during and outside of mealtimes may be particularly influential for the development of eating behaviours. Additionally, these interactions guide intake in younger children, who are not yet responsible for their own food environment (Anzman, Rollins, & Birch, 2010; Patrick, Nicklas, Hughers, & Morales, 2005). It is likely that mealtime interactions between parents and children with high and low impulsivity levels differ. Nevertheless, little is known about the potential differences in high and low impulsive children’s mealtime behaviours and their parents’ use of feeding practices

Research has shown that parents of less impulsive 3-9-year-olds were more likely to use lower levels of restriction for health but not weight to control their child’s eating behaviour (Tan & Holub, 2011). In addition, research has indicated that child impulsivity and inhibitory control moderate the relationship between parental restrictive feeding practices, general restriction, eating behaviour and the risk for weight gain over time (Anzman & Birch, 2009; Rollins, Loken, Savage, & Birch, 2014). Anzman and Birch found that child-perceived restrictive feeding at age 7 was particularly detrimental to weight gain over time (assessed up until 15 years) if females were low in parent-reported inhibitory control. Unfortunately, this study relied on child perceptions of restriction and did not involve direct mealtime observations. Furthermore, the impact of parental feeding on weight was only assessed from age 7, precluding any inference of its impact on early weight gain and eating behaviour in children. Overall, these research findings highlight that parents may use different levels of restrictive feeding practices depending on their child's inhibitory control and impulsivity levels and that the impact of these feeding strategies on weight trajectories and eating behaviours may differ depending on the child's impulsivity levels. However, observational evidence for these effects is largely missing. Observations of mealtime interactions between parent-child dyads including children with high and low levels of impulsivity may help to shed further light on the mechanisms underlying the links between impulsivity, eating behaviour and obesity risk, especially with regard to parental restriction.

Few studies have addressed associations between pressure and child impulsivity. Chapter Three within this thesis showed that parent-reported impulsivity and pressure to eat were positively associated in 2-4-year-olds. The reason for this link is not clear. Pressure to eat is often used to increase the intake of healthy foods or of food in general (Faith et al., 2004a; Faith, Scanlon, Birch, Francis, & Sherry, 2004b). Nevertheless, this feeding practice has been linked with impaired self-regulation abilities as well as with the rejection and dislike of foods that the child is pressured to eat (Galloway, Fiorito, Francis, & Birch, 2006; Van Strien & Bazelier, 2007). It is possible that parents of impulsive children use this practice to focus their children's attention on the mealtime as more impulsive children may be more likely to become distracted or to behave disruptively during mealtimes (e.g. leaving the table, fidgeting). Research on children with clinically elevated impulsivity levels and Attention Deficit Hyperactivity Disorder (ADHD), has indicated that these children find it difficult to remain seated during mealtimes (Lickteig, Isaacs, Zahor, & Hodgens, 1999). Differences in mealtime behaviours of healthy children with varying impulsivity levels that are not clinically elevated, have not yet been examined. While parental pressure may be a reaction to the child's impulsivity, the use of pressure could also lead to impulsive behaviours. A meta-analysis by Karreman, Van Tuijl, Van Aken, and Dekovic (2006) found links between greater power-assertive and over-controlling parenting and poorer self-regulation in children aged 2 to 5 years. Positive controlling parenting techniques on the other hand were linked with better self-regulation outcomes in children. These findings highlight the importance of an appropriate alignment of parenting and child behaviour and suggest that intrusive parenting is a poor fit for impulsive children with low levels of inhibitory control (Rubin, Burgess, Dwyer, & Hastings, 2003).

Finally, few other parental feeding strategies and their associations with impulsivity and inhibitory control have been investigated in children. Farrow (2012) reported that monitoring moderated the link between impulsivity and emotional eating in 10-13-year-olds. The association between both variables was only positive if parents used low levels of monitoring, suggesting that less intrusive parental feeding strategies may have a protective impact on child eating behaviour and subsequently weight gain. It remains unclear whether any protective effect of less intrusive parental feeding could potentially be observed in younger children, in the context of mealtimes and with regard to snack intake in general.

Little is known about links between impulsivity and other feeding practices like teaching, bargaining or praise, which are often used during mealtimes (Moore, Tapper, & Murphy, 2007; Orrell-Valente et al., 2007). Research should therefore investigate whether the use of these feeding practices may differ in mealtimes involving parent-child dyads, in which children have varying levels of impulsivity. As there is some evidence that over-controlling, power-assertive parenting techniques (in general and specific to eating behaviour) are detrimental to child self-regulation abilities, further insights into how these feeding practices are used by parents of children with high and low levels of impulsivity may aid the understanding of mechanisms underlying the links between impulsivity, eating behaviour and obesity risk. Additionally, further knowledge in this area may provide information to develop guidelines for parents of impulsive children, on the utility and impact of different feeding strategies on child eating behaviour.

4.2.1 Aims and hypotheses

The current study aimed to examine observed mealtime interactions between parent-child dyads where children had high or low levels of impulsivity. As the current study's sample size was small, gender differences were not explored. It was hypothesized that children with high compared to low levels of impulsivity would display more disruptive mealtime behaviours (Food Play, Fidgeting, Getting out of the Chair) and make more Food Requests (one-tailed hypotheses). Additionally, it was hypothesized that children with high and low levels of impulsivity would differ in the number of Mouthfuls consumed, Verbal/Physical Refusals and Negative Vocalisations displayed and in the Duration of their Mealtimes (two-tailed hypotheses). Furthermore, it was hypothesized that parents of children with high compared to low levels of impulsivity would differ in their feeding strategies and mealtime behaviours. Based on previous research, it was hypothesized that parents of children with high rather than low levels of impulsivity would use greater levels of Restriction, Verbal/Physical Pressure and Encouragement to Eat during mealtimes (one-tailed hypotheses). Additionally, it was hypothesized that parents of children with high rather than low impulsivity levels would use more Restraint and would check more frequently if their child had finished eating (one-tailed hypotheses). It was also hypothesized that parents of children with high and low impulsivity levels would differ in their use of Comparison, Teaching, Bargaining, Instruction (food-related), Praise (food-related), and Reprimand (two-tailed hypotheses). Finally, it was hypothesized that mealtimes including children with high and low levels of impulsivity would differ in the amount of Mealtime Conversation and Mealtime Unrelated Conversation they contained (one tailed-hypotheses; see Figure 4.1 for an overview of explored differences). The decision to use one- or two-tailed hypotheses was based on previous research and the existing evidence-base for explored effects.

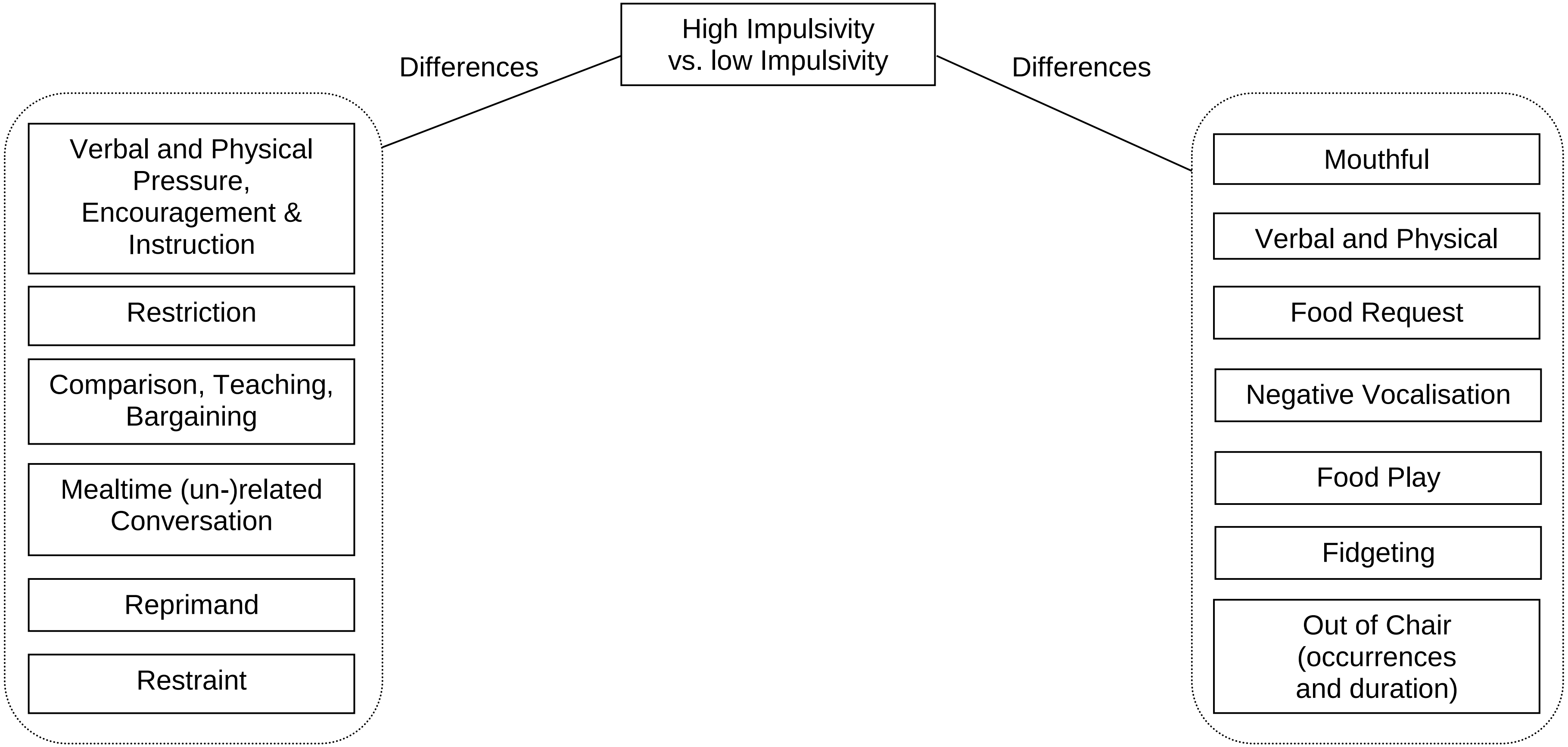


Figure 4.1. This model shows the differences in mealtime behaviours displayed by children with high and low levels of impulsivity to be explored in this chapter (child factors). This model also shows differences in mealtime behaviours and feeding practices displayed by parents of children with high and low levels of impulsivity, which will be explored (parent factors).

4.3 Method

4.3.1 Participants

A subsample of 36 of the 95 parent-child dyads previously described in Chapter Three (Section 3.3.1) were included in the current investigation. The 18 children with the highest and the 18 children with the lowest levels of parent-reported impulsivity (Early Childhood Behaviour Questionnaire [ECBQ] Impulsivity subscale; Putnam, Gartstein, & Rothbart, 2006) were selected for this chapter to maximise the difference in impulsivity levels between children in the high and low impulsivity groups. For the current sample's descriptive statistics see Section 4.4.1 (Table 4.3). For additional information on the recruitment procedures and inclusion/exclusion criteria please refer to Chapter Three (Section 3.3.1 and Table 3.1).

4.3.2 Apparatus

Recording equipment. Mealtimes were observed and recorded (see Chapter Two, Section 2.8.3 for details).

Mealtime foods and preparation. See Chapter Three, Section 3.3.2 for a description of the mealtime composition.

4.3.3 Parent-report measures and procedure

See Chapter Three, Section 3.3.3. for information on all measures capturing sample demographics, parent-reported child impulsivity and for information on the procedure.

4.3.4 Mealtime observations

An adaptation of the Family Mealtime Coding Scale developed by Haycraft and Blissett (2008) was used to code children's and parents' mealtime behaviours.

Mealtime recordings were transcribed using InqScribe software (Version 2.2; Loh, Baumgartner, & Brown, 2005), which allows the simultaneous viewing and transcribing of a video recording and the insertion of time codes, ensuring that durations of behaviours could be recorded accurately. Child and parent vocalisations and actions were coded, yielding detailed, accurate representations of the mealtimes. An experienced researcher coded all occurrences of behaviours and durations of certain behaviours that were observed during the mealtimes.

Children's mealtime behaviours were grouped into nine categories: Mouthful, Verbal Refusal, Physical Refusal, Food Request, Food Play, Fidgeting, Negative Vocalisation, Out of Chair (occurrence), Out of Chair (duration). Detailed descriptions and corresponding examples for all child behaviours can be seen in Table 4.1. Parental mealtime behaviours and feeding strategies were grouped into 16 categories: Mealtime Conversation, Mealtime Unrelated Conversation, Mealtime Termination, Comparison, Teaching, Bargaining, Restriction, Pressure (face), Pressure (hand), Pressure (plate), Verbal Pressure, Verbal Encouragement, Instruction (food-related), Praise (food-related), Reprimand, Restraint. Detailed descriptions and corresponding examples for all parental mealtime behaviours and feeding strategies can be seen in Table 4.2. Additionally, the mealtime duration was recorded.

Secondary coding. A trained, independent second observer coded a randomly selected subsample of 11.1% (*n*=4) of mealtime transcripts and recordings. Inter-rater reliability was established by calculating Intra-Class Correlation coefficients on absolute values for all variables using SPSS version 20 statistical software. Intra-

Class Correlation coefficients ranged from .71-1, indicating good reliability for the coding of the child and parent mealtime behaviours.

Table 4.1

Descriptions of children's mealtime behaviours observed and coded during mealtimes

Mealtime behaviour	Description	Example
Mouthful*	Any occurrence of the child putting food into the mouth, chewing it and swallowing it.	
Verbal Refusal	Vocalisations indicating that the child does not want to eat a certain food or no more food in general.	I don't like …(food)... Ewww/yuk. Mummy eat them. I don't want anymore.
Physical Refusal	Physical behaviours or movements indicating that the child does not want to eat a certain food or no more food in general.	Throwing food, pushing the plate away, spitting food out or taking it out of the mouth, blocking the mother's hand or turning the body/head away or leaving the table when physically pressured to eat.
Food Request	The child demands/requests some of the mother's food.	I want some of your chocolate. Child tries to take mother's grape. Can I have some of your cheese?
Food Play	Child plays with the food on the plate/table/floor. Does not include taking sandwich apart.	Squashes/squeezes food with finger. Rolls grape on table. Dipping food into water. Juggling food.

Mealtime behaviour	Description	Example
Fidgeting	Child fidgets in chair but not to avoid eating (see physical refusal).	Kicking table, jumping on chair, climbing on chair, dancing in chair.
Negative Vocalisation	Any negative utterance made during the mealtime. Does not include negative comments made about any foods (see verbal refusal).	Crying, screaming, moaning
Out of Chair (occurrence)	Any occurrence of the child getting out of the chair. Does not include the child standing up by the table to eat.	The child getting out of the chair to walk around, sit at a different table, in a different chair, to sit on the mother's lap, to play with toys on the floor, to inspect the room.
Duration out of Chair (duration in s)	Duration: child out of chair until child back in chair, fully seated.	

Notes. *The overall number of mouthfuls consumed during the mealtime was recorded. Mouthfuls per minute were additionally calculated to establish the intake rate (total number of mouthfuls divided by mealtime duration in minutes).

Table 4.2

Descriptions of parental mealtime behaviours and feeding strategies observed and coded during mealtimes

Mealtime behaviour	Description	Example
Mealtime Conversation	Any conversation with a topic related to the mealtime (e.g. sensory and visual properties of the food, or its quantity) initiated by the mother or the child. As child utterances were occasionally unintelligible maternal responses were coded in those instances instead.	What else is on your plate? How many cookies have you got? It's really sweet/spicy. What does it taste/smell like? It smells like…? Does it taste nice? It's a yummy/tasty lunch isn't it? It's hot/cold. It's sticky/wet/soft. The grapes are very juicy, aren't they? It's crispy/crunchy. It feels prickly.
Mealtime Unrelated Conversation	Any conversation with a topic unrelated to the mealtime initiated by the mother.	Where would you like to go this afternoon? What did you and Daddy do yesterday?
Mealtime Termination	Checking if the child has finished eating.	Have you finished? Are you full up? Have you had enough? Do you want any more food? Are we done?
Comparison	Comparing a food to a present or non-present food.	These grapes look like little apples. It tastes like pineapple.
Teaching	Teaching the child about a food. What it is, where it comes from, whether it's (un-) healthy etc.	Grapes are good for you. Crisps are made from potatoes.

Mealtime behaviour	Description	Example
Bargaining	Attempts to encourage the child to eat food A by promising food B or an activity in return.	If you eat your sandwich you can have one of Mummy's chocolate buttons. If you have one more bite you can go and play with the toys.
Restriction	Restricting the child's access to certain foods overall or until a certain point in the mealtime by verbal or physical means. The child may be aware or unaware of restriction.	These are for pudding. One cookie is enough. You've had enough crisps now. Taking food out of the child's hand or mouth or removing food from the child's plate (during or prior to the start of the mealtime) and placing it on the table, cupboard, in a napkin, on the mother's own plate. Turning the plate so the child cannot reach certain foods.
Pressure (face)	Any physical attempts to encourage consumption by bringing the food closer to the child's face.	Holding a sandwich up so the child can take a bite.
Pressure (hand)	Any physical attempts to encourage consumption by placing the food into the child's hand.	Holding the child's hand and placing a sandwich into it.

Mealtime behaviour	Description	Example
Pressure (plate)	Any physical attempts to encourage consumption by placing the food onto the child's plate, turning the plate or by moving the plate closer.	Placing a grape back onto the child's plate after he/she put it onto the mother's plate.
Verbal Pressure	Telling the child to eat, smell, lick, or touch the food. Forceful (raised) tone of voice.	Eat your sandwich! Come on, have a grape. Chew it up. Swallow it! Bite it. Pick it up. Give it a sniff.
Encouragement	Verbally encouraging the child to eat, lick, smell, touch or generally engage with the food. Usually phrased as a question or gentle request. Normal loudness and non-forceful tone of voice. Does not involve telling the child to eat, lick, smell or touch a food (see verbal pressure).	Would you like some of your sandwich? How about some grapes? Would you like to try some cookie? Can you smell/touch it for me?
Instruction (food-related)	Telling the child how to eat or interact with the food.	Leave it by the side of your plate. Hold you sandwich with two hands. Put it on your plate please. Chew it properly.
Praise (food-related)	Verbally or physically praising the child for eating food.	Well done (for trying). That's a good girl/boy. Mummy is so proud of you. High-five. Stroking the child.

Mealtime behaviour	Description	Example
Reprimand	Telling the child off for their behaviour.	You are not listening very well, are you? Stop playing with your food! That's naughty!
Restraint	Asking the child not to get out of the chair/leave the table, not to walk/run. Telling the child to come back/sit back down. Physically preventing the child from getting out of the chair, leaving the table, walking/running around by holding/carrying the child. Does not include preventing the child from eating any foods (see restriction).	Come back to your seat. Sit down (please). You can get up when we are finished with our lunch, let's finish it first. Picking the child up and putting him/her back into the chair. Walking the child back to the table. Holding the child down on the lap by wrapping arm/s around him/her.

4.3.5 Data analysis

SPSS version 20 statistical software was used to analyse the data. The criterion alpha for significance was .05 and histograms were inspected, indicating that the majority of data were normally distributed. Initially descriptive statistics for child impulsivity were calculated and potential differences in child age, BMI z-score, family annual income, education and gender as well as ethnicity between the high and low impulsivity samples were explored using independent samples *t*-tests and Chi-squared analyses. The impact of potential covariates like child age, BMI z-score, maternal BMI, education level and family annual income on child and parent mealtime behaviours was assessed. ANOVAs, controlling for covariates as appropriate, were carried out to examine potential differences in child and parent mealtime behaviours in the high and low impulsivity samples.

4.4 Results

4.4.1 Descriptive statistics

Parent and child demographic characteristics. Table 4.3 shows the demographic characteristics of the sample overall and of the high and low impulsivity subsamples separately. Thirty-four mothers and two fathers attended with their children. Parent-reported impulsivity scores on the ECBQ in the current sample ranged from 2.8 to 6.6 (M=4.92, SD=.94). Similar impulsivity scores have previously been reported for non-clinical groups of American and Italian children aged 18 to 36 months (Cozzi et al., 2013; Putnam et al., 2006). The high and low impulsivity samples did not differ in child age ($t(34)=1.01$, $p=.32$), parent income ($t(34)=1.21$, $p=.23$) or education ($t(34)=.94$, $p=.35$). There were also no differences in gender ($\chi^2=(1, N=36)=.11$, $p=.74$) or ethnicity ($\chi^2=(2, N=36)=2$, $p=.37$) between samples. Children differed in ECBQ Impulsivity ($t(34)=-9.35$, $p<.001$) and in child BMI z-score ($t(33)=-2.76$, $p=.01$), with children in the high impulsivity sample being more impulsive and heavier than those in the low impulsivity sample.

The sample of dyads that was selected for the video analysis and the overall sample of dyads, differed in child gender composition, parent education, income and ethnicity but not in child age, BMI z-score or impulsivity measured by the ECBQ (see Appendix C-4).

Table 4.3

Demographic characteristics, including means and SDs of age (in months), BMI z-score and impulsivity, of the sample overall (N=36) and of the high (n=18) and low (n=18) impulsivity samples separately

	Overall	Low Impulsivity	High impulsivity
Child Gender	19 female, 17 male	9 female, 9 male	10 female, 8 male
Child Age	29.5 (5.94)	30.5 (6.09)	28.5 (5.77)
Range	23 - 45	23 - 45	23 - 42
Child BMI z-score	.56 (1.04)	.15 (.79)	1.03 (1.11)
Range	-1.53 - 3.62	-1.53 - 1.35	-.93 - 3.62
Parent Education	33.3% Post-graduate qualification (*n*=12) 36.1% University graduate (*n*=13) 11.1% A-Levels (*n*=4) 13.9% GCSEs (*n*=5) 2.8% Some secondary education (*n*=1) 2.8% Other (*n*=1)	38.9% Post-graduate qualification (*n*=7) 38.9% University graduate (*n*=7) 16.7% A-Levels (*n*=3) 5.6% GCSEs (*n*=1) 0% Some secondary education (*n*=0) 0% Other (*n*=0)	27.8% Post-graduate qualification (*n*=5) 33.3% University graduate (*n*=6) 5.6% A-Levels (*n*=1) 22.2% GCSEs (*n*=4) 5.6% Some secondary education (*n*=1) 5.6% Other (*n*=1)
Parent Income	11.1% > £75000 (*n*=4) 19.4% £60-75000 (*n*=7) 27.8% £45-60000 (*n*=10) 16.7% £30-45000 (*n*=6) 22.2% £15-30000 (*n*=8) 2.8% < £15000 (*n*=1)	16.7%> £75000 (*n*=3) 16.7% £60-75000 (*n*=3) 33.3% £45-60000 (*n*=6) 16.7% £30-45000 (*n*=3) 16.7% £15-30000 (*n*=3) 0% < £15000 (*n*=0)	5.6% > £75000 (*n*=1) 22.2% £60-75000 (*n*=4) 22.2% £45-60000 (*n*=4) 16.7% £30-45000 (*n*=3) 27.8% £15-30000 (*n*=5) 5.6% < £15000 (*n*=1)

	Overall	Low Impulsivity	High impulsivity
Ethnicity	94.4% White British (*n*=34) 2.8% Black British (*n*=1) 2.8% Asian/Asian British (*n*=1)	94.4% White British (*n*=17) 5.6% Asian/Asian British (*n*=1)	94.4% White British (*n*=17) 5.6% Black/Black British (*n*=1)
ECBQ Impulsivity	4.92 (.94)	4.13 (.6)	5.71 (.38)

4.4.2 Covariates

Pearson's correlations were carried out to assess associations between impulsivity and child and parent mealtime behaviours, mealtime duration and confounding variables such as child age, BMI z-score, maternal BMI and family annual income. Based on previous research it was hypothesized that child impulsivity would be associated with child age and family annual income, while child and parent mealtime behaviours observed during the mealtime would be associated with child age, BMI-z score, maternal BMI and family annual income. It was additionally examined whether mealtime duration was associated with child or parent mealtime behaviours; it was hypothesized that longer mealtimes would be associated with a greater frequency of all behaviours.

The analyses indicated that impulsivity was not associated with any of the potential confounds (Table 4.4). Nevertheless, there was a significant difference in child BMI z-score between the high and low impulsivity groups (see Section 4.4.1). All analyses therefore controlled for child BMI z-score.

The child mealtime behaviours Fidgeting as well as Mealtime Duration were positively associated with annual income, while Food Requests were negatively associated with annual income (Table 4.4). All analyses examining differences in these child mealtime behaviours and in Mealtime Duration therefore controlled for annual income. Physical Refusal of food was positively associated with child BMI z-score; analyses looking at differences in physical refusal controlled for child weight.

The parent mealtime behaviours and feeding strategies Teaching, Verbal Pressure, Instruction (food-related) and Praise (food-related) were positively associated with child age, suggesting that parents of older children used these strategies more frequently during mealtimes than parents of younger children (Table 4.5). All analyses looking at differences in these behaviours in the high and low impulsivity samples controlled for child age. Additionally, Mealtime Conversation was positively associated with annual income, while Mealtime Unrelated Conversation was positively associated with child BMI z-score; analyses looking at differences in these conversations between groups controlled for these variables accordingly.

Finally, Mealtime Duration was positively associated with the overall number of Mouthfuls children consumed during the mealtime and with the Mouthfuls per minute; children consumed more Mouthfuls and at a faster rate in longer mealtimes (Table 4.4). Mealtime Duration was also positively associated with the parent mealtime behaviours and feeding strategies Comparison and Encouragement, as well as with Mealtime Unrelated Conversation and Mealtime Conversation, indicating that a greater number of these behaviours were observed during longer mealtimes (Table 4.5). All analyses examining difference between samples in these behaviours therefore controlled for Mealtime Duration.

Table 4.4

Correlations between impulsivity, child mealtime behaviours and mealtime duration and potential confounds

	Child BMI z-score	Child age	Maternal BMI	Annual Income	Mealtime duration
ECBQ Impulsivity	.32	-.21	.05	-.03	-.16
Mouthful	-.1	.14	.23	.32	.41*
Number of mouthfuls per minute	-.1	.14	.23	.32	.41*
Verbal Refusal	.21	.21	.11	.27	.18
Physical Refusal	.37*	-.02	-.16	-.04	-.03
Food Request	.32	-.03	-.17	-.34*	-.29
Food Play	.04	.19	.33	-.07	.18
Fidgeting	-.17	.02	-.12	.34*	-.01
Negative Vocalisation	-.003	-.3	.08	-.02	.06
Out of Chair (occurrence)	.09	-.23	-.09	-.04	.08
Out of Chair (duration, s)	.21	-.31	-.15	-.03	.26
Mealtime Duration	-.11	-.03	.3	.35*	-

*p<.05

Table 4.5

Correlations between parent mealtime behaviours and feeding strategies and potential confounds

	Child BMI z-score	Child age	Maternal BMI	Annual Income	Mealtime duration
Mealtime Conversation	-.04	.09	.33	.34*	.34*
Mealtime Unrelated Conversation	.38*	.04	.05	.12	.35*
Mealtime Termination	-.24	-.21	-.22	-.04	.04
Comparison	-.1	.11	.28	.32	.49**
Teaching	.27	.42*	.31	.17	.16
Bargaining	.001	.32	-.19	.1	.11
Restriction	-.1	.09	-.23	.01	-.004
Pressure (face)	-.09	-.25	-.16	.06	-.09
Pressure (hand)	.27	-.08	-.09	-.03	.07
Pressure (plate)	.13	.13	.06	-.09	.04
Verbal Pressure	-.13	.43**	.05	-.22	-.16
Verbal Encouragement	.14	-.26	.17	.23	.36*
Instruction (food-related)	-.04	.62**	-.11	-.17	.14
Praise (food-related)	.08	.39*	-.15	-.07	.003
Reprimand	.09	.1	.31	-.11	.2
Restraint	-.04	-.26	.03	-.29	-.09

$^{*}p<.05$, $^{**}p<.01$

4.4.3 Differences in mealtime duration and child mealtime behaviours by impulsivity group.

Initially it was assessed whether there were differences in mealtime duration between children with low compared to high levels of impulsivity. An ANCOVA controlling for annual income and child BMI z-score showed that there was no difference in mealtime duration between children in the low (M=25.71, SD=6.06) and high (M=21.58, SD=6.04) impulsivity samples ($F(1, 31)=2.91$, p=.1, partial η^2=.09).

Secondly, it was assessed whether there were differences in the number of mealtime behaviours children in the high and low impulsivity samples displayed. ANCOVAs controlling for child BMI z-score, annual income and mealtime duration where appropriate showed that children with high and low impulsivity levels did not differ in the number of Mouthfuls overall or the number of Mouthfuls per minute they consumed during the mealtime. Additionally, children did not differ in the number of Verbal and Physical Refusal behaviours, Food Play, Fidgeting or Negative Vocalizations. Finally, children did not differ in the number of times they left the table during the mealtime (Out of Chair, occurrence) or in the overall duration they spent away from it (Out of Chair, duration). There was a significant difference in the number of Food Requests children with high and low levels of impulsivity made during a mealtime; children with high levels of impulsivity made more Food Requests than children with low levels of impulsivity (see Table 4.6).

Table 4.6

Means and SD of mealtime behaviours observed in children with high and low impulsivity levels and results of analyses assessing differences in their frequency between groups

Mealtime behaviour	Low impulsivity	High impulsivity	ANCOVA+
Mouthful~	55.94 (27.01)	43.77 (18.7)	$F(1, 31)=.48$, $p=.5$, partial $\eta^2=.02$
Number of mouthfuls per minute~	.93 (.45)	.72 (.31)	$F(1, 31)=.48$, $p=.5$, partial $\eta^2=.02$
Verbal Refusal	9.61 (5.71)	8.71 (6.94)	$F(1, 32)=1.16$, $p=.29$, partial $\eta^2=.04$
Physical Refusal	8.89 (6.03)	12.59 (10.12)	$F(1, 32)=.18$, $p=.67$, partial $\eta^2=.01$
Food Request^*	.78 (1.21)	2.94 (2.56)	$F(1, 31)=5.6$, $p=.01$, partial $\eta^2=.15$
Food Play*	3.22 (2.76)	3.12 (2.98)	$F(1, 32)=.05$, $p=.42$, partial $\eta^2=.001$
Fidgeting^*	1.17 (1.58)	1.41 (2.18)	$F(1, 31)=1.55$, $p=.11$, partial $\eta^2=.05$
Negative Vocalisation	.72 (1.27)	1 .06 (1.64)	$F(1, 32)=.57$, $p=.46$, partial $\eta^2=.02$
Out of Chair (occurrence)*	3.61 (4.65)	4.18 (4.33)	$F(1, 32)=.02$, $p=.44$, partial $\eta^2=.001$
Out of Chair (duration, s)^*	109.89 (178.75)	227.24 (352.78)	$F(1, 32)=.63$, $p=.22$, partial $\eta^2=.02$

+ Controlling for child BMI z-score, ^ controlling for annual income, ~ controlling for mealtime duration, * one-tailed hypothesis

4.4.4 Differences in parent mealtime behaviours and feeding strategies by impulsivity group.

It was also assessed whether there were any differences in the number of the different mealtime behaviours and feeding strategies that parents of children with high and low levels of impulsivity displayed. ANCOVAs controlling for child BMI z-score, child age, annual income and mealtime duration where appropriate showed that there were a number of similarities and differences in the number of mealtime behaviours and feeding strategies displayed by parents of children with low and high levels of impulsivity (see Table 4.7). Mealtimes of parent-child dyads where children had high or low impulsivity levels did not differ in the amount of Mealtime Conversation, Mealtime Unrelated Conversation or Mealtime Termination that parents engaged in. Parents of children with high levels of impulsivity made a greater number of attempts to encourage intake through Pressure (plate), but not Pressure (hand or face) than parents of children with low levels of impulsivity. Parents of children high in impulsivity also used more Verbal Pressure, and food-related Instruction than parents of children with low impulsivity levels; there was no difference in the amount of Verbal Encouragement to eat parents used. Furthermore, parents of children with low levels of impulsivity used a greater number of Reprimands during mealtimes than parents of children with high levels of impulsivity. Finally, parents of children with low and high impulsivity levels did not differ in their use of Comparison, Teaching, Bargaining, Restriction, food-related Praise or Restraint.

Table 4.7

Means and SD of mealtime behaviours and feeding behaviours observed in parents of children with high and low impulsivity levels and results of analyses assessing differences in their frequency between groups

Mealtime behaviour	Low impulsivity	High impulsivity	ANCOVA+
Mealtime Conversation~-	27.11 (16.87)	20.41 (11.39)	F(1, 30)=.41, p=.53, partial η^2=.01
MT Unrelated Conversation~	9.94 (7.13)	9.59 (7)	F(1, 31)=.28, p=.6, partial η^2=.01
Mealtime Termination*	4.28 (4.68)	2.53 (2.15)	F(1, 32)=.78, p=.19, partial η^2=.02
Comparison~	1.22 (1.59)	1.24 (1.52)	F(1, 31)=1.99, p=.17, partial η^2=.06
Teaching^	3 (2.81)	2.47 (2.04)	F(1, 31)=.77, p=.39, partial η^2=.02
Bargaining	2.06 (2.31)	1.35 (1.77)	F(1, 32)=1.22, p=.28, partial η^2=.04
Restriction*	2.22 (3.14)	1.59 (4.64)	F(1, 32)=.07, p=.4, partial η^2=.002
Pressure (face)*	4.17 (7.81)	2.47 (2.43)	F(1, 32)=.49, p=.25, partial η^2=.02
Pressure (hand)*	1.06 (1.21)	1 (1.54)	F(1, 32)=.8, p=.19, partial η^2=.02

Mealtime behaviour	Low impulsivity	High impulsivity	ANCOVA+
Pressure (plate)*	4.44 (3.73)	8.53 (6.4)	$F(1, 32)=4.7$, $p=.02$, partial $\eta^2=.13$
Verbal Pressure^*	12.72 (9.65)	17 (14.01)	$F(1, 31)=8.27$, $p=.004$, partial $\eta^2=.21$
Verbal Encouragement~*	13.72 (10.05)	12.88 (8.51)	$F(1, 31)=0$, $p=1$, partial $\eta^2=0$
Instruction (food-related)^	2.94 (2.44)	3.35 (4.4)	$F(1, 31)=5.07$, $p=.03$, partial $\eta^2=.14$
Praise (food-related)^	5.06 (5.41)	5.24 (5.12)	$F(1, 31)=.51$, $p=.48$, partial $\eta^2=.02$
Reprimand	2.28 (2.24)	1.18 (1.07)	$F(1, 32)=5.52$, $p=.03$, partial $\eta^2=.15$
Restraint*	4.44 (8.14)	6.53 (7.05)	$F(1, 32)=1.01$, $p=.16$, partial $\eta^2=.03$

+ Controlling for child BMI z-score, ^ controlling for child age, ~ controlling for mealtime duration, - controlling for annual income, * one-tailed hypothesis

4.5 Discussion

Few studies have explored the potential impact of impulsivity on the mealtime behaviours of children with high and low levels of impulsivity and their parents (e.g. Anzman & Birch, 2009). The current study therefore aimed to explore potential differences in a range of different child and parent mealtime behaviours through observation, while taking child impulsivity into account. The results showed that there were no differences in disruptive mealtime behaviours (Food Play, Fidgeting, Negative Vocalisations, Out of Chair occurrences and duration) displayed by children with high or low levels of impulsivity and that there were no differences in Mealtime Duration or number of Mouthfuls and intake rate by impulsivity group. Children with high rather than low levels of impulsivity made more Food Requests during mealtimes. Parents of children with high rather than low levels of impulsivity used more Pressure and food-related Instruction during mealtimes, while also Reprimanding their children less. Parents did not differ in their use of Comparison, Teaching, Bargaining, Restriction, food-related Praise or Restraint during mealtimes (see Figure 4.2 for an overview of observed differences).

It was hypothesized that children with high compared to low impulsivity levels would display more disruptive mealtime behaviours. The results of the present study did not confirm this hypothesis. Children with high levels of impulsivity did not leave the table more frequently and did not spend more time away from it during mealtimes than their less impulsive peers. Limited previous research has suggested that children with clinically elevated levels of impulsivity find it harder to sit at a table during a mealtime (Lickteig et al., 1999). Additionally, children with high and low levels of impulsivity did not differ in the frequency with which they displayed fidgeting behaviours (e.g. kicking the table while seated, jumping on the chair, climbing on the chair, dancing in the chair) or with which they made negative vocalisations (e.g. crying, screaming/shouting) or displayed food play. It is important to stress that the children participating in this study did not have clinically elevated impulsivity levels or diagnosed impulsivity-related disorders. Children rated as high in impulsivity had an average score of 5.71 out of 7 on the ECBQ, while children rated as low in impulsivity scored 4.13. Impulsivity scores on this measure have been reported to range from 4.09 to 5.99 in Italian and US samples of children aged 18 to 36 months (Cozzi et al., 2013; Putnam et al., 2006). This indicates that the ECBQ values obtained for children in the current study are representative of those of children in a similar age range. It is possible that the impulsive children in this study were not impulsive enough or that the difference in impulsivity scores between children rated as high and low in impulsivity was not large enough to observe differences in disruptive mealtime behaviours.

To the best of the author's knowledge this is the first study to investigate potential differences in mealtime duration based on child impulsivity. Research has indicated that toddlers who are picky/fussy eaters eat more slowly during mealtimes (Reau, Senturia, Lebailly, & Christoffel, 1996). Results from the current study showed that there were no differences in the duration of mealtimes of children with high or low levels of impulsivity. Additionally, there was no difference in children's verbal or physical refusal of foods offered during mealtimes. While the current study did not focus on picky/fussy eating behaviours exhibited by children with different impulsivity levels it would be interesting to explore differences in these tendencies.

In addition to a lack of differences in mealtime duration, there were also no differences in the overall number of mouthfuls or in the number of mouthfuls per minute that children consumed during mealtimes. Research into the link between intake rate and obesity risk has indicated that these factors may be associated with an increased risk for the development of overweight and obesity in children (Berkowitz et al., 2010). Adding to this body of research the results of the current study suggest that impulsivity does not affect intake rate in 2-4-year-olds and that intake rate does not provide an explanation for potential differences in weight or obesity risk between children with high and low levels of impulsivity. Other factors such as meal or snack frequency or food type may be more important in explaining such differences.

Interestingly, children with high compared to low levels of impulsivity made more requests for additional food during mealtimes. Previous research has suggested that impulsive individuals are more reactive to their food environment and prone to overeating if they are presented with a variety of palatable food choices (Haws & Redden, 2013; Guerrieri, Nederkoorn, & Jansen, 2008b). As previous research has only assessed the impact of variety on the intake of snacks rather than in the context of a mealtime it is unclear whether the findings can be extended to the mealtime context. It would be interesting to establish whether impulsive children made more requests for the palatable, energy-dense foods such as the cookies, chocolate buttons and crisps, rather than for the grapes or the sandwich, which all formed part of the meal. Due to the small sample size it was not possible to explore this in the current study. Future research should therefore replicate the current study using a larger sample, while taking the food type for which requests are made into account.

Furthermore, it was hypothesized that parents of children with high compared to low levels of impulsivity would differ in their mealtime behaviours and feeding strategies. In line with this hypothesis, parents of children with high compared to low levels of impulsivity used more food-related instruction, more pressure to eat by repeatedly placing rejected food back onto the child's plate and more verbal pressure. The results of the current study showed that global parent-perceived child impulsivity affected eating behaviour specific, controlling parenting during a mealtime. These differences were found despite all analyses controlling for child BMI z-score, suggesting that parents of more impulsive children used these practices irrespective of their child's weight status. A positive link between pressure to eat and impulsivity was also found in Chapter Three within this thesis. It was hypothesized that in line with previous research indicating that parents use this practice to increase general intake or intake of healthy foods, parents may use pressuring feeding strategies to focus their impulsive children's attention on the mealtime, thereby increasing intake (Fisher, Mitchell, Smiciklas-Wright, & Birch, 2002; Moore et al., 2007; Orrell-Valente et al., 2007; Scaglioni, Salvioni, & Galimberti, 2008). In contrast to the intention with which this feeding practice is used, pressure to eat has been linked with food refusal, lower fruit and vegetable intake and a dislike for the food that the child is pressured to eat (Galloway et al., 2006; Fisher et al.). Additionally, pressure to eat has been linked with poor self-regulation and problematic eating behaviours in children (Carper, Fisher, & Birch, 2000; Fox, Devaney, Reidy, Razafindrakoto, & Ziegler, 2006; Scaglioni et al.; Van Strien & Bazelier, 2007). These findings indicate that the use of pressure to eat in children with high levels of impulsivity could lead to weight gain over time and may be detrimental to the development of healthy eating behaviours. By using higher levels of pressure to eat during mealtimes parents of more impulsive children could teach their children to gradually override their internal satiety mechanisms and to consume food due to external and emotional stimuli. Higher levels of pressure to eat in combination with more requests for additional food made by more impulsive children could have a cumulative effect on energy ingestion over time. The effects of this may not be displayed until later in life, as an immediate impact could not be observed in the current study, with impulsive children not consuming a greater number of mouthfuls during mealtimes. Mealtimes consumed by parents and children with high and low levels of impulsivity did not differ in the amount of mealtime conversation and mealtime unrelated conversation that occurred, indicating that there were no differences in the way in which dyads interacted verbally during mealtimes. Furthermore, these findings suggest that impulsivity did not affect the focus (food-related conversations vs. non-food-related conversations) of verbal mealtime interactions. Parents of children with low and high levels of impulsivity did not differ in their use of food-related praise; parents of children with high levels of impulsivity reprimanded their children less, indicating that children experienced a similar amount of positive reinforcement for their mealtime behaviour and that parental tone and attitude was not negatively affected by child impulsivity.

Similarly, parents did not differ in their use of restraint during mealtimes. As children did not differ in the frequency with which they left the table or in the overall time they spent away from it this is hardly surprising. In contrast to the hypothesis, parents of children with low and high impulsivity levels did not differ in their use of strategies aimed at increasing a child's engagement with food (Comparison, Teaching, Bargaining; e.g. Moore et al., 2007).

Contrary to the hypothesis, parents of children with high and low levels of impulsivity did not differ in their use of restriction during the mealtime. This is surprising, as previous research and results within this thesis have indicated that impulsivity and restriction for health are positively associated (Tan & Holub, 2011). The present results may be due to previously reported difficulties in observing covert control, which may be due to social desirability biases (Orrell-Valente et al., 2007). Additionally, it may be possible that restriction is more likely to be observed in the context of snack food ingestion rather than during a meal or when parents are particularly concerned about their child's eating behaviour or weight gain (Blissett & Haycraft, 2011; Fisher & Birch, 1999).

This study is not without limitations. Firstly, the sample size was small, which meant that food-type and gender analyses could not be carried out. Nevertheless, much of the research linking parental feeding strategies and child eating behaviour in the context of impulsivity has found effects for females. Secondly, the observational approach of this study may have led to changes in parent-behaviours during mealtimes due to social desirability biases. This could have particularly affected the use of restriction. Thirdly, the current study did not assess a number of other important parent and child mealtime behaviours such as modelling or monitoring of intake, attempts to change attitudes to food or child distractibility (Moore et al., 2007). Future research should therefore extend the assessment of dyadic mealtime interactions in more and less impulsive children to these and other behaviours.

Finally, children were categorised into high and low impulsivity groups based on the median-split of the overall sample's ECBQ score. Nevertheless, differences in categorisation may have arisen if behavioural impulsivity had been selected to categorise children into high and low impulsivity groups. Ultimately, the ECBQ was chosen as this measure was completed for all children who participated in this research study, while there were variations in the number of children who completed the different impulsivity tasks.

Despite these limitations this study provides observational evidence for similarities and differences in the mealtime behaviours displayed by children with high and low levels of impulsivity and their parents. Our results suggest that there are few differences in children's mealtime behaviours; children did not differ in disruptive mealtime behaviours or mealtime intake. Children with high levels of impulsivity made more requests for additional food. There were some differences in parent mealtime behaviours and feeding strategies, as parents of children with high compared to low levels of impulsivity used instructing and pressuring strategies more frequently during mealtimes. As these strategies have been linked with the development of problematic eating behaviours it appears important to ensure that parents are aware of the impact of their feeding behaviour, especially if their child is impulsive.

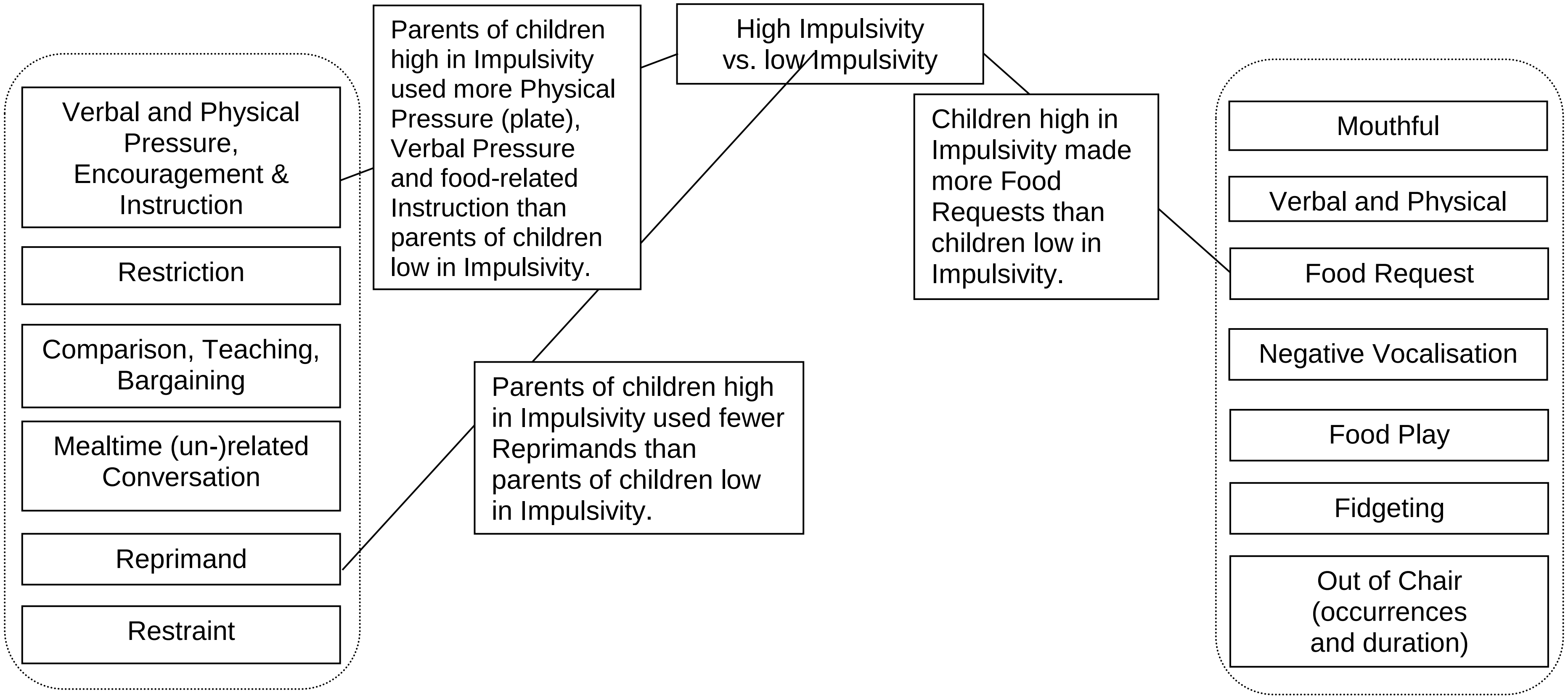


Figure 4.2. This model summarises the differences in mealtime behaviours displayed by children with high and low levels of impulsivity that were observed in this chapter (child factors). This model also shows differences in mealtime behaviours and feeding practices used by parents of children with high and low levels of impulsivity, which were observed (parent factors). Solid lines indicate observed differences, while the lack of lines indicates the absence of observed differences.

CHAPTER FIVE

IMPULSIVITY, EATING AND FEEDING BEHAVIOUR IN 7-11-YEAR-OLDS

5.1 Abstract

Impulsivity has been shown to impact on body weight in children and adults. Few studies have examined links between impulsivity, eating behaviour and parental feeding strategies using a range of behavioural impulsivity and parent-report tools. The present study aimed to establish whether there are links between impulsivity, eating and feeding variables, using a variety of impulsivity measures. Fifty 7-11-year-olds completed four behavioural impulsivity tasks (Go/No-Go task, Door Opening task, Circle Drawing task, Delay Discounting task). Their parents completed two parent-report measures of child impulsivity and functioning. Pearson's correlations revealed positive links between impulsivity, weight, parental pressure, and dietary restraint, especially in the male subsample. Impulsivity and snack intake as well as parental restriction for health were positively linked in the female subsample. Monitoring emerged as a moderator of the relationships between impulsivity and dietary restraint, while it also moderated the relationship between impulsivity and weight in the male subsample, suggesting that a lack of monitoring may be detrimental to weight control in males. The study's findings and limitations are discussed.

5.2 Introduction

As previously outlined (see Chapter One, Section 1.3) childhood obesity and its associated health complications are a major health concern in the UK and around the world. Impulsivity and inhibitory control have been identified as potential vulnerabilities for weight gain and obesity while also being possible targets for interventions in children and adults. Research with young children has indicated that impulsivity levels measured through inhibitory control, reward sensitivity and delay of gratification tasks as well as through parent-report measures of child impulsivity are associated with the risk for overweight and obesity during later childhood and adolescence (Francis & Susman, 2009; Graziano, Calkins, & Keane, 2010; Seeyave et al., 2009).

Research has highlighted relationships between early impulsivity levels and inhibitory control capacities and child weight (Thamotharan, Lange, Zale, Huffhines, & Fields, 2013). Additionally, studies have indicated that obese children have higher impulsivity levels than their healthy weight peers and that success in weight reduction programmes is affected by underlying impulsivity levels (Braet, Claus, Verbeken, & Van Vlierberghe, 2007; Bruce et al., 2011; Nederkoorn, Braet, Van Eijs, Tanghe, & Jansen, 2006; Pauli-Pott, Albayrak, Hebebrand, & Pott, 2010). Nevertheless, some studies have failed to identify links between impulsivity and weight in children, which may be attributable to the measures that were used to assess impulsivity (e.g., Tan & Holub, 2011). Thamotharan et al. have recently outlined that behavioural tasks assessing the impulsivity facets of decision-making and disinhibition were particularly associated with weight outcomes in studies on paediatric populations. Finally, imaging studies have shown abnormalities in networks associated with inhibitory control, motivation and the regulation of food intake in overweight and obese children (Batterink, Yokum, & Stice, 2010; Bruce et al., 2010). Findings from these studies suggest an association between increased weight, hypo-functioning of inhibitory control regions and increased responding to food rewards.

Research has also indicated that more impulsive individuals may be prone to making poorer food choices and to eat in the absence of physiological need, which may inadvertently lead to weight gain (Davis, Strachan, & Berkson, 2004; Davis et al., 2007; Graziano et al., 2010; Guerrieri et al., 2007; Nederkoorn, Houben, Hofmann, Roefs, & Jansen, 2010; Riggs, Spruijt-Metz, Sakuma, Chou, & Pentz, 2010). In line with these reports emotional, external and restrained eating have been found to be linked with impulsivity, indicating that more impulsive children are more prone to eat in response to negative emotions and in response to external food stimuli and variety (Ahern, Field, Yokum, Bohon, & Stice, 2010; Farrow, 2012; Guerrieri, Nederkoorn, & Jansen, 2008b; Jasinska et al., 2012; Tan & Holub, 2011). Some studies have also indicated that individuals with greater impulsivity levels may also report more dietary restraint (e.g. Nederkoorn, Van Eijs, & Jansen, 2004). Additionally, the parental feeding strategies restriction and monitoring have been linked with child impulsivity and identified as moderators of the relationship between impulsivity and child weight and eating behaviour (Anzman & Birch, 2009; Farrow; Tan & Holub; Rollins Loken, Savage, & Birch, 2014). Results from Chapter Three within this thesis highlighted the moderating effects of monitoring on the relationship between impulsivity and food approach behaviour in 2-4-year-olds, suggesting that monitoring may protect children from displaying problematic eating behaviours.

Overall, research has shown that impulsivity is related to eating behaviour from childhood to adulthood. Parents can affect this relationship in different ways through their use of feeding practices and by managing their child's food environment. Nevertheless, many of the cited studies are based on samples of overweight or obese adults and children, sometimes with clinically elevated impulsivity levels. Additionally, many studies have relied on self-reported impulsivity alone or have used a limited range of tasks to assess impulsivity. A replication of the findings that impulsivity is linked with child weight, eating and feeding variables in a sample of healthy weight children without clinically elevated levels of impulsivity is therefore desirable. Using a wider range of tools to assess child-impulsivity may also allow us to gain a greater insight into which facets of impulsivity may be particularly crucial for this link.

5.2.1 Aims and hypotheses

This study replicated the analyses carried out in Chapter Three, exploring relationships between impulsivity, measured through a range of behavioural tasks and parent-report tools, weight, eating and feeding variables, but this time in 7-11-year-olds. Chapter Three highlighted interesting associations between impulsivity, weight and controlling feeding practices in 2-4-year-olds, especially in females. Furthermore, monitoring was found to moderate the association between impulsivity and food approach behaviour, highlighting its potentially protective effect for problematic eating behaviour. Replication of the analyses in this older sample will allow some inferences about development of the links between impulsivity, eating and feeding behaviour in childhood. Changes in these relationships are likely because of children's increasing independence with regard to dietary choices as they grow. Additionally, children's abilities to self-report their eating behaviour at this age presented new avenues for exploration.

It was hypothesized that weight, parent-reported impulsivity and impulsivity task performance would be linked. Additionally, associations between impulsivity and eating behaviour were explored. It was hypothesized that impulsivity would be linked with food approach and avoidance behaviour, external, emotional and restrained eating, and ad libitum snack intake. This study also aimed to explore relationships between impulsivity and parental controlling feeding practices hypothesising that these would be linked. No directional hypotheses were made as previous findings have been mixed. Finally, this study explored the moderating effects of monitoring on the relationship between impulsivity and eating behaviour. Monitoring may have a protective effect on less healthy eating behaviours and may therefore be a useful tool for parents wanting to improve eating patterns, especially in more impulsive children. Additionally, the moderating impact of controlling feeding practices on the link between impulsivity and child weight was assessed. Previous research has highlighted the impact of pressure, restriction and monitoring on child weight and eating behaviour and it is possible that these controlling feeding practices will affect weight differently depending on children's underlying impulsivity levels (see Figure 5.1 for an overview).

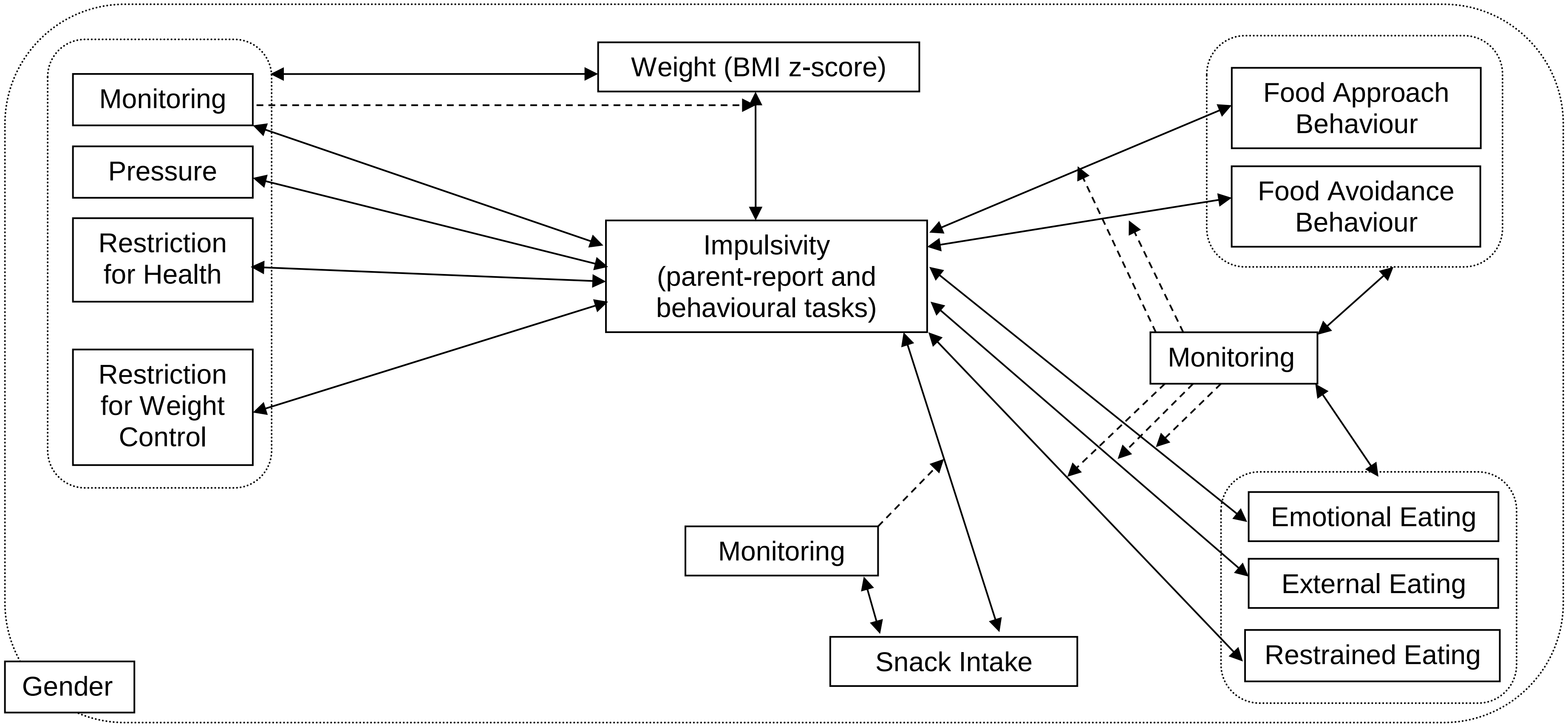


Figure 5.1. This model shows the relationships between impulsivity, weight, eating behaviour and controlling parental feeding practices to be explored in this chapter (solid arrows). Additionally, the moderating effects of monitoring on the relationship between impulsivity and eating behaviour and of controlling feeding on the relationship between impulsivity and child weight to be explored within this chapter are highlighted (dashed arrows). The parental feeding practices monitoring, pressure to eat and restriction for health and weight control address parent factors, while impulsivity, weight, snack intake and eating behaviour variables address child factors.

5.3 Method

5.3.1 Participants

Fifty 7-11-year-olds and their parents participated in this study. Parents and children were recruited through the Infant and Child Laboratory (ICL) database, from schools in and around Birmingham and through an advert in a parent magazine (*Families*) delivered in and around Birmingham (see Appendices A-2 for leaflets handed out at schools and A-3 for magazine advert). Recruitment and testing took place between September 2012 and September 2013. Exclusion criteria included the presence of known food allergies, of disorders affecting eating, current or recent major illness or diagnosed intellectual disabilities and diagnosed impulsivity-related or anxiety disorders. Overall, 77 parents were contacted of whom 50 agreed to participate in this study, leading to a response rate of 65%. Child gender was balanced and children were on average healthy weight for their age and gender. Children had predominantly middle class, White British backgrounds. The sample's demographic characteristics can be seen in Table 5.1.

5.3.2 Apparatus

Snack session recording. Snack sessions were observed and recorded (see Chapter Two, Section 2.8.3 for details).

Snack composition and preparation. Children had access to six different sweet (chocolate chip cookies, Haribo Gold Bears, green grapes) and savoury (ready salted crisps, salted pretzels, carrot sticks) snack foods that varied in fat and sugar content during a 10-minute snack session. The snack foods were presented in white square plastic bowls (10x10cm) and were weighed before and after the snack session using an electronic scale (Kern: EMB 600-2); the calories consumed for each snack food, as well as overall calorie intake were calculated using manufacturer information (see Chapter Two, Section 2.8.2). Water was available throughout the snack session.

5.3.3 Measures and procedure

All questionnaires were completed by the children's mothers. More detail on all measures can be found in Chapter Two (see Appendix B for the selected questionnaires).

Demographic information. Mothers provided information on their child's age and gender, their own age, ethnicity, their annual household income and level of education. Mothers and children were measured and weighed by a trained researcher at the laboratory, wearing light indoor clothing, without shoes. Where fathers attended (*n*=2) mothers were contacted and their self-reported height and weight were recorded. Maternal BMIs and child BMI z-scores, adjusting for age and gender, were calculated.

Children's Eating Behaviour Questionnaire (CEBQ; Wardle, Guthrie, Sanderson, & Rapoport, 2001). The CEBQ measures parent-reported Food Approach and Food Avoidance behaviours displayed by children as young as 2 years. The Cronbach's alpha for the Food Approach subscale was .88 and the Cronbach's alpha for the Food Avoidance subscale was .89, indicating that both subscales had good internal consistency.

Comprehensive Feeding Practices Questionnaire (CFPQ; Musher-Eizenman & Holub, 2007). The CFPQ is a measure of parental feeding practices. This measure was used to assess the controlling feeding practices Monitoring, Pressure, Restriction for Weight Control and Restriction for Health. The Cronbach's alpha for Monitoring was .87, the alpha for Pressure was .83, while the alphas for Restriction for Weight Control and Restriction for Health were .86 and .82, respectively; these scores indicate that all subscales had good internal consistency.

Temperament in Middle Childhood Questionnaire (TMCQ, version 3.0; Simonds & Rothbart, 2004). The TMCQ measures child temperament and was used to measure parent-perceived child impulsivity. The Cronbach's alpha for the Impulsivity subscale was .9, indicating that it had excellent internal consistency.

Conners' Parent Rating Scale (CPRS-R [L]; Conners, Sitarenios, Parker, & Epstein, 1998). The CPRS was used to assess parents' perceptions of child impulsivity and hyperactivity over the past month. The Cronbach's alpha for the Hyperactivity subscale was .83, and for the CGI: Restless-Impulsive was .86, indicating that both subscales had good internal consistency.

Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997). The SDQ measures child behaviour difficulties during the past six months. The Cronbach's alpha for overall difficulties was .68, indicating that the scale had sufficient internal consistency.

Dutch Eating Behaviour Questionnaire-Child version (DEBQ-C; Van Strien & Oosterfeld, 2008). The DEBQ-C assesses self-reported eating behaviour in children as young as 7 years. The Cronbach's alpha for the Emotional Eating subscale was .67, for the Restrained Eating subscale was .77 and for the External Eating subscale was .8, indicating that all subscales had good internal consistency.

Child-reported hunger. Child hunger was measured using the "Teddy" picture rating scale (PRS, Bennett & Blissett, 2014). The scale consists of five black and white cartoon bear silhouettes with labels describing varying levels of hunger ranging from 1 (*very hungry*) to 5 (*not hungry at all/very full*) (see Appendix B-9 for scale validation).

Go/No-Go task (GNG task; Bezdjian, Baker, Lozano, & Raine, 2009). This task assesses a child's ability to inhibit prepotent responses to non-food stimuli. Children were asked to respond to one of two stimuli with a key press (sun) while inhibiting the response to the other stimulus (flower). The task consisted of 12 practice trials and 100 experimental trials. The ratio between targets and non-targets was 3:1. Errors of commission and Go trial reaction time (RT) were recorded, with more errors (poorer inhibitory control) and faster RT (i.e. numerically lower, faster response speed) reflecting higher levels of impulsivity.

Door Opening task (Daugherty & Quay, 1991; Nederkoorn et al., 2006; Verbeken et al., 2009). This task measures reward sensitivity. Children could open up to 100 sequentially presented doors, through a key-press. Behind each door either a happy face, associated with winning a point or a sad face, associated with losing a point, was displayed. After each block of ten doors the probability of finding a happy face reduced by 10%. The number of doors opened dependent variable (DV) was recorded as an indicator of reward sensitivity, with more impulsive children opening more doors.

Delay Discounting task (Johnson, Parry, & Drabman, 1978). This task measures a child's ability to delay gratification. Over four practice and 32 experimental trials children selected either an immediate small reward (one plastic counter) or a larger delayed reward (two plastic counters) through a key press. The number of trials in which a larger delayed reward was selected was recorded (DV) and a greater number of delays were indicative of a greater ability to delay gratification and lower levels of impulsivity.

Circle Drawing task (CDT; Bachorowski & Newman, 1990; Verbeken et al., 2009). The CDT measures a child's motor impulsivity. Children traced the outline of a large circle (ø=50.8cm), drawn onto a wooden square, with their index finger, once without instruction and while being told to trace as slowly as possible. The tracing time during the inhibition condition was recorded. Slower tracing (i.e. larger values) indicated lower motor impulsivity.

Control task. Children completed a non-challenging maths game with the researcher; this task had no implications for the current chapter, but was used to compare the potential effects of a stressful task on snack intake in Chapter Six (see also Chapter Two, Section 2.9.1).

Parents and children visited the ICL twice. During each visit children were fitted with a heart rate monitor on arrival (only relevant to Chapter Six, see also Chapter Two, Section 2.10.1) and child self-reported hunger was measured using the Teddy PRS. Children completed the DEBQ-C at one visit and the impulsivity tasks at the other visit. Parents completed the questionnaires in an adjacent room while children were working with the researcher. Parents could see their child through a one-way mirror at all times. After completing the questionnaire/impulsivity tasks children completed a control or stress task, which was immediately followed by a 10-minute snack session, during which the researcher left the room. Only the snack intake that followed the non-stressful control task is considered in the current chapter. Children had access to reading and colouring materials during the snack session. Following the snack session children chose a toy and stickers as a thank you for taking part. Parents were debriefed after the second visit and reimbursed (£5) for their travel expenses at each visit. The Ethical Review Committee of the University of Birmingham approved this study (ERN 12-0465P).

5.3.4 Statistical analysis

SPSS version 20 statistical software was used to analyse the data. The criterion alpha for significance was .01 to account for multiple testing and the rise in the family-wise error rate. Histograms were inspected and indicated that the majority of data were normally distributed. Data from four children was excluded on all analyses involving the CDT, as their task performance was anomalous (slow tracing time more than three *SD* above the mean). Descriptive statistics for impulsivity were calculated and potential gender differences explored using independent samples *t*-tests. The impact of potential covariates like child age, BMI z-score, maternal BMI and family annual income on impulsivity, eating and feeding variables was assessed. Pearson's correlations controlling for covariates where appropriate, were carried out to examine relationships between parent-reported impulsivity and impulsivity task performance and child weight, eating and feeding variables. These analyses were carried out for the sample overall and for females and males separately. Finally, moderation analyses were carried out to assess if the feeding practice monitoring moderated the relationship between impulsivity and the eating behaviour measures and if parental controlling feeding practices moderated the relationship between impulsivity and weight.

5.4 Results

5.4.1 Descriptive statistics

Demographic characteristics. Table 5.1 shows the demographic characteristics of the overall sample. Gender differences in child age and weight were assessed. Females were aged 7 to 11 years (*M*=8.21, *SD*=1.12) and males were aged 7 to 10 years (*M*=8.25, *SD*=.98). A *t*-test indicated that there was no difference in age by gender (*t*(48)=-.135, *p*=.89). BMI z-scores in females ranged from -2.19 to 2.71 (*M*=.16, *SD*=1.3) and in males ranged from -.95 to 1.81 (*M*=.59, *SD*=.66). A *t*-test indicated that there were no differences in BMI z-scores by gender (*t*(41.78)=-1.53, *p*=.13).

Table 5.1

Demographic characteristics of the sample overall (N=50)

Variables	Parent Characteristics	Child Characteristics
Gender	48 female, 2 male	28 female, 22 male
Age, mean (*SD*)	38.44 (5.41)	8.22 (1.05)
Age range	27 – 50	7 – 11
BMI, mean (*SD*)	25.84 (4.9)	.35 (1.07)*
Range	18.86 – 45.79	-2.19 – 2.71
Educational level	30% Undergraduate degree (*n*=15)	
	26% A-Levels (*n*=13)	
	24% Qualified professional (*n*=12)	
	18% Postgraduate degree (*n*=9)	
	2% GCSEs (*n*=1)	
Ethnicity	82% White Caucasian (British/Irish) (*n*=41)	
	6% Asian (*n*=3)	
	6% Black (African/Caribbean) (*n*=3)	
	2% Chinese (*n*=1)	
	2% Mixed (*n*=1)	
	2% Other (*n*=1)	

* For children BMIs (mean and *SD*) are adjusted for their age and gender (BMI z-scores).

Child behaviour difficulties. Overall, 80.4% of children (*n*=37) had an SDQ Total Difficulties score in the “normal” range (0-13), 8.7% of children (*n*=4) had a score in the “borderline” range (14-16), and 10.8% of children (*n*=5) had a score in the “abnormal” range (17-40). The SDQ Total Difficulties scores suggest that five children in the current sample may have had underlying conduct, emotional, or peer problems or issues around hyperactivity. None of the children had a formal diagnosis of Attention Deficit Hyperactivity Disorder or of other impulsivity-related disorders at the time of participation. There were no differences in the results when analyses were conducted without the five children with SDQ scores in the "abnormal" range.

Parent-reported impulsivity. Table 5.2 shows that parent-reported impulsivity scores had a wide variety, suggesting that impulsivity levels in the current sample had a sufficient range to allow explorations of associations with eating and feeding variables.

A number of *t*-tests were carried out to assess whether there were gender differences for parent-reported impulsivity. These analyses indicated that there were no gender differences in impulsivity measured by the TMCQ ($t(47)=-.24$, $p=.81$), the CGI: Restless-Impulsive ($t(45)=-.83$, $p=.41$) or the CPRS Hyperactivity ($t(45)=-1.34$, $p=.19$).

Table 5.2

Impulsivity scores on parent-report measures of impulsivity for the sample overall and for females (n=28) and males (n=22) separately

		Mean (*SD*)	Min	Max	*N*
TMCQ Impulsivity	Overall	2.74 (.66)	1.31	3.83	49
	Females	2.72 (.69)	1.31	3.83	27
	Males	2.76 (.63)	1.38	3.77	22
CGI: Restless-Impulsive	Overall	4.92 (3.82)	0	14	47
	Females	4.48 (4.08)	0	13	25
	Males	5.41 (3.53)	0	14	22
CPRS Hyperactivity	Overall	5.53 (4.03)	0	18	47
	Females	4.8 (3.64)	0	13	25
	Males	6.36 (4.37)	0	18	22

Impulsivity task performance. Table 5.3 shows impulsivity task performance, indicating that performance varied widely across children and that the majority completed all tasks. One child refused to complete the Door Opening task, while for three children data on the GNG task were lost due to a technical error.

T-tests were carried out to assess whether there were gender differences in impulsivity task performance. These analyses indicated that there were no gender differences in child performance on the GNG task in terms of go trial RT ($t(45)=-.56$, $p=.58$) and number of commission errors ($t(45)=.48$, $p=.63$). There were also no gender differences in performance on the Door Opening task ($t(47)=1$, $p=.32$), the Delay Gratification task ($t(48)=-.64$, $p=.53$) or the CDT ($t(44)=.91$, $p=.37$).

Table 5.3

Overview of impulsivity task performance scores for the sample overall and for females (n=28) and males (n=22) separately

		Mean (*SD*)	Min	Max	*N*
GNG task:	Overall	370.69 (29.01)	295.69	423.38	47
Go trial RT (msec)	Females	368.62 (28.38)	317.17	423.38	27
	Males	373.48 (30.36)	295.69	416.72	20
GNG task:	Overall	8.26 (3.12)	2	15	47
Errors of Commission	Females	8.44 (3.36)	2	15	27
	Males	8 (2.83)	3	13	20
Door Opening task:	Overall	43.74 (32.06)	1	100	49
Doors Opened	Females	47.71 (34.73)	1	100	28
	Males	38.43 (28.05)	1	100	21
Delay of Gratification task:	Overall	9.66 (8.64)	0	32	50
Number of Delays	Females	8.96 (7.15)	0	32	28
	Males	10.55 (10.35)	0	32	22
CDT: Slow Tracing Time (s)	Overall	69.19 (42.69)	4.62	187.97	46
	Females	74.21 (44.78)	11	187.97	26
	Males	62.66 (39.98)	4.62	173	20

5.4.2 Covariates

Pearson's correlations were carried out to assess associations between the experimental variables (impulsivity, weight, eating behaviour, parental feeding) and confounding variables such as child age, BMI z-score, maternal BMI and parent education level. Based on previous research it was hypothesized that impulsivity would be associated with child age and parent education level, while BMI z-score would be associated with child age, maternal BMI and parent education level. It was also hypothesized that eating behaviour would be associated with child age and BMI-z-score. Finally, it was hypothesized that parental feeding practices would be associated with BMI z-score, maternal BMI and parent education level.

The analyses indicated that none of the potential confounds were associated with parent-reported impulsivity. Performance on the Door Opening task was associated with maternal BMI. Analyses evaluating links between Door Opening task performance, weight, eating and feeding behaviour therefore controlled for maternal BMI. None of the potential confounds were associated with eating behaviour. Finally, while there were no associations between the potential confounds and feeding practices monitoring or restriction (health/weight), pressure was associated with parent education level. Analyses evaluating links between pressure and impulsivity therefore controlled for parent education level (see Table 5.4).

5.4.3 Child hunger

Child hunger ratings before the snack session were examined and the relationship between hunger and intake was explored. Children's self-reported hunger ratings ranged from 1 (*very hungry*) to 5 (*not hungry at all/very full*), with a median hunger rating of 3 (*just right, not too hungry and not too full*). As the variable was not normally distributed, Spearman's correlations were carried out to assess whether pre-snack hunger was associated with intake. The analysis showed that there was no association between hunger and snack intake ($r_s(49)=-.21$, $p=.14$).

Table 5.4

Correlations between measures of interest and potential confounds

	Child BMI z-score	Child age	Maternal BMI	Parent education level
TMCQ Impulsivity	.31	-.08	.07	-.07
CGI: Restless-Impulsive	.26	-.04	.11	-.08
CPRS Hyperactivity	.27	-.21	.2	-.11
GNG task: Go trial RT	-.25	-.28	.06	-.19
GNG task: errors of commission	.05	.31	-.12	-.02
Door Opening task	.05	-.07	.42*	.04
Delay of Gratification task	-.12	-.16	.09	.09
CDT	.15	.01	.09	.18
Food Approach	.15	-.01	-.07	.15
Food Avoidance	-.22	-.03	-.02	-.29
Dietary Restraint	.12	-.17	.25	.13
Emotional Eating	-.16	-.05	-.07	.14
External Eating	-.17	-.09	.04	.19
Snack Intake	.3	.24	.21	.01
Monitoring	.07	-.1	-.07	.26
Pressure	-.34	-.08	.03	-.4*
Restriction Health	.27	-.06	.19	.11
Restriction Weight	.23	.03	.31	.22
Child BMI z-score	-	-.13	.35	.08

*p<.01

5.4.4 Child impulsivity

Parent-reported impulsivity and impulsivity task performance. Firstly, it was assessed whether parent-reported impulsivity was associated with impulsivity task performance. These analyses indicated that the number of GNG task errors of commission were positively associated with TMCQ Impulsivity, CPRS Hyperactivity and the CGI: Restless-Impulsive for the sample overall. Associations between TMCQ Impulsivity and the CGI: Restless-Impulsive and GNG task errors of commission also reached significance in the male subsample. There were no further associations between parent-reported impulsivity and impulsivity task performance (see Table 5.5).

Table 5.5

Correlations between parent-reported impulsivity and impulsivity task performance for the sample overall and by gender

Measure		GNG task: Go trial RT	GNG task: Errors of commission	Door Opening task+	Delay of Gratification task	Circle Drawing task
TMCQ Impulsivity	Overall	-.21	.47*	-.04	.001	.01
	Females	-.27	.37	-.01	.14	-.11
	Males	-.12	.65*	-.09	-.13	.23
CGI: Restless-Impulsive	Overall	-.14	.5*	.07	.07	.04
	Females	-.23	.46	.11	.1	-.12
	Males	-.05	.63*	.02	.03	.36
CPRS Hyperactivity	Overall	-.26	.42*	-.03	.14	-.03
	Females	-.34	.43	.18	.24	-.06
	Males	-.2	.47	-.33	.06	-0.7

* *p*<.01, + controlling for maternal BMI

Intercorrelations between parent-reported impulsivity. It was examined whether the scores on the parent-report measures of impulsivity were intercorrelated. These analyses indicated that the individual questionnaire subscales were all highly positively correlated in the sample overall and in both subsamples (see Table 5.6).

Table 5.6

Intercorrelations between parent-reported impulsivity for the sample overall and by gender

Measure		CGI: Restless-Impulsive	CPRS Hyperactivity
TMCQ Impulsivity	Overall	.67*	.64*
	Female	.63*	.63*
	Male	.72*	.67*
CGI: Restless-Impulsive	Overall		.8*
	Female		.91*
	Male		.68*

*p<.01

Intercorrelations between impulsivity task performance scores. It was also examined whether performance scores on the individual impulsivity tasks were intercorrelated. Few correlations were observed. GNG task go trial RT and number of commission errors were negatively correlated, indicating that children who responded faster also made more errors (see Table 5.7).

Table 5.7

Intercorrelations between child impulsivity tasks for the sample overall and by gender

Measure		GNG task: Errors of commission	Door Opening task+	Delay of Gratification task	Circle Drawing task
GNG task: Go trial RT	Overall	-.61*	.21	.26	.07
	Female	-.64*	.02	.13	.11
	Male	-.57	.57	.37	.05
GNG task: Errors of commission	Overall		-.16	-.15	-.1
	Female		-.11	-.18	-.27
	Male		-.28	-.11	.17
Door Opening task+	Overall			.05	.28
	Female			.07	.3
	Male			.08	.25
Delay of Gratification task	Overall				.24
	Female				.39
	Male				.23

* *p*<.01, + controlling for maternal BMI

5.4.5 Impulsivity and child weight

Parent-reported impulsivity and weight. Pearson's correlations were carried out to assess whether parent-reported impulsivity was associated with weight. These analyses indicated that parent-reported impulsivity was generally not associated with weight. For males only, a positive association between weight and the CGI: Restless-Impulsive emerged, suggesting that males who were more impulsive were heavier.

Table 5.8

Correlations between parent-reported impulsivity and child BMI z-score

		TMCQ Impulsivity	CGI: Restless-Impulsive	CPRS Hyperactivity
Child BMI z-score	Overall	.31	.26	.27
	Females	.3	.13	.19
	Males	.4	.53*	.35

*p=.01

Impulsivity task performance and weight. Pearson's correlations (partial; controlling for maternal BMI on associations between Door Opening task performance and weight) were carried out to examine whether impulsivity task performance was associated with weight. These analyses indicated that task performance was generally not associated with weight. For males only, a positive association between BMI z-score and GNG task errors of commission emerged, suggesting that males who made more errors and had poorer inhibitory control were heavier.

Table 5.9

Correlations between impulsivity task performance and child BMI z-score

		GNG task: Go trial RT	GNG task: Errors of commission	Door Opening task+	Delay of Gratification task	Circle Drawing task
Child BMI z-score	Overall	-.25	.05	-.11	-.12	.15
	Females	-.2	-.1	-.08	-.16	.13
	Males	-.53	.59*	-.19	-.16	.3

* p<.01, + controlling for maternal BMI

5.4.6 Impulsivity and child eating behaviour

Parent-reported impulsivity and eating behaviour. Pearson's correlations were carried out to assess whether parent-reported impulsivity was associated with parent-reported food approach or avoidance behaviours, with child-reported emotional, external or restrained eating, or with snack intake. These analyses indicated that there were no associations between parent-reported impulsivity and eating behaviour in the sample overall or in female and male subsamples (see Table 5.10).

Table 5.10

Correlations between parent-reported impulsivity, parent-reported eating behaviours, child self-reported eating behaviours and snack intake

Measure		Food Approach	Food Avoidance	Emotional Eating	External Eating	Restrained Eating	Snack Intake
TMCQ	Overall	.23	.17	.27	.2	-.08	-.03
Impulsivity	Female	.41	-.03	.36	.38	-.13	.08
	Male	.004	.43	.15	-.01	0	-.15
CGI:	Overall	.19	.29	.17	.09	-.12	.03
Restless-	Female	.32	.29	.35	.18	-.22	.34
Impulsive	Male	-.02	.37	-.07	.03	.02	-.3
CPRS	Overall	.23	.2	.14	.17	-.11	-.06
Hyperactivity	Female	.41	.28	.24	.22	-.25	.3
	Male	.01	.2	.04	.2	.03	-.4

*$p \leq .01$

Impulsivity task performance and eating behaviour. Pearson's correlations (partial; controlling for maternal BMI on associations between Door Opening task performance and eating behaviour) were carried out to examine whether impulsivity task performance was associated with parent-reported eating behaviour (food approach and avoidance behaviour), child self-reported eating behaviour (emotional, external and restrained eating) or snack intake. These analyses indicated that there were no associations between impulsivity task performance and food approach or avoidance behaviours. GNG task go trial RT was positively associated with self-reported restrained eating in the male subsample only, indicating that males who responded more slowly and were less impulsive, reported more restrained eating. Emotional and external eating were not associated with impulsivity task performance. Finally, GNG task go trial RT was negatively associated with snack intake in the sample overall, and specifically in females, indicating that females, who responded faster and were more impulsive, consumed more calories from snacks. No further associations emerged (see Table 5.11).

Table 5.11

Correlations between impulsivity task performance scores and parent-reported eating behaviours, child self-reported eating behaviours and snack intake

Measure		Food Approach	Food Avoidance	Emotional Eating	External Eating	Restrained Eating	Snack Intake
GNG task:	Overall	-.13	.03	.01	.003	.32	-.41*
Go trial RT	Female	-.28	.26	.03	.05	.09	-.56*
	Male	-.09	-.14	-.01	-.01	.61*	-.32
GNG task:	Overall	-.03	.15	.1	.1	-.27	.15
Errors of	Female	.06	-.08	.2	.22	-.19	.27
commission	Male	.11	.45	-.05	-.14	-.4	.05
Door	Overall	-.05	.18	-.01	-.06	.22	-.17
Opening	Female	.06	.25	.01	-.23	.05	-.19
task+	Male	-.17	.05	-.03	.16	.05	-.16
Delay of	Overall	.12	-.04	.02	.12	.05	-.24
Gratification	Female	.18	.18	.03	.11	-.19	-.19
task	Male	.03	-.17	.001	.14	.27	-.3
Circle	Overall	-.25	.29	.14	.1	-.17	-.11
Drawing	Female	-.33	.22	.18	.06	-.1	-.06
task	Male	-.09	.36	.09	.13	-.28	-.15

*p<.01, + controlling for maternal BMI

5.4.7 Impulsivity and controlling feeding practices

Parent-reported impulsivity and controlling feeding practices. Pearson's correlations (partial; controlling for parent education on associations between impulsivity and pressure) were carried out to assess the relationships between impulsivity and monitoring, pressure and restriction (health/weight). These analyses indicated that the CGI: Restless-Impulsive and CPRS Hyperactivity were positively associated with restriction for health in the female subsample; parents of more impulsive females reported using more restriction for health. Pressure and monitoring were not associated with parent-reported impulsivity (see Table 5.12).

Table 5.12

Correlations between parent-reported impulsivity and parental controlling feeding practices

Measure		Monitoring	Pressure^	Restriction Health	Restriction Weight
TMCQ Impulsivity	Overall	-.06	-.07	.16	-.13
	Female	-.11	-.05	.37	-.11
	Male	.02	-.15	-.19	-.17
CGI: Restless-Impulsive	Overall	-.21	.11	.22	-.12
	Female	-.36	.24	.58*	-.02
	Male	.02	-.19	-.38	-.28
CPRS Hyperactivity	Overall	-.09	-.02	.27	-.07
	Female	-.26	.16	.66*	.07
	Male	.09	-.38	-.18	-.26

**p*≤.01, ^ controlling for parent education

Impulsivity task performance and controlling feeding practices. Pearson's correlations (partial; controlling for maternal BMI [and parent education] on associations between impulsivity [measured by Door Opening task performance] and pressure) were carried out to assess the relationships between impulsivity task performance, monitoring, pressure and restriction (health/weight). These analyses showed that GNG task go trial RT was positively associated with pressure in males; parents of males who responded more slowly and were less impulsive reported using more pressure. No other associations were observed (see Table 5.13).

Table 5.13

Correlations between impulsivity task performance scores and parental controlling feeding practices

Measure		Monitoring	Pressure^	Restriction Health	Restriction Weight
GNG task: Go trial RT	Overall	-.17	.27	-.3	.01
	Female	-.06	.03	-.31	.04
	Male	-.37	.62*	-.31	-.05
GNG task: Errors of commission	Overall	.1	-.06	.22	-.23
	Female	.07	.07	.32	-.25
	Male	.19	-.26	.04	-.16
Door Opening task+	Overall	-.33	-.11	-.06	-.08
	Female	-.37	-.22	.1	.01
	Male	-.26	.14	-.35	-.16
Delay of Gratification task	Overall	-.19	.19	-.11	.1
	Female	-.18	.003	-.13	.07
	Male	-.24	.32	-.12	.1
Circle Drawing task	Overall	-.11	-.21	-.22	-.14
	Female	-.03	-.25	-.15	.08
	Male	-.27	-.02	-.33	-.45

**p*<.01, ^ controlling for parent education, + controlling for maternal BMI

5.4.8 Moderating effects of parental monitoring on associations between impulsivity and eating behaviour

Monitoring and eating behaviour. Initially it was assessed whether monitoring was related to food approach and avoidance behaviours, emotional, external or restrained eating and snack intake. Analyses showed that there were no associations between monitoring and the eating behaviour variables (see Table 5.14).

Table 5.14

Correlations between monitoring and eating behaviour

		Food Approach	Food Avoidance	Emotional Eating	External Eating	Restrained Eating	Snack Intake
Monitoring	Overall	-.25	-.35	.14	.26	.04	.05
	Female	-.29	-.34	.2	.29	.12	-.16
	Male	-.22	-.36	.04	.27	-.11	.36

Moderating effects of monitoring. Analyses assessing the moderating effect of monitoring on the relationship between impulsivity and food approach and food avoidance behaviour, emotional, external and restrained eating style and snack intake were carried out (see Appendix C-5 for all analyses). The analyses indicated monitoring did not moderate the relationship between impulsivity and food approach behaviour, emotional or external eating but did moderate the relationship between TMCQ Impulsivity and food avoidance behaviour in the female subsample. Although the overall interaction term was significant, the relationship between TMCQ Impulsivity and food avoidance behaviour did not reach significance at low, average or high levels of monitoring.

Monitoring moderated the relationship between GNG task errors of commission and dietary restraint in the sample overall and in females. For the sample overall the relationship between GNG task errors of commission and dietary restraint was significant if monitoring was low (1 *SD* below mean: b=-.13, t=-3.9, p=.0003), and if parents reported using average amounts of monitoring (mean: b=-.06, t=-2.73, p=.009). The relationship was not significant if parents reported using high levels of monitoring (1 *SD* above mean: b=.01, t=.03, p=.53). The relationship between impulsivity and dietary restraint was negative if monitoring was low and positive if monitoring was average (see Figure 5.2). Although the overall interaction term for the female subsample was also significant, the relationship between GNG task errors of commission and dietary restraint did not reach significance at low, average or high levels of monitoring.

Finally, monitoring did not moderate the relationship between impulsivity and snack intake for the sample overall or for females and males separately.

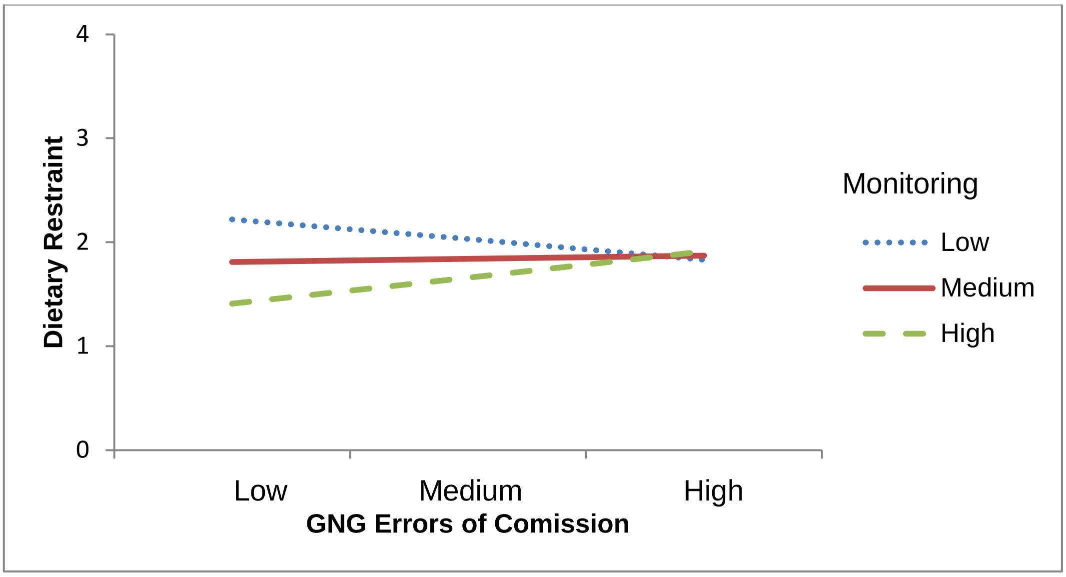


Figure 5.2. Plot of the moderating effect of monitoring on the relationship between impulsivity task performance on the GNG task (errors of commission) and dietary restraint in the sample overall.

5.4.9 Moderating effects of controlling feeding practices on associations between impulsivity and weight

Controlling feeding practices and weight. Initially it was assessed whether monitoring, pressure, restriction (health/weight) were associated with child BMI z-score. These analyses indicated that there was a negative association between weight and pressure in the male subsample only, indicating that males whose parents used greater levels of pressure had a lower weight (Table 5.15).

Table 5.15

Correlations between child BMI z-score and controlling feeding practices

		Monitoring	Pressure	Restriction Health	Restriction Weight
Child BMI z-score	Overall	.07	-.34	.27	.23
	Female	.01	-.36	.43	.44
	Male	.24	-.56*	-.25	-.32

Moderating effects of controlling feeding practices. Analyses assessing the moderating effects of controlling feeding practices on the relationship between impulsivity and child BMI z-score were carried out (see Appendix C-6 for all analyses). These analyses indicated that restriction (health/weight) and pressure did not moderate the relationship between impulsivity and weight. Monitoring, however, moderated the relationship between the CGI: Restless-Impulsive and weight in the male subsample. The relationship was significant if monitoring was low (1 *SD* below mean: b=.17, t=6.88, p<.0001), and if parents reported using average amounts of monitoring (mean: b=.12, t=6.01, p<.0001), but not if parents reported using high levels of monitoring (1 *SD* above mean: b=.06, t=1.97, p=.06). The relationship between impulsivity and BMI z-score was positive if monitoring was low or average (see Figure 5.3).

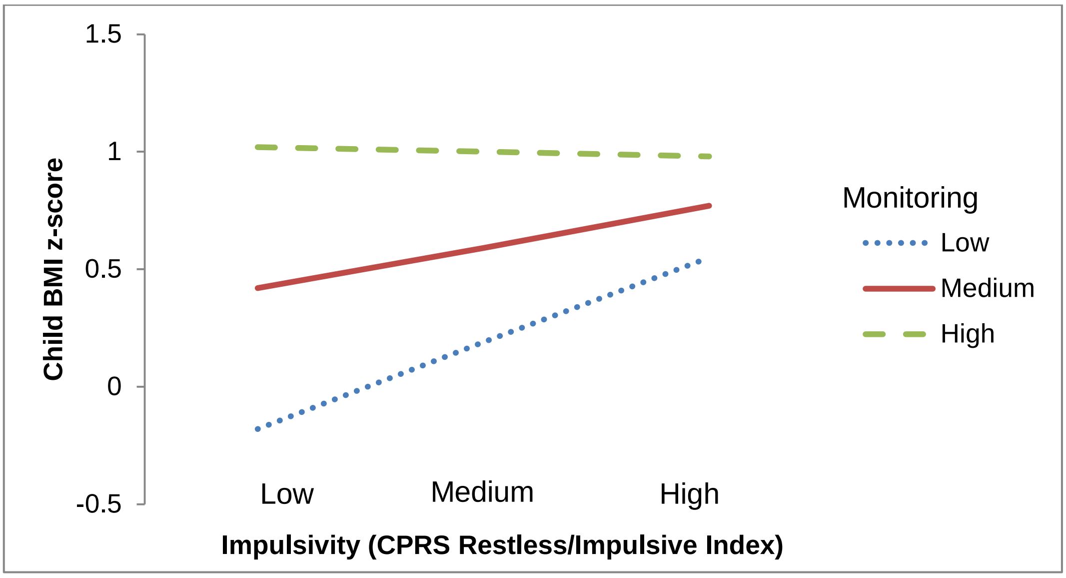


Figure 5.3. Plot of the moderating effect of monitoring on the relationship between parent-reported impulsivity and child BMI z-score in males.

5.5 Discussion

The current study aimed to explore links between impulsivity, measured through a range of parent-report tools and behavioural tasks, weight, eating and feeding variables in a sample of 7-11-year-olds. Research in children and adults has indicated that impulsivity and inhibitory control are linked with body weight (Braet et al., 2007; Bruce et al., 2011; Graziano et al., 2010; Thamotharan et al., 2013), eating behaviour and snack food intake (Guerrieri et al., 2008; Riggs et al., 2010) as well as with parental feeding practices (Anzman & Birch, 2009). Nevertheless few studies have used a variety of impulsivity measures to capture its many facets. Overall, we observed few associations between impulsivity, weight, eating behaviour and feeding practices in this age group. Associations between impulsivity, weight, and restrained eating behaviour emerged for males, while impulsivity and snack intake were associated in females. Impulsivity and restriction for health were related in females, while impulsivity and pressure to eat were associated in males. Finally, monitoring had moderating effects on the relationship between impulsivity and dietary restraint in the sample overall and on the association between impulsivity and weight in males (see Figure 5.4 for an overview).

Based on previous research we hypothesized that impulsivity would be associated with child weight (e.g., Nederkoorn et al., 2006; Nederkoorn et al., 2010). This hypothesis was partly confirmed; more impulsive males were found to have larger BMI z-scores. This association emerged for parent-reported impulsivity measured by the CGI: Restless-Impulsive and for GNG task commission errors which assesses the inhibitory control facet of impulsivity. Both measures may be particularly sensitive to factors conferring vulnerability for early weight gain. In line with our findings, Batterink et al. (2010) showed that the number of commission errors on a food-specific GNG task was positively associated with BMI in a sample of female adolescents, suggesting that the inhibitory control facet of impulsivity may be particularly relevant to impulsivity-related weight gain. The CGI: Restless-Impulsive has not commonly been used in studies linking impulsivity and weight. Nevertheless, the measure may be a useful parent-report tool, measuring impulsivity facets such as inhibitory control and the ability to delay gratification, which may place males at risk for weight gain (Braet et al., 2007). No associations between impulsivity and child weight emerged for females. This finding was unexpected as previous research and results from Chapter Three within this thesis highlighted links between behavioural impulsivity and increased weight in females (Batterink et al.). This suggests that there may be shifts in the influence of impulsivity on child weight by gender, with the impact of impulsivity on weight gain being less powerful for older compared to younger females. It is possible that societal expectations for female thinness are beginning to exert more pressure on females at this age, thereby becoming more important determinants of weight than impulsivity. Additionally, factors such as developmental stage may be particularly important for weight trajectories in females at this age, weakening the potential impact of impulsivity.

To explore whether the differences in the weight-impulsivity link between males and females at this age may be related to underlying differences in eating behaviour, the relevant associations were assessed. Interestingly parent-reported eating behaviour was not related to impulsivity in the current sample. Previous research has highlighted that overeating measured by the CEBQ mediates the impulsivity-weight link in children aged 6 to 13 years (Van den Berg et al., 2011). In addition to parent-perceived eating behaviour, child self-reported eating behaviours such as emotional, external and restrained eating have previously been associated with impulsivity. Farrow (2012) e.g. found that more impulsive 10-13-year-olds self-reported more emotional and external eating tendencies. Findings for dietary restraint have been mixed; some studies have highlighted links between better inhibitory control and greater dietary restraint (Leitch, Morgan, & Yeomans, 2013), while other studies have found that increased impulsivity was linked with greater intention to diet and dietary restraint (Jasinska, et al., 2012; Nederkoorn et al., 2004). In the current study, impulsivity measured by the GNG task (go trial RT) and dietary restraint were positively related in the male subsample, suggesting that less impulsive males, were more concerned about restricting their intake and controlling their weight. Previous research has indicated that low levels of impulsivity in combination with dietary restraint appear to lead to more successful dieting outcomes and less disinhibited eating (Jansen et al., 2009; Meule, Lukito, Vögele, & Kübler, 2011; Nederkoorn, Jansen, Mulkens, & Jansen, 2007; Van Koningsbruggen, Stroebe, & Aarts, 2013).

In support of the hypothesized link between impulsivity and overeating, children (females in particular), who performed more impulsively on the GNG task (go trial RT), consumed more calories from a snack. Similar findings have previously been reported by Guerrieri and colleagues (Guerrieri, Nederkoorn, & Jansen, 2007; Guerrieri, Nederkoorn, Stankiewicz et al., 2007), especially in the context of a varied food environment (Guerrieri et al., 2008b). The findings are correlational and do not allow an inference of causality, nevertheless, they do lend further support to the notion that impulsivity may lead to overeating, especially in females (Guerrieri et al., 2007).

Furthermore, it was hypothesized that parental controlling feeding practices would be associated with impulsivity. This hypothesis was partly confirmed, as parents of males who performed more impulsively on the GNG task (go trial RT), reported using less pressure to eat. Contrary findings were observed in the female subsample of the younger cohort in this thesis (Chapter Three). Parents of more impulsive males described in the current chapter, who were also heavier, may perceive little need to increase their child’s intake and may therefore use this practice less frequently. Additionally, parents of females described in the current chapter rated as more impulsive on both CPRS subscales, used more restriction for health to curb their child’s intake of unhealthy foods. Nevertheless, recent research has highlighted that parental restriction of palatable foods may be particularly detrimental to children with lower inhibitory control, leading to greater increases in eating in the absence of hunger than in peers with better inhibitory control (Rollins et al., 2014). Supporting the findings by Rollins et al., females with greater impulsivity in the current study also consumed more snack foods. These findings highlight the importance of making parents aware of the potentially detrimental effects of dietary restriction. Covert restriction, not assessed in the current study, may have a more positive impact on child eating behaviour over time; future research should explore this possibility.

While monitoring was not associated with impulsivity, it did moderate the association between inhibitory control and dietary restraint in the sample overall. Children with higher impulsivity levels were less restrained than their less impulsive peers, if parents used low levels of monitoring. Conversely, children with higher impulsivity levels were more restrained than their less impulsive peers, if their parents used average amounts of monitoring. These findings suggest that in children whose parents used little monitoring, dietary restraint decreased as a function of impulsivity. More impulsive children may feel little motivation to control their eating behaviour through dietary restraint if their parents provide few subtle cues in the form of monitoring that suggest that a regulation of their intake would be desirable. In children whose parents used average levels of monitoring, however, dietary restraint increased with impulsivity, indicating that more impulsive children may become more motivated to control their intake when parents monitor their intake, providing some cues that intake regulation would be desirable. Interestingly, this interactive effect did not emerge in children whose parents used high levels of monitoring; this may be due to a lack of power to detect such an effect. Alternatively, high levels of monitoring may preclude a link between impulsivity and dietary restraint as the high number of cues and nudges that parents provide mean that there is little need for children to engage in additional dietary restraint.

Previous research investigating the impact of monitoring on intake has indicated that children make fewer non-nutritive food choices and consume fewer calories overall if they believe that their parents are monitoring their intake (Klesges et al., 1991). Nevertheless, dietary restraint has been linked with negative eating behaviours like disinhibition and poor dieting success, especially in impulsive individuals (Jansen et al., 2009; Nederkoorn et al., 2007). How dietary restraint self-reported by children in the current sample is reflected in their food choices and daily intake is unclear. Nevertheless, these findings give rise to the question whether restraint in combination with parental monitoring has the potential to influence more impulsive children to make fewer poor food choices or to reduce overall intake. Future research should explore this link further.

Finally, monitoring moderated the relationship between parent-reported impulsivity and child BMI z-score in the male subsample. It is important to note that all children in the current study had BMI z-scores in the healthy range. Positive associations between impulsivity and weight emerged if parents used low or average amounts of monitoring, but not if they used high levels of monitoring. The finding that weight increased with impulsivity in males whose parents monitored their intake to an average or low amount indicates that a lack of monitoring may be detrimental for weight control, especially in more impulsive males. The mechanism underlying this link is unclear. Furthermore, parents of heavier males appeared to monitor their intake more closely, irrespective of underlying impulsivity levels. Klesges et al. (1991) reported positive effects of monitoring on food intake and selection in 4-7-year-olds. It is possible that monitoring affects problematic eating behaviours, such as binge and loss of control eating episodes, not assessed in this study. These eating behaviours have previously been associated with both impulsivity and weight gain in children and adults (Hartman, Czaja, Rief, & Hilbert, 2010; Nasser, Gluck, & Geliebter, 2004).

This study has several limitations. Although the overall sample size was appropriate, sample sizes for the analyses by gender were small and a replication of the findings in larger subsamples is necessary to validate the findings. Several of the moderation analyses indicated significant overall interaction terms for the subsamples, but failed to show significant associations when analysed further. This suggests that there was not enough power to identify more subtle gender differences. A considerable amount of correlational analyses were carried out and the alpha level was adjusted to .01 to address increases in family-wise error rate. Nevertheless, a more stringent cut-off for significance may have been desirable. Additionally, five of the children participating in this study had an SDQ Total Difficulties score in the “abnormal” range using a conservative cut-off of 17. Although none of the children had been diagnosed with any impulsivity disorders at the time of participation, it is possible that some children may have had underlying behaviour problems.

Previous research has indicated that tasks using food stimuli as targets (e.g. GNG task; Batterink et al., 2010) or as rewards (Delay of Gratification task; Bonato & Boland, 1983) may be more suited to detect associations between impulsivity and weight in children and adults. As the current study only used non-food stimuli the lack of further associations between impulsivity task performance and child weight may be due to this approach.

Overall, the results suggest that the influence of impulsivity on weight, eating behaviour and feeding behaviour can be detected in females and males aged 7 to 11 years. While impulsivity was associated with elevations in males’ weight, it was also associated with less pressure to eat. In females, impulsivity was linked with increased restriction for health. The combination of high impulsivity and parental restriction has been shown to be particularly detrimental to child eating behaviour fostering eating in the absence of hunger. In line with this, females were also found to consume more snacks, highlighting the need to make parents aware of the negative impact of dietary restriction. Parental monitoring influenced the relationship between impulsivity and dietary restraint in the sample overall and emerged as a moderator of the relationship between impulsivity and weight in males, indicating that a lack of monitoring may be detrimental to weight control in males.

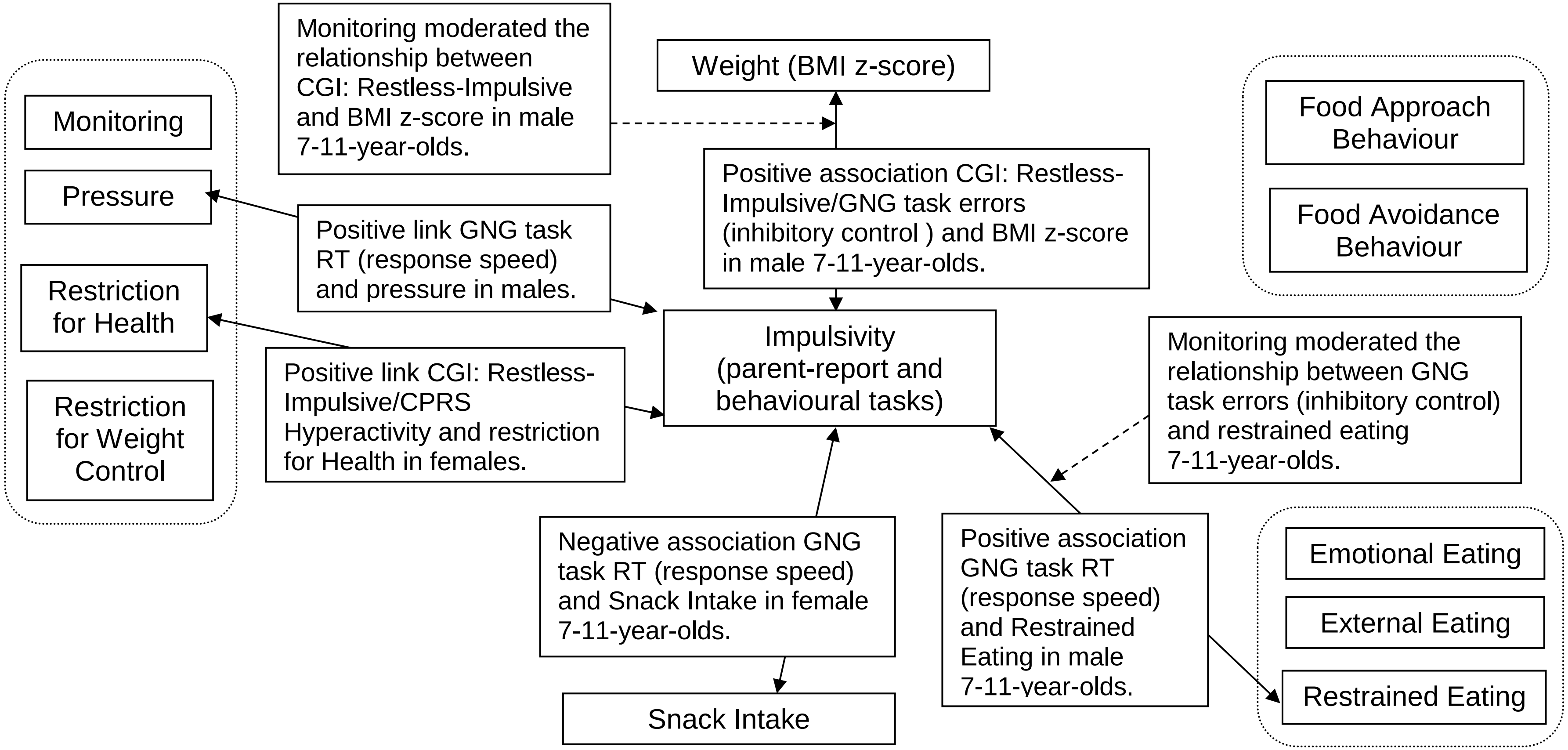


Figure 5.4. This model summarises the observed associations between impulsivity, weight, eating and feeding behaviour. It also highlights the moderating effects of monitoring on the relationship between impulsivity and food approach behaviour observed in this chapter.

CHAPTER SIX

STRESS AFFECTS SUCCESSFUL DIETARY RESTRAINT IN IMPULSIVE AND NON-IMPULSIVE CHILDREN

6.1 Abstract

Impulsivity and dietary restraint have been found to interact to affect dietary intake in adults. Few studies have investigated this effect in children, while also taking the potential impact of stress into consideration. The current study aimed to investigate the interactive effects of impulsivity, restraint and stress on intake. Fifty 7-11-year-olds participated in this experimental laboratory-based study. Impulsivity was assessed through parent-report measures and behavioural tasks; children self-reported dietary restraint. Children visited the lab twice and had access to a range of snack foods after a stress and control task; intake was recorded. Hunger at arrival and stress levels, were assessed. Within-subjects analyses confirmed that children felt significantly more stressed in the stress than the control condition. While 2 x 2 between-subjects ANCOVAs indicated that impulsivity and dietary restraint interacted to affect intake, 2 x 2 x 2 split-plot ANCOVAs showed that condition, impulsivity and dietary restraint also interacted to affect intake. The analyses were followed-up with split-plot ANCOVAs in high and low impulsivity samples separately and showed that impulsive, restrained children engaged in successful dietary restraint after a stress task. The availability of resources to engage in restraint in impulsive children and the activation of a weight control goal under stress may explain the observed pattern of results.

6.2 Introduction

Research has shown that impulsivity plays an important role in eating behaviour and weight regulation. Impulsivity levels are elevated in overweight compared to healthy weight individuals (e.g. Braet, Claus, Verbeken, & Van Vlierberghe, 2007) and inhibitory control abilities in early childhood have been found to be predictive of later weight and obesity risk (Graziano, Calkins, & Keane, 2010). Findings from Chapters Three and Five within this thesis also highlight potential gender differences in the impact of impulsivity on eating behaviour and weight. In addition to links between impulsivity, weight and eating behaviour per se, research has indicated that impulsivity is linked with dietary restraint and that high levels of impulsivity in combination with high levels of dietary restraint may be particularly detrimental to eating behaviour in adults (e.g. Nederkoorn, Van Eys, & Jansen, 2004; Meule, Lukito, Vögele, & Kübler, 2011). Furthermore, the impact of stress on eating behaviour has been well documented and many factors, such as stress type, gender and dietary restraint have been identified as moderators of the link between stress and eating behaviour. However, the impact of stress on eating behaviour has not been investigated in combination with measures of impulsivity and dietary restraint in a non-clinical sample of healthy weight children.

6.2.1 Impulsivity and dietary restraint

A number of studies on child and adult samples have highlighted links between dietary restraint and impulsivity. Findings in this area have been mixed, with some studies suggesting that restrained women had better inhibitory control (Leitch, Morgan, & Yeomans, 2013; Meule et al., 2011), and others reporting links between higher levels of dietary restraint and increased self-reported and behavioural impulsivity (Jasinska, et al., 2012; Nederkoorn et al., 2004). Differences in the measurement of dietary restraint and impulsivity are likely to underlie these conflicting findings (see Chapter One, Section 1.4.2). The combination of high impulsivity and dietary restraint may place adults and children at greater risk for overeating and weight gain. Impulsive individuals, especially those high in dietary restraint, have been found to exhibit disinhibited eating tendencies and to be less successful dieters than their less impulsive peers (Meule et al., 2011; Nederkoorn, Jansen, Mulkens, & Jansen, 2007; Van Koningsbruggen, Stroebe, & Aarts, 2013). Jansen et al. (2009) e.g. looked at the interactive effect of impulsivity and dietary restraint in a sample of female, healthy weight, college students. They found that restrained females (classified with a Restraint Scale; RS; Herman & Polivy, 1975) only overate if they were also impulsive as indicated by their performance on a stop-signal task. Furthermore, Van Koningsbruggen et al. (2013) found that female and male restrained eaters (classified with a revised RS) with lower levels of self-reported trait impulsivity were more likely to be successful dieters. In unrestrained eaters, impulsivity had no impact on dieting success. The authors suggest that lower levels of impulsivity may aid restrained eaters to form associative links between tempting foods and thoughts of dieting, leading them to engage in more successful dietary restraint in the long-term (Fishbach, Friedman, & Kruglanski, 2003; Stroebe, Van Koningsbruggen, Papies, & Aarts, 2013).

Guerrieri, Nederkoorn, Schrooten, Martijn, and Jansen (2009) observed a different pattern of results in a sample of female undergraduates after priming participants to act impulsively or to exert inhibitory control. Participants' current dieting status and dietary restraint measured by the RS were assessed. The authors split the sample into three groups. A dieting group (RS score irrelevant), a low restraint non-dieting group, and a high-restraint non-dieting group. The induction of impulsivity led to an increased intake of snack foods in low and high restrained eaters, who were not currently dieting. In participants who reported being current dieters, however, the induction of impulsivity compared to the induction of inhibitory control, led to a sharp decrease in snack intake. Guerrieri et al. explained these counterintuitive findings by referencing the ego-strength model of self-regulation, according to which there is a lack of resources available for successful dietary restraint in inhibited individuals as they have already exerted a vast amount of their resources to remain inhibited (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Muraven, Tice, & Baumeister, 1998). In addition, these findings suggest that current dieting status but not dietary restraint measured by the RS was a key factor in impulsivity-related eating behaviour. Nevertheless, the lack of a control group limits the interpretability of the study's findings and future research should aim to replicate these results using a more robust study design.

6.2.2 Stress

Research has shown that stress can have varying effects on dietary intake in adults and children (see Chapter One, Section 1.5 for more detail). Wardle, Chida, Gibson, Whitaker, and Steptoe (2011) carried out a meta-analysis of longitudinal studies assessing the impact of psychosocial stress on adiposity risk and found that stress increased the risk for weight gain, but that effect sizes were very small (r=.014). A range of factors, such as gender, restraint and weight, moderate the link between stress and intake and subsequently the risk for weight gain. Females (Klein, Faraday, & Grunberg, 1996), restrained eaters (Wardle, Steptoe, Oliver, & Lipsey, 2000), and overweight individuals (Pine, 1985) have generally been found to increase their intake in the face of mild chronic and acute stress. Conversely, the intake of males, healthy weight and unrestrained eaters tended to remain the same or to be reduced under similar conditions (Greeno & Wing, 1994; Grunberg & Straub, 1992; Roemmich, Wright, & Epstein, 2002).

6.2.3 Links between stress and dietary restraint

As highlighted, dietary restraint is one factor that has been found to moderate the link between stress and weight gain. Dietary restraint has been linked with disinhibited eating and dieting failure (Polivy & Herman, 1985). Nevertheless, some researchers have found that restrained eaters can successfully engage in dieting behaviour (Laessle, Tuschl, Kotthaus, & Pirke, 1989). These conflicting findings are likely due to differences in concepts and behaviours measured by different dietary restraint scales (Laessle et al.). Importantly, researchers have found that dietary restraint may be particularly detrimental during periods of stress (Baucom & Aiken, 1981; Schotte, Cools, & McNally, 1990). Wardle et al. (2000) carried out a longitudinal study comparing participants' intake during high and low work stress periods. They found that individuals consumed a significantly greater amount of overall energy, fat and sugar, during high compared to low stress periods. This effect was moderated by dietary restraint; the increase in intake was only observed in restrained, but not unrestrained eaters. Additionally, Roemmich et al. (2002) found that 9-year-olds low in restraint decreased their intake of overall calories, fat, protein and carbohydrates from a snack following a stressful task in comparison to a non-stressful control task. There was also a trend for children high in restraint to consume more calories following the stress compared to the control task. These results indicate that dietary restraint plays an important role in stress-related eating behaviour in adults and children.

6.2.4 Stress, impulsivity and health behaviours

Individual differences in impulsivity levels have been found to moderate the impact of stress on health behaviours in adults and adolescents. Much of the research in this area comes from the addiction field with only few studies investigating the impact of stress and impulsivity on eating behaviour in adults. In general, researchers have highlighted that stress can have detrimental effects on task performance, self-control and the inhibition of pre-potent responses, favouring impulsive behaviour (Cohen, 1980; Flora, Wilkerson, & Flora, 2003; Muraven & Baumeister, 2001).

Fox, Bergquist, Gu, and Sinha (2010) reported that recent and cumulative life stress as well as self-reported impulsivity predicted harmful drinking patterns in regular drinkers. Importantly, stress and impulsivity interacted, with high levels of each factor leading to the most harmful drinking patterns. Additionally, Fields, Collins, Leraas, and Reynolds (2009) found that impulsivity measured through delay discounting mediated the positive relationship between perceived stress and smoking in adolescents so that more impulsive adolescents were more likely to report smoking if they reported higher levels of stress.

Few researchers have addressed the interplay between impulsivity, stress and eating behaviour. Tice, Bratslavsky, and Baumeister (2001) found that people who felt emotionally distressed were less likely to control their behaviour and consumed more sweet, fatty snack-foods, especially if they believed that their emotional state was modifiable. Tice et al. suggest that stress may lead to more impulsive behaviour by shifting long term priorities, such as working toward a temporally distant goal like weight loss, to a more immediate gratification of needs, such as the improvement of mood. Similarly, Bekker, Van de Meerendonk, and Mollerus (2004) found that more rather than less impulsive individuals tended to be more susceptible to the impact of negative mood on emotional eating. Finally, not all studies have found interactive effects of impulsivity and mood on intake. Van Strien and Ouwens (2007) e.g. found that there was no difference in intake of savoury crackers in female students following a stress or control task and that impulsivity did not interact with condition to affect intake. Overall, these results indicate that impulsivity may play a role for the relationship between stress and eating behaviour in adults. Whether similar moderating effects of impulsivity on stress-related eating behaviour in children exist is not yet clear, however.

Overall, research has indicated that impulsivity and dietary restraint impact on eating behaviour and weight in children and adults. Additionally, both factors have been found to interact with each other, affecting eating behaviour in adults. To date research has not addressed whether similar interactive effects of impulsivity and dietary restraint on eating behaviour can be observed in children. Independent from this area of research, stress has also been found to have a significant impact on eating behaviour and weight in children and adults. Interestingly, both impulsivity and dietary restraint in isolation, appear to moderate the impact of stress on eating behaviour in adults. To the best of our knowledge, there has been no investigation of the impact of stress on the interactive effect of impulsivity and dietary restraint in adults or children.

6.2.5 Aims and hypotheses

This study aimed to assess the impact of stress on the interactive effects of impulsivity and dietary restraint on eating behaviour in healthy weight 7-11-year-olds. Due to the sample size and the study design potential gender differences were not explored.

Based on previous research it was hypothesized that impulsivity and dietary restraint would interact; children with high compared to low levels of impulsivity and dietary restraint would consume more calories from a snack. Additionally, it was hypothesized that the interactive effect of impulsivity and dietary restraint would be exacerbated in a stress compared to a control condition. It was expected that children with high compared to low levels of impulsivity and dietary restraint would consume more calories from a snack if they had to complete a stressful compared to a non-stressful control task prior to snack food access (see Figure, 6.1 for an overview).

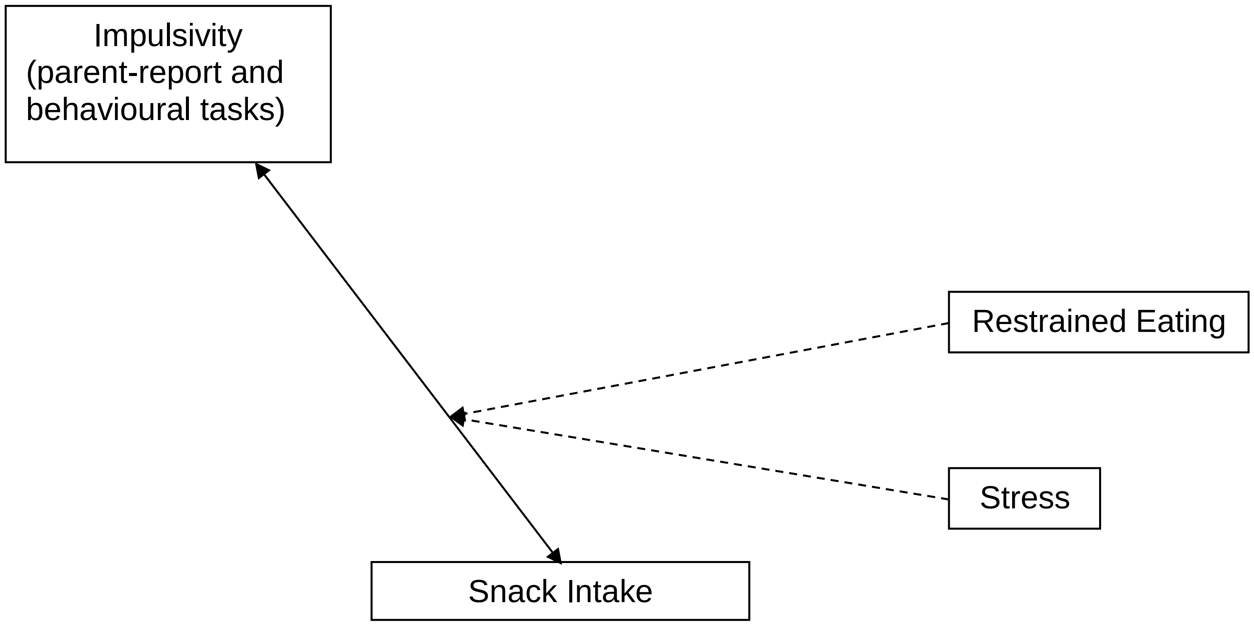


Figure 6.1. This model shows the interactive effects between the child factors impulsivity, dietary restraint and stress in their effect over snack intake to be explored in this chapter.

6.3 Method

6.3.1 Participants

Please see Chapter Five, Section 5.3.1 and Table 5.1 for a description of the sample.

6.3.2 Apparatus

Recording Equipment. Snack sessions were observed and recorded (see Chapter Two, Section 2.8.3 for details).

Snack composition and preparation. Children had access to six different sweet (chocolate chip cookies, Haribo Gold Bears, green grapes) and savoury (ready salted crisps, salted pretzels, carrot sticks) snack foods that varied in fat and sugar content during a 10-minute snack session. Foods were presented in square white plastic bowls (10x10cm). Overall calorie intake was calculated (see Chapter Two, Section 2.8.2 for more detail).

6.3.3 Measures and procedure

Please see Chapter Five, Section 5.3.3. for information regarding the parent-report and child self-report measures and the behavioural impulsivity tasks used.

Control task. As described in Chapter Five, children completed a non-challenging maths game with the researcher; this task was used to compare the potential effects of a stressful task on snack intake (see also Chapter Two, Section 2.9.1). Each mathematical problem was displayed on one PowerPoint slide (e.g.

1+1=? a: 1, b: 2, c: 3). Children controlled the speed of the slide presentation, were allowed to discuss responses with the researcher and received positive feedback.

Stress task. Children also completed a challenging, stressful mental arithmetic test with the researcher (see also Chapter Two, Section 2.9.2). Each mathematical problem consisted of three parts displayed on three separate PowerPoint slides (e.g., slide 1: 4*3; slide 2: +8; slide 3: -12; answer = ?). The first two slides were displayed for 2.5 seconds, while the third slide was displayed for 4 seconds. Children received positive and negative feedback from the researcher.

The order in which children completed the stress and control tasks was randomized; 50% of children completed the stress task during the first visit and the control task during the second visit, while 50% of children completed the control task first and stress task second.

Visual analogue scale. Children self-reported perceived stress using a 100mm visual analogue scale (VAS) with the anchors "*not stressed at all*" and "*extremely stressed*". Stress ratings made immediately before and after the stress/control tasks provided the key measurements. Reactivity was calculated as the rating made immediately after the stress/control task minus the rating made preceding the stress/control task.

Heart rate. Children's heart rate (HR) was measured in 5s intervals using a wireless HR monitor (Polar RS 400). The key HR measurement periods were baseline, the minute before stress task onset, and the seven minutes of the stress task. Reactivity was calculated as the average stress/control task HR minus the baseline HR.

Parents and children visited the Infant and Child Laboratory twice during an eight-week period. During each visit, children were fitted with a HR monitor on arrival. The monitor was fitted by parents and checked for accurate placement by the researcher. At each visit children completed a hunger rating, which was followed by a range of questionnaires at one visit and the impulsivity tasks at the other visit. Parents completed the questionnaire pack in an adjacent room and were able to see their child through a one-way mirror at all times. After completing the questionnaires/impulsivity tasks children completed a VAS stress rating, which was followed by the control or stress task. Immediately after this task children made a further VAS stress rating, which was immediately followed by a 10-minute snack session, during which the researcher left the room. Children also had access to reading and colouring materials during the snack session. After ten minutes the researcher re-entered the room, removed the foods and recorded intake. Following the snack session children chose a toy and stickers as a thank you for participation. Parents were reimbursed (£5) for their travel expenses for each visit and debriefed after the second visit. The Ethical Review Committee of the University of Birmingham approved this study (ERN 12-0465P).

6.3.4 Statistical analysis

SPSS version 20 statistical software was used to analyse the data. The criterion alpha for significance was .05. Histograms were inspected and indicated that the majority of data, except for hunger ratings, were normally distributed. Data from four children was excluded on all analyses involving the Circle Drawing task (CDT), as their performance was anomalous (slow tracing time more than three SD above the mean). Initially, descriptive statistics for impulsivity were calculated and potential gender differences explored using independent samples *t*-tests. The impact of potential covariates on intake and stress ratings in the stress and control conditions was assessed. Additionally, the impact of hunger on intake in each condition was assessed through Spearman's rank correlations and a Wilcoxon signed-rank test was carried out to assess whether children felt equally hungry at arrival for each visit.

Within-subjects ANOVAs on children's HR and VAS reactivity to the stress/control tasks, controlling for significant covariates, were carried out to examine whether children felt stressed by the stressor. Additionally, analyses controlling for significant covariates were carried out to examine whether all children felt equally stressed, by assessing associations between HR and VAS reactivity to the stress/control tasks, impulsivity and dietary restraint.

Firstly, a number of 2 (Impulsivity: high vs. low) X 2 (Dietary restraint: high vs. low) between-subjects ANOVAs, controlling for significant covariates, were carried out to examine whether parent-reported impulsivity and impulsivity task performance, and dietary restraint interacted to affect calorie intake in the control condition.

Secondly, a number of 2 (Condition: stress vs. control) X 2 (Impulsivity: high vs. low) X 2 (Dietary restraint: high vs. low) split-plot ANOVAs, controlling for significant covariates, with condition as the within-subjects factor and impulsivity and dietary restraint as the between-subjects factors and calorie intake as the outcome variable, were carried out.

Thirdly, significant 2x2x2 interactions were followed up by separate split-plot ANOVAs, controlling for significant covariates, in the high and low impulsivity subsamples. As before, condition was the within-subjects factor and dietary restraint the between-subjects factor, while calorie intake was the outcome measure. This method allowed the elimination of impulsivity as the between-subjects factor and led to an improved ability to interpret significant interactions.

6.4 Results

6.4.1 Descriptives

Please refer to Chapter Five, Section 5.4.1 (Table 5.1) for parent and child demographic characteristics, child behaviour difficulties, parent-reported impulsivity levels (Table 5.2), impulsivity task performance (Table 5.3) and gender differences.

Medians of scores on the parent-report impulsivity measures and impulsivity tasks were calculated to provide median-splits for the subsequent analyses (Table 6.1).

Table 6.1

Median and Interquartile range (IQR) for all variables of interest

Measure	Median (IQR)
Dutch Eating Behaviour Questionnaire-Child version (DEBQ-C) Dietary restraint	1.86 (.86)
Temperament in Middle Childhood Questionnaire (TMCQ) Impulsivity	2.69 (.81)
Conners' Global Index (CGI): Restless-Impulsive	4 (6)
Conners' Parent Rating Scale (CPRS) Hyperactivity	5 (5.5)
Door Opening task	40 (49)
Delay of Gratification task	7.5 (10.5)
Go/No-Go (GNG) task: Go trial RT (msec)	375.5 (42.42)
GNG task: Errors of Commission	8 (4)
CDT: Slow Tracing Time(s)	59.81 (59.5)

6.4.2 Covariates

Pearson's correlations were carried out to assess associations between the calorie intake and confounding variables such as child age, BMI z-score and maternal BMI. Based on previous research it was hypothesized that calorie intake would be positively associated with child age and BMI z-score, maternal BMI and parent education level irrespective of condition. Partly in line with these hypotheses child BMI z-score was positively associated with calorie intake. All further analyses examining differences in calorie intake between conditions controlled for child BMI z-score (see Table 6.2).

Furthermore, Pearson's correlations were carried out to assess the potential relationships between reactivity (HR and VAS) to the stress and control tasks and confounding variables such as child age, BMI z-score, maternal BMI and parent education level. It was hypothesized that child age, and parent education level would be associated with VAS reactivity to the stress and control tasks. Additionally, it was hypothesized that parent BMI and child BMI z-score would be associated with HR reactivity to the stress and control tasks. The results indicated that HR reactivity was not related to the potential confounds. VAS reactivity to the control task was only positively associated with child age, suggesting that older children were more reactive to the control task. Analyses into VAS reactivity therefore controlled for child age (see Table 6.2).

Finally, Spearman's correlations were carried out, to assess the relationship between hunger and intake, as hunger ratings were not normally distributed. It was hypothesized that calorie intake would be negatively associated with hunger at arrival irrespective of condition. Contrary to these hypotheses, hunger was not associated with any intake measure under control or stress conditions (see Table 6.5). Additionally, a Wilcoxon signed-rank test confirmed that there was no significant difference in hunger at arrival in the stress (Median hunger rating=3, *IQR*=1) and control conditions (Median hunger rating=3, *IQR*=1), *W*=90.5, *Z*=-.59, *p*=.56. Further analyses did not control for child hunger.

Table 6.2

Correlations between intake measures and stress/control task reactivity measures and potential confounds

	Child Age	Child BMI z-score	Parent BMI	Parent Education Level	Hunger at Arrival
			Control Condition		
Calorie Intake	.24	.3*	.21	.01	-.21
VAS Reactivity	.35*	-.22	-.09	-.08	-
HR Reactivity	-.2	-.1	-.21	-.02	-
			Stress Condition		
Calorie Intake	.18	.32*	.09	.17	-.09
VAS Reactivity	-.11	-.07	.08	-.12	-
HR Reactivity	.07	-.11	-.05	.1	-

*p<.05

6.4.3 Stress levels

To assess whether the stress manipulation was effective, within-subjects analyses were carried out on the stress measures. A within-subjects ANCOVA, controlling for child age, showed there was a significant difference in children's self-reported (VAS) reactivity to a stress and a control task (Pillai's trace, $F(1, 39)=13.71$ $p=.001$). Children reported a greater increase in perceived stress ($M=3.87$, $SD=2.6$) when completing the stress task than when completing the control task ($M=.41$, $SD=1.64$). Additionally, there was a significant difference in HR reactivity to the stress and the control tasks (Pillai's trace, $F(1, 37)=20.69$, $p<.001$). Children had a greater increase in HR when completing the stress task ($M=3.86$, $SD=5.01$) than when completing the control task ($M=-1.13$, $SD=5.56$; see Figure 6.2).

Additionally, it was assessed whether all children were equally stressed by examining potential relationships between HR and VAS reactivity to the stress and control tasks, dietary restraint and impulsivity. Pearson's correlations showed that HR reactivity was not associated with dietary restraint or impulsivity (Table 6.3). Additionally, partial Pearson's correlations, controlling for child age, indicated that self-reported reactivity to the stress and control tasks was not associated with dietary restraint and the majority of the impulsivity measures. Positive associations between self-reported reactivity to the stress and control tasks and GNG task: Go trial RT were observed, indicating that children who responded more slowly on this task were more reactive to the stress and the control tasks (Table 6.3).

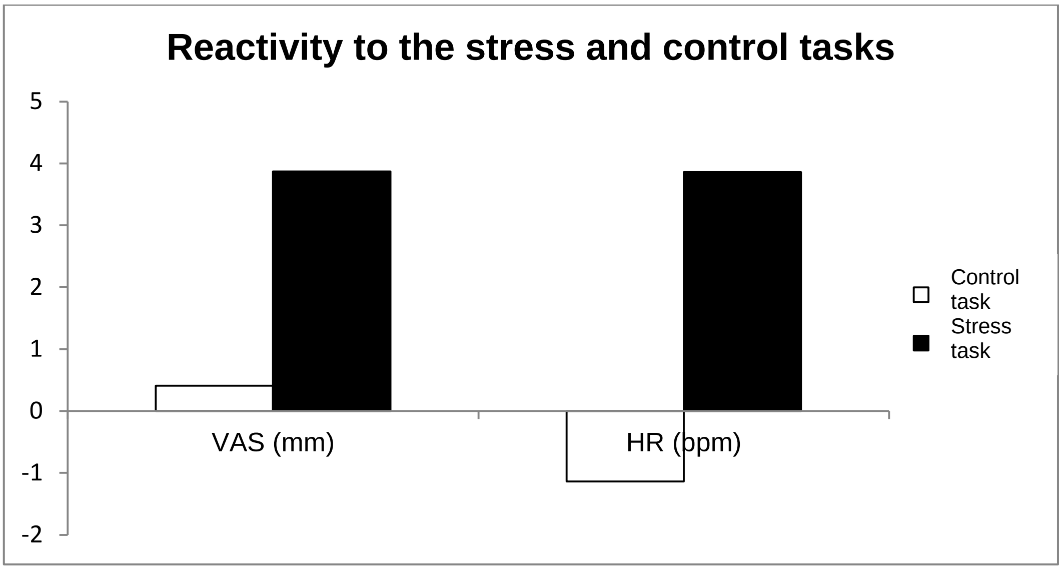


Figure 6.2. Reactivity to the stress and control tasks for VAS ratings in mm and HR reactivity in bpm.

Table 6.3

Associations between HR reactivity to the stress and control tasks, self-reported reactivity to the stress and control tasks measured by a VAS and dietary restraint and impulsivity measures

	HR Reactivity to the Stress Task	HR Reactivity to the Control Task	VAS Reactivity to the Stress Task+	VAS Reactivity to the Control Task+
DEBQ-C Dietary Restraint	-.11	-.25	.2	.08
TMCQ Impulsivity	.04	.24	-.08	-.13
CGI: Restless-Impulsive	-.31	.14	-.07	-.02
CPRS Hyperactivity	-.17	.18	-.14	-.06
Door Opening task	-.11	-.1	.08	.08
Delay of Gratification task	-.001	.08	-.04	.11
GNG task: Go trial RT	.08	-.04	.44**	.38*
GNG task: Errors of Commission	-.3	.16	-.03	-.21
CDT	.15	-.06	-.11	.07

*p<.05, ***p*<.01, +controlling for child age

6.4.4 Interactive effects between impulsivity and dietary restraint in the control condition

A series of 2 (Impulsivity: high vs. low) X 2 (Dietary Restraint: high vs. low) between-subjects ANCOVAs were carried out to assess interactions affecting calorie intake during the control condition; analyses controlled for child BMI z-score. Analyses were carried out for the three parent-report impulsivity measures and for the five impulsivity tasks. Table 6.4 shows that impulsivity, as measured by the CDT, and dietary restraint interacted to affect calorie intake (Figure 6.3). Children with high levels of impulsivity and dietary restraint consumed a greater amount of calories than their less impulsive peers and children low in impulsivity but high in dietary restraint. Children high in impulsivity and restraint consumed slightly more calories than children low in both measures.

Table 6.4

Interactive effects of impulsivity and dietary restraint affecting calorie intake during the control condition

	Calorie Intake+
TMCQ X DEBQ-C Restraint	$F(1, 39)=3.95$, $p=.05$, partial $\eta^2=.09$
CGI: Restless-Impulsive X DEBQ-C Restraint	$F(1, 38)=.05$, $p=.83$, partial $\eta^2=.001$
CPRS Hyperactivity X DEBQ-C Restraint	$F(1, 33)=.06$, $p=.81$, partial $\eta^2=.002$
Door Opening task X DEBQ-C Restraint	$F(1, 28)=.01$, $p=.94$, partial $\eta^2=0$
Delay of Gratification task X DEBQ-C Restraint	$F(1, 40)=.07$, $p=.8$, partial $\eta^2=.002$
GNG task: Go trial RT X DEBQ-C Restraint	$F(1, 39)=.11$, $p=.74$, partial $\eta^2=.003$
GNG task: Errors of commission X DEBQ-C Restraint	$F(1, 39)=1.6$, $p=.21$, partial $\eta^2=.04$
CDT Slow X DEBQ-C Restraint	$F(1, 40)=6.14$, $p=.02$, partial $\eta^2=.13$

+ Controlling for child BMI z-score

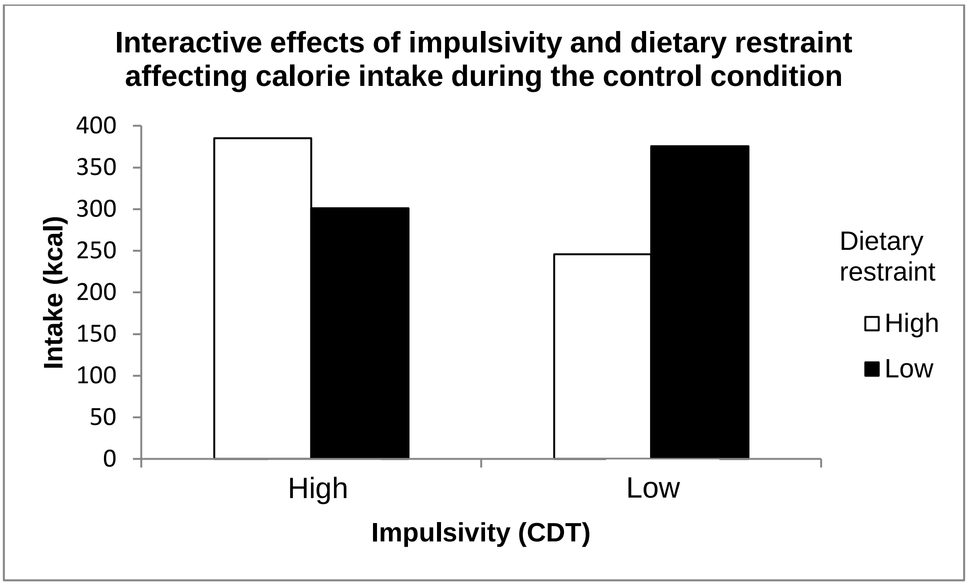


Figure 6.3. Interactive effects of impulsivity measured by the CDT and dietary restraint affecting calorie intake.

6.4.5 Interactive effects between condition, impulsivity and dietary restraint

A number of 2 (Condition: stress vs. control) X 2 (Impulsivity: high vs. low) X 2 (Dietary Restraint: high vs. low) split-plot ANCOVAs were carried out to assess interactions affecting calorie intake; analyses controlled for child BMI z-score. As before, all analyses were carried out for the three parent-report impulsivity measures and for the five impulsivity task indices. Table 6.5 shows that condition, impulsivity as measured by the CDT, and dietary restraint interacted to affect calorie intake.

Table 6.5

Interactive effects of condition, impulsivity and dietary restraint affecting calorie intake

Sample Overall	Calorie Intake+
Condition X TMCQ X DEBQ-C Restraint	*F*(1, 42)=.36, *p*=.55, partial η^2=.01
Condition X CGI Restless-Impulsive X DEBQ-C Restraint	*F*(1, 40)=.26, *p*=.61, partial η^2=.01
Condition X CPRS Hyperactivity X DEBQ-C Restraint	*F*(1, 35)=.83, *p*=.37, partial η^2=.02
Condition X Door Opening task X DEBQ-C Restraint	*F*(1, 43)=.08, *p*=.77, partial η^2=.002
Condition X Delay of Gratification task X DEBQ-C Restraint	*F*(1, 43)=.71, *p*=.41, partial η^2=.02
Condition X GNG task: Go trial RT X DEBQ-C Restraint	*F*(1, 41)=.6, *p*=.44, partial η^2=.02
Condition X GNG task: Errors of commission X DEBQ-C Restraint	*F*(1, 41)=.08, *p*=.77, partial η^2=.002
Condition X CDT Slow X DEBQ-C Restraint	*F*(1, 39)=5.85, *p*=.02, partial η^2=.13

+ Controlling for BMI z-score

6.4.6 Interactive effects between condition and dietary restraint in high and low impulsivity samples

The significant 2 (Condition: stress vs. control) X 2 (CDT-Impulsivity: high vs. low) X 2 (Dietary Restraint: high vs. low) interaction was followed-up by separate split-plot ANCOVAs on the high and low impulsivity subsamples. These analyses indicated that there was a significant interaction between condition and dietary restraint in the high impulsivity sample (Pillai's trace, $F(1, 18)=4.83$, $p=.04$), but not in the low impulsivity sample (Pillai's trace, $F(1, 20)=1.77$, $p=.2$). Impulsive children who were high in dietary restraint decreased their calorie intake in the stress compared to the control condition. Impulsive children low in dietary restraint conversely increased their intake in the stress compared to the control condition (Figure 6.4a). Children with low levels of impulsivity did not differ in intake in the stress or control conditions, regardless of their level of dietary restraint (Figure 6.4b).

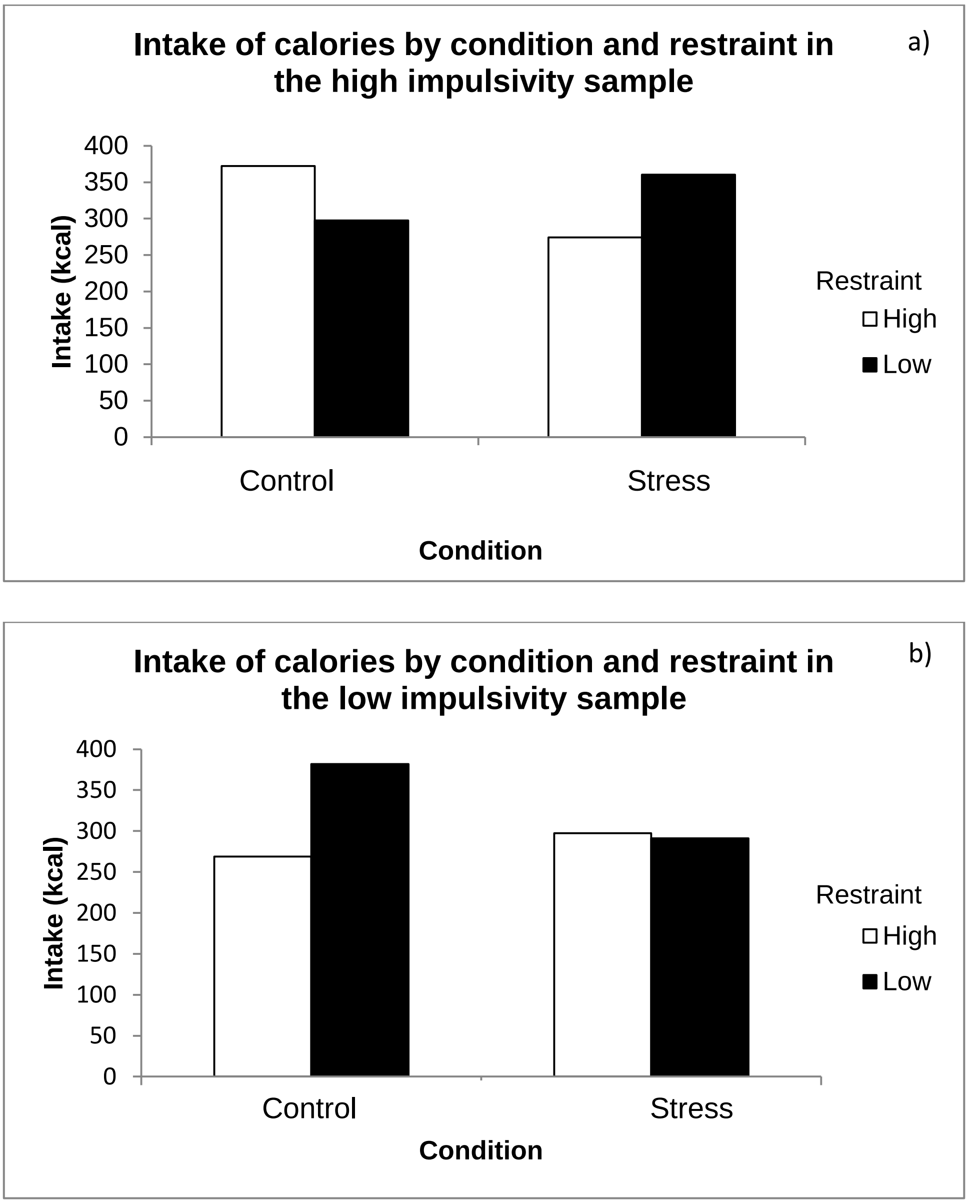


Figure 6.4. Interactive effects of condition and dietary restraint affecting intake in the high impulsivity sample (a) and the low impulsivity sample (b); Impulsivity measured by the CDT.

6.5 Discussion

The current study aimed to assess the impact of stress on the interactive effects of impulsivity and dietary restraint on eating behaviour in healthy weight 7-11-year-olds. Research in children has identified links between impulsivity and weight, poorer food choices and dieting success (Nederkoorn et al., 2006; Thamotharan, Lange, Zale, Huffhines, & Fields, 2013). Additionally, impulsivity has been found to interact with dietary restraint (e.g. Jansen et al., 2009). Stress also has a detrimental effect on eating behaviour and may also affect the interactive effect of impulsivity and dietary restraint on eating behaviour (Wardle et al., 2011). Research in the addiction field has highlighted that interactions between stress and impulsivity affect smoking and problematic drinking behaviours in adolescents and adults (Fields et al., 2009; Fox et al., 2010), with few studies investigating such effects on eating behaviour in adults (Bekker et al., 2004; Tice et al., 2001; Van Strien & Ouwens, 2007). Furthermore, studies have highlighted that stress in combination with dietary restraint can have particularly detrimental effects on eating behaviour and weight regulation in children and adults (Wardle et al., 2000; Roemmich et al., 2002). Up to now, research has not investigated the interactive effects of impulsivity and dietary restraint on eating behaviour in children, while considering the impact of stress. The results of the current study showed that impulsivity and dietary restraint interacted to affect calorie intake under non-stressful conditions. Additionally, condition, dietary restraint and impulsivity interacted to affect calorie intake. Follow-up analyses of these effects indicated that interactive effects on intake emerged in the high impulsivity sample only (see Figure 6.5 for an overview of observed interactive effects).

Firstly, it was hypothesized that dietary restraint and impulsivity would interact, indicating that children with high scores on both factors would consume more calories under non-stressful conditions. Findings from the adult literature have highlighted that combinations of impulsivity and restraint can lead to disinhibited eating in food-rich environments (Jansen et al., 2009; Meule et al., 2011; Nederkoorn et al. 2007; Van Koningsbruggen et al., 2013). In line with the hypothesis and research in adults, impulsivity and dietary restraint interacted to affect calorie intake. Children high in impulsivity and dietary restraint consumed more calories than children high in impulsivity and low in restraint, or low in impulsivity and high in restraint. They also consumed slightly more calories than children scoring low on both measures. Overall, this pattern suggests that in healthy weight 7-11-year-olds the combination of impulsivity and dietary restraint is linked with a tendency toward poorer intake control also seen in adults.

Secondly, it was hypothesized that stress would exacerbate the interactive effects of impulsivity and dietary restraint over intake. In line with the hypothesis condition, impulsivity and dietary restraint interacted to affect calorie intake if impulsivity was assessed by the CDT. Nevertheless, follow-up analyses of these interactions indicated that, contrary to the hypothesis, children with high compared to low levels of impulsivity and dietary restraint engaged in successful dietary restraint, decreasing their intake of calories in a stress condition. These results are surprising and as this is the first study to investigate the joint impact of stress, impulsivity and dietary restraint on intake in children, there is little research available to provide an explanation for the mechanism underlying this finding. Research in adult populations has suggested that restrained eaters show more successful intake regulation if they have the necessary self-control resources (Houben, Nederkoorn, & Jansen, 2012). Low levels of these resources are thought to lead to eating behaviour driven by factors like mood and approach behaviours (e.g., Hofmann & Friese, 2008; Hofmann, Rauch, & Gawronski, 2007).

In line with these suggestions a potential explanation of the current results is based on the Ego-Strength Model of Self-Regulation developed by Baumeister and colleagues (Baumeister et al., 1998; Muraven et al., 1998). According to this model different acts of volition draw on the same underlying resources. If resources are depleted by an act of volition then subsequent acts of volition will be impaired due to a lack of resources. In line with this model impulsive children consumed similar amounts of calories, regardless of their dietary restraint levels. Children with high levels of impulsivity and dietary restraint had the necessary resources to engage in successful dietary restraint under control and stress conditions, as they did not exert energy to remain inhibited. Instead they only exerted energy to complete the stressful task and to engage in dietary restraint, which they managed to do successfully. One finding the model fails to explain is why children with high levels of impulsivity and dietary restraint failed to successfully engage in dietary restraint in the control condition. These children should have been even more capable to control their intake without the stress task making demands on their underlying resources. A potential explanation comes from the Goal Conflict Model of Eating Behaviour (Stroebe et al., 2013), according to which there are two goals (eating enjoyment and weight control), which can be activated and inhibited by food environments, cognitions and emotions. In restrained eaters these goals are incompatible; activation of one goal will lead to the inhibition of the other. In line with this model the completion of the control task and subsequent exposure to palatable snack foods could have led to an increased accessibility of the food enjoyment goal and may have fostered sensitivity to food cues, leading to the intake of snack foods. In the stress condition aspects of the stress task may have led to an increased accessibility of the weight control goal and an inhibition of the eating enjoyment goal; aspects of this task may have also reduced the child's sensitivity to food cues. In addition to the activation of the weight control goal children had the necessary resources to engage in restraint. Although the exact mechanism through which stress may activate the weight control goal and inhibit the eating enjoyment goal is unclear, this would provide a basic explanation of the pattern of results.

A different pattern of results was observed in children high in impulsivity but low in restraint, as they increased their intake of calories in a stress compared to a control condition. These children exerted no energy to remain inhibited or restrained, and only drew on their resources to complete the stress task. A depletion of resources can therefore not explain these findings. Nevertheless, children low in dietary restraint have no or little intention to control their intake, so that an activation of the weight control goal is unlikely (Laessle et al., 1989). Additionally, the Goal Conflict Model states that both goals can co-exist and are not in competition in unrestrained individuals. There may also be an activation of the eating enjoyment goal and an increased sensitivity to food cues in the control condition. In impulsive children low in dietary restraint a mild stressor in combination with impulsivity may have therefore led to the typical increase in snack food intake (Bekker et al., 2004). Finally, children with low levels of impulsivity exerted energy to remain inhibited. In these children dietary restraint and condition did not interact to affect intake, which could be due to a depletion of their resources due to their constant effort to remain inhibited. This meant that completing the stress task or engaging in dietary restraint had little additional impact on their behaviour, as there were no resources to draw on, irrespective of any goal activation.

Overall, the results suggest that the availability of resources and activation of eating enjoyment and weight control goals play a crucial role in eating behaviour in stressful and non-stressful situations. The Ego-Strength Model of Self-Regulation (Baumeister et al., 1998; Muraven et al., 1998) and additional factors from the Goal Conflict Model of Eating Behaviour (Stroebe et al., 2013) provide a first step towards a useful explanation for the observed results. Future research in larger samples should establish whether different models and approaches could also explain the current findings. Additionally, gender differences in these effects should be explored.

The interactive effects of impulsivity, restraint and condition were only observed in the CDT, which assesses motor impulsivity. Parent-reported impulsivity and other impulsivity tasks measuring the ability to delay gratification, reward sensitivity, response speed or inhibitory control, showed no effects in combination with restraint and/or condition. This suggests that motor impulsivity assessed by the CDT may be particularly sensitive to the impact of dietary restraint and stress on intake in children. Research in adult populations has highlighted associations between motor impulsivity, measured through self-report, and disinhibited eating (e.g. Lyke & Spinella, 2004), suggesting that impulsive individuals are more likely to overeat in palatable food environments. Additionally, motor impulsivity in particular has been implicated in problematic eating behaviours observed in clinical populations, such as individuals with Binge Eating Disorder, suggesting that motor impulsivity in particular may be associated with more problematic forms of eating behaviour than other types of impulsivity (Nasser, Gluck, & Geliebter, 2004).

This study has several limitations. The sample was split into high and low impulsivity subsamples based on the median-split of scores on impulsivity measures. This method may not have been sensitive enough to create meaningful groups of children high and low in impulsivity. Although more rigorous methods of grouping children may have provided less arbitrary cut-offs other researchers have also relied on median-splits to group their participants (Jansen et al., 2009). It is also important to highlight that none of the children participating in this study had clinically elevated impulsivity levels. Children labelled as high in impulsivity were impulsive only in comparison to the other children in the sample. The lack of interactions between many impulsivity measures and dietary restraint may be explained by the fact that the difference between impulsivity levels in "impulsive" and "non-impulsive" children were not large enough. The impulsivity and dietary restraint measures were carried out before the control/stress tasks and snack session to avoid the depletion of resources due to the stress task, affecting impulsivity task performance. Additionally, the experience of a snack session could have affected subsequent responses on the DEBQ-C. Nevertheless, completing the DEBQ-C before the snack session may have activated the dietary restraint goal, influencing eating behaviour subsequently (Jansen et al., 2009; Shmueli & Prochaska, 2009).

Overall, the results of the current study indicate that the interaction between impulsivity and dietary restraint is affected by stress and that successful dietary restraint under stress may depend on the availability of underlying resources and the activation of eating enjoyment and weight control goals.

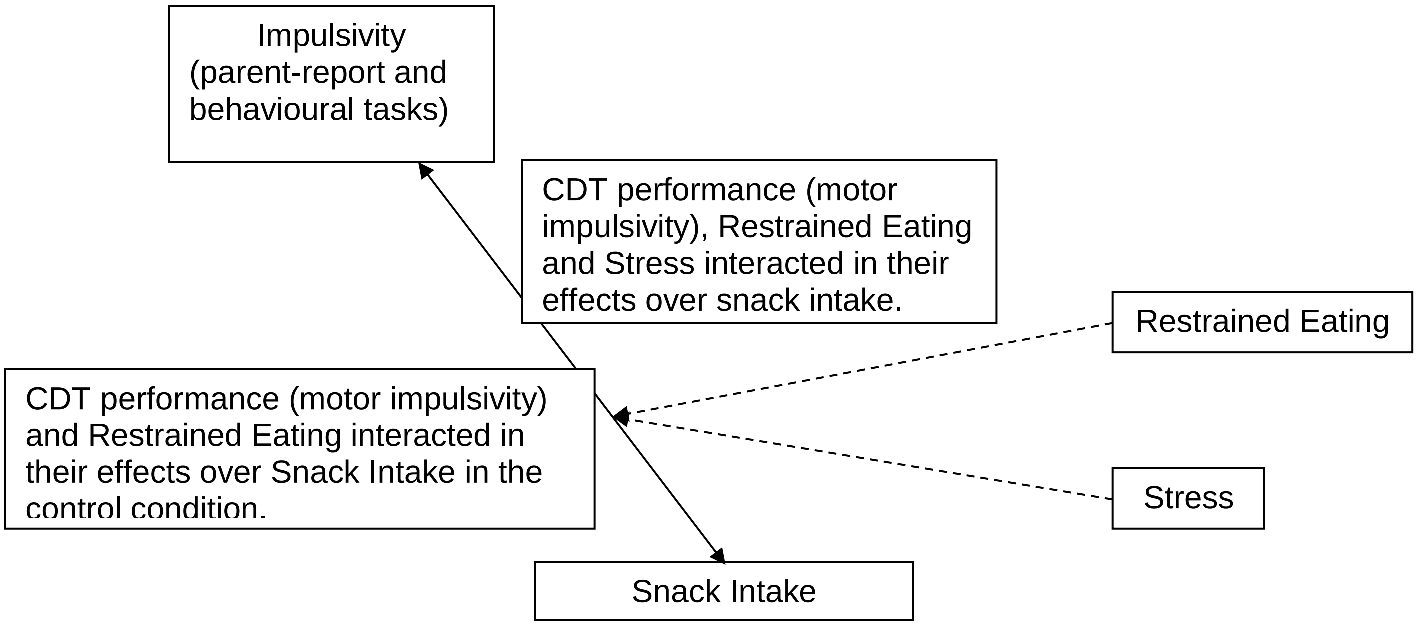


Figure 6.5. This model summarises the observed interactive effects between the child factors impulsivity and dietary restraint over snack intake in the control condition and between the child factors impulsivity, dietary restraint and stress over snack intake observed in this chapter.

CHAPTER SEVEN

EATING BEHAVIOUR AND FEEDING PRACTICES IN CHILDREN WITH AND WITHOUT ADHD

7.1 Abstract

Research has indicated that children with clinically elevated impulsivity levels, as seen in Attention Deficit Hyperactivity Disorder (ADHD), may be at a greater risk for the development of overweight/obesity. Little is known about the potential underlying mechanisms for this link. The current study aimed to explore whether differences in eating behaviours and parental feeding practices may explain the reported difference in obesity risk. Parents of 5-15-year-olds with ADHD (*n*=61) and without ADHD (*n*=44) completed a web-based survey on impulsivity, BMI, eating behaviour and parental feeding practices. ANOVAs demonstrated that children with ADHD were significantly more impulsive and displayed more behaviour problems than children without ADHD but groups did not differ in BMI z-score. Furthermore, males with ADHD were rated higher in food approach behaviour than males without ADHD but groups did not differ in food avoidance. Compared to parents of children without ADHD, parents of children with ADHD used greater levels of monitoring and restriction for weight control but did not differ in their use of restriction for health or pressure to eat. The results of this study provide information on potential mechanisms underlying the link between ADHD and the risk for overweight/obesity in children. The study's implications and limitations are discussed.

7.2 Introduction

A growing body of research has indicated potential links between Attention Deficit Hyperactivity Disorder (ADHD; for a detailed description of the disorder and its features please see Chapter One, Section 1.2.1) and the risk for overweight and obesity in children and adults (Erhart et al., 2012; Holtkamp et al., 2004; Khalife et al., 2014). Epidemiological and clinical studies have reported greater than expected rates of obesity in children and adults with ADHD despite controlling for potential confounds such as gender, socio-economic status, dietary intake patterns, physical activity levels and concurrent psychiatric conditions (Chen, Kim, Houtrow, & Newacheck, 2010; Curtin, Bandini, Perrin, Tybor, & Must, 2005). Waring and Lapane (2008) carried out a large nationally representative study of 5-17-year-olds, diagnosed with Attention Deficit Disorder (ADD) or ADHD by a healthcare professional according to parent-report. Children who were not receiving any stimulant medication to control their ADD/ADHD symptoms had 1.5 times the risk of being overweight, while those medicated had 1.6 times the odds of being underweight compared to children and adolescents without ADD/ADHD. Similarly, Erhart et al. carried out a large community-based study on a sample of 7-17-year-olds and found that children with ADHD were 1.9 times more likely to be overweight or obese. Additionally, Holtkamp et al. found that BMI z-scores for males (N=97) aged 5.5 to 14.7 years, accessing psychiatric services and diagnosed with ADHD according to DSM-IV criteria, were significantly higher than the population reference value (0.25 vs. 0) and that a greater proportion of males with ADHD, compared to a healthy reference population, fell into the overweight/obese category. Based on these findings, it has been suggested that unmedicated children with ADHD are part of an at-risk group for the development of overweight and obesity (Waring & Lapane).

In addition to studies highlighting an increased risk of obesity in children with ADHD, researchers have also found higher than expected rates of ADHD in obese children and adults accessing obesity treatment or psychiatric services (Agranat-Meged et al., 2005; Altfas, 2002; Dempsey, Dyehouse, & Schafer, 2011; Levy, Fleming, & Klar, 2009). Studies on children accessing obesity clinics as well as large epidemiological studies have suggested that overweight and obese 7-17-year-olds are significantly more likely to meet the DSM-IV criteria for ADHD than their healthy weight peers.

Some researchers have failed to find links between ADHD and obesity (Biederman et al., 2003; Spencer et al., 1996). Dubnov-Raz, Perry, and Berger (2011) e.g. found that 6-16-year-olds with ADHD were less likely to become overweight or obese. Similarly, Rojo, Ruiz, Dominguez, Calaf, and Livianos (2006) found no links between BMI and self-reported ADHD characteristics assessed by self-reports on the Strengths and Difficulties Questionnaire (SDQ; Goodman, Meltzer, & Bailey 1998) in a large community sample of 13-15-year-olds. In morbidly obese males only a tendency for more ADHD characteristics (27.9%) was observed. Although the assessment of ADHD was less thorough than in other studies, Rojo et al.’s findings raise the question whether positive links between ADHD and overweight/obesity risk may be specific to populations accessing psychiatric facilities and obesity clinics. Overall, the evidence suggests that ADHD is associated with the risk for the development of overweight and obesity in paediatric populations. The mixed findings of studies outlined above are likely due to differences in methodology, setting, inclusion/exclusion criteria (e.g. presence of co-morbidities), and variations in the control for potential confounds such as medication status (Egmond-Fröhlich, Widhalm, & de Zwaan, 2012).

The mechanisms underlying the link between ADHD, its characteristics and the risk for the development of overweight/obesity have received increasing attention, but remain largely unclear. One potential reason for greater rates of overweight in individuals with ADHD could be disordered eating tendencies such as binge eating seen in Bulimia Nervosa (BN), Binge Eating Disorder (BED) and the binge/purge subtype of Anorexia Nervosa (AN), which can be seen at higher than expected rates in individuals with ADHD (Cortese, Bernardina, & Mouren, 2007; Surman, Randall, & Biederman, 2006). Additionally, the inhibitory control deficits associated with ADHD may lead to poor intake monitoring, rapid consumption of foods and eating in the absence of hunger (Smith, Williamson, Bray, & Ryan, 1999; Wilhelm et al., 2011). Furthermore, children with ADHD are averse to delays and have a preference for immediate rewards over larger delayed rewards (Bitsakou, Psychogiou, Thompson, & Sonuga-Barke, 2009). Erhart et al. (2012) report that this effect is amplified in the context of edible rewards, suggesting that children with ADHD may be particularly vulnerable to making unhealthy food choices and selecting palatable, energy-dense “fast foods” when healthier choices are not immediately available or need to be prepared (e.g. home-cooked meals and healthy snacks; see also Davis et al., 2006). Attention deficits and executive function problems may also make it difficult for individuals with ADHD to follow regular eating patterns thus leading to irregular, abnormal intake patterns instead. Fleming and Levy (2002) suggested that females with ADHD are less sensitive to internal hunger and satiety cues, leading to overeating and bingeing once hunger is detected. Finally, compulsive eating has been suggested as a compensatory reaction towards the frustration generated by difficulties with attention and organisation experienced by individuals with ADHD (Schweickert, Strober, & Moskowitz, 1997).

A further factor, which may affect eating behaviour and the development of eating pathology in children with ADHD, is parental feeding behaviour. Research addressing differences in feeding practices used by parents of children with and without ADHD is largely absent. Nevertheless, a number of studies have addressed associations between child impulsivity levels and parental feeding practices like restriction, pressure and monitoring in non-clinical populations (see also Chapters Three, Four and Five). Two widely used controlling feeding practices, restriction and monitoring, have e.g. been linked with impulsivity and were identified as moderators of the relationship between impulsivity and child weight and eating behaviour, respectively (Anzman & Birch, 2009; Farrow, 2012; Rollins Loken, Savage, & Birch, 2014; Tan & Holub 2011). Results from such studies suggest that intrusive feeding practices like restriction may be particularly detrimental to the development of healthy eating behaviours in impulsive children, while less intrusive practices like covert restriction and monitoring may be more appropriate. The presence of ADHD could also affect children's mealtime behaviours, which may also affect their parents' use of feeding practices (Lickteig, Isaacs, Zachor, & Hodgens, 1999; see also Chapter Four). Findings from the general parenting literature have indicated that parenting problems and stress may be more prevalent in families of children with ADHD; this could influence mealtime interactions (Theule, Wiener, Tannock, & Jenkins, 2013). Overall, the research findings from samples of children without clinically elevated levels of impulsivity suggest that there could be differences in the way parents of children with and without ADHD feed and interact with their children during mealtimes and in the context of snack consumption. Research confirming these assumptions by comparing feeding practices in parents of children with and without ADHD is missing.

Overall, there is evidence to suggest that children with ADHD have an increased risk of developing overweight and obesity. Little research exploring the underlying mechanisms is currently available. Eating pathologies and food approach behaviours such as emotional and external eating are potential factors, which are receiving increasing attention. Some controlling parental feeding behaviours may also play an important role for the development of problematic eating behaviours and the regulation of intake and weight in children with ADHD. Research addressing these potential mechanisms further is needed in order to understand these links and to inform interventions improving outcomes for children with ADHD at risk of developing overweight and obesity.

7.2.1 Aims and hypotheses

The current study aimed to explore differences in weight, eating behaviour and the use of controlling feeding practices in children with and without ADHD and their parents. Based on previous research it was hypothesized that children with ADHD would be heavier and rated higher in food approach but lower in food avoidance behaviours than children without ADHD. Finally, it was hypothesized that parents of children with ADHD would report using greater levels of monitoring, pressure to eat and restriction for health and weight control than parents of children without ADHD (see Figure 7.1 for an overview of differences to be explored).

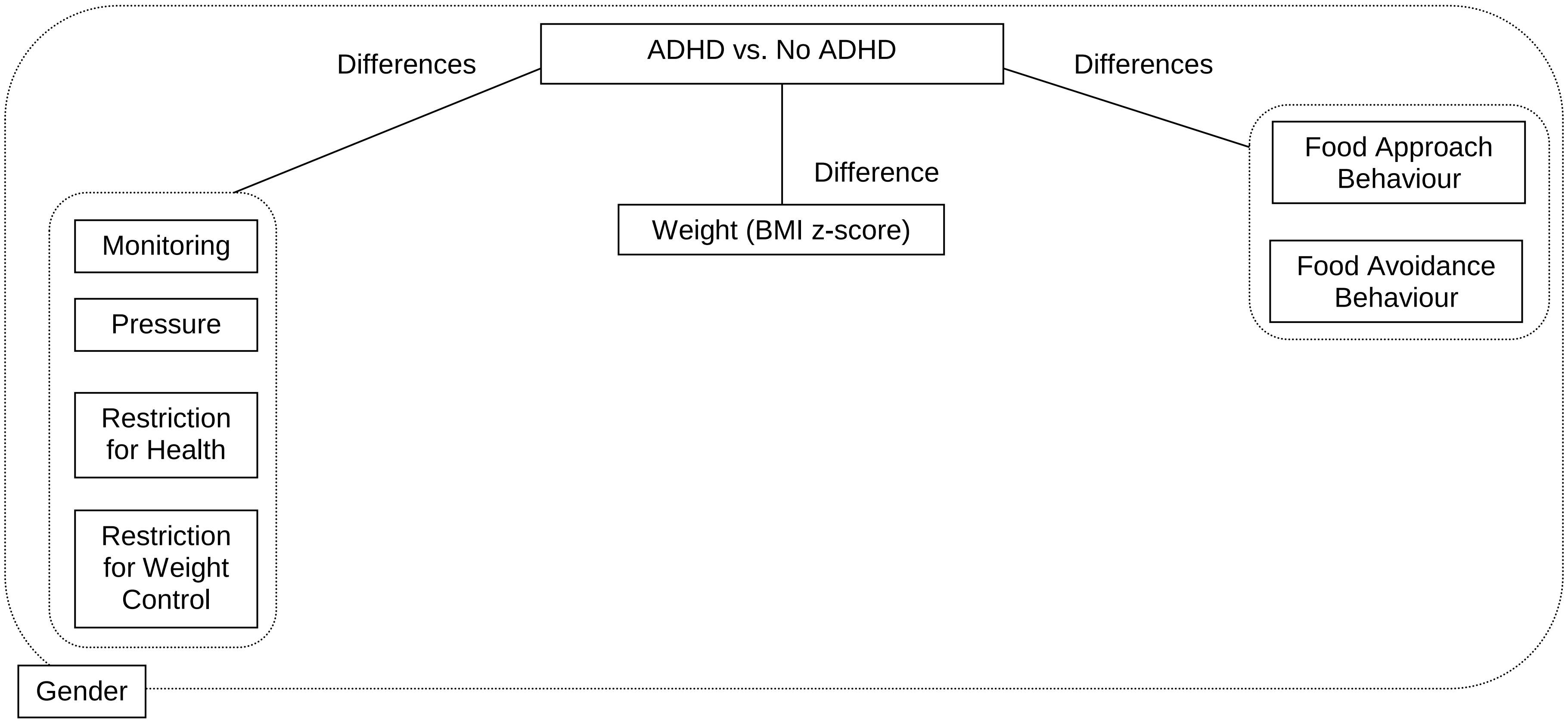


Figure 7.1. This model shows the differences in weight and eating behaviours and controlling feeding practices displayed by children and parents of children with and without ADHD to be explored in this chapter. The parental feeding practices monitoring, pressure to eat and restriction for health and weight control address parent factors, while ADHD diagnosis, weight and eating behaviour variables address child factors.

7.3 Method

7.3.1 Participants

Overall, 117 parents participated in this study and completed an online survey (Limesurvey 2.00) on the links between eating behaviour, weight, self-control and parent-child interactions. Parents were recruited through parenting websites, ADHD forums and through Facebook and social media platforms such as the University of Birmingham's e-newsletter and twitter services. Recruitment took place between November 2012 and April 2014. Inclusion criteria for this study included having a child aged 5 to 15 years of age and being able to complete a survey in English. Overall, 117 parents completed the survey. The data from six participants had to be excluded due to their children not meeting the age-criteria and a further six participants were excluded due to missing data regarding their child's ADHD diagnosis. The final sample consisted of 105 participants. Parents of 61 children reported that their child had been diagnosed with ADHD by a healthcare professional; parents of 44 children reported that their child had no known impulsivity-related disorder. Of the 61 children with ADHD, 43 took medication to control the symptoms of ADHD. Parents of seven children reported that their child had been diagnosed with a predominantly inattentive subtype of ADHD, 14 children had been diagnosed with a predominantly hyperactive-impulsive subtype and 27 children had been diagnosed with a combined subtype; the subtype of 13 children was unknown (n=11) or not reported (n=2). The sample's demographic characteristics can be seen in Table 7.1. Children with and without ADHD were aged 5 to 15 years and had a large variety in BMI z-scores. Parents were aged 22 to 54 years and had a large variety in BMI scores. Parents of children with and without

ADHD were predominantly well-educated and had Caucasian backgrounds. A small proportion of children with and without ADHD (<10%) had food intolerances or allergies to nuts, wheat or dairy. Additionally, 39.3% (*n*=24) of children with ADHD had a learning difficulty (e.g., dyslexia, dysgraphia, speech impediments or auditory impairments), and 32.8% (*n*=20) had a co-morbid disorder (e.g., Oppositional Defiant Disorder, anxiety or social difficulties).

7.3.2 Measures and procedure

The majority of the questionnaires were completed by children's mothers. More detail on all measures can be found in Chapter Two (see Appendix B for the selected questionnaires).

Demographic information. Parents provided information on their own and their child's age, gender, height and weight their own ethnicity and education level; parent education level was reported on a 7-point Likert scale ranging from 1 (*[Some] secondary education*) to 7 (Professional/Doctorate). Parental BMI and child BMI z-scores (adjusting for age and gender) were calculated based on this self-reported information.

Children's Eating Behaviour Questionnaire (CEBQ; Wardle, Guthrie, Sanderson, & Rapoport, 2001). The CEBQ measures parent-reported Food Approach and Food Avoidance behaviours displayed by children as young as 2 years. The Cronbach's alpha for the Food Approach subscale was .89 and for the

Food Avoidance scale was .89, indicating that the subscales had good internal consistency.

Comprehensive Feeding Practices Questionnaire (CFPQ; Musher-Eizenman & Holub, 2007). The CFPQ is a measure of parental feeding practices. This measure was used to assess the controlling feeding practices Monitoring, Pressure, Restriction for Weight Control and Restriction for Health. The Cronbach's alpha for Monitoring was .91, the alpha for Pressure was .76, while the alphas for Restriction for Weight Control and Restriction for Health were .84 and .83, respectively; these scores indicate that all subscales had good internal consistency.

Temperament in Middle Childhood Questionnaire (TMCQ, version 3.0; Simonds & Rothbart, 2004). The TMCQ measures child temperament and was used to measure parent-perceived child impulsivity. The Cronbach's alpha for the Impulsivity subscale was .94, indicating that the subscale had excellent internal consistency.

Conners' Parent Rating Scale (CPRS-R [L]; Conners, 1998). The CPRS was used to assess parents' perceptions of child impulsivity and hyperactivity over the past month. The Cronbach's alpha for the Hyperactivity subscale was .95, and for the CGI: Restless-Impulsive was .95, indicating that both subscales had excellent internal consistency.

Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997). The SDQ measures child behaviour difficulties during the past six months. The Cronbach's alpha for overall difficulties was .76, indicating that the scale had sufficient internal consistency.

ADHD and comorbid disorders. Parents self-reported whether their child had been diagnosed with ADHD by a healthcare professional in the past (Has your child been diagnosed with Attention Deficit Hyperactivity Disorder (ADHD)?). For children diagnosed with ADHD, the ADHD subtype and the medication status were explored. Additionally, parents self-reported whether a healthcare professional had diagnosed their child with any co-morbid disorders in the past and whether their child had any learning difficulties or developmental disorders.

The link to the online survey and a more detailed information sheet were posted on websites and social media platforms. By following the link parents were initially given access to an information page. Interested parents were then able to complete a consent form and access the online survey. The completion of the survey took 20-30 minutes. Parents were able to save and submit their responses at any time, and could also save and return to the survey at a later time. None of the questions were mandatory, allowing parents to skip questions. At the end of the survey parents had the option of providing their email address to enter a prize draw for a £25 Amazon voucher. Following this, parents were automatically directed to a debrief page containing information for sources of support and the researchers' contact details, and exited the survey. The Ethical Review Committee of the University of Birmingham approved this study (ERN_12-1011).

7.3.3 Statistical analysis

SPSS version 20 statistical software was used to analyse the data. The criterion alpha for significance was .05. Histograms were inspected and indicated that the majority of data were normally distributed. Preliminary analyses were carried out to assess whether there were significant differences in the outcome measures between medicated and unmedicated children with ADHD. These analyses indicated that there were no significant differences in impulsivity, BMI z-score, eating behaviour or parental feeding strategies between the two samples (see Appendix C-7); medicated and unmedicated children with ADHD were therefore combined to form one cohesive sample of children with ADHD in all further analyses.

Descriptive statistics for both samples were calculated and potential differences in confounding variables such as parent and child age, weight and parent education were calculated using *t*-tests. Differences in child gender between both groups were explored using Chi-squared analyses. Between-subjects ANOVAs, controlling for covariates where appropriate, were carried out to assess differences in child impulsivity, BMI z-score, eating behaviour and the use of parental feeding practices between groups, for the sample overall and for the male and female subsamples separately.

7.4 Results

7.4.1 Descriptive statistics

Demographic characteristics. Parent and child demographic characteristics by diagnosis can be seen in Table 7.1. *T*-tests indicated that there were no differences between children with and without ADHD and their parents in child age ($t(79.75)=.51$, $p=.61$), BMI z-score ($t(65)=.38$, $p=.71$), parent age ($t(100)=1.26$, $p=.21$), or parent BMI ($t(71)=.54$, $p=.59$). Parents differed in their educational background ($t(88)=-2.06$, $p=.04$). Parents of children without ADHD reported being more educated ($M=3.98$, $SD=1.56$) than parents of children without ADHD ($M=3.29$, $SD=1.59$). Additionally, a Chi-squared analysis was carried out to assess whether there were differences in child gender between both groups. This analysis showed that there was a significant difference in the number of females and males in the two groups ($\chi^2=(1, N=103)=9.28$, $p=.002$), with significantly more males in the sample of children with ADHD than in the sample without ADHD.

Table 7.1

Characteristics of the sample divided by diagnosis

Variables	ADHD Diagnosis (*n*=61)	No ADHD Diagnosis (*n*=44)
Child age	5-15, 9.69 (2.8)	5-15, 9.36 (3.49)
Child BMI SDS	-3-3.98, .91 (1.53)	-4.6-4.86, .75 (1.87)
Child gender	16 female, 43 male, 2 missing	25 female, 19 male
Parent age	25-54, 39.57, (6.91)	22-54, 37.75 (7.67)
Parent BMI	20.2-51.42, 27.79 (7.09)	19.72-40.09, 26.95 (5.5)
Parent gender	58 female, 2 male, 1 missing	41 female, 2 male, 1 missing
Education level	1.6% Professional/Doctorate (*n*=1)	6.8% Professional/Doctorate (*n*=3)
	13.1% Post-Graduate Qualification (*n*=8)	25% Post-Graduate Qualification (*n*=11)
	29.5% University graduate (*n*=18)	22.7% University graduate (*n*=10)
	4.9% A-Levels (*n*=3)	22.7% A-Levels (*n*=10)
	29.5% (Some) Secondary education (*n*=18)	18.2% (Some) Secondary education (*n*=8)
	21.3% Other or unknown (*n*=13)	4.5% Other or unknown (*n*=2)
Ethnicity	91.8% Caucasian (*n*=56)	93.2% Caucasian (*n*=41)
	4.9% Mixed background (*n*=3)	6.8% Black background (*n*=3)
	3.3% Unknown (*n*=2)	

7.4.2 Covariates

Pearson's correlations were carried out to assess associations between child impulsivity, behaviour problems, eating behaviour, parental controlling feeding practices and confounding variables such as child BMI z-score, age, parent BMI and education level. Based on previous research it was hypothesized that impulsivity would be associated with child age and parent education level, while child BMI z-score would be associated with child age, parent BMI and parent education level in both samples. It was also hypothesized that food approach and avoidance behaviours would be associated with child age and BMI-z-score in both samples. Finally, it was hypothesized that parental controlling feeding practices would be associated with child age, BMI z-score, maternal BMI and parent education level in both samples.

In children with ADHD these hypotheses were partly confirmed; impulsivity, measured by the TMCQ and the CPRS Hyperactivity subscale, was negatively associated with child age. Conversely, child behaviour problems, measured by the SDQ Total Difficulties score, were positively associated with child age. All analyses looking at differences in these measures between children with and without ADHD therefore controlled for child age. TMCQ Impulsivity was additionally negatively linked with parent education level; further analyses controlled for this variable. Food approach behaviour was positively associated with BMI-z score, while food avoidance was not associated with any of the potential confounds. Restriction for health and weight control were also positively associated with BMI z-score, while monitoring and pressure to eat were not associated with any potential confounds. All analyses looking at differences in these measures between children with and without

ADHD therefore controlled for BMI z-score. Finally, there were no links between BMI z-score and any of the potential confounds in children with ADHD (see Table 7.2).

Contrary to the hypothesis, in children without ADHD there were no associations between any of the impulsivity measures, child behaviour problems, eating behaviour, controlling feeding practices or child weight and the potential confounding variables (see Table 7.3). As there were significant differences in child gender and parent education level between the two samples, all further analyses looking at differences between children with and without ADHD controlled for these variables.

Table 7.2

Correlations between measures of interest and potential confounds in children with ADHD (n=61)

	Child BMI z-score	Child age	Maternal BMI	Parent education level
TMCQ Impulsivity	.04	-.38**	.1	-.36*
CGI: Restless-Impulsive	-.27	-.29	.01	-.21
CPRS Hyperactivity	-.39	-.42*	.1	-.3
SDQ Total Difficulties	-.18	.5*	-.03	.04
Food Approach	.56**	.06	-.22	-.31
Food Avoidance	-.33	-.04	.22	.24
Monitoring	.11	-.17	-.17	.02
Pressure	-.26	-.49	.14	-.05
Restriction Health	.53**	-.11	-.14	.01
Restriction Weight	.68**	.18	-.21	.1
Child BMI z-score	-	.14	.02	.1

**p*<.05, ***p*<.01

Table 7.3

Correlations between measures of interest and potential confounds in children without ADHD (n=44)

	Child BMI z-score	Child age	Maternal BMI	Parent education level
TMCQ Impulsivity	.37	.01	.01	-.12
CGI: Restless-Impulsive	.19	-.23	-.02	.28
CPRS Hyperactivity	.19	-.25	-.05	.25
SDQ Total Difficulties	.21	-.91	-.72	-.96
Food Approach	-.03	.19	.02	-.26
Food Avoidance	.04	-.05	-.03	.03
Monitoring	-.12	-.22	-.36	.17
Pressure	.28	-.23	.034	-.15
Restriction Health	-.19	-.11	-.09	.15
Restriction Weight	-.14	.28	.15	-.21
Child BMI z-score	-	.02	-.08	-.16

7.4.3 Differences in parent-reported impulsivity and behaviour problems in children with and without ADHD

ANOVAs, controlling for child gender and parent education for analyses addressing the sample overall and controlling for parent education only for gender specific analyses, were carried out to assess differences in impulsivity levels and behaviour problems between children with and without ADHD. These analyses were carried out to confirm the ecological validity of the approach. It was specifically hypothesized that children with ADHD would have greater scores on the impulsivity and behaviour problem measures. The analyses indicated that children with ADHD were rated as being significantly more impulsive on all measures; they were also rated as having more behaviour problems than children without ADHD. These results were maintained for gender specific analyses (see Table 7.4).

Table 7.4

Differences in impulsivity levels and child behaviour problems between children with and without ADHD

Variables		ADHD Diagnosis (*n*=61)	No ADHD Diagnosis (*n*=44)	ANCOVA+
TMCQ Impulsivity*	Overall	4.2 (.8)	2.95 (.86)	$F(1, 62)=29.23$, $p<.001$, partial $\eta^2=.32$
	Females	4.03 (1.01)	2.95 (.91)	$F(1, 23)=6.85$, $p=.01$, partial $\eta^2=.23$
	Males	4.28 (.69)	2.95 (.84)	$F(1, 36)=24.74$, $p<.001$, partial $\eta^2=.41$
CGI: Restless-Impulsive	Overall	3.34 (.59)	1.62 (.69)	$F(1, 56)=105.04$, $p<.001$, partial $\eta^2=.65$
	Females	3.25 (.68)	1.99 (.81)	$F(1, 20)=16.78$, $p=.001$, partial $\eta^2=.46$
	Males	3.39 (.55)	1.35 (.44)	$F(1, 34)=131.49$, $p<.001$, partial $\eta^2=.8$
CPRS Hyperactivity*	Overall	2.98 (.74)	1.54 (.52)	$F(1, 54)=71.89$, $p<.001$, partial $\eta^2=.57$
	Females	2.74 (.8)	1.71 (.63)	$F(1, 20)=13.33$, $p=.001$, partial $\eta^2=.4$
	Males	3.12 (.68)	1.41 (.37)	$F(1, 31)=72.69$, $p<.001$, partial $\eta^2=.7$
SDQ Total Difficulties Score*	Overall	7.55 (.85)	4.93 (1.03)	$F(1, 16)=14.62$, $p=.003$, partial $\eta^2=.57$
	Females	7.9 (.42)	-	-
	Males	7.4 (.96)	4.93 (1.03)	$F(1, 8)=10.01$, $p=.01$, partial $\eta^2=.56$

+ Controlling for child gender (on analyses for the sample overall only) and parent education, * controlling for child age

7.4.4 Differences in weight between children with and without ADHD

ANOVAs (controlling for child gender and parent education for analyses addressing the sample overall and controlling for parent education only for gender specific analyses) were carried out to assess whether children with ADHD were heavier than children without ADHD. These analyses showed that children with ADHD were not significantly heavier than children without ADHD for the sample overall or when split by gender (Table 7.5).

Table 7.5

Means and SDs of child BMI z-scores in children with and without ADHD and differences in BMI z-scores between the samples overall and between the female and male subsamples separately

Variables		ADHD Diagnosis (*n*=61)	No ADHD Diagnosis (*n*=44)	ANCOVA+
BMI z-score	Overall	.95 (1.59)	.94 (1.58)	$F(1, 58)=0$, $p=.5$, partial $\eta^2=0$
	Females	.97 (1.37)	.94 (1.78)	$F(1, 25)=.01$, $p=.47$, partial $\eta^2=0$
	Males	.94 (1.71)	.95 (1.35)	$F(1, 31)=.01$, $p=.47$, partial $\eta^2=0$

+ Controlling for child gender (on analyses for the sample overall only) and parent education

7.4.5 Differences in eating behaviour between children with and without ADHD

ANOVAs, controlling for (where appropriate) child gender, BMI z-score and parent education for analyses addressing the sample overall and controlling for BMI z-score and parent education only for gender specific analyses, were carried out to assess whether children with ADHD exhibited more food approach and less food avoidance behaviour than children without ADHD. These analyses indicated that in line with the hypothesis, there was a near significant trend for children with ADHD to score higher in food approach behaviour than children without ADHD (see Table 7.6). Gender analyses revealed that males, but not females with ADHD, scored significantly higher on food approach behaviour than males without ADHD. Contrary to the hypothesis, there were no differences in food avoidance behaviour between children with and without ADHD overall, or when split by gender (see Table 7.6).

Table 7.6

Means and SDs of food approach and avoidance behaviour in children with and without ADHD and differences in food approach and avoidance behaviour between the samples overall and between the female and male subsamples separately

		ADHD Diagnosis (*n*=61)	No ADHD Diagnosis (*n*=44)	ANCOVA+
Food Approach*	Overall	2.96 (.79)	2.57 (.55)	$F(1, 41)=3.05$, $p=.05$, partial η^2=07
	Females	2.7 (.93)	2.64 (.62)	$F(1, 18)=.01$, $p=.46$, partial $\eta^2=.001$
	Males	3.08 (.72)	2.45 (.41)	$F(1, 20)=6.33$, $p=.01$, partial $\eta^2=.24$
Food Avoidance	Overall	2.87 (.74)	2.85 (.63)	$F(1, 57)=.15$, $p=.36$, partial $\eta^2=.003$
	Females	2.81 (.93)	2.99 (.62)	$F(1, 22)=.02$, $p=.44$, partial $\eta^2=.001$
	Males	2.9 (.64)	2.74 (.63)	$F(1, 33)=.51$, $p=.24$, partial $\eta^2=.02$

+ Controlling for child gender (on analyses for the sample overall only) and parent education, * controlling for child BMI z-score

7.4.6 Differences in controlling parental feeding practices between parents of children with and without ADHD

ANOVAs, controlling for (where appropriate) child gender, BMI z-score and parent education for analyses addressing the sample overall and controlling for BMI z-score and parent education only for gender specific analyses, were carried out to assess whether parents of children with ADHD reported using greater levels of the controlling feeding practices monitoring, pressure or restriction (health/weight), than parents of children without ADHD. These analyses indicated that in line with the hypotheses parents of children with ADHD used greater levels of monitoring than parents of children without ADHD (see Table 7.7). Gender analyses showed that this difference was observable for males, but not for females. Additionally, parents of children with ADHD reported using greater levels of restriction for weight control than parents of children without ADHD. This difference could not be observed when conducting gender specific analyses. Contrary to the hypotheses parents of children with ADHD did not use greater levels of pressure to eat or restriction for health than parents of children without ADHD.

Table 7.7

Means and SDs of the controlling parental feeding practices monitoring, pressure and restriction for health and weight control in parents of children with and without ADHD and differences in the use of these feeding practices between the samples overall and between the female and male subsamples separately

		ADHD Diagnosis (*n*=61)	No ADHD Diagnosis (*n*=44)	ANCOVA+
Monitoring	Overall	4.41 (.84)	4.05 (.85)	$F(1, 66)=3.5$, $p=.04$, partial $\eta^2=.05$
	Females	4.38 (1.17)	4.07 (1.02)	$F(1, 26)=.64$, $p=.22$, partial $\eta^2=.02$
	Males	4.43 (.65)	4.03 (.67)	$F(1, 38)=4.17$, $p=.02$, partial $\eta^2=.1$
Pressure	Overall	2.92 (1.01)	2.85 (1.08)	$F(1, 62)=.01$, $p=.47$, partial $\eta^2=0$
	Females	2.71 (1.3)	2.64 (1.05)	$F(1, 25)=.16$, $p=.35$, partial $\eta^2=.01$
	Males	3.03 (.83)	3.06 (1.11)	$F(1, 35)=.51$, $p=.24$, partial $\eta^2=.01$
Restriction Health*	Overall	3.89 (1.22)	3.39 (1.08)	$F(1, 44)=1.84$, $p=.09$, partial $\eta^2=.04$
	Females	3.75 (1.26)	3.27 (1.18)	$F(1, 18)=.55$, $p=.24$, partial $\eta^2=.03$
	Males	3.96 (1.23)	3.55 (.98)	$F(1, 23)=1.35$, $p=.13$, partial $\eta^2=.06$
Restriction Weight*	Overall	2.5 (1.06)	2.05 (.67)	$F(1, 42)=3.33$, $p=.04$, partial $\eta^2=.07$
	Females	2.58 (1.33)	2.05 (.6)	$F(1, 16)=1.52$, $p=.12$, partial $\eta^2=.09$
	Males	2.46 (.95)	2.05 (.79)	$F(1, 23)=1.66$, $p=.11$, partial $\eta^2=.07$

+ Controlling for child gender and parent education, * controlling for child BMI z-score

7.5 Discussion

Although studies have suggested that there are differences in the risk of overweight/obesity in children with and without ADHD, research has not yet addressed potential mechanisms underlying this link (Erhart et al., 2012; Khalife et al., 2014; Waring & Lapane, 2008). The current study aimed to explore whether differences in eating behaviours and parental feeding practices may underlie some of the observed differences in the obesity risk in children with or without ADHD. The results of the current study showed that there were no differences in BMI z-score between 5-15-year-olds with and without ADHD. Nevertheless, children with ADHD (males in particular) were rated as being higher in food approach behaviour than children without ADHD, by their parents. There were no differences in food avoidance behaviour between groups. There were some differences in controlling feeding practices used by parents of children with and without ADHD. Parents of children with ADHD (especially parents of males) reported using greater levels of monitoring and parents of children with ADHD overall used greater levels of restriction for weight control than parents of children without ADHD (see Figure 7.2 for an overview of observed differences).

Firstly, and in line with previous research, it was hypothesized that children with ADHD would be heavier than children without ADHD (Holtkamp et al., 2004; Dempsey et al., 2011; Erhart et al., 2012). This hypothesis was not confirmed; there were no differences in BMI z-scores between both samples, even when split by gender. There are several potential reasons why links between ADHD and weight were not observed in this sample. The current study combined medicated and unmedicated children with ADHD. Research has, however, suggested that some medications used to control the symptoms of ADHD may have anorexigenic effects leading to weight loss if taken long-term (Barkely, 2004; Swanson et al., 2007). Preliminary analyses showed that there were no differences in BMI z-scores or any eating and feeding variables between medicated and unmedicated children with ADHD in this study, suggesting that the combination of both groups into one sample of children with ADHD is not likely to underlie the absence of observable differences in weight. Nevertheless, the current study may have lacked power to detect weight differences between children with and without ADHD due to a large amount of missing data on child height and weight. Additionally, some parents may have misreported these values. Measurements of height and weight by trained researchers, which would have been preferable and would have allowed greater confidence in the validity of the results, were not possible due to the web-based nature of this study. The current results support findings by researchers such as Dubnov-Raz et al. (2011), who have suggested that ADHD and the risk for the development of overweight/obesity are not linked. Instead, these authors suggest that the mixed results in the literature may be due to biases in sampling and that these links are confined to specific populations of children accessing facilities such as ADHD or obesity clinics (Agranat-Meged et al., 2005; Holtkamp et al.). Nevertheless, large population-based studies, which were not limited by such sampling biases, have found links between ADHD and overweight in children and adolescents, suggesting that further well-conducted research in this area is necessary to draw firm conclusions (Erhart et al.).

Secondly, it was hypothesized that children with ADHD would score higher on food approach and lower on food avoidance measures than children without ADHD.

Partly in line with the hypothesis, the current study showed that there was a significant trend for children with ADHD to be rated higher in food approach behaviour than children without ADHD. Gender analyses showed that this difference was significant in males, but not females. Children did not differ in food avoidance behaviour. The finding that males with ADHD in particular were rated as displaying higher levels of food approach behaviour is in line with research from non-clinical populations linking impulsivity and inhibitory control deficits and emotional and external eating, as well as overeating in the context of variety (Ahern, Field, Yokum, Bohon, & Stice, 2010; Farrow, 2012; Guerrieri, Nederkoorn, & Jansen, 2008; Jasinska et al., 2012; Tan & Holub, 2011). Additionally, results within this thesis showed that more impulsive female 7-11-year-olds consumed more snacks than less impulsive peers (Chapter Five), while 2-4-year-olds with high compared to low levels of impulsivity made more demands for food (Chapter Four). Although the current study did not find a link between ADHD and obesity risk, these findings provide some evidence that elevated food approach behaviours may underlie the previously reported increased risk for the development of overweight and obesity in children, especially males, with ADHD over time. The results of this study also suggest that differences in parent-perceived food avoidance behaviour in children with and without ADHD are less likely to explain underlying mechanisms of the previously reported ADHD-obesity link.

These results are also in line with research linking ADHD symptoms with emotional and external eating and binge eating in adults (Davis et al., 2006; Dempsey et al., 2011). Eating pathologies such as BN and BED have been linked with ADHD suggesting a further mechanism through which this disorder may impact on weight (Biederman et al., 2007; Mikami et al., 2008). Unfortunately, the current study did not assess such pathologies. Symptoms of BN and BED are usually established through self-reports, while this study relied on parent-reports of child eating behaviour. Furthermore, the sample consisted of children aged 5 to 15 years (mean age in children with ADHD=9.69 years, without ADHD= 9.36 years), which meant that the majority of children were too young to provide reliable self-reports of such behaviours. It was therefore felt that an investigation of eating pathologies was not appropriate and would not have yielded reliable results.

Finally, it was hypothesized that parents of children diagnosed with ADHD would report using greater levels of controlling feeding practices. Partly confirming this hypothesis, parents of children with ADHD used greater levels of monitoring than parents of children without ADHD. Gender analyses indicated that this difference could be observed in parents of males, but not females. Previous research has highlighted potential benefits of parental monitoring on food selection and intake in non-clinical populations of 4-7-year-olds (Klesges, Stein, Eck, Isbell, & Klesges, 1991). Monitoring has additionally been identified as an important moderator of the relationship between impulsivity and child weight and food approach behaviour (e.g. Farrow, 2012). Results from Chapter Five within this thesis suggested that a lack of monitoring could be detrimental for weight control in male 7-11-year-olds, while Chapter Three indicated that it may protect children from the impact of impulsivity on food approach behaviour. The results of the current study suggest that parents of children with clinically elevated impulsivity levels also use monitoring to influence their children’s (especially males’) eating behaviour. This makes intuitive sense in the light of the finding that males with ADHD are also perceived to engage in greater levels of food approach behaviour than males without ADHD.

Interestingly and contrary to the hypothesis, parents of children with ADHD did not use greater levels of pressure to eat. Previous research has indicated that children with ADHD find it difficult to remain seated during mealtimes (Lickteig et al., 1999) and it was hypothesized that parents of children with ADHD would use more pressure to focus their child's attention on the mealtime and to encourage intake. Chapter Four within this thesis, showed that although more impulsive children were not more disruptive during mealtimes, their parents did use more instructing and pressuring techniques during a mealtime than parents of less impulsive peers. The findings of the current study suggest that parents of children with clinically elevated impulsivity levels do not report the use of pressure to eat more commonly than parents of children without ADHD. This may be due to a perceived lack of necessity to encourage intake or because of its ineffectiveness in increasing intake.

Parents of children with ADHD reported using greater levels of restriction for weight control than parents of children without ADHD. Gender analyses showed that while this difference was seen in the sample overall, it was not significant in the male or female subsamples, likely due to a lack of power. Research looking at links between parental restriction in non-clinical populations has indicated that parents of children with low levels of impulsivity and better inhibitory control capacities used lower levels of restriction for health (Tan & Holub, 2011). Parental restriction of intake has been linked with reduced intake, but it may also lead to an increase in the preoccupation with the restricted foods (Ogden, Cordey, Cutler, & Thomas, 2013). Additionally, it has been suggested that in females especially, restriction can lead to overeating and weight gain through eating in the absence of hunger (Carper, Fisher, & Birch, 2000). Importantly, the impact of parental restriction on eating behaviour and weight may be particularly detrimental for children with low levels of inhibitory control such as children with ADHD (Anzman & Birch, 2009). Higher levels of restriction used by parents of children with ADHD may therefore also play a role in the link between ADHD and the risk for overweight and obesity. These findings highlight the importance of informing parents of their child's innate ability to regulate intake, while also highlighting the detrimental impact of overt restriction on eating behaviour and weight. Furthermore, it may be useful to foster the use of less intrusive controlling feeding practices such as monitoring and covert control in parents of children with ADHD (Ogden, Reynolds, & Smith, 2006). Unfortunately, the current study did not explore the long-term effects of restriction in combination with food approach tendencies on weight regulation over time. A long-term evaluation of this effect could, however, provide valuable information and guidance for parents of children with ADHD.

This study has a number of limitations. Firstly, the study relied on responses made through a web-based survey. This technique is prone to errors in reporting and offers little control over participants. Although steps were taken to avoid participation by ineligible individuals it is impossible to determine whether all respondents to the survey were genuine. Nevertheless, the length and depth of the survey is likely to have deterred potential "fake-responders". Due to the nature of the web-based survey and the decision to make responses to questions non-mandatory there were large amounts of missing data, especially with regards to child height and weight, which limited the power of the statistical analyses to detect differences between children with and without ADHD. Secondly, the reliance on parent-reports of child height, weight and eating behaviour as well as impulsivity, and the reliance on self-reports of parents' use of feeding strategies may have introduced some bias and the use of observational as well as child self-report measures would have been desirable. Thirdly, the current study did not split the sample of children with ADHD by ADHD subtypes. Mikami et al. (2008) differentiated between females with a combined and predominantly inattentive subtype of ADHD and found that females with a combined subtype displayed slightly elevated levels of eating pathology compared to females with a predominantly inattentive subtype and females in the control group. Although the current study collected information on the ADHD subtype a child was diagnosed with this information was provided in too few cases to allow a reliable analysis by subtype. Additionally, due to the small sample size of children diagnosed with each subtype there would not have been enough power to detect any effects.

Despite these limitations this study provides some information on potential mechanisms underlying the proposed link between ADHD and the risk for the development of overweight and obesity in a paediatric sample. Our results show that children with ADHD may be more prone to problematic eating behaviours such as emotional overeating than peers without ADHD. Over time these maladaptive eating behaviours may lead to weight gain. Our results also showed that parents of children with ADHD use greater levels of positive (monitoring) and less adaptive (restriction for weight control) feeding practices to control child intake than parents of children without ADHD. Fostering a greater use of less intrusive and covert techniques to control intake could therefore be useful. Nevertheless, it is clear that this study only provides a first step towards a thorough investigation of the mechanisms underlying the link between ADHD and overweight and obesity risk in children and that more research in this area is required.

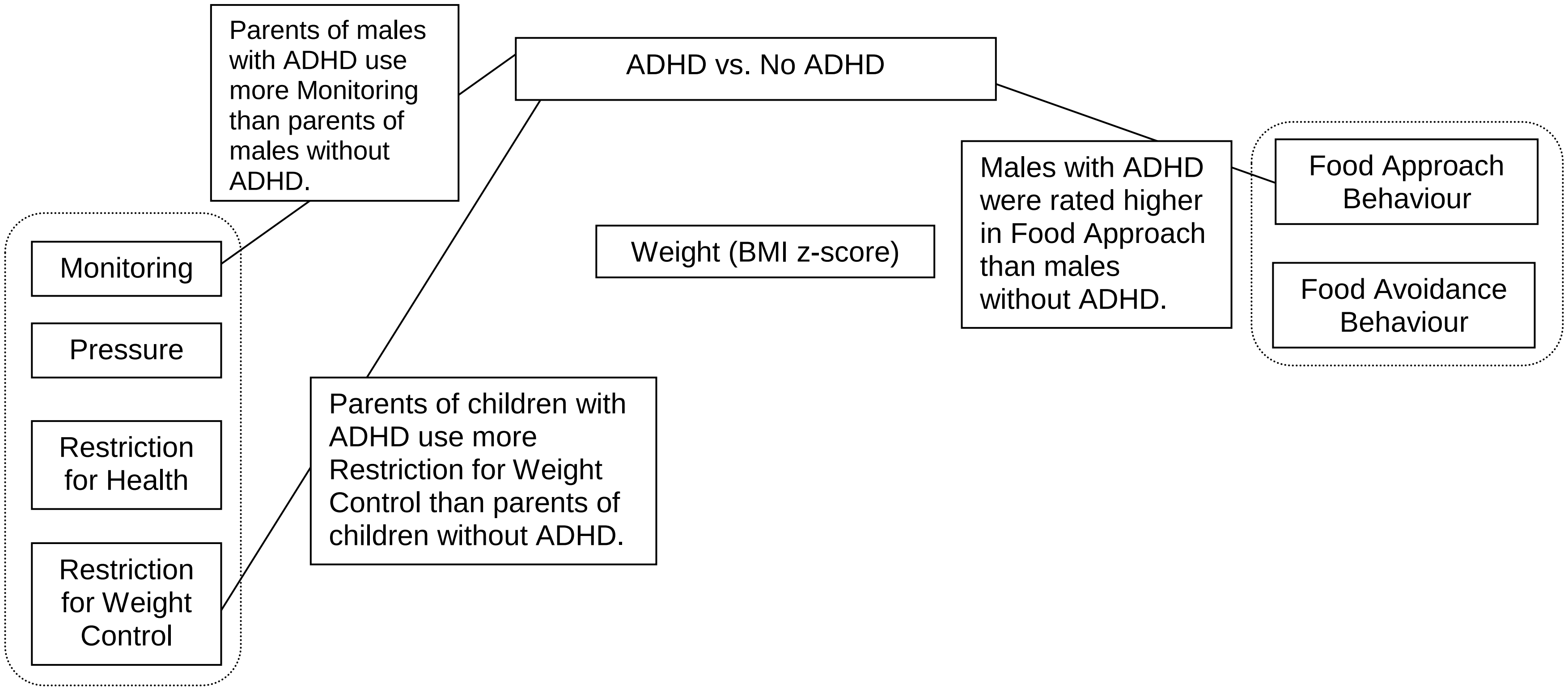


Figure 7.2. This model summarises the differences in child weight and eating behaviours displayed by children with and without ADHD which were found in this chapter (child factors). The model also shows the differences in parental controlling feeding practices used by parents of children with and without ADHD, which were found (parent factors). Solid lines indicate observed differences, while the absence of lines indicates a lack of observed differences.

CHAPTER EIGHT

GENERAL DISCUSSION

8.1 Introduction to the general discussion

This chapter aims to provide an overview of the findings described in this thesis. Firstly, the aims of the thesis will be re-stated. Secondly, the key findings will be summarised and clinical implications indicated. Thirdly, the strengths and weaknesses of the chapters will be briefly discussed and finally, an overall conclusion will be drawn.

8.2 Aims of the thesis

The primary aim of this thesis was to explore the relationships between impulsivity, child weight, eating behaviour and parental feeding practices and differences in these variables in children with high and low impulsivity levels, using a wide variety of measures to capture a number of impulsivity facets. Secondary aims included the exploration of moderating effects of controlling parental feeding practices on the relationship between impulsivity and weight and eating behaviour. Additionally, the potential impact of stress on the relationship between different impulsivity facets and snack intake was considered. Finally, differences in weight, eating behaviour and parental feeding practices in children with and without clinically elevated impulsivity levels as indicated by the presence or absence of a diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) were assessed. Gender differences were explored wherever possible. Figure 8.1 summarises the relationships between impulsivity, weight, eating and feeding variables and differences in these variables between children with high (including clinically elevated) and low levels of impulsivity identified in the chapters within this thesis. The findings will be additionally summarised and discussed in the following section.

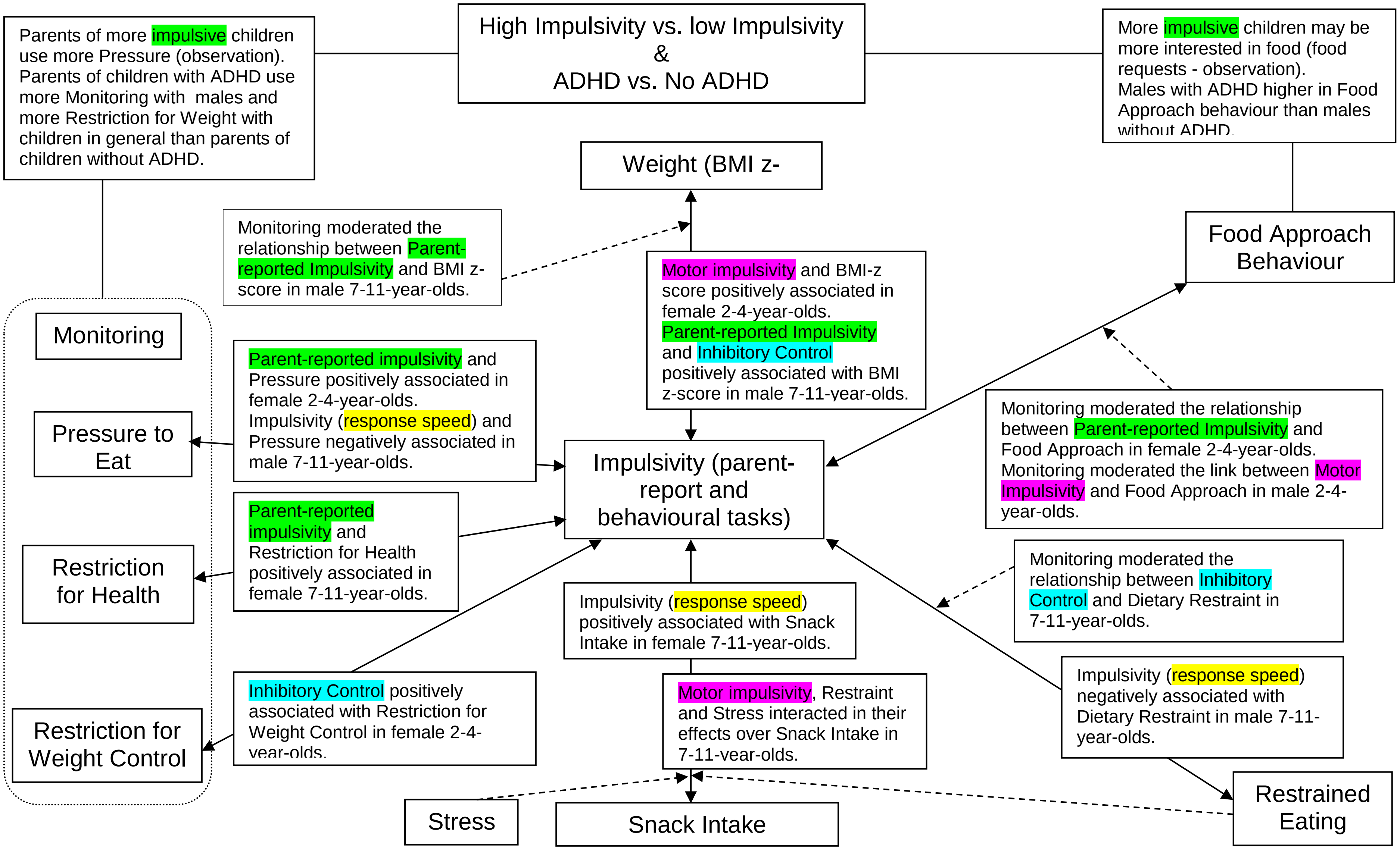

High Impulsivity vs. low Impulsivity
&
ADHD vs. No ADHD
Parents of more impulsive children use more Pressure (observation). Parents of children with ADHD use more Monitoring with males and more Restriction for Weight with children in general than parents of children without ADHD.
More impulsive children may be more interested in food (food requests - observation). Males with ADHD higher in Food Approach behaviour than males without ADHD
Weight (BMI z-
Monitoring moderated the relationship between Parent-reported Impulsivity and BMI z-score in male 7-11-year-olds.
Motor impulsivity and BMI-z score positively associated in female 2-4-year-olds. Parent-reported Impulsivity and Inhibitory Control positively associated with BMI z-score in male 7-11-year-olds.
Food Approach Behaviour
Monitoring
Pressure to Eat
Restriction for Health
Restriction for Weight Control
Parent-reported impulsivity and Pressure positively associated in female 2-4-year-olds. Impulsivity (response speed) and Pressure negatively associated in male 7-11-year-olds.
Impulsivity (parent-report and behavioural tasks)
Monitoring moderated the relationship between Parent-reported Impulsivity and Food Approach in female 2-4-year-olds. Monitoring moderated the link between Motor Impulsivity and Food Approach in male 2-4-year-olds.
Parent-reported impulsivity and Restriction for Health positively associated in female 7-11-year-olds.
Monitoring moderated the relationship between Inhibitory Control and Dietary Restraint in 7-11-year-olds.
Impulsivity (response speed) positively associated with Snack Intake in female 7-11-year-olds.
Inhibitory Control positively associated with Restriction for Weight Control in female 2-4-year-olds.
Motor impulsivity, Restraint and Stress interacted in their effects over Snack Intake in 7-11-year-olds.
Impulsivity (response speed) negatively associated with Dietary Restraint in male 7-11-year-olds.
Restrained Eating
Stress
Snack Intake

Figure 8.1. This model provides a summary and overview of the relationships (solid arrows), moderations (dotted arrows), differences (solid lines) and interactive effects (dotted arrows) of variables that were observed in individual chapters within this thesis. The various impulsivity facets and parent-report measures for which associations/differences were observed are highlighted in different colours. Motor Impulsivity: pink, Inhibitory Control: blue, Response Speed: yellow, Parent-reported Impulsivity: green. Variables for which no associations/differences were observed throughout this thesis are not included in this model to aid clarity.

8.3 Summary of results

8.3.1 Child weight

Associations between impulsivity and child weight were scarce, but could be observed for parent-reported impulsivity and impulsivity task performance in females and males. Chapter Three showed that 2 to 4 year old females with greater levels of motor impulsivity measured by the Line Walking task had greater BMI z-scores. In Chapter Five males aged 7 to 11 years whose parents rated them as more impulsive on the CGI: Restless-Impulsive and who performed more impulsively on the GNG task (inhibitory control) had greater BMI z-scores. Previous research has highlighted links between impulsivity measured through delay of gratification tasks and child weight and weight gain over time (Francis & Susman, 2009; Graziano, Calkins, & Keane, 2010; Seeyave et al., 2009). The results of the studies within this thesis extend the reported links between delay of gratification and child weight to additional impulsivity facets, such as motor impulsivity in females and inhibitory control in males. Additionally, these results indicate that parent-reported impulsivity, which measures impulsivity across a number of social contexts and is likely to reflect more stable, trait like tendencies to behave impulsively, is also related to child weight in 7-11-year-olds but not 2-4-year-olds (Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001; Thamotharan, Lange, Zale, Huffhines, & Fields, 2013).

Although many studies have shown that children with clinically elevated impulsivity as seen in ADHD may be at an increased risk for the development of overweight and obesity (Erhart et al., 2012; Khalife et al., 2014; Waring & Lapane, 2008) others have failed to observe such differences (Dubnov-Raz, Perry, & Berger, 2011; Rojo, Ruiz, Dominguez, Calaf, & Livianos, 2006). In line with the latter body of research, Chapter Seven failed to find differences in BMI z-scores of children with and without ADHD. As discussed in Chapter Seven, sampling and data collection approaches may explain these findings.

Overall, parent-reported and behavioural impulsivity (motor impulsivity and inhibitory control facets) seemed to play a role in child weight in children without clinically elevated impulsivity. The measurement of impulsivity using a range of parent-report measures and behavioural impulsivity tasks proved to be a useful approach highlighting gender differences in impulsivity and weight links.

8.3.2 Eating behaviour: CEBQ, intake, observations

Previous research has suggested that impulsivity is linked with the development of problematic eating behaviours leading to overeating, especially in the context of food-variety (Guerrieri, Nederkoorn, & Jansen, 2008b; Van den Berg et al., 2011). The results of the chapters within this thesis provide only some support for links between impulsivity and eating behaviour in children. Chapters Three and Five showed that parent-reported impulsivity and impulsivity task performance were not associated with food approach or avoidance behaviours in 2-4-year-olds or 7-11-year olds. Both used the CEBQ to assess food approach and avoidance behaviours in children. Although this tool has previously been linked with child weight (Carnell & Wardle, 2007; Farrow & Blissett, 2012; Viana, Sinde, & Saxton, 2008) few studies have used it to explore links with impulsivity (Van den Berg et al.).

Nonetheless, observational evidence from Chapter Four did indicate that more impulsive children may have a tendency to be more responsive to food during mealtimes. Findings in Chapter Four also suggested that more impulsive children were not more disruptive than less impulsive peers during mealtimes. Additionally, the results of Chapter Seven, showed males with ADHD were rated as being higher in food approach behaviour than males without ADHD by their parents. This study is the first to show differences in food approach behaviours measured by the CEBQ in children with and without ADHD. These differences may provide some explanation for the link between impulsivity and the risk for the development of overweight and obesity in populations of children with ADHD.

Despite a lack of associations between impulsivity and eating behaviour measured by the CEBQ or mealtime intake, a link between behavioural impulsivity and snack intake was observed in females (Chapter Five). Females who were more impulsive (response speed facet of impulsivity), consumed more overall calories from a variety of snacks. These findings add to previous research, which has linked the impulsivity facet reward sensitivity with snack food intake in 8-10-year-olds (Guerrieri et al., 2008b). The current study extends these findings by highlighting that these links may especially exist in females when considering the response speed facet of impulsivity, an aspect not previously linked with calorie intake in children. More impulsive females could therefore potentially benefit from food environments characterised by a variety of readily available healthy food choices, in which the array of unhealthy but palatable food choices is limited to a minimum.

8.3.3 Eating behaviour: emotional, external and restrained eating

Contrary to the results of previous studies in children and adults, Chapter Five found little evidence for links between impulsivity and emotional, external and restrained eating in children (Farrow, 2012; Jasinska et al., 2012). This was true despite the use of a number of parent-report and behavioural measures, which captured a variety of impulsivity facets. In males only, behavioural impulsivity (response speed) was linked with restraint, indicating that less impulsive males were more restrained. This finding in 7-11-year-olds supports research that has found similar links in adults (Leitch, Morgan, & Yeomans, 2013; Meule, Lukito, Vögele, & Kübler, 2011). In addition, Chapter Six within this thesis showed that motor impulsivity and dietary restraint interacted in their effect on snack intake in 7-11-year-olds. High dietary restraint in combination with high levels of impulsivity have been linked with less successful weight regulation and overeating in adults; the results of Chapter Six extend these findings highlighting that such effects can also be seen in children (Jansen et al., 2009; Van Koningsbruggen, Stroebe, & Aarts, 2013).

Overall, links between dietary restraint and impulsivity only emerged when impulsivity was assessed using behavioural measures. This suggests that state-dependent impulsivity (especially the impulsivity facets of response speed and motor impulsivity) rather than more general impulsivity assessed through parent-report, play an important role in the expression of this eating behaviour and its effect on intake. The results suggest that impulsive children at risk for the development of overweight or already overweight could benefit from interventions that aim to reduce behavioural impulsivity (Houben, 2011; Houben & Jansen, 2011; 2014). The effectiveness of such interventions in adults has received increasing attention and outcomes of studies using inhibition tasks appear to yield promising results (Houben).

8.3.4 Stress, impulsivity and eating behaviour.

In Chapter Six, stress, motor impulsivity and dietary restraint interacted to affect eating behaviour, indicating that stress-related eating behaviour in children varies as a function of their underlying impulsivity levels. This was the first investigation of interactive effects of impulsivity, stress and eating behaviour in children and the interpretation of these findings was difficult considering the lack of previous research in this area. Children high in motor impulsivity and dietary restraint decreased their snack intake under stress, while children low in dietary restraint increased their intake under stress. Children low in motor impulsivity did not differ in their intake irrespective of dietary restraint or stress.

It was speculated that the activation of different goals (eating enjoyment vs. weight control) as well as the cognitive resources available to a child to engage in restraint, play a crucial role in how stress will affect eating behaviour in impulsive children (Baumeister et al., 1998; Muraven et al., 1998; Stroebe et al., 2013). This study only provided a first step into the investigation of stress-related eating behaviour in children with varying impulsivity levels. Future research should explore whether eating behaviours other than dietary restraint play a role in the expression of stress-related eating in more or less impulsive children. Additionally, these findings should be extended to more naturalistic settings to explore their ecological validity.

8.3.5 Parental controlling feeding practices

A number of interesting associations between impulsivity and the controlling parental feeding practices restriction for health and weight control and pressure to eat emerged. Monitoring was identified as a moderator of the links between impulsivity and weight and impulsivity and eating behaviour. Additionally, differences in how these controlling feeding practices were used by parents of more or less impulsive children were observed during mealtimes and in self-reports of parents of children with and without ADHD. The results for individual controlling feeding practices are summarised in more detail in the following sections.

Restriction. In line with previous research, Chapter Five within this thesis found positive associations between parent-reported impulsivity and parental restriction for health in females. This further consolidates previous research findings, suggesting that parents' perceptions of their child's impulsivity across contexts is linked with their use of restriction to improve health outcomes, but not to influence weight (e.g. Tan & Holub, 2011). Although parents use this practice with good intentions, studies assessing the impact of restriction on child weight and eating behaviour have indicated that, especially in more impulsive children, high levels of restriction lead to poorer weight outcomes and to eating in the absence of hunger (Anzman & Birch, 2009; Rollins, Loken, Savage, & Birch, 2014). The findings within this thesis suggest that parents of impulsive children should be careful with the use restrictive feeding practices, relying on less intrusive feeding practices instead.

Chapter Three within this thesis additionally showed that, in females, behavioural impulsivity (inhibitory control) was linked with restriction for weight. Interestingly, parents of more impulsive females used less restriction to control their weight. This could be due to its perceived ineffectiveness to positively impact on child weight. Previous research, relying on parent-reported impulsivity failed to establish such a link, underlining the value of including behavioural impulsivity measures in future research (Tan & Holub, 2011). Interestingly, observational evidence from Chapter Four failed to establish differences in the use of restriction by parents of more or less impulsive children. The current findings suggest that parent-perceived impulsivity (which relates to broader personality traits) and behavioural impulsivity (inhibitory control facet- which captures more state-dependent impulsive response tendencies), may relate differently to restriction for health and weight control in females.

Chapter Seven showed that parents of children with ADHD used greater levels of restriction for weight control, but not for health, than parents of children without ADHD. Parents of children with ADHD may use restriction for weight to a greater extent, as they also perceive their children to be higher in food approach behaviour. Whether this is effective in the long-term cannot be established due to the cross-sectional nature of the study. Previous research linking restriction with overeating and weight gain over time, especially in more impulsive children, suggests that restriction will not successfully control weight in children with ADHD (Anzman & Birch, 2009; Birch, Fisher, & Davison, 2003; Johnson & Birch, 1994). Future studies using longitudinal designs will have to be carried out to investigate the impact of these differences on weight in children with ADHD further.

Monitoring. Although parental monitoring of child intake was not linked with parent-reported or behavioural impulsivity, results in Chapter Seven showed that parents of children with ADHD, especially of males, use greater levels of monitoring than parents of children without ADHD. This less intrusive controlling feeding practice has previously been linked with better intake control and food selection in children

(Klesges, Stein, Eck, Isbell, & Klesges, 1991) and its greater use in males with ADHD may be a response to elevated food approach behaviours also seen in this population.

Monitoring was not associated with parent-reported or behavioural impulsivity per se. Nevertheless, Chapter Three showed that monitoring moderated the relationship between parent-reported impulsivity and food approach behaviour in females. It also moderated the relationship between motor impulsivity and food approach behaviour in the sample overall and especially in males. The association between parent-reported and motor impulsivity and food approach behaviour was positive in children whose parents used low levels of monitoring. A lack of monitoring appeared to have a detrimental impact on eating behaviours linked with overeating and weight gain in females and males. This is an interesting finding, highlighting that parents of impulsive children at risk for the development of overweight should be trained in their use of less intrusive, covert feeding practices to regulate their children's intake more successfully.

Chapter Five showed that monitoring significantly moderated the relationship between behavioural impulsivity (inhibitory control) and dietary restraint in children overall. In children whose parents used little monitoring, dietary restraint decreased as a function of impulsivity, while restraint increased with impulsivity in children whose parents used average levels of monitoring. It was speculated that monitoring provided cues to more impulsive children to engage in dietary restraint. Dietary restraint and impulsivity have been linked with less successful intake and weight regulation in adults (Jansen et al., 2009; Nederkoorn et al., 2007; Van Koningsbruggen, Stroebe, & Aarts, 2013). Therefore one important question that should be addressed by future research is whether monitoring fosters negative intake control tendencies or whether it leads to the development of functional intake regulation strategies in the long-term. In addition, Chapter Five showed that monitoring moderated the relationship between parent-reported impulsivity and weight in males. Impulsivity and child weight were positively associated if parents used low or average amounts of monitoring, but not if they used high levels of monitoring. These findings indicate that a lack of monitoring may have a detrimental impact on weight control in impulsive males. These findings provide further evidence for the importance of parental monitoring in eating behaviour and weight regulation. Overall, the results of the chapters within this thesis highlight that parental monitoring plays a complex and important role in impulsivity-related eating behaviour and weight-regulation in younger and older children; future research should investigate its long-term impact.

Pressure. Research has not previously addressed potential links between impulsivity and pressure to eat. Several of the chapters within this thesis aimed to address this gap in the literature by assessing links between impulsivity and pressure to eat and differences in the use of this practice in children with high (including clinically elevated) and low levels of impulsivity. Chapter Three showed that parents who perceived their children to be more impulsive, used more pressure to eat, especially with female children. Similarly, Chapter Four showed that parents of children with high compared to low levels of impulsivity used more verbal and physical pressure and instruction during mealtimes. As discussed, parents may use pressure to focus their child's attention on the mealtime and to increase intake.

Nevertheless, pressure is unlikely to lead to increased intake fostering a dislike for foods that the child is pressured to eat instead (Brown, Ogden, Vögele, & Gibson, 2008; Fisher, Mitchell, Smiciklas-Wright, & Birch, 2002; Galloway, Fiorito, Francis, & Birch, 2006; Patrick, Nicklas, Hughes, & Morales, 2005; Wardle, Carnell, & Cooke, 2005).

Chapter Five conversely showed that parents of males higher in behavioural impulsivity (response speed) used less pressure to eat. As discussed in Chapter Five, parents may not consider pressure to be an effective technique to increase intake in more impulsive males. It is unlikely that the reverse, i.e. a reduction in behavioural impulsivity unrelated to the eating context, would be the result of reduced pressure.

While parents appear to use more pressure to encourage intake in more impulsive females this does not appear to be true for more impulsive males, stressing the value of exploring gender differences. The observed associations also indicate that parent-perceived and behavioural impulsivity may affect parental feeding behaviour differently.

8.4 Methodological strengths and weaknesses

One of the primary strengths of the studies discussed within this thesis is the use of a variety of parent-report impulsivity measures and behavioural impulsivity tasks that capture a number of impulsivity facets (e.g. inhibitory control, motor impulsivity, reward sensitivity, the ability to delay gratification and response speed). Additionally, impulsivity was not just assessed from the parent's singular view or with the child's performance in mind. Instead, the impulsivity assessment included both measures of more subjective experiences of the child's behaviour across social contexts and measures of more objective state-dependent behavioural tendencies to act impulsively.

The inclusion of gender analyses in all chapters where sample sizes were large enough to allow a meaningful and sufficiently powered exploration of potential differences is another important strength of the studies included in this thesis. The differences that emerged from these analyses provide useful areas of future research and highlight the value of such analyses.

The studies discussed within this thesis are not without limitations. Although a wide variety of impulsivity facets were captured by the impulsivity tasks that were used, some facets (e.g. reflection impulsivity) were missed. This is mainly due to a trade-off between capturing as many impulsivity facets as possible and efforts to minimise participation time, fatigue and boredom in 2-4-year-olds who visited the laboratory once and 7-11-year-olds, who visited it twice. The included tasks were chosen as they measured the facets most often linked with child weight, eating behaviour and parental feeding in the literature.

All samples of children and parents discussed in this thesis were self-selected, responding to adverts and invitations. It is therefore possible that parents with particular concerns about their child's weight, eating behaviour or impulsivity levels chose to take part. Additionally, the majority of parents and children who participated in the studies discussed within this thesis were White/British and had middle-class backgrounds. This occurred despite efforts to reach families from a variety of backgrounds by visiting nurseries and toddler groups in and around Birmingham and by advertising the studies in magazines, on websites and social media platforms.

This limits the generalisability of the findings. Replications of this research in more ethnically and economically diverse samples would therefore be desirable.

The power to detect associations, moderations and differences was potentially affected by the small sample sizes of some studies (e.g. Chapters Four, Five and Six). Whilst the use of multiple measures of parent-reported and behavioural impulsivity was a strength of the research within this thesis, this approach resulted in multiple testing when associations between impulsivity and weight, eating and feeding variables were explored. Although the criterion alpha for significance was reduced to .01 to account for multiple testing and to reduce the associated rise in the family-wise error rate, a more stringent cut-off may have been desirable. Additionally, future studies should aim for larger sample sizes achieving the power necessary to carry out more complex and gender specific analyses.

Finally, the reliance on cross-sectional research designs means that causality cannot be inferred. Longitudinal studies exploring long-term links between impulsivity, eating behaviour and parental feeding practices are necessary to explore the directions of the identified links.

8.5 Conclusions

Despite the highlighted limitations, the described findings make a valuable contribution to the literature linking impulsivity, weight, eating behaviour and the use of parental feeding practices in children. This thesis advances our understanding of the complexity with which impulsivity and eating behaviour are linked. Parent-perceived impulsivity, motor impulsivity and response speed facets in particular appear relevant to weight gain and overeating in females, suggesting that the ability to slow down an activity, potentially allowing for the consideration of the consequences of a behaviour, could be a target for intervention. The outcomes of this thesis have further clinical implications. The observed associations between broader parent-perceived impulsivity as well as motor impulsivity, response speed and inhibitory control facets of impulsivity and weight, eating behaviour and parental feeding have highlighted the potential merit of exploring impulsivity levels of children at risk of developing overweight. Children with high levels of impulsivity or ADHD may particularly benefit from the use of less controlling feeding practices such as pressure and restriction. Parents of children with elevated impulsivity levels should instead be advised on how to use less intrusive feeding strategies such as monitoring.

This thesis highlights the importance of assessing impulsivity using a variety of measures to capture its many facets. The reported differences in the associations between parent-reported impulsivity measures and the different behavioural impulsivity tasks and weight, eating and feeding variables stress the value of such an approach. Furthermore, gender emerged as a critical factor for the relationship between impulsivity, weight and many of the eating and feeding variables, highlighting the importance of exploring this factor in future research. Observational approaches to assessing mealtime behaviours of children with high and low levels of impulsivity and their parents provided interesting insights into how these interactions compare. Furthermore, an exploration of differences in eating and feeding variables in children with and without ADHD and their parents provided a first step towards understanding how differences in obesity risk emerge. The assessment of interactive effects of impulsivity and dietary restraint, and especially the inclusion of stress, extended research previously limited to the adult literature, while also making a valuable contribution to a little investigated area of research in its own right. Future research should continue to explore such effects.

REFERENCE LIST

Achenbach, T. M., & Edelbrock, C. (1983*). Manual for the Child Behavior Checklist and Revised Child Behavior Profile.* University of Vermont, Department of Psychiatry, Burlington.

Agranat-Meged, A. N., Deitcher, C., Goldzweig, G., Leibenson, L., Stein, M., & Galili-Weisstub, E. (2005). Childhood obesity and attention deficit/hyperactivity disorder: A newly described comorbidity in obese hospitalized children. *International Journal of Eating Disorders, 37*(4), 357-359.

Ahern, A. L., Field, M., Yokum, S., Bohon, C., & Stice, E. (2010). Relation of dietary restraint scores to cognitive biases and reward sensitivity. *Appetite, 55*(1), 61-68.

Altfas, J. R. (2002). Prevalence of attention deficit/hyperactivity disorder among adults in obesity treatment. *BioMed Central Psychiatry, 2*(9), 1-8.

Anzman, S. L., & Birch, L. L. (2009). Low inhibitory control and restrictive feeding practices predict weight outcomes. *The Journal of Pediatrics, 155*(5), 651-656.

Anzman, S. L., Rollins, B. Y., & Birch, L. L. (2010). Parental influence on children's early eating environments and obesity risk: Implications for prevention. *International Journal of Obesity, 34*(7), 1116-1124.

Avila, C., Cuenca, I., Félix, V., Parcet, M., & 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.

Bachorowski, J., & Newman, J. P. (1990). Impulsive motor behavior: Effects of personality and goal salience. *Journal of Personality and Social Psychology, 58*(3), 512.

Barkley, R. A. (2004). Adolescents with attention-deficit/hyperactivity disorder: An overview of empirically based treatments. *Journal of Psychiatric Practice, 10*(1), 39-56.

Batterink, L., Yokum, S., & Stice, E. (2010). Body mass correlates inversely with inhibitory control in response to food among adolescent girls: An fMRI study. *Neuroimage, 52*(4), 1696-1703.

Baucom, D. H., & Aiken, P. A. (1981). Effect of depressed mood on eating among obese and nonobese dieting and nondieting persons. *Journal of Personality and Social Psychology, 41*(3), 577-585.

Baughcum, A. E., Powers, S. W., Johnson, S. B., Chamberlin, L. A., Deeks, C. M., Jain, A., & Whitaker, R. C. (2001). Maternal feeding practices and beliefs and their relationships to overweight in early childhood. *Journal of Developmental & Behavioral Pediatrics, 22*(6), 391-408.

Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. M. (1998). Ego depletion: Is the active self a limited resource? *Journal of Personality and Social Psychology, 74*(5), 1252-1265.

Bekker, M. H. J., Van de Meerendonk, C., & Mollerus, J. (2004). Effects of negative mood induction and impulsivity on self-perceived emotional eating. *International Journal of Eating Disorders, 36*(4), 461-469.

Benton, D. (2004). Role of parents in the determination of the food preferences of children and the development of obesity. *International Journal of Obesity, 28*(7), 858-869.

Berkowitz, R. I., Moore, R., Faith, M. S., Stallings, V. A., Kral, T. V., & Stunkard, A. J. (2010). Identification of an obese eating style in 4-year-old children born at high and low risk for obesity. *Obesity, 18*(3), 505-512.

Bezdjian, S., Baker, L. A., Lozano, D. I., & Raine, A. (2009). Assessing inattention and impulsivity in children during the Go/NoGo task. *British Journal of Developmental Psychology, 27*(2), 365-383.

Biederman, J., Faraone, S. V., Monuteaux, M. C., Plunkett, E. A., Gifford, J., & Spencer, T. (2003). Growth deficits and attention-deficit/hyperactivity disorder revisited: Impact of gender, development, and treatment. *Pediatrics, 111*(5), 1010-1016.

Biederman, J., Mick, E., & Faraone, S. V. (2000). Age-dependent decline of symptoms of attention deficit hyperactivity disorder: Impact of remission definition and symptom type. *American Journal of Psychiatry, 157*(5), 816-818.

Biederman, J., Spencer, T. J., Monuteaux, M. C., & Faraone, S. V. (2010). A naturalistic 10-year prospective study of height and weight in children with attention-deficit hyperactivity disorder grown up: Sex and treatment effects. *The Journal of Pediatrics, 157*(4), 635-640.

Birch, L. L., Fisher, J. O., & Davison, K. K. (2003). Learning to overeat: Maternal use of restrictive feeding practices promotes girls' eating in the absence of hunger. *The American Journal of Clinical Nutrition, 78*(2), 215-220.

Birch, L. L., Fisher, J., Grimm-Thomas, K., Markey, C., Sawyer, R., & Johnson, S. L. (2001). Confirmatory factor analysis of the child feeding questionnaire: A measure of parental attitudes, beliefs and practices about child feeding and obesity proneness. *Appetite, 36*(3), 201-210.

Bitsakou, P., Psychogiou, L., Thompson, M., & Sonuga-Barke, E. J. (2009). Delay aversion in attention deficit/hyperactivity disorder: An empirical investigation of the broader phenotype. *Neuropsychologia, 47*(2), 446-456.

Blissett, J., & Bennett, C. (2012). Cultural differences in parental feeding practices and children’s eating behaviours and their relationships with child BMI: A comparison of black afro-Caribbean, white British and white German samples. *European Journal of Clinical Nutrition, 67*(2), 180-184.

Blunden, S. L., Milte, C. M., & Sinn, N. (2011). Diet and sleep in children with attention deficit hyperactivity disorder: Preliminary data in Australian children. *Journal of Child Health Care, 15*(1), 14-24.

Bonato, D. P., & Boland, F. J. (1983). Delay of gratification in obese children. *Addictive Behaviors, 8*(1), 71-74.

Braet, C., Claus, L., Verbeken, S., & Van Vlierberghe, L. (2007). Impulsivity in overweight children. *European Child & Adolescent Psychiatry, 16*(8), 473-483.

Brown, K. A., Ogden, J., Vögele, C., & Gibson, E. L. (2008). The role of parental control practices in explaining children's diet and BMI. *Appetite, 50*(2), 252-259.

Bruce, A. S., Holsen, L. M., Chambers, R. J., Martin, L. E., Brooks, W. M., Zarcone, J. R. et al. (2010). Obese children show hyperactivation to food pictures in brain networks linked to motivation, reward and cognitive control. *International Journal of Obesity, 34(*10), 1494-1500.

Buss, A. H., & Plomin, R. (1984). *Temperament: early developing personality traits*. Hillsdale, NJ: Erlbaum.

Carlson, N. R. (2006). *Physiology of behavior* (9th ed.). London: Pearson.

Carnell, S., & Wardle, J. (2007). Measuring behavioural susceptibility to obesity: Validation of the child eating behaviour questionnaire. *Appetite, 48*(1), 104-113.

Carper, J. L., Orlet Fisher, J., & Birch, L. L. (2000). Young girls' emerging dietary restraint and disinhibition are related to parental control in child feeding. *Appetite, 35*(2), 121-129.

Carver, C. S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS scales. *Journal of Personality and Social Psychology, 67*(2), 319-333.

Casalin, S., Luyten, P., Vliegen, N., & Meurs, P. (2012). The structure and stability of temperament from infancy to toddlerhood: A one-year prospective study. *Infant Behavior and Development, 35*(1), 94-108.

Chen, A. Y., Kim, S. E., Houtrow, A. J., & Newacheck, P. W. (2010). Prevalence of obesity among children with chronic conditions. *Obesity, 18*(1), 210-213.

Chrousos, G. P. (2009). Stress and disorders of the stress system. *Nature Reviews Endocrinology, 5*(7), 374-381.

Chrousos, G. P., & Gold, P. W. (1992). The concepts of stress and stress system disorders: Overview of physical and behavioral homeostasis. *Journal of the American Medical Association, 267*(9), 1244-1252.

Cloninger, C. R., Svrakic, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. *Archives of General Psychiatry, 50*(12), 975-990.

Coderre, L., Vallega, G. A., Pilch, P. F., & Chipkin, S. R. (1996). In vivo effects of dexamethasone and sucrose on glucose transport (GLUT-4) protein tissue distribution. *American Journal of Physiology-Endocrinology and Metabolism, 34*(4), E643-E648.

Cohen, S. (1980). Aftereffects of stress on human performance and social behaviour: A review of research and theory. *Psychological Bulletin, 88*(1), 82-108.

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.

Cortese, S., Bernardina, B. D., & Mouren, M. (2007). Attention-Deficit/Hyperactivity disorder (ADHD) and binge eating. *Nutrition Reviews, 65*(9), 404-411.

Cortese, S., Konofal, E., Yateman, N., Mouren, M., & Lecendreux, M. (2006). Sleep and alertness in children with attention-deficit/hyperactivity disorder: A systematic review of the literature. *Sleep, 29*(4), 504-511.

Costa Jr., P. T., & McCrae, R. R. (1992). Four ways five factors are basic. *Personality and Individual Differences, 13*(6), 653-665.

Costello, E. J., Edelbrock, C. S., & Costello, A. J. (1985). Validity of the NIMH diagnostic interview schedule for children: A comparison between psychiatric and pediatric referrals. *Journal of Abnormal Child Psychology, 13*(4), 579-595.

Cota, D., Tschöp, M. H., Horvath, T. L., & Levine, A. S. (2006). Cannabinoids, opioids and eating behavior: The molecular face of hedonism? *Brain Research Reviews, 51*(1), 85-107.

Cozzi, P., Putnam, S. P., Menesini, E., Gartstein, M. A., Aureli, T., Calussi, P., & Montirosso, R. (2013). Studying cross-cultural differences in temperament in toddlerhood: United States of America (US) and Italy. *Infant Behavior and Development, 36*(3), 480-483.

Craig, R. & Mindell, J. (Eds.). (2012). *Health Survey for England 2012*. Leeds: The Health and Social Care Information Centre.

Cullen, K. W., Baranowski, T., Rittenberry, L., Cosart, C., Hebert, D., & de Moor, C. (2001). Child-reported family and peer influences on fruit, juice and vegetable consumption: Reliability and validity of measures. *Health Education Research, 16*(2), 187-200.

Curtin, C., Bandini, L. G., Perrin, E. C., Tybor, D. J., & Must, A. (2005). Prevalence of overweight in children and adolescents with attention deficit hyperactivity disorder and autism spectrum disorders: A chart review. *BioMed Central Pediatrics, 5*, 48-55.

Dallman, M. F., Pecoraro, N., Akana, S. F., la Fleur, S. E., Gomez, F., Houshyar, H., & Manalo, S. (2003). Chronic stress and obesity: A new view of "comfort food". *Proceedings of the National Academy of Sciences of the United States of America, 100*(20), 11696-11701.

Dallman, M. F., Pecoraro, N. C., & la Fleur, S. E. (2005). Chronic stress and comfort foods: Self-medication and abdominal obesity. *Brain, Behavior, and Immunity, 19*(4), 275-280.

Daugherty, T. K., & Quay, H. C. (1991). Response perseveration and delayed responding in childhood behavior disorders. *Journal of Child Psychology and Psychiatry, 32*(3), 453-461.

Davis, C., Levitan, R. D., Muglia, P., Bewell, C., & Kennedy, J. L. (2004). Decision-making deficits and overeating: A risk model for obesity. *Obesity Research, 12*(6), 929-935.

Davis, C., Levitan, R. D., Smith, M., Tweed, S., & Curtis, C. (2006). Associations among overeating, overweight, and attention deficit/hyperactivity disorder: A structural equation modelling approach. *Eating Behaviors, 7*(3), 266-274.

Davis, C., Patte, K., Levitan, R., Reid, C., Tweed, S., & Curtis, C. (2007). From motivation to behaviour: A model of reward sensitivity, overeating, and food preferences in the risk profile for obesity. *Appetite, 48*(1), 12-19.

Davis, C., Strachan, S., & Berkson, M. (2004). Sensitivity to reward: Implications for overeating and overweight. *Appetite, 42*(2), 131-138.

Dawe, S., & Loxton, N. J. (2004). The role of impulsivity in the development of substance use and eating disorders. *Neuroscience & Biobehavioral Reviews, 28*(3), 343-351.

Dempsey, A., Dyehouse, J., & Schafer, J. (2011). The relationship between executive function, AD/HD, overeating, and obesity. *Western Journal of Nursing Research, 33*(5), 609-629.

Derryberry, D., & Reed, M. A. (2002). Anxiety-related attentional biases and their regulation by attentional control. *Journal of Abnormal Psychology, 111*(2), 225-236.

Dougherty, D. M., Mathias, C. W., Marsh, D. M., & Jagar, A. A. (2005). Laboratory behavioral measures of impulsivity. *Behavior Research Methods, 37*(1), 82-90.

Dubnov-Raz, G., Perry, A., & Berger, I. (2011). Body mass index of children with attention-deficit/hyperactivity disorder. *Journal of Child Neurology, 26*(3), 302-308.

DuPaul, G. J., Anastopoulos, A. D., Power, T. J., Reid, R., Ikeda, M. J., & McGoey, K. E. (1998). Parent ratings of attention-deficit/hyperactivity disorder symptoms: Factor structure and normative data. *Journal of Psychopathology and Behavioral Assessment, 20*(1), 83-102.

Ebbeling, C. B., Pawlak, D. B., & Ludwig, D. S. (2002). Childhood obesity: Public-health crisis, common sense cure. *The Lancet, 360*(9331), 473-482.

Epel, E., Lapidus, R., McEwen, B., & Brownell, K. (2001). Stress may add bite to appetite in women: A laboratory study of stress-induced cortisol and eating behavior. *Psychoneuroendocrinology, 26*(1), 37-49.

Epstein, L. H., Paluch, R. A., Gordy, C. C., & Dorn, J. (2000). Decreasing sedentary behaviors in treating pediatric obesity. *Archives of Pediatrics & Adolescent Medicine, 154*(3), 220-226.

Erhart, M., Herpertz-Dahlmann, B., Wille, N., Sawitzky-Rose, B., Hölling, H., & Ravens-Sieberer, U. (2012). Examining the relationship between attention-deficit/hyperactivity disorder and overweight in children and adolescents. *European Child & Adolescent Psychiatry, 21*(1), 39-49.

Evenden, J. (1999a). Impulsivity: A discussion of clinical and experimental findings. *Journal of Psychopharmacology, 13*(2), 180-192.

Evenden, J. L. (1999b). Varieties of impulsivity. *Psychopharmacology, 146*(4), 348-361.

Eysenck, H. J., & Eysenck, M. W. (1987). *Personality and individual differences.* Plenum.

Eysenck, H. J., Wilson, G. D., & Jackson, C. J. (1996). *Manual of the eysenck personality profiler (short).* Psi-Press.

Eysenck, S. B., Easting, G., & Pearson, P. R. (1984). Age norms for impulsiveness, venturesomeness and empathy in children. *Personality and Individual Differences, 5*(3), 315-321.

Eysenck, S. B., Pearson, P. R., Easting, G., & Allsopp, J. F. (1985). Age norms for impulsiveness, venturesomeness and empathy in adults. *Personality and Individual Differences, 6*(5), 613-619.

Faith, M. S., Berkowitz, R. I., Stallings, V. A., Kerns, J., Storey, M., & Stunkard, A. J. (2004). Parental feeding attitudes and styles and child body mass index: Prospective analysis of a gene-environment interaction. *Pediatrics, 114*(4), e429-e436.

Faith, M. S., Scanlon, K. S., Birch, L. L., Francis, L. A., & Sherry, B. (2004). Parent-child feeding strategies and their relationships to child eating and weight status. *Obesity Research, 12*(11), 1711-1722.

Farrow, C., & Blissett, J. (2012). Stability and continuity of parentally reported child eating behaviours and feeding practices from 2 to 5 years of age. *Appetite, 58*(1), 151-156.

Farrow, C. V. (2012). Do parental feeding practices moderate the relationships between impulsivity and eating in children? *Eating Behaviors, 13*(2), 150-153.

Feingold, A. (1994). Gender differences in personality: A meta-analysis. *Psychological Bulletin, 116*(3), 429-456.

Fields, S., Collins, C., Leraas, K., & Reynolds, B. (2009). Dimensions of impulsive behaviour in adolescent smokers and non-smokers. *Experimental and Clinical Psychopharmacology, 17*(5), 302-311.

Fishbach, A., Friedman, R. S., & Kruglanski, A. W. (2003). Leading us not into temptation: Momentary allurements elicit overriding goal activation. *Journal of Personality and Social Psychology, 84*(2), 296-309.

Fisher, J. O., & Birch, L. L. (1999). Restricting access to palatable foods affects children's behavioral response, food selection, and intake. *The American Journal of Clinical Nutrition, 69*(6), 1264-1272.

Fleming, J., & Levy, L. (2002). Eating disorders in women with AD/HD. In P. O. Quinn & K. G. Nadeau (Eds.), *Gender Issues and AD/HD: Research, Diagnosis, and Treatment* (pp. 411-426). Silver Springs, MD: Advantage Books.

Flora, S. R., Wilkerson, L. R., & Flora, D. B. (2003). Effects of cold pressor pain on human self-control for positive reinforcement. *The Psychological Record, 53*(2), 243-252.

Fox, H. C., Bergquist, K. L., Gu, P., & Sinha, S. (2010). Interactive effects of cumulative stress and impulsivity on alcohol consumption. *Alcoholism: Clinical and Experimental Research, 34*(8), 1376-1385.

Fox, M. K., Devaney, B., Reidy, K., Razafindrakoto, C., & Ziegler, P. (2006). Relationship between portion size and energy intake among infants and toddlers: Evidence of self-regulation. *Journal of the American Dietetic Association, 106*(1), 77-83.

Francis, L. A., & Susman, E. J. (2009). Self-regulation and rapid weight gain in children from age 3 to 12 years. *Archives of Pediatrics & Adolescent Medicine, 163*(4), 297-302.

Galloway, A. T., Fiorito, L. M., Francis, L. A., & Birch, L. L. (2006). 'Finish your soup': Counterproductive effects of pressuring children to eat on intake and affect. *Appetite, 46*(3), 318-323.

Garner, D. (1991). *Eating Disorder Inventory-2, Professionals Manual.* Odessa, FL: Psychological Assessment Resources.

Gibson, E. L. (2006). Emotional influences on food choice: Sensory, physiological and psychological pathways. *Physiology & Behavior, 89*(1), 53-61.

Goodman, R. (1997). The strengths and difficulties questionnaire: A research note. *Journal of Child Psychology and Psychiatry, 38*(5), 581-586.

Goodman, R., & Scott, S. (1999). Comparing the strengths and difficulties questionnaire and the child behavior checklist: Is small beautiful? *Journal of Abnormal Child Psychology, 27*(1), 17-24.

Graziano, P. A., Calkins, S. D., & Keane, S. P. (2010). Toddler self-regulation skills predict risk for pediatric obesity. *International Journal of Obesity, 34*(4), 633-641.

Green, L., Fry, A. F., & Myerson, J. (1994). Discounting of delayed rewards: A life-span comparison. *Psychological Science, 5*(1), 33-36.

Greeno, C. G., & Wing, R. R. (1994). Stress-induced eating. *Psychological Bulletin, 115*(3), 444-464.

Gregory, J. E., Paxton, S. J., & Brozovic, A. M. (2010). Pressure to eat and restriction are associated with child eating behaviours and maternal concern about child weight, but not child body mass index, in 2-to 4-year-old children. *Appetite, 54*(3), 550-556.

Grunberg, N. E., & Straub, R. O. (1992). The role of gender and taste class in the effects of stress on eating. *Health Psychology, 11*(2), 97-100.

Guerrieri, R., Nederkoorn, C., & Jansen, A. (2007). How impulsiveness and variety influence food intake in a sample of healthy women. *Appetite, 48*(1), 119-122.

Guerrieri, R., Nederkoorn, C., & Jansen, A. (2008a). The effect of an impulsive personality on overeating and obesity: Current state of affairs. *Psihologijske Teme, 17*(2), 265-286.

Guerrieri, R., Nederkoorn, C., & Jansen, A. (2008b). The interaction between impulsivity and a varied food environment: Its influence on food intake and overweight. *International Journal of Obesity, 32*(4), 708-714.

Guerrieri, R., Nederkoorn, C., Schrooten, M., Martijn, C., & Jansen, A. (2009). Inducing impulsivity leads high and low restrained eaters into overeating, whereas current dieters stick to their diet. *Appetite, 53*(1), 93-100.

Guerrieri, R., Nederkoorn, C., Stankiewicz, K., Alberts, H., Geschwind, N., Martijn, C., & Jansen, A. (2007). The influence of trait and induced state impulsivity on food intake in normal-weight healthy women. *Appetite, 49*(1), 66-73.

Hartmann, A. S., Czaja, J., Rief, W., & Hilbert, A. (2010). Personality and psychopathology in children with and without loss of control over eating. *Comprehensive Psychiatry, 51*(6), 572-578.

Haws, K. L., & Redden, J. P. (2013). In control of variety. High self-control reduces the effect of variety on food consumption. *Appetite, 69*, 196-203.

Haycraft, E. L., & Blissett, J. M. (2008). Maternal and paternal controlling feeding practices: Reliability and relationships with BMI. *Obesity, 16*(7), 1552-1558.

Heatherton, T. F., Herman, C. P., Polivy, J., King, G. A., & McGree, S. T. (1988). The (mis) measurement of restraint: An analysis of conceptual and psychometric issues. *Journal of Abnormal Psychology, 97*(1), 19-28.

Herman, C. P., & Polivy, J. (1980). Restrained eating. In A.J. Stunkard (Ed.), *Obesity* (pp. 208-225). Philadelphia: W.B. Saunders.

Hinshaw , S. P., & Blachman, D. R. (2005). Attention-deficit/hyperactivity disorder. In D. Bell-Dolan, S. Foster, E. J. Mash (Eds.), *Handbook of behavioral and emotional problems in girls* (pp.117-147). New York: Kluwer Academic/Plenum.

Hofmann, W., & Friese, M. (2008). Impulses got the better of me: Alcohol moderates the influence of implicit attitudes toward food cues on eating behavior. *Journal of Abnormal Psychology, 117*(2), 420-427.

Hofmann, W., Rauch, W., & Gawronski, B. (2007). And deplete us not into temptation: Automatic attitudes, dietary restraint, and self-regulatory resources as determinants of eating behavior. *Journal of Experimental Social Psychology, 43*(3), 497-504.

Holtkamp, K., Konrad, K., Müller, B., Heussen, N., Herpertz, S., Herpertz-Dahlmann, B., & Hebebrand, J. (2004). Overweight and obesity in children with attention-deficit/hyperactivity disorder. *International Journal of Obesity, 28*(5), 685-689.

Houben, K. (2011). Overcoming the urge to splurge: Influencing eating behavior by manipulating inhibitory control. *Journal of Behavior Therapy and Experimental Psychiatry, 42*(3), 384-388.

Houben, K., & Jansen, A. (2011). Training inhibitory control. A recipe for resisting sweet temptations. *Appetite, 56*(2), 345-349.

Houben, K., & Jansen, A. (2014). Lacking Skills to Improve Self-Control: Reward-Induced Loss of Inhibitory Control and Overeating in Restrained Eaters*. Journal of Experimental Psychopathology, 5*(1), 29-37.

Houben, K., Nederkoorn, C., & Jansen, A. (2012). Too tempting to resist? past success at weight control rather than dietary restraint determines exposure-induced disinhibited eating. *Appetite, 59*(2), 550-555.

Jansen, A., Nederkoorn, C., Van Baak, L., Keirse, C., Guerrieri, R., & Havermans, R. (2009). High-restrained eaters only overeat when they are also impulsive. *Behaviour Research and Therapy, 47*(2), 105-110.

Jasinska, A. J., Yasuda, M., Burant, C. F., Gregor, N., Khatri, S., Sweet, M., & Falk, E. B. (2012). Impulsivity and inhibitory control deficits are associated with unhealthy eating in young adults. *Appetite, 59*(3), 738-747.

Johnson, S. L., & Birch, L. L. (1994). Parents' and children's adiposity and eating style. *Pediatrics, 94*(5), 653-661.

Johnson, W. G., Parry, W., & Drabman, R. S. (1978). The performance of obese and normal size children on a delay of gratification task. *Addictive Behaviors, 3*(3), 205-208.

Kagan, J. (1965). Reflection-impulsivity and reading ability in primary grade children *Child Development, 36*(3), 609-628.

Karreman, A., Van Tuijl, C., Van Aken, M. A., & Deković, M. (2008). Parenting, coparenting, and effortful control in preschoolers. *Journal of Family Psychology, 22*(1), 30-40.

Katzman, M. A., Weiss, L., & Wolchik, S. A. (1986). Speak don't eat! Teaching women to express their feelings. *Women & Therapy, 5*(2-3), 143-157.

Kessler, R. C., Adler, L., Ames, M., Demler, O., Faraone, S., Hiripi, E., et al. (2005). The world health organization adult ADHD self-report scale (ASRS): A short screening scale for use in the general population. *Psychological Medicine, 35*(02), 245-256.

Khalife, N., Kantomaa, M., Glover, V., Tammelin, T., Laitinen, J., Ebeling, H., et al. (2014). Childhood attention-deficit/hyperactivity disorder symptoms are risk factors for obesity and physical inactivity in adolescence. *Journal of the American Academy of Child & Adolescent Psychiatry, 53*(4), 425-436.

Klasen, H., Woerner, W., Wolke, D., Meyer, R., Overmeyer, S., Kaschnitz, W., et al. (2000). Comparing the German versions of the strengths and difficulties questionnaire (SDQ-deu) and the child behavior checklist. *European Child & Adolescent Psychiatry, 9*(4), 271-276.

Klein, L., Faraday, M., & Grunberg, N. (1996). Gender differences in eating after exposure to a noise stressor. *Annals of Behavioral Medicine, 18*, S103.

Klesges, R. C., Stein, R. J., Eck, L. H., Isbell, T. R., & Klesges, L. M. (1991). Parental influence on food selection in young children and its relationships to childhood obesity. *The American Journal of Clinical Nutrition, 53*(4), 859-864.

Kochanska, G., Murray, K. T., & Harlan, E. T. (2000). Effortful control in early childhood: Continuity and change, antecedents, and implications for social development. *Developmental Psychology, 36*(2), 220-232.

Kochanska, G., Murray, K., Jacques, T. Y., Koenig, A. L., & Vandegeest, K. A. (1996). Inhibitory control in young children and its role in emerging internalization. *Child Development, 67*(2), 490-507.

Laessle, R. G., Tuschl, R. J., Kotthaus, B. C., & Pirke, K. M. (1989). A comparison of the validity of three scales for the assessment of dietary restraint. *Journal of Abnormal Psychology, 98*(4), 504-507.

Lambillotte, C., Gilon, P., & Henquin, J. C. (1997). Direct glucocorticoid inhibition of insulin secretion. An in vitro study of dexamethasone effects in mouse islets. *The Journal of Clinical Investigation, 99*(3), 414-423.

Leitch, M. A., Morgan, M. J., & Yeomans, M. R. (2013). Different subtypes of impulsivity differentiate uncontrolled eating and dietary restraint. *Appetite, 69*(1), 54-63.

Levy, L., Fleming, J., & Klar, D. (2009). Treatment of refractory obesity in severely obese adults following management of newly diagnosed attention deficit hyperactivity disorder. *International Journal of Obesity, 33*(3), 326-334.

Lickteig, K., Isaacs, J., Zachor, D., & Hodgens, B. (1999). Attention deficit hyperactivity disorder treatment, appetite changes and growth [Abstract]. *Clinical Nutrition Care, 99*(9), A-14.

Liu, L., Li, B., Yang, J., & Wang, Y. (2008). Does dopaminergic reward system contribute to explaining comorbidity obesity and ADHD? *Medical Hypotheses, 70*(6), 1118-1120.

Logan, G. D., Schachar, R. J., & Tannock, R. (1997). Impulsivity and inhibitory control. *Psychological Science, 8*(1), 60-64.

Lyke, J. A., & Spinella, M. (2004). Associations among aspects of impulsivity and eating factors in a nonclinical sample. *International Journal of Eating Disorders, 36*(2), 229-233.

Matthys, W., Van Goozen, S. H., Vries, H. d., Cohen-Kettenis, P. T., & Engeland, H. v. (1998). The dominance of behavioural activation over behavioural inhibition in conduct disordered boys with or without attention deficit hyperactivity disorder. *Journal of Child Psychology and Psychiatry, 39*(5), 643-651.

McKenna, R. J. (1972). Some effects of anxiety level and food cues on the eating behavior of obese and normal subjects: A comparison of the schachterian and psychosomatic conceptions. *Journal of Personality and Social Psychology, 22*(3), 311.

Meule, A., Lukito, S., Vögele, C., & Kübler, A. (2011). Enhanced behavioral inhibition in restrained eaters. *Eating Behaviors, 12*(2), 152-155.

Mikami, A. Y., Hinshaw, S. P., Patterson, K. A., & Lee, J. C. (2008). Eating pathology among adolescent girls with attention-deficit/hyperactivity disorder. *Journal of Abnormal Psychology, 117*(1), 225.

Mischel, W., Shoda, Y., & Rodriguez, M. I. (1989). Delay of gratification in children. *Science, 244*(4907), 933-938.

Moeller, F. G., Barratt, E. S., Dougherty, D. M., Schmitz, J. M., & Swann, A. C. (2001). Psychiatric aspects of impulsivity. *American Journal of Psychiatry, 158*(11), 1783-1793.

Moore, S. N., Tapper, K., & Murphy, S. (2007). Feeding strategies used by mothers of 3-5-year-old children. *Appetite, 49*(3), 704-707.

Muraven, M., & Baumeister, R. F. (2000). Self-regulation and depletion of limited resources: Does self-control resemble a muscle? *Psychological Bulletin, 126*(2), 247-259.

Muraven, M., Tice, D. M., & Baumeister, R. F. (1998). Self-control as a limited resource: Regulatory depletion patterns. *Journal of Personality and Social Psychology, 74*(3), 774-789.

Musher-Eizenman, D. R., de Lauzon-Guillain, B., Holub, S. C., Leporc, E., & Charles, M. A. (2009). Child and parent characteristics related to parental feeding practices. A cross-cultural examination in the US and France. *Appetite, 52*(1), 89-95.

Musher-Eizenman, D., & Holub, S. (2007). Comprehensive feeding practices questionnaire: Validation of a new measure of parental feeding practices. *Journal of Pediatric Psychology, 32*(8), 960-972.

Nasser, J. A., Gluck, M. E., & Geliebter, A. (2004). Impulsivity and test meal intake in obese binge eating women. *Appetite, 43*(3), 303-307.

National Institute for Health and Clinical Excellence (NICE). (2009). *Attention deficit hyperactivity disorder. The NICE guideline on diagnosis and management of ADHD in children, young people and adults. National clinical practice guideline number 72.* Leicester: The British Psychological Society.

Nederkoorn, C., Braet, C., Van Eijs, Y., Tanghe, A., & Jansen, A. (2006). Why obese children cannot resist food: The role of impulsivity. *Eating Behaviors, 7*(4), 315-322.

Nederkoorn, C., Van Eijs, Y., & Jansen, A. (2004). Restrained eaters act on impulse. *Personality and Individual Differences, 37*(8), 1651-1658.

Nederkoorn, C., Houben, K., Hofmann, W., Roefs, A., & Jansen, A. (2010). Control yourself or just eat what you like? Weight gain over a year is predicted by an interactive effect of response inhibition and implicit preference for snack foods. *Health Psychology, 29*(4), 389-393.

Nederkoorn, C., Jansen, E., Mulkens, S., & Jansen, A. (2007). Impulsivity predicts treatment outcome in obese children. *Behaviour Research and Therapy, 45*(5), 1071-1075.

Newman, E., O’Connor, D. B., & Conner, M. (2007). Daily hassles and eating behaviour: The role of cortisol reactivity status. *Psychoneuroendocrinology, 32*(2), 125-132.

O’Connor, R. M., Colder, C. R., & Hawk Jr., L. W. (2004). Confirmatory factor analysis of the sensitivity to punishment and sensitivity to reward questionnaire. *Personality and Individual Differences, 37*(5), 985-1002.

Ogden, J., Cordey, P., Cutler, L., & Thomas, H. (2013). Parental restriction and children’s diets. The chocolate coin and easter egg experiments. *Appetite, 61*, 36-44.

Ogden, J., Reynolds, R., & Smith, A. (2006). Expanding the concept of parental control: A role for overt and covert control in children's snacking behaviour? *Appetite, 47*(1), 100-106.

Orlet Fisher, J., Mitchell, D. C., Wright, H. S., & Birch, L. L. (2002). Parental influences on young girls’ fruit and vegetable, micronutrient, and fat intakes. *Journal of the American Dietetic Association, 102*(1), 58-64.

Orrell-Valente, J. K., Hill, L. G., Brechwald, W. A., Dodge, K. A., Pettit, G. S., & Bates, J. E. (2007). “Just three more bites”: An observational analysis of parents’ socialization of children's eating at mealtime. *Appetite, 48*(1), 37-45.

Pagoto, S. L., Curtin, C., Lemon, S. C., Bandini, L. G., Schneider, K. L., Bodenlos, J. S., & Ma, Y. (2009). Association between adult attention deficit/hyperactivity disorder and obesity in the US population. *Obesity, 17*(3), 539-544.

Patrick, H., Nicklas, T. A., Hughes, S. O., & Morales, M. (2005). The benefits of authoritative feeding style: Caregiver feeding styles and children's food consumption patterns. *Appetite, 44*(2), 243-249.

Patton, J. H., & Stanford, M. S. (1995). Factor structure of the barratt impulsiveness scale. *Journal of Clinical Psychology, 51*(6), 768-774.

Pauli-Pott, U., Albayrak, O., Hebebrand, J., & Pott, W. (2010). Does inhibitory control capacity in overweight and obese children and adolescents predict success in a weight-reduction program? *European Child & Adolescent Psychiatry, 19*(2), 135-141.

Peeke, P. M., & Chrousos, G. P. (1995). Hypercortisolism and obesity. *Annals of the New York Academy of Sciences, 771*(1), 665-676.

Pelham Jr., W. E., Gnagy, E. M., Greenslade, K. E., & Milich, R. (1992). Teacher ratings of DSM-III-R symptoms for the disruptive behavior disorders. *Journal of the American Academy of Child & Adolescent Psychiatry, 31*(2), 210-218.

Pervanidou, P., & Chrousos, G. P. (2011). Stress and obesity/metabolic syndrome in childhood and adolescence. *International Journal of Pediatric Obesity, 6*(S1), 21-28.

Piazza, J., Bering, J. M., & Ingram, G. (2011). “Princess Alice is watching you”: Children’s belief in an invisible person inhibits cheating. *Journal of Experimental Child Psychology, 109*(3), 311-320.

Pine, C. J. (1985). Anxiety and eating behaviour in obese and nonobese American Indians and white Americans. *Journal of Personality and Social Psychology, 49*(3), 774-780.

Pliszka, S. R. (2000). Patterns of psychiatric comorbidity with attention-deficit/hyperactivity disorder. *Child and Adolescent Psychiatric Clinics of North America, 9*(3), 525-540.

Polanczyk, G., de Lima, M., Horta, B., Biederman, J., & Rohde, L. (2007). The worldwide prevalence of ADHD: A systematic review and metaregression analysis. *American Journal of Psychiatry, 164*(6), 942-948.

Ptacek, R., Kuzelova, H., Paclt, I., Zukov, I., & Fischer, S. (2009). Anthropometric changes in non-medicated ADHD boys. *Neuro Endocrinology Letters, 30*(3), 377-381.

Putnam, S. P., Gartstein, M. A., & Rothbart, M. K. (2006). Measurement of fine-grained aspects of toddler temperament: The early childhood behavior questionnaire. *Infant Behavior and Development, 29*(3), 386-401.

Reau, N. R., Senturia, Y. D., Lebailly, S. A., & Christoffel, K. K. (1996). Infant and toddler feeding patterns and problems: Normative data and a new direction. *Journal of Developmental & Behavioral Pediatrics, 17*(3), 149-153.

Riggs, N. R., Spruijt-Metz, D., Sakuma, K., Chou, C., & Pentz, M. A. (2010). Executive cognitive function and food intake in children. *Journal of Nutrition Education and Behavior, 42*(6), 398-403.

Roemmich, J. N., Wright, S. M., & Epstein, L. H. (2002). Dietary restraint and stress-induced snacking in youth. *Obesity Research, 10*(11), 1120-1126.

Rojo, L., Ruiz, E., Domínguez, J. A., Calaf, M., & Livianos, L. (2006). Comorbidity between obesity and attention deficit/hyperactivity disorder: Population study with 13-15-year-olds. *International Journal of Eating Disorders, 39*(6), 519-522.

Rollins, B. Y., Loken, E., Savage, J. S., & Birch, L. L. (2014). Effects of restriction on children's intake differ by child temperament, food reinforcement, and parent's chronic use of restriction. *Appetite, 73*, 31-39.

Rosmond, R. (2005). Role of stress in the pathogenesis of the metabolic syndrome. *Psychoneuroendocrinology, 30*(1), 1-10.

Rosval, L., Steiger, H., Bruce, K., Israël, M., Richardson, J., & Aubut, M. (2006). Impulsivity in women with eating disorders: Problem of response inhibition, planning, or attention? *International Journal of Eating Disorders, 39*(7), 590-593.

Rothbart, M. K. (1989). Temperament and development. In G. A. Kohnstamm, J. E. Bates, M. K. Rothbart (Eds.), *Temperament in childhood* (pp. 187-247). Oxford, England: John Wiley & Sons.

Rothbart, M. K., Ahadi, S. A., & Evans, D. E. (2000). Temperament and personality: Origins and outcomes. *Journal of Personality and Social Psychology, 78*(1), 122-135.

Rothbart, M. K., Ahadi, S. A., Hershey, K. L., & Fisher, P. (2001). Investigations of temperament at three to seven years: The children's behavior questionnaire. *Child Development, 72*(5), 1394-1408.

Rubin, K. H., Burgess, K. B., Dwyer, K. M., & Hastings, P. D. (2003). Predicting preschoolers' externalizing behaviors from toddler temperament, conflict, and maternal negativity. *Developmental Psychology, 39*(1), 164-176.

Scaglioni, S., Salvioni, M., & Galimberti, C. (2008). Influence of parental attitudes in the development of children eating behaviour. *British Journal of Nutrition, 99*(S1), S22-S25.

Scahill, L., & Schwab-Stone, M. (2000). Epidemiology of ADHD in school-age children. *Child and Adolescent Psychiatric Clinics of North America 9*(3), 541-555.

Schachar, R., & Logan, G. D. (1990). Impulsivity and inhibitory control in normal development and childhood psychopathology. *Developmental Psychology, 26*(5), 710-720.

Schotte, D. E., Cools, J., & McNally, R. J. (1990). Film-induced negative affect triggers overeating in restrained eaters. *Journal of Abnormal Psychology, 99*(3), 317-320.

Schweickert, L. A., Strober, M., & Moskowitz, A. (1997). Efficacy of methylphenidate in bulimia nervosa comorbid with attention-deficit hyperactivity disorder: A case report. *International Journal of Eating Disorders, 21*(3), 299-301.

Seeyave, D. M., Coleman, S., Appugliese, D., Corwyn, R. F., Bradley, R. H., Davidson, N. S. (2009). Ability to delay gratification at age 4 years and risk of overweight at age 11 years. *Archives of Pediatrics & Adolescent Medicine, 163*(4), 303-308.

Shmueli, D., & Prochaska, J. J. (2009). Resisting tempting foods and smoking behavior: Implications from a self-control theory perspective. *Health Psychology, 28*(3), 300-306.

Simonds, J., & Rothbart, M. K. (2004, October). *The temperament in middle childhood questionnaire (TMCQ): A computerized self-report instrument for ages 7–10.* Poster Session presented at the Occasional Temperament Conference, Athens, GA.

Smedje, H., Broman, J., Hetta, J., & Von Knorring, A. (1999). Psychometric properties of a Swedish version of the “Strengths and difficulties questionnaire”. *European Child & Adolescent Psychiatry, 8*(2), 63-70.

Smith, C., Williamson, D., Bray, G., & Ryan, D. (1999). Flexible vs. rigid dieting strategies: Relationship with adverse behavioral outcomes. *Appetite, 32*(3), 295-305.

Solanto, M. V., Abikoff, H., Sonuga-Barke, E., Schachar, R., Logan, G. D., Wigal, T. et al. (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.

Spencer, T. J., Biederman, J., Harding, M., O'Donnell, D., Faraone, S. V., & Wilens, T. E. (1996). Growth deficits in ADHD children revisited: Evidence for disorder-associated growth delays? *Journal of the American Academy of Child & Adolescent Psychiatry, 35*(11), 1460-1469.

Striegel-Moore, R. H., Rosselli, F., Perrin, N., DeBar, L., Wilson, G. T., May, A., et al. (2009). Gender difference in the prevalence of eating disorder symptoms. *International Journal of Eating Disorders, 42*(5), 471-474.

Stroebe, W., Van Koningsbruggen, G. M., Papies, E. K., & Aarts, H. (2013). Why most dieters fail but some succeed: A goal conflict model of eating behavior. *Psychological Review, 120*(1), 110-138.

Stunkard, A. J., & Messick, S. (1985). The three-factor eating questionnaire to measure dietary restraint, disinhibition and hunger. *Journal of Psychosomatic Research, 29*(1), 71-83.

Surman, C. B., Randall, E. T., & Biederman, J. (2006). Association between attention-deficit/hyperactivity disorder and bulimia nervosa: Analysis of 4 case-control studies. *Journal of Clinical Psychiatry, 67*(3), 351-354.

Swanson, J. M., Elliott, G. R., Greenhill, L. L., Wigal, T., Arnold, L. E., Vitiello, B., et al. (2007). Effects of stimulant medication on growth rates across 3 years in the MTA follow-up. *Journal of the American Academy of Child & Adolescent Psychiatry, 46*(8), 1015-1027.

Tan, C. C., & Holub, S. C. (2011). Children's self-regulation in eating: Associations with inhibitory control and parents' feeding behavior. *Journal of Pediatric Psychology, 36*(3), 340-345.

Tellegen, A., & Waller, N. G. (2008). Exploring personality through test construction: Development of the multidimensional personality questionnaire. In G. J. Boyle, G. Matthews, & D. H. Saklofske (Eds.),*The SAGE Handbook of Personality Theory and Assessment Volume 2*, (pp.261-292). London: Sage Publications.

Thamotharan, S., Lange, K., Zale, E. L., Huffhines, L., & Fields, S. (2013). The role of impulsivity in pediatric obesity and weight status: A meta-analytic review. *Clinical Psychology Review, 33*(2), 253-262.

Theule, J., Wiener, J., Tannock, R., & Jenkins, J. M. (2013). Parenting stress in families of children with ADHD: A meta-analysis. *Journal of Emotional and Behavioral Disorders, 21*(1), 3-17.

Tice, D. M., Bratslavsky, E., & Baumeister, R. F. (2001). Emotional distress regulation takes precedence over impulse control: If you feel bad, do it! *Journal of Personality and Social Psychology, 80*(1), 53-67.

Van den Berg, L., Pieterse, K., Malik, J., Luman, M., Van Dijk, K. W., Oosterlaan, J., & Delemarre-Van de Waal, H. (2011). Association between impulsivity, reward responsiveness and body mass index in children. *International Journal of Obesity, 35*(10), 1301-1307.

Van Egmond-Fröhlich, A., Widhalm, K., & de Zwaan, M. (2012). Association of symptoms of attention-deficit/hyperactivity disorder with childhood overweight adjusted for confounding parental variables. *International Journal of Obesity, 36*(7), 963-968.

Van Koningsbruggen, G. M., Stroebe, W., & Aarts, H. (2013). Successful restrained eating and trait impulsiveness. *Appetite, 60*, 81-84.

Van Strien, T., & Bazelier, F. G. (2007). Perceived parental control of food intake is related to external, restrained and emotional eating in 7–12-year-old boys and girls. *Appetite, 49*(3), 618-625.

Van Strien, T., Frijters, J. E. R., Bergers, G. P. A., & Defares, P. B. (1986). The Dutch eating behavior questionnaire (DEBQ) for assessment of restrained, emotional, and external eating behavior. *International Journal of Eating Disorders, 5*(2), 295-315.

Van Strien, T., & Oosterveld, P. (2008). The children's DEBQ for assessment of restrained, emotional, and external eating in 7- to 12-year-old children. *International Journal of Eating Disorders, 41*(1), 72-81.

Van Strien, T., & Ouwens, M. A. (2007). Effects of distress, alexithymia and impulsivity on eating. *Eating Behaviors, 8*(2), 251-257.

Verbeken, S., Braet, C., Claus, L., Nederkoorn, C., & Oosterlaan, J. (2009). Childhood obesity and impulsivity: An investigation with performance-based measures. *Behaviour Change, 26*(03), 153-167.

Viana, V., Sinde, S., & Saxton, J. (2008). Children's eating behaviour questionnaire: Associations with BMI in Portuguese children. *British Journal of Nutrition, 100*(02), 445-450.

Wardle, J., Carnell, S., & Cooke, L. (2005). Parental control over feeding and children’s fruit and vegetable intake: How are they related? *Journal of the American Dietetic Association, 105*(2), 227-232.

Wardle, J., Chida, Y., Gibson, E. L., Whitaker, K. L., & Steptoe, A. (2011). Stress and adiposity: A Meta-Analysis of longitudinal studies. *Obesity, 19*(4), 771-778.

Wardle, J., Guthrie, C. A., Sanderson, S., & Rapoport, L. (2001). Development of the children's eating behaviour questionnaire. *Journal of Child Psychology and Psychiatry, 42*(7), 963-970.

Wardle, J., Steptoe, A., Oliver, G., & Lipsey, Z. (2000). Stress, dietary restraint and food intake. *Journal of Psychosomatic Research, 48*(2), 195-202.

Waring, M. E., & Lapane, K. L. (2008). Overweight in children and adolescents in relation to attention-deficit/hyperactivity disorder: Results from a national sample. *Pediatrics, 122*(1), e1-e6.

Whiteside, S. P., & Lynam, D. R. (2001). The five factor model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and Individual Differences, 30*(4), 669-689.

Wilhelm, C., Marx, I., Konrad, K., Willmes, K., Holtkamp, K., Vloet, T., & Herpertz-Dahlmann, B. (2011). Differential patterns of disordered eating in subjects with ADHD and overweight. *World Journal of Biological Psychiatry, 12*(S1), 118-123.

Zuckerman, M., Michael Kuhlman, D., Thornquist, M., & Kiers, H. (1991). Five (or three) robust questionnaire scale factors of personality without culture. *Personality and Individual Differences, 12*(9), 929-941.

APPENDICES

APPENDIX A: RECRUITMENT MATERIALS

A-1 Leaflet/poster advertising a study on mealtime interactions for 2-4-year-olds

A-2 Leaflet/poster advertising a study on stress, impulsivity and eating behaviour in 7-11-year-olds

A-3 Magazine listing advertising a study on stress, impulsivity and eating behaviour in 7-11-year-olds

A-4 Text posted on websites, forums and other social media platforms to inform parents of 5-15-year-olds about a study on weight, eating and feeding differences in children with and without Attention Deficit Hyperactivity Disorder

APPENDIX B: QUESTIONNAIRES AND MEASURES

B-1 Children's Eating Behaviour Questionnaire (CEBQ; Wardle, Guthrie, Sanderson, & Rapoport, 2001)

B-2 Dutch Eating Behaviour Questionnaire-Child version (DEBQ-C; Van Strien & Oosterfeld, 2008)

B-3 Comprehensive Feeding Practices Questionnaire (CPFQ; Musher-Eizenman & Holub, 2007)

B-4 Early Childhood Behaviour Questionnaire (ECBQ; Putnam, Gartstein, & Rothbart, 2006)

B-5 Temperament in Middle Childhood Questionnaire (TMCQ, version 3.0; Simonds & Rothbart, 2004)

B-6 Conners' Parent Rating Scale (CPRS-R [L]; Conners, 1998)

B-7 Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997)

B-8 Demographics and additional assessments

B-9 Teddy Picture Rating Scale (PRS; Bennett & Blissett, 2014)

APPENDIX C: ADDITIONAL STATISTICAL ANALYSES

C-1 Differences in age and gender of children completing and failing to complete the impulsivity tasks in Chapter Three

C-2 Moderating effects of monitoring on the relationships between impulsivity and food approach and avoidance behaviours and mealtime intake in Chapter Three

C-3 Moderating effects of parental controlling feeding practices on the relationship between impulsivity and BMI z-score in Chapter Three

C-4 Differences between parent-child dyads selected and not selected for the video analysis in Chapter Four

C-5 Moderating effects of monitoring on the relationships between impulsivity and food approach and avoidance behaviours and mealtime intake in Chapter Five

C-6 Moderating effects of controlling parental feeding practices on the relationship between impulsivity and BMI z-score in Chapter Five

C-7 Analyses assessing differences in demographic characteristics between medicated and unmedicated children with ADHD in Chapter Seven

Eating behaviour in Children

Dr Jackie Blissett, Dr Suzanne Higgs, Dr Gill Harris
School of Psychology, University of Birmingham

Young children are often reluctant to try new foods, especially fruits and vegetables. At the University of Birmingham, we are trying to find out more about how to encourage children to try new fruits and vegetables.

We are therefore inviting parents and their children aged 24-36 months to have a **free lunch** at the university during which time we will offer your child a fruit they have not eaten before, and observe how willing they are to try it.

Taking part in the study will take no longer than 1 1/2 hours.
All children taking part in this study will get a toy for taking part and all parents will be reimbursed for their travel expenses **(£10)**.

If you are interested in taking part in our study, or if you would like some further information on what taking part will involve, please do not hesitate to contact one of the research assistants (details below).

Anna Fogel **Carmel Bennett**

Stress and Eating in Children

Researchers: Carmel Bennett and Dr Jackie Blissett, School of Psychology, University of Birmingham

Have you ever noticed that you or other people around you eat more or maybe less when things get a bit stressful? Do you sometimes wonder why that is or if certain factors like the ability to control yourself or the way you were fed by your own parents influence your eating behaviour under stress?

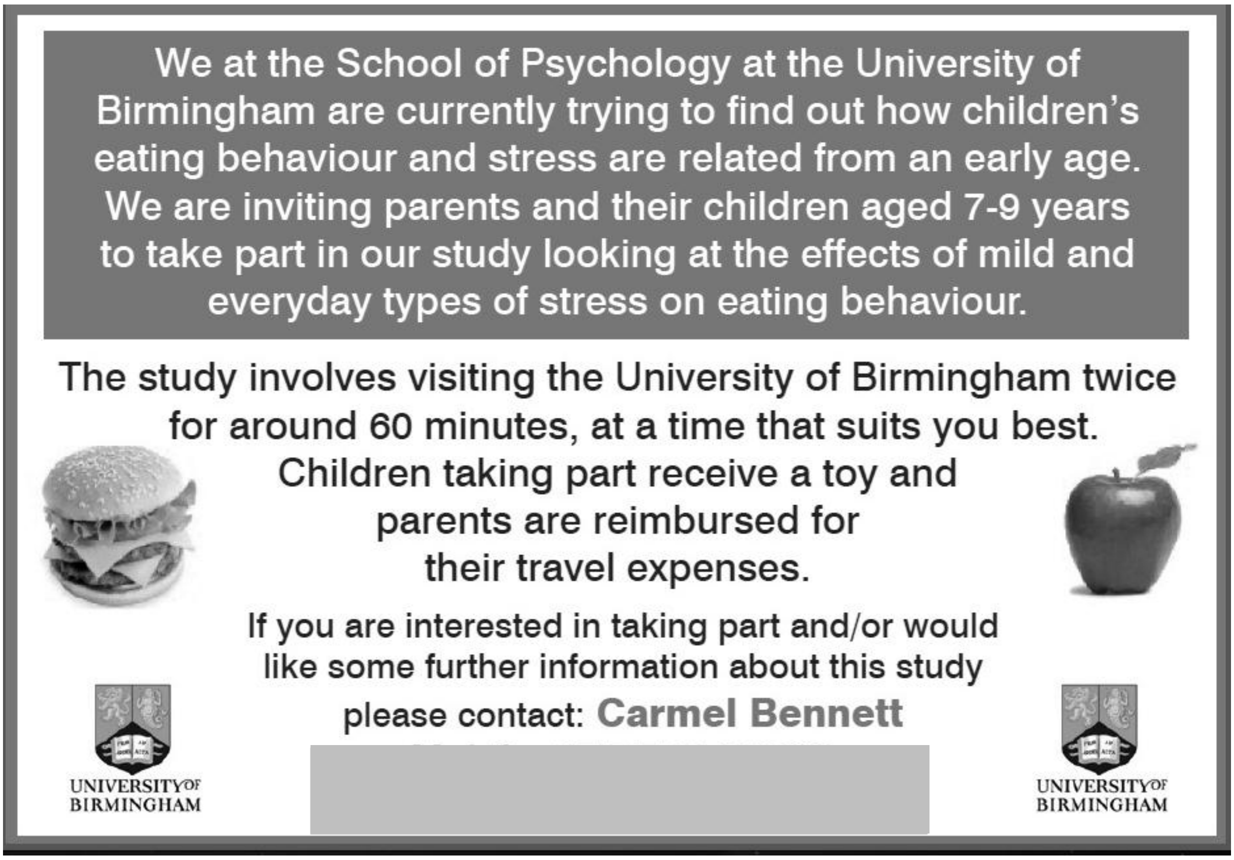
We at the psychology department of the University of Birmingham are currently trying to find out how eating behaviour and stress are related from an early age. We are therefore inviting parents and their children aged 7-9 years to take part in our study looking at the effects of mild and everyday types of stress on eating behaviour in children.

Parents will be asked to fill in some questionnaires, while children will complete some games and tasks before being offered some common snack-foods, like cookies and crisps.

The study we are doing will take no longer than 1.5 hours. All children taking part in our study will get a toy for taking part and all parents will be reimbursed for their travel expenses (£5).

If you are interested in taking part in our study or if you would like some further information on what taking part will involve please do not hesitate to contact one of the researchers below.

Carmel Bennett	Dr Jackie Blissett


We at the School of Psychology at the University of Birmingham are currently trying to find out how children's eating behaviour and stress are related from an early age. We are inviting parents and their children aged 7-9 years to take part in our study looking at the effects of mild and everyday types of stress on eating behaviour.
The study involves visiting the University of Birmingham twice for around 60 minutes, at a time that suits you best.
Children taking part receive a toy and parents are reimbursed for their travel expenses.
If you are interested in taking part and/or would like some further information about this study please contact: Carmel Bennett
UNIVERSITY OF BIRMINGHAM
UNIVERSITY OF BIRMINGHAM

Hello mums and dads!

I am a researcher from the University of Birmingham trying to find out how children's self-control abilities are related to their eating behaviour and weight!

In addition I am looking at differences in these links in families of children with and without Attention Deficit Hyperactivity Disorder (ADHD). I am therefore asking parents of children (aged 5-15 years) with and without ADHD to complete my online survey.

If you complete the survey you will also be able to enter a Prize Draw for a £25 Amazon Voucher.

The link to the survey and a more detailed information sheet is below

Thanks for your support,
Carmel

Child Eating Behaviour Questionnaire

Children have a lot of different eating habits. **Please rate how often this child does the following things by circling the most relevant number.**	Never	Seldom	Sometimes	Often	Always
1. My child loves food	1	2	3	4	5
2. My child eats more when worried	1	2	3	4	5
3. My child has a big appetite	1	2	3	4	5
4. My child finishes his/her meal quickly	1	2	3	4	5
5. My child is interested in food	1	2	3	4	5
6. My child is always asking for a drink	1	2	3	4	5
7. My child refuses new foods at first	1	2	3	4	5
8. My child eats slowly	1	2	3	4	5
9. My child eats less when angry	1	2	3	4	5
10. My child enjoys tasting new foods	1	2	3	4	5
11. My child eats less when s/he is tired	1	2	3	4	5
12. My child is always asking for food	1	2	3	4	5
13. My child eats more when annoyed	1	2	3	4	5
14. If allowed to, my child would eat too much	1	2	3	4	5
15. My child eats more when anxious	1	2	3	4	5
16. My child enjoys a wide variety of foods	1	2	3	4	5
17. My child leaves food on his/her plate at the end of a meal	1	2	3	4	5
18. My child takes more than 30 minutes to finish a meal	1	2	3	4	5
19. Given the choice, my child would eat most of the time	1	2	3	4	5
20. My child looks forward to mealtimes	1	2	3	4	5
21. My child gets full before his/her meal is finished	1	2	3	4	5
22. My child enjoys eating	1	2	3	4	5
23. My child eats more when s/he is happy	1	2	3	4	5
24. My child is difficult to please with meals	1	2	3	4	5
25. My child eats less when upset	1	2	3	4	5
26. My child gets full up easily	1	2	3	4	5
27. My child eats more when s/he has nothing else to do	1	2	3	4	5
28. Even if my child is full up s/he finds room to eat his/her favourite food	1	2	3	4	5
29. If given the chance, my child would drink continuously throughout the day	1	2	3	4	5
30. My child cannot eat a meal if s/he has had a snack just before	1	2	3	4	5
31. If given the chance, my child would always be having a drink	1	2	3	4	5
32. My child is interested in tasting food s/he hasn’t tasted before	1	2	3	4	5
33. My child decides that s/he doesn’t like a food, even without tasting it	1	2	3	4	5
34. If given the chance, my child would always have food in his/her mouth	1	2	3	4	5
35. My child eats more and more slowly during the course of a meal	1	2	3	4	5

Dutch Eating Behvaiour Questionnaire – Child Versions

Instructions
Below are some questions about eating. Please read each question carefully and circle the answer that describes how you eat. You are only allowed to circle one answer for each question. Please do not skip any answers.
There are no right or wrong answers; it is your opinion that matters!

1.	Do you feel like eating whenever you see or smell yummy food?	No	Sometimes	Yes
2.	If you feel sad do you feel like eating food?	No	Sometimes	Yes
3.	If you feel lonely do you feel like eating food?	No	Sometimes	Yes
4.	Do you watch exactly what you eat?	No	Sometimes	Yes
5.	Does walking past a sweetshop make you feel like eating?	No	Sometimes	Yes
6.	Do you ever try to eat foods that will make you thinner?	No	Sometimes	Yes
7.	Does watching others eat make you feel like eating too?	No	Sometimes	Yes
8.	If you have eaten too much do you eat less than usual on the next day?	No	Sometimes	Yes
9.	If you feel worried about something do you feel like eating?	No	Sometimes	Yes
10	Do you find it difficult to stay away from yummy food?	No	Sometimes	Yes
11.	Do you sometimes eat less so you don't put on weight?	No	Sometimes	Yes
12.	If things go wrong at home or in school for example, do you feel like eating?	No	Sometimes	Yes
13.	Do you feel like eating when you walk past a snack bar or a fish and chips stand?	No	Sometimes	Yes
14.	Have you ever tried not to eat in between meals to get thinner?	No	Sometimes	Yes
15.	If you feel restless and cannot sit still do you feel like eating food?	No	Sometimes	Yes
16.	Have you ever tried not to eat after your evening meal to get thinner?	No	Sometimes	Yes
17.	When you feel scared do you feel like eating?	No	Sometimes	Yes
18.	Do you ever think that food will make you fat or will make you thin when you eat?	No	Sometimes	Yes
19.	If you feel sorry do you feel like eating?	No	Sometimes	Yes
20.	If somebody prepares food do you get excited about eating the food?	No	Sometimes	Yes

Comprehensive Feeding Practices Questionnaire

Parents take many different approaches to feeding their children and may have different concerns about feeding depending on their child. **Please answer the following questions as honestly as possible.**	Never	Rarely	Sometimes	Mostly	Always
1. How much do you keep track of the sweet foods (sweets, ice cream, cake, biscuits, pastries) that your child eats?	1	2	3	4	5
2. How much do you keep track of the snack food (crisps, Doritos, cheese puffs) that your child eats?	1	2	3	4	5
3. How much do you keep track of the high-fat foods that your child eats?	1	2	3	4	5
4. How much do you keep track of the sugary drinks (fizzy pop, sugary squashes) this child drinks?	1	2	3	4	5
5. Do you let your child eat whatever s/he wants?	1	2	3	4	5
6. At dinner, do you let this child choose the foods s/he wants from what is served?	1	2	3	4	5
7. When this child gets irritable, is giving him/her something to eat or drink the *first* thing you do?	1	2	3	4	5
8. Do you give this child something to eat or drink if s/he is bored even if you think s/he is not hungry?	1	2	3	4	5
9. Do you give this child something to eat or drink if s/he is upset even if you think s/he is not hungry?	1	2	3	4	5
10. If this child does not like what is being served, do you make something else?	1	2	3	4	5
11. Do you allow this child to eat snacks whenever s/he wants?	1	2	3	4	5
12. Do you allow this child to leave the table when s/he is full, even if your family has not finished eating?	1	2	3	4	5
13. Do you encourage this child to eat healthy foods before unhealthy ones?	1	2	3	4	5

Please continue to answer the following questions as honestly as possible.	Disagree	Slightly disagree	Neutral	Slightly agree	Agree
14. Most of the food I keep in the house is healthy.	1	2	3	4	5
15. I involve my child in planning family meals.	1	2	3	4	5
16. I keep a lot of snack food (crisps, Doritos, cheese puffs) in my house.	1	2	3	4	5
17. My child should always eat all of the food on his/her plate.	1	2	3	4	5
18. I have to be sure that my child does not eat too many high-fat foods.	1	2	3	4	5
19. I offer my child his/her favourite foods in exchange for good behaviour.	1	2	3	4	5
20. I allow my child to help prepare family meals.	1	2	3	4	5
21. If I did not guide or regulate my child's eating, s/he would eat too much of his/her favourite foods.	1	2	3	4	5
22. A variety of healthy foods are available to my child at each meal served at home.	1	2	3	4	5
23. I offer sweet foods (sweets, ice cream, biscuits, cake, pastries) to my child as a reward for good behaviour.	1	2	3	4	5
24. I encourage my child to try new foods.	1	2	3	4	5
25. I discuss with my child why it's important to eat healthy foods.	1	2	3	4	5
26. I tell my child that healthy food tastes good.	1	2	3	4	5
27. I encourage my child to eat less so he/she won't get fat.	1	2	3	4	5
28. If I did not guide or regulate my child's eating, s/he would eat too many junk foods.	1	2	3	4	5
29. I give my child small helpings at meals to control his/her weight.	1	2	3	4	5
30. If my child says, "I'm not hungry," I try to get him/her to eat anyway.	1	2	3	4	5
31. I discuss with my child the nutritional value of foods.	1	2	3	4	5
32. I encourage my child to participate in grocery shopping.	1	2	3	4	5
33. If my child eats more than usual at one meal, I try to restrict his/her eating at the next meal.	1	2	3	4	5
34. I restrict the food my child eats that might make him/her fat.	1	2	3	4	5
35. There are certain foods my child shouldn't eat because they will make him/her fat.	1	2	3	4	5
36. I withhold sweets/dessert from my child in response to bad behaviour.	1	2	3	4	5
37. I keep a lot of sweet foods (sweets, biscuits, ice cream, cake, pastries) in my house.	1	2	3	4	5
38. I encourage my child to eat a variety of foods.	1	2	3	4	5

Please continue to answer the following questions as honestly as possible.	Disagree	Slightly disagree	Neutral	Slightly agree	Agree
39. If my child eats only a small helping, I try to get him/her to eat more.	1	2	3	4	5
40. I have to be sure that my child does not eat too much of his/her favourite foods.	1	2	3	4	5
41. I don’t allow my child to eat between meals because I don’t want him/her to get fat.	1	2	3	4	5
42. I tell my child what to eat and what not to eat without explanation.	1	2	3	4	5
43. I have to be sure that my child does not eat too many sweet foods (sweets, ice cream, cake, biscuits or pastries).	1	2	3	4	5
44. I model healthy eating for my child by eating healthy foods myself.	1	2	3	4	5
45. I often put my child on a diet to control his/her weight.	1	2	3	4	5
46. I try to eat healthy foods in front of my child, even if they are not my favourite.	1	2	3	4	5
47. I try to show enthusiasm about eating healthy foods.	1	2	3	4	5
48. I show my child how much I enjoy eating healthy foods.	1	2	3	4	5
49. When he/she says he/she is finished eating, I try to get my child to eat one more (two more, etc.) bites of food.	1	2	3	4	5

Early Childhood Behavior Questionnaire

Please contact the measure's authors for a full copy of this measure

Conners' Parent Rating Scale

Please contact the measure's author for a full copy of this measure.

Strengths and Difficulties Questionnaire

For each item, please mark the box for Not True, Somewhat True or Certainly True. It would help us if you answered all items as best you can even if you are not absolutely certain or the item seems strange! Please give your answers on the basis of the child's behaviour over the last six months.

	Not True	Somewhat True	Certainly True
Considerate of other people's feeling	□	□	□
Restless, overactive, cannot stay still for long	□	□	□
Often complains of headaches, stomach-aches or sickness	□	□	□
Shares readily with other children (treats, toys, pencils etc.)	□	□	□
Often has temper tantrums or hot tempers	□	□	□
Rather solitary, tends to play alone	□	□	□
Generally obedient, usually does what adults request	□	□	□
Many worries, often seems worried	□	□	□
Helpful if someone is hurt, upset or feeling ill	□	□	□
Constantly fidgeting or squirming	□	□	□
Has at least one good friend	□	□	□
Often fights with other children or bullies them	□	□	□
Often unhappy, down-hearted or tearful	□	□	□
Generally liked by other children	□	□	□

	Not True	Somewhat True	Certainly True
Easily distracted, concentration wanders	□	□	□
Nervous or clingy in new situations, easily loses confidence	□	□	□
Kind to younger children	□	□	□
Often lies or cheats	□	□	□
Picked on or bullied by other children	□	□	□
Often volunteers to help others (parents, teachers, other children)	□	□	□
Thinks things out before acting	□	□	□
Steals from home, school or elsewhere	□	□	□
Gets on better with adults than with other children	□	□	□
Many fears, easily scared	□	□	□
Sees tasks through to the end, good attention span	□	□	□

Questions exploring Demographic Characteristics

1. What is your month and year of birth? ___________________________________
2. What is your height …………………………(cm)
3. What is your weight …………………………(kg)
4. How many adults live in your home? _________

5. How many children live in your home? _________

6. Which race/ethnic group best describes you? (please tick)

White British/Caucasian ☐ *Black/Black British* ☐

Asian/Asian British ☐ *Oriental* ☐ *Mixed* ☐

Other ☐ ______________________ *(please specify)*

6a. Please describe **your child's ethnic background** using one of the categories listed above……………………………………………………………………..

7. Which of the following categories best describes your **total** annual household income?

Under £15,000 ☐ *£15,000-£30,000* ☐ *£30,000-£45,000* ☐

£45,000-£60,000 ☐ *£60,000-£75,000* ☐ *£75,000+* ☐

8. Which of the following best describes your educational background?
(Please tick only your highest qualification)

☐ *Some secondary school education*
☐ *GCSEs*
☐ *A-levels*
☐ *University graduate (e.g. Bachelor's degree)*
☐ *Post-graduate certificates (e.g. PGCE)*
☐ *Master's degree*
☐ *Professional or Doctorate degree*
*Other:*____________________________

9. Your child's month and year of birth (the child participating in this study)
____

10. Please indicate the gender of your child (participating in this study):
Male ☐ *Female* ☐

11. What is your relation to this child? (Please tick)

Parent ☐ *Step-parent* ☐ *Guardian* ☐ *Other:* ___________

12. Does **your child** eat a special diet for any of the following reasons?

Yes ☐ *No* ☐

If yes, please describe:

Medical: ______________________ *Ethical:* _______________________
Religious: ______________________ *Weight-loss:* ___________________
Other: ________________________

13. Do **you** eat a special diet for any of the following reasons?

Yes ☐ *No* ☐

If yes, please describe:

Medical: ______________________ *Ethical:* _______________________
Pregnancy: ____________________ *Weight-loss:* ___________________
Religious: _____________________ *Other:* ________________________

Additional questions exploring the presence of ADHD, Comorbid Disorders and Learning Difficulties in Chapter Seven

1. Has your child been diagnosed with **Attention Deficit Hyperactivity Disorder** (ADHD)?
Yes ☐ *No* ☐

If yes, which **ADHD subtype** has your child been diagnosed with (please tick appropriate boxes)?

☐ Predominantly Inattentive
☐ Predominantly Hyperactive-Impulsive
☐ Combined Type
☐ Other (please state)______________________
☐ Not known/ Not applicable

2. Has your child has been diagnosed with any **other disorders** (e.g. *Conduct Disorder* (CD), Oppositional Defiant Disorder (ODD), or any anxiety disorder)? Yes ☐ No ☐

If yes, please state the name(s) of any disorder(s):

____

3. Does your child take any **medications** (e.g. stimulants like Ritalin, antidepressants)?
Yes ☐ *No* ☐

If yes, please list any medications your child takes:

____

4. Does your child suffer from any serious **food allergies**? *Yes* ☐ *No* ☐

If yes, please list any food allergies:

____

5. Does your child suffer from any **food intolerances** (e.g. lactose intolerance, Coeliac disease)? Yes ☐ No ☐

If yes, please list any food intolerances:

____

6. Does your child have **learning difficulties or developmental disorders**? *Yes* ☐ *No* ☐

If yes, please list the learning difficulties or developmental disorders:

____

Measuring Hunger and Satiety in Primary School Children: Validation of a New Picture Rating Scale

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Abstract

Measuring hunger and satiety in children is essential to many studies of childhood eating behaviour and obesity. Despite this, few validated measures currently exist that allow children to make accurate and reliable ratings of their hunger/satiety. Three studies aimed to address this issue by validating the use of a new categorical rating scale, Teddy the Bear, in the context of estimated and real eating episodes. Forty-seven 6-8 year old primary school pupils participated in Study 1, which used a between-participant design. Results from this study indicated that the majority of children were able to use the scale to make estimated hunger/satiety ratings for a character in a story using the scale. No significant differences in the ratings of hunger/satiety of children measured before and after lunch were observed and likely causes are discussed. To account for inter-individual differences in hunger/satiety perceptions Study 2 employed a within-participant design. Fifty-four 5-7 year olds participated in this study and made estimated hunger/satiety ratings for a story character and real hunger/satiety ratings before and after lunch. The results from this study indicated that the majority of children were able to use the scale to make estimated and real hunger and satiety ratings. Children were also found to be significantly hungrier before compared to after lunch. As it was not possible to establish what types of food and in what quantity children ate for lunch a third study was carried out in a controlled laboratory environment. Thirty-six 6-9 year olds participated in Study 3 and made hunger/satiety ratings before and after ingesting an ad libitum snack of known composition and quantity. Results indicate that children felt hungrier before than after the snack and that pre-snack hunger/satiety, as well as changes in hunger/satiety, were associated with ad libitum snack intake. Overall, the studies indicate that our new categorical rating scale has potential for use with primary school children. Implications of our findings and possible contexts for its application are discussed.

Keywords: Hunger, Satiety, Rating Scale

DIFFERENCES IN AGE AND GENDER OF CHILDREN COMPLETING AND FAILING TO COMPLETE THE IMPULSIVITY TASKS IN CHAPTER THREE

There were no differences in child age between task completers and non-completers for the Snack Delay task ($t(93)=2.42$, $p=.02$), the Line Walking task ($t(93)=1.61$, $p=.11$) or the Tower task ($t(93)=.9$, $p=.37$). Additionally, there were no gender differences between task completers and non-completers for the Snack Delay task ($\chi^2(1, N=95)=1.06$, $p=.3$), the Line Walking task ($\chi^2(1, N=95)=.32$ $p=.57$), or the Tower task ($\chi^2(1, N=95)=.95$ $p=.33$).

MODERATING EFFECTS OF MONITORING ON THE RELATIONSHIPS BETWEEN IMPULSIVITY AND FOOD APPROACH AND AVOIDANCE BEHAVIOURS AND MEALTIME INTAKE IN CHAPTER THREE

Table A

Moderation analyses assessing the moderating effect of monitoring on the relationship between impulsivity and food approach for the sample overall and for females and males separately

Moderator: Monitoring	Outcome: Food Approach Behaviour	Predictor	Sample	Coefficient b	*t*	*p*
		Impulsivity ECBQ	Overall	-.28	-2.29	.02
			Female	-.43	-2.63	.01
			Male	-.17	-.95	.35
		Snack Delay task	Overall	.1	1.81	.08
			Female	.19	2.36	.03
			Male	-.04	-.28	.79
		Line Walking task	Overall	-.07	-3.11	.003
			Female	-.12	-1.14	.26
			Male	-.07	-2.73	.01
		Tower task	Overall	.01	.46	.65
			Female	.04	.95	.35
			Male	.01	.14	.89

*$p \leq .01$

Table B

Moderation analyses assessing the moderating effect of monitoring on the relationship between impulsivity and food avoidance for the sample overall and for females and males separately

Moderator: Monitoring	Outcome: Food Avoidance Behaviour	Predictor	Sample	Coefficient b	*t*	*p*
		Impulsivity ECBQ	Overall	.15	1.32	.19
			Female	-.13	-.77	.45
			Male	.33	1.81	.08
		Snack Delay task	Overall	-.05	-.52	.61
			Female	-.06	-.64	.53
			Male	-.05	-.33	.74
		Line Walking task	Overall	-.01	-.28	.78
			Female	-.02	-.21	.83
			Male	-.02	-.61	.55
		Tower task	Overall	-.02	-.53	.6
			Female	.01	.22	.83
			Male	-.06	-.96	.34

Table C

Moderation analyses assessing the moderating effect of monitoring on the relationship between impulsivity and mealtime intake for the sample overall and for females and males separately

Moderator: Monitoring	Outcome: Mealtime Intake	Predictor	Sample	Coefficient b	*t*	*p*
		Impulsivity ECBQ	Overall	19.25	1.03	.31
			Female	19.25	.5	.62
			Male	20.72	.81	.42
		Snack Delay task	Overall	10.42	.95	.35
			Female	8.34	.67	.51
			Male	13.34	.79	.44
		Line Walking task	Overall	4.1	1.1	.28
			Female	-19.4	-1.43	.17
			Male	4.37	.53	.6
		Tower task	Overall	5.52	1.07	.29
			Female	3.26	.47	.65
			Male	6	.49	.63

MODERATING EFFECTS OF CONTROLLING PARENTAL FEEDING PRACTICES ON THE RELATIONSHIP BETWEEN IMPULSIVITY AND BMI Z-SCORE IN CHAPTER THREE

Table A

Moderation analyses assessing the moderating effect of restriction for weight control on the relationship between impulsivity and child weight for the sample overall and for females and males separately

Moderator: Restriction Weight Control	Outcome: Weight	Predictor	Sample	Coefficient b	*t*	*p*
		Impulsivity ECBQ	Overall	-.09	-.4	.69
			Female	-.08	-.18	.86
			Male	-.09	-.33	.75
		Snack Delay task	Overall	.14	1.14	.26
			Female	.19	.29	.77
			Male	-.06	-.27	.79
		Line Walking task	Overall	-.08	-1.01	.32
			Female	.11	1.22	.23
			Male	-.27	-1.41	.17
		Tower task	Overall	.06	.92	.36
			Female	.08	.92	.37
			Male	.06	.55	.59

Table B

Moderation analyses assessing the moderating effect of restriction for health on the relationship between impulsivity and child weight for the sample overall and for females and males separately

Moderator: Restriction Health	Outcome: Weight	Predictor	Sample	Coefficient b	*t*	*p*
		Impulsivity ECBQ	Overall	-.11	-.84	.41
			Female	-.14	-.52	.61
			Male	-.1	-.45	.65
		Snack Delay task	Overall	-.15	-1.95	.06
			Female	-.11	-1.27	.22
			Male	-.17	-.95	.35
		Line Walking task	Overall	-.02	-.48	.63
			Female	.04	.3	.77
			Male	-.01	-.18	.86
		Tower task	Overall	.001	.02	.99
			Female	.02	.19	.85
			Male	.02	.13	.9

Table C

Moderation analyses assessing the moderating effect of pressure to eat on the relationship between impulsivity and child weight for the sample overall and for females and males separately

Moderator: Pressure to eat	Outcome: Weight	Predictor	Sample	Coefficient b	*t*	*p*
		Impulsivity ECBQ	Overall	-.01	-.08	.93
			Female	-.27	-1.08	.29
			Male	.07	.61	.55
		Snack Delay task	Overall	-.04	-.38	.71
			Female	.17	.75	.46
			Male	.01	.04	.97
		Line Walking task	Overall	-.04	-1	.32
			Female	-.05	-.55	.59
			Male	-.003	-.04	.97
		Tower task	Overall	-.02	-.22	.83
			Female	.02	.22	.83
			Male	-.11	-2.41	.02

Table D

Moderation analyses assessing the moderating effect of monitoring on the relationship between impulsivity and child weight for the sample overall and for females and males separately

Moderator: Monitoring	Outcome: Weight	Predictor	Sample	Coefficient b	*t*	*p*
		Impulsivity ECBQ	Overall	-.11	-.44	.66
			Female	-.48	-1.28	.21
			Male	.11	.28	.78
		Snack Delay task	Overall	-.01	-.09	.93
			Female	.09	.56	.58
			Male	-.23	-.6	.56
		Line Walking task	Overall	-.07	-.81	.42
			Female	.11	.54	.59
			Male	-.03	-.61	.54
		Tower task	Overall	.01	.14	.89
			Female	.02	.12	.91
			Male	-.02	-.17	.87

DIFFERENCES BETWEEN PARENT-CHILD DYADS SELECTED AND NOT SELECTED FOR THE VIDEO ANALYSIS IN CHAPTER FOUR

	Children selected for video analysis (n=36)	Children not selected for video analysis (n=59)	Outcomes of analyses of differences
Child Gender	23 female, 13 male	18 female, 41 male	$\chi^2(1, N=95)=10.16$, $p=.001$
Child Age	29.14 (5.57) months	29.83 (5.41)	$t(72.5)=-.59$, $p=.56$
Child BMI z-score	.45 (1.39)	.27 (1.05)	$t(91)=.72$, $p=.47$
Parent Education	36.2% Post-graduate qualification (*n*=13) 38.9% University graduate (*n*=14) 8.3% A-Levels (*n*=3) 13.9% GCSEs (*n*=5) 0% Some secondary education (*n*=0) 2.8% Other (*n*=1)	35.7% Post-graduate qualification (*n*=21) 33.9% University graduate (*n*=20) 23.7% A-Levels (*n*=14) 3.4% GCSEs (*n*=2) 1.7% Some secondary education (*n*=1) 1.8% Other (*n*=1)	$\chi^2(7, N=95)=19.76$, $p=.01$
Parent Income	13.9% > £75000 (*n*=5) 22.2% £60-75000 (*n*=8) 19.4% £45-60000 (*n*=7) 16.7% £30-45000 (*n*=6) 22.2% £15-30000 (*n*=8) 5.6% < £15000 (*n*=2)	16.9%> £75000 (*n*=10) 3.4% £60-75000 (*n*=2) 23.7% £45-60000 (*n*=14) 33.9% £30-45000 (*n*=20) 20.3% £15-30000 (*n*=12) 1.7% < £15000 (*n*=1)	$\chi^2(5, N=95)=11.37$, $p=.05$
Ethnicity	94.4% White British (*n*=34) 2.8% Black British (*n*=1) 2.8% Asian/Asian British (*n*=1)	71.2% White British (*n*=42) 15.3% Asian/Asian British (*n*=9) 3.4% Mixed background (*n*=2) 10.2% Other background (*n*=6)	$\chi^2(4, N=95)=11.34$, $p=.02$
ECBQ Impulsivity	4.99 (.92)	5 (.78)	$t(93)=-.08$, $p=.94$

MODERATING EFFECTS OF MONITORING ON THE RELATIONSHIPS BETWEEN IMPULSIVITY AND FOOD APPROACH AND AVOIDANCE BEHAVIOURS, EMOTIONAL, RESTRAINED AND EXTERNAL EATING AND SNACK INTAKE IN CHAPTER FIVE

Table A

Moderation analyses assessing moderating effect of monitoring on the relationship between impulsivity and food approach for the sample overall and for females and males separately

Moderator: Monitoring	Outcome: Food Approach Behaviour	Predictor	Sample	Coefficient b	*t*	*p*
		Impulsivity TMCQ	Overall	.27	1.01	.32
			Female	.06	.2	.85
			Male	.81	1.07	.3
		CGI: Restless-Impulsive	Overall	.05	1.2	.24
			Female	.08	1.03	.32
			Male	.07	.39	.7
		CPRS Hyperactivity	Overall	.04	.53	.6
			Female	.14	1.52	.14
			Male	.04	.35	.73
		GNG task: Go trial RT	Overall	-.001	-.06	.95
			Female	0	-.004	1
			Male	.01	.32	.75
		GNG task: Errors of Commission	Overall	.01	.2	.85
			Female	-.04	-.54	.6
			Male	.19	1	.33
		Door Opening task	Overall	.01	1.81	.08
			Female	.01	1.63	.12
			Male	.003	.14	.89
		Delay of Gratification task	Overall	.03	1.37	.18
			Female	.05	1.33	.2
			Male	-.02	-.41	.69
		Circle Drawing task	Overall	.0001	.05	.96
			Female	-.0003	-.05	.96
			Male	.0004	.1	.92

Table B

Moderation analyses assessing the moderating effect of monitoring on the relationship between impulsivity and food avoidance for the sample overall and for females and males separately

Moderator: Monitoring	Outcome: Food Avoidance Behaviour	Predictor	Sample	Coefficient b	*t*	*p*
		Impulsivity TMCQ	Overall	-.5	-2.03	.05
			Female	-.54	-2.67	.01
			Male	-.4	-.79	.44
		CGI: Restless-Impulsive	Overall	-.07	-1.91	.06
			Female	-.12	-1	.33
			Male	-.05	-.71	.49
		CPRS Hyperactivity	Overall	-.03	-.71	.48
			Female	-.1	-.81	.43
			Male	.01	.1	.92
		GNG task: Go trial RT	Overall	.01	.83	.41
			Female	.01	.56	.58
			Male	.01	.87	.4
		GNG task: Errors of Commission	Overall	-.1	-1.67	.1
			Female	-.06	-.77	.45
			Male	-.07	-.8	.44
		Door Opening task	Overall	.002	.4	.69
			Female	.002	.32	.76
			Male	-.0003	-.02	.98
		Delay of Gratification task	Overall	.03	.9	.37
			Female	.003	.08	.94
			Male	.04	1.1	.29
		Circle Drawing task	Overall	-.002	-.66	.51
			Female	.001	.17	.87
			Male	-.004	-1.23	.23

Table C

Moderation analyses assessing the moderating effect of monitoring on the relationship between impulsivity and emotional eating for the sample overall and for females and males separately

Moderator: Monitoring	Outcome: Emotional Eating	Predictor	Sample	Coefficient b	*t*	*p*
		Impulsivity TMCQ	Overall	.2	1.06	.3
			Female	.3	1.17	.25
			Male	.43	.22	.67
		CGI: Restless-Impulsive	Overall	-.02	-.4	.69
			Female	.06	.73	.48
			Male	-.05	-.48	.64
		CPRS Hyperactivity	Overall	-.02	-.65	.52
			Female	.0002	.001	1
			Male	-.02	-.39	.7
		GNG task: Go trial RT	Overall	-.001	-.22	.83
			Female	-.004	-.78	.45
			Male	.01	.72	.48
		GNG task: Errors of Commission	Overall	-.05	-.83	.41
			Female	-.06	-.72	.48
			Male	-.14	-1.19	.25
		Door Opening task	Overall	-.001	-.17	.87
			Female	-.001	-.15	.88
			Male	-.01	-.49	.63
		Delay of Gratification task	Overall	-.004	-.18	.86
			Female	-.01	-.27	.79
			Male	-.004	-.08	.94
		Circle Drawing task	Overall	.001	.63	.53
			Female	.0002	.07	.94
			Male	.002	.33	.74

Table D

Moderation analyses assessing the moderating effect of monitoring on the relationship between impulsivity and restrained eating for the sample overall and for females and males separately

Moderator: Monitoring	Outcome: Restrained Eating	Predictor	Sample	Coefficient b	*t*	*p*
		Impulsivity TMCQ	Overall	.15	.72	.47
			Female	.11	.36	.72
			Male	.29	.52	.61
		CGI: Restless-Impulsive	Overall	.05	1.47	.15
			Female	.06	.83	.42
			Male	.08	1.07	.3
		CPRS Hyperactivity	Overall	.05	1.72	.09
			Female	.07	.57	.58
			Male	.07	1.31	.21
		GNG task: Go trial RT	Overall	.001	.1	.92
			Female	.002	.23	.82
			Male	-.01	-.96	.35
		GNG task: Errors of Commission	Overall	.14	3.49	.001
			Female	.16	2.82	.01
			Male	.09	.88	.39
		Door Opening task	Overall	-.001	-.3	.77
			Female	-.004	-.59	.56
			Male	-.001	-.06	.96
		Delay of Gratification task	Overall	.01	.6	.55
			Female	.03	.76	.45
			Male	.03	.65	.52
		Circle Drawing task	Overall	.0002	.08	.94
			Female	-.001	-.15	.88
			Male	.001	.3	.77

Table E

Moderation analyses assessing the moderating effect of monitoring on the relationship between impulsivity and external eating for the sample overall and for females and males separately

Moderator: Monitoring	Outcome: External Eating	Predictor	Sample	Coefficient b	*t*	*p*
		Impulsivity TMCQ	Overall	.22	.93	.36
			Female	.25	.86	.4
			Male	.26	.44	.67
		CGI: Restless-Impulsive	Overall	-.07	-1.53	.14
			Female	-.07	-.96	.35
			Male	-.07	-.83	.42
		CPRS Hyperactivity	Overall	-.03	-.54	.6
			Female	-.06	-.5	.62
			Male	-.02	-.13	.9
		GNG task: Go trial RT	Overall	.002	.22	.83
			Female	-.001	-.08	.93
			Male	.01	.48	.64
		GNG task: Errors of Commission	Overall	-.14	-1.6	.12
			Female	-.18	-1.57	.13
			Male	-.2	-1.87	.08
		Door Opening task	Overall	.01	.82	.42
			Female	.01	1.26	.22
			Male	-.01	-.38	.71
		Delay of Gratification task	Overall	.02	.6	.56
			Female	.01	.22	.83
			Male	.04	.64	.53
		Circle Drawing task	Overall	.002	1.09	.28
			Female	.005	.94	.36
			Male	.0004	.03	.98

Table F

Moderation analyses assessing the moderating effect of monitoring on the relationship between impulsivity and snack intake for the sample overall and for females and males separately

Moderator: Monitoring	Outcome: Snack Intake	Predictor	Sample	Coefficient b	*t*	*p*
		Impulsivity TMCQ	Overall	-118.45	-1.62	.11
			Female	-116.91	-1.24	.23
			Male	-106.88	-.51	.61
		CGI: Restless-Impulsive	Overall	1.59	.1	.92
			Female	19.49	.9	.38
			Male	-2.8	-.12	.91
		CPRS Hyperactivity	Overall	-15.49	-1.16	.25
			Female	-.99	-.04	.97
			Male	-16.6	-.6	.56
		GNG task: Go trial RT	Overall	2.43	1.19	.24
			Female	1.07	.38	.71
			Male	5.81	.95	.36
		GNG task: Errors of Commission	Overall	-7.28	-.41	.68
			Female	-9.56	-.43	.67
			Male	-26.52	-.54	.6
		Door Opening task	Overall	-1.71	-.49	.62
			Female	-2.58	-.95	.35
			Male	9.54	2.1	.05
		Delay of Gratification task	Overall	-7.35	-1.05	.3
			Female	-15.57	-1.8	.09
			Male	17.22	1.26	.22
		Circle Drawing task	Overall	-.07	-.08	.93
			Female	-.46	-.48	.64
			Male	.24	.32	.75

MODERATING EFFECTS OF CONTROLLING PARENTAL FEEDING PRACTICES ON THE RELATIONSHIP BETWEEN IMPULSIVITY AND BMI Z-SCORE IN CHAPTER FIVE

Table A

Moderation analyses assessing the moderating effect of restriction for weight on the relationship between impulsivity and child weight for the sample overall and for females and males separately

Moderator: Restriction Weight	Outcome: BMI z-score	Predictor	Sample	Coefficient b	*t*	*p*
		Impulsivity TMCQ	Overall	-.38	.1.06	.29
			Female	-.21	-.25	.81
			Male	-.34	-1.05	.31
		CGI: Restless-Impulsive	Overall	-.03	.055	.58
			Female	.01	.07	.94
			Male	.003	.05	.96
		CPRS Hyperactivity	Overall	.05	1.1	.28
			Female	.11	.87	.4
			Male	.05	.89	.39
		GNG task: Go trial RT	Overall	-.01	-.8	.43
			Female	-.01	-.33	.74
			Male	-.004	-.31	.76
		GNG task: Errors of Commission	Overall	-.04	-.35	.73
			Female	.01	.06	.95
			Male	-.09	-1.23	.24
		Door Opening task	Overall	.002	.27	.79
			Female	.01	.64	.53
			Male	-.01	-1.24	.23
		Delay of Gratification task	Overall	.006	.16	.88
			Female	.04	1.04	.31
			Male	-.06	-1.49	.16
		Circle Drawing task	Overall	.003	.91	.37
			Female	.01	1.06	.3
			Male	.002	.48	.64

Table B

Moderation analyses assessing the moderating effect of restriction for health on the relationship between impulsivity and child weight for the sample overall and for females and males separately

Moderator: Restriction Health	Outcome: BMI z-score	Predictor	Sample	Coefficient b	*t*	*p*
		Impulsivity TMCQ	Overall	-.29	-1.31	.2
			Female	-.08	-.5	.62
			Male	-.09	-.27	.79
		CGI: Restless-Impulsive	Overall	-.07	-2.48	.02
			Female	-.07	-.95	.35
			Male	.06	.89	.39
		CPRS Hyperactivity	Overall	-.04	-.84	.41
			Female	-.03	-.27	.79
			Male	.05	.96	.35
		GNG task: Go trial RT	Overall	-.01	-.67	.51
			Female	-.01	-.65	.53
			Male	-.003	-.41	.69
		GNG task: Errors of Commission	Overall	-.03	-.28	.78
			Female	.07	.82	.42
			Male	-.04	-.77	.45
		Door Opening task	Overall	-.0004	-.05	.97
			Female	.001	.07	.95
			Male	-.01	-.85	.41
		Delay of Gratification task	Overall	.02	1.31	.2
			Female	.04	1.03	.31
			Male	.001	.04	.97
		Circle Drawing task	Overall	.003	1.67	.1
			Female	.003	1.4	.18
			Male	-.002	-.13	.9

Table C

Moderation analyses assessing moderating effect of pressure on the relationship between impulsivity and child weight for the sample overall and for females and males separately

Moderator: Pressure	Outcome: BMI z-score	Predictor	Sample	Coefficient b	*t*	*p*
		Impulsivity TMCQ	Overall	-.45	-1.49	.14
			Female	-.6	-1.42	.17
			Male	.36	1.24	.23
		CGI: Restless-Impulsive	Overall	-.06	-1.15	.26
			Female	-.1	-1.29	.21
			Male	.06	1.51	.15
		CPRS Hyperactivity	Overall	-.04	-.96	.34
			Female	-.1	-1.17	.26
			Male	.06	1.21	.24
		GNG task: Go trial RT	Overall	.01	1.68	.1
			Female	.003	.43	.67
			Male	.003	.43	.67
		GNG task: Errors of Commission	Overall	-.04	-.93	.36
			Female	-.05	-.67	.51
			Male	-.03	-.65	.53
		Door Opening task	Overall	.003	.67	.51
			Female	.003	.51	.62
			Male	.001	.09	.93
		Delay of Gratification task	Overall	-.01	-.22	.83
			Female	-.01	-.2	.85
			Male	-.01	-.57	.58
		Circle Drawing task	Overall	-.001	-.2	.84
			Female	-.001	-.17	.87
			Male	.003	.41	.68

Table D

Moderation analyses assessing the moderating effect of monitoring on the relationship between impulsivity and child weight for the sample overall and for females and males separately

Moderator: Monitoring	Outcome: BMI z-score	Predictor	Sample	Coefficient b	*t*	*p*
		Impulsivity TMCQ	Overall	-.5	-.76	.45
			Female	-.44	-.41	.69
			Male	-.81	-1.82	.09
		CGI: Restless-Impulsive	Overall	-.01	-.13	.9
			Female	.07	.48	.63
			Male	-.13	-2.73	.01
		CPRS Hyperactivity	Overall	-.03	-.22	.83
			Female	.11	.64	.53
			Male	-.07	-.43	.67
		GNG task: Go trial RT	Overall	.02	1.09	.28
			Female	.02	.9	.38
			Male	.01	.61	.55
		GNG task: Errors of Commission	Overall	-.07	-.37	.71
			Female	-.02	-.07	.95
			Male	.01	.16	.88
		Door Opening task	Overall	-.01	-.83	.41
			Female	-.02	-.66	.52
			Male	-.02	-1.11	.28
		Delay of Gratification task	Overall	-.05	-.63	.53
			Female	-.06	-.53	.6
			Male	-.001	-.02	.98
		Circle Drawing task	Overall	-.01	-.86	.4
			Female	-.01	-.82	.42
			Male	-.004	-.43	.67

ANALYSES ASSESSING DIFFERENCES IN DEMOGRAPHIC CHARACTERISTICS AND OUTCOME VARIABLES BETWEEN MEDICATED AND UNMEDICATED CHILDREN WITH ADHD IN CHAPTER SEVEN

Analyses were carried out to examine whether children with ADHD who were medicated or un-medicated differed in age and BMI or whether their parents differed in age and BMI or education. *T*-tests showed that there were no differences in child BMI z-score, parent age, BMI or education. Children did, however, differ in age as children with ADHD, who were medicated were significantly older than those children with ADHD, who were not medicated. All analyses assessing differences in impulsivity and the eating variables therefore controlled for child age.

Table A

Means, SDs and differences in demographic characteristics for children with ADHD not on medication (n=18) and children with ADHD on medication (n=43)

Variable	ADHD no medication (*n*=18)	ADHD medication (*n*=43)	*t*-test results
Child age	7.94 (2.21)	10.42 (2.71)	$t(59)=3.42$, $p=.001$
Child BMI z-score	.59 (1.64)	1.05 (1.49)	$t(36)=.87$, $p=.39$
Parent age	38 (5.53)	40.17 (7.34)	$t(56)=1.07$, $p=.29$
Parent BMI	27.39 (7.42)	27.95 (7.07)	$t(41)=.23$, $p=.82$
Parent Education	3.67 (1.54)	3.15 (1.54)	$t(47)=-1.09$. $p=.28$

Additionally, Chi-squared analyses were carried out to assess whether the two groups differed in ethnicity and child gender. These analyses showed that there were no differences ethnicity $\chi^2(2, N=59)=2.41$, $p=.3$) or gender $\chi^2(1, N=59)=.81$, $p=.52$) between groups.

Additionally, analyses were carried out to assess whether medicated and unmedicated children with ADHD differed in impulsivity measures or eating and feeding variables. ANCOVAs controlling for child age indicated that there were no differences in child impulsivity levels between the medicated and unmedicated children diagnosed with ADHD. Additionally, there were no differences in any eating or feeding variables between both samples of children (see Table B). It was therefore appropriate to combine both samples to form one cohesive ADHD group for the future analyses.

Table B

Mean, SDs and differences in impulsivity, eating behaviour and parental feeding strategies for children with ADHD not on medication (n=18) and children with ADHD on medication (n=43)

Variable	ADHD no medication	ADHD medication	ANCOVA results*
TMCQ Impulsivity	4.12 (.76)	4.21 (.73)	$F(2, 44)=3.17$, $p=.08$, partial $\eta^2=.07$
CPRS Hyperactivity	2.98 (.74)	3.08 (.75)	$F(2, 32)=2.07$, $p=.16$, partial $\eta^2=.06$
CGI: Restless-Impulsive	3.31 (.55)	3.42 (.57)	$F(2, 38)=2.41$, $p=.13$, partial $\eta^2=.06$
CEBQ Food Approach	2.76 (.91)	2.78 (.66)	$F(2, 37)=.01$, $p=.93$, partial $\eta^2=0$
CEBQ Food Avoidance	3.09 (1.02)	2.78 (.56)	$F(2, 41)=1.73$, $p=.2$, partial $\eta^2=.04$
CFPQ Monitoring	4.37 (.64)	4.41 (.99)	$F(2, 45)=.58$, $p=.45$, partial $\eta^2=.01$
CFPQ Pressure	3.06 (.98)	2.84 (1.1)	$F(2, 42)=.85$, $p=.36$, partial $\eta^2=.02$
CFPQ Restriction Weight	2.13 (.89)	2.17 (.96)	$F(2, 42)=.13$, $p=.72$, partial $\eta^2=.003$
CFPQ Restriction Health	3.58 (1.12)	3.26 (1.46)	$F(2, 43)=.2$, $p=.66$, partial $\eta^2=.01$

* Controlling for child age