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The Influence of Early Childhood Parental Feeding Behaviors on Self-Regulation & Food Decision-Making in Young Adults

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Abstract

This study used data from a diverse set of undergraduates from the Claremont Colleges to examine the relationship between cognitive control (impulsivity and response inhibition) and self-regulatory ability as an indicator of sustained early childhood parental feeding behaviors in adulthood. In addition, the current study explored if early childhood parental feeding behaviors predicted food decision-making in adulthood as a result of perceived taste and nutritional value of food items. It was hypothesized that heightened impulsivity and impaired response inhibition as measures of cognitive control would correlate to poorer self-regulation, in turn reflecting a particular mode of early childhood parental feeding behaviors; it was then postulated that cognitive control, serving as a proxy for early childhood parental feeding behaviors, would predict future dietary behavior in young adults. While response inhibition was not significantly associated with self-regulatory ability, individuals' degree of impulsivity did predict their ability to self-regulate—with higher impulsiveness and lower self-regulation exhibiting the strongest association. Exploratory analyses found that heightened impulsivity and impaired response inhibition did not relate to either unhealthy or healthy perceived taste and nutritional value for all food items except one, which indicated that early childhood parental feeding behaviors did not influence dietary assessments and decision-making in young adults. These findings provide insight into the influence of early childhood parental feeding behaviors on the development of self-regulation and suggest that with more refined measures, this relationship may have possible implications on how young adults approach food choice and eating behaviors.

Contents

Introduction

The rise of child adiposity, the state of being obese, is increasing at an alarming rate in the United States, but it is the psychological and cognitive consequences of obesogenic eating behaviors that merit critical intervention (Doan et al., 2022; Gordon-Larson et al., 2009). The risk of obesity is starting at younger ages—as young as 6 years old—and obesity in childhood tracks into adulthood, underscoring the public health implication for obesity prevention during early childhood (Gordon-Larson et al., 2009). While climbing rates of obesity risk are causes for concern independently, the impairment of cognitive ability that arises as a consequence of adiposity has long-term, detrimental health outcomes. Physiological changes in brain tissue as a result of obesity drive declines in cognitive control, which have been shown to decrease the quality of life in adulthood (Powers et al. 2006). Cognitive control in the context of this paper refers to the process of selecting and exhibiting appropriate emotions and behaviors based on situational demands in the pursuit of internal goals while simultaneously suppressing maladaptive thoughts and actions (Dixon, 2015).

The prevention of impairments in cognitive control as a result of eating behavior starts in early childhood, where parental feeding behaviors greatly influence the formation of eating behaviors in children (Birch & Fisher, 1998; Birch et al., 2003; Birch et al., 2007; Liu et al., 2013). Eating behaviors are initially informed by metabolic control processes, an inherent part of human biological systems that are responsible for hunger and satiety responses by initiating and terminating food intake via low- and high-energy states (Jasinska et al., 2012). Recognizing and appropriately responding to hunger and satiety cues is determined through cognitive control processes, namely, inhibitory control and impulsivity, which are regulated through learned experience (Jasinska et al., 2012). Interactions between metabolic and cognitive control processes regulate eating behaviors in children that are sustained through adulthood, and these eating behaviors are shaped by parental feeding behaviors in early childhood (Birch et al., 2007; Cusick & Georgieff, 2022; Jasinska et al., 2012).

Of all growth stages, early childhood is the time that parental feeding behaviors exert the greatest effect on a child's development, so understanding the extent of this influence on eating behaviors will provide insight into methods that improve health status later in life (Birch et al., 2007). In this paper, parental feeding behavior will be examined through three modes: power over food choices, serving as models for feeding patterns, and employing feeding behaviors to manipulate child behavior (Birch et al., 2007; Liu et al., 2013). During early childhood, parental figures act as socialization agents, which means that in the context of food consumption, their purpose is to relay social and behavioral norms via the aforementioned modes of feeding behaviors, which are then adopted in children (Birch et al., 1980; Rollins et al., 2016; Sleddens et al., 2014). Furthermore, comprehensive literature on children's eating behaviors provides evidence that the foundation of eating behaviors in early childhood is predictive of eating behaviors throughout adulthood, so understanding the influence of parental feeding behaviors during this stage will lay the groundwork to examine its role in adult food decision-making (Birch et. al, 2003; Birch & Fisher, 1998).

Parental Feeding Behaviors

I. Power Over Food Choices

Parental feeding behaviors warrant examination because the significant amount of learning occurring during this time can be hampered by behaviors that interrupt the development of children's regulation of food intake and responsiveness—undermining opportunities for internal awareness (Birch & Fisher, 1998; Powers et al., 2006). The development of internal awareness is critical for balanced physiological regulation, so adverse parental feeding behaviors during early childhood can result in long-term physical and cognitive impairments in adulthood, such as poor impulse control (Hall et al., 2021; Schreiber et al., 2012).

Evidence indicates that the influence of parental feeding behaviors takes effect as early as the transition from milk to solid food, where children's dietary behavior and food preferences start to take form (Birch & Fisher, 1998). Parental figures naturally exert a considerable amount of control on children's eating behaviors by determining what food will be consumed, when it will be consumed, and the social norms regarding food intake and behavior. While necessary in early childhood, parental agency over food choices can either be beneficial through structure and active guidance or harmful if overtly controlling and restrictive (Birch et al., 2003; Larsen et al., 2015; Rollins et al., 2016; Sleddens et al., 2014).

Parental control is an authoritarian parental feeding behavior that directly coerces and manipulates children's dietary behavior, whereas structure is seen as setting consistent guidelines with appropriate feedback while engaging and discussing food with the child (Morris et al., 2007; Rollins et al., 2016). Authoritarian parental feeding behaviors impose practices that limit opportunities for children to develop self-control and autonomy by "controlling meal times and food choices, restricting a child's eating of high-fat or high-sugar foods, pressuring a child to eat more food, and using food as a reward for prosocial behavior" (Powers et al., 2006). Restrictive parental feeding behaviors are positively associated with child adiposity, and obese children are more likely to become obese adults and bear the effects of cognitive impairments (Baughcum et al., 2001; Doan et al., 2022). Nutrients in health foods are necessary metabolic substrates that support energy metabolism, and control over the amount of nutrient consumption from restrictive parental feeding behaviors affects the development of primary neural systems that mediate functions like inhibitory control and reward mediation (Cusick & Georgieff, 2022). Amount and type of nutrient consumption aid in programming metabolic pathways that regulate metabolic processes via hunger and satiety signals; disruption of this programming from restrictive parental feeding behaviors increases the risk of deficits in cognitive control, with one study even finding a direct link between early nutrition deficits and attention deficit hyperactivity disorder (ADHD)—a disorder that is characterized by an excess of impulsive behavior (Cusick & Georgieff, 2022; Davis et al., 2006). Once such metabolic pathways are modified in early childhood, they are solidified for an individual's entire lifespan—well into adulthood—so the importance of nutrition value in food choices cannot be understated.

II. Food as a Behavioral Tool

A parental feeding behavior that merits a deeper investigation within authoritarian feeding behaviors is that of instrumental feeding practices. Instrumental parental feeding behaviors posit food as a reward or punishment and are intrinsically linked to emotional feeding behaviors, where parental figures use food to influence a child's emotions (Larsen et al., 2015; Sleddens et al., 2014). A study on maternal feeding behaviors found that this was a highly frequent practice used in early childhood to reinforce or discourage certain behaviors (Baughcum et al., 1998). In using food as a behavioral tool, food was seen as more useful in shaping appropriate conduct instead of addressing hunger (Baughcum et al., 1998; Powers et al., 2006). Food was used to stop a temper tantrum or to coerce a child to engage in a particular action rather than to just satisfy hunger (Baughcum et al., 1998). In using food to manipulate behavior, parents interfere with children's ability to regulate food intake and recognize internal hunger cues and may alter their perception of food as associated with reward and punishment

(Baughcum et al., 1998; Powers et al., 2006). In one study, authoritarian feeding practices during childhood led to long-term dysregulated dietary behavior, such as mindless eating (eating in the absence of hunger), that continued 2 and 4 years later, indicating the continuation of adverse effects through the transition to adolescence (Rollins et al., 2016). It is probable, then, to connect the effects of early childhood parental feeding behaviors to adult dietary behavior, and consequently, the ability to make appropriate food decisions for oneself.

III. Parental Modeling

Unlike authoritarian and reward-based parental feeding behaviors, modeling supports the development of children's regulatory abilities through autonomy granting in the context of food consumption (Bandura, 2004; Birch et al., 1980; Liu et al., 2013). Broadly, modeling is defined as a cognitive process in which an individual learns through observations of another person performing a behavior to inform their own behavior (Bandura, 2004). The dimension of modeling in parental feeding behavior is tied to parents as socialization agents because the frequency in which parents eat healthily and demonstrate the pleasures of food consumption without restriction can encourage the adoption of similar attitudinal and self-efficacy beliefs, affecting consumption behavior positively (Bandura, 2004; Birch et al., 1980; Morris et al., 2007). Because parental modeling can convey to children how to respond or feel about environmental stimuli—food—through food choices and level of intake, modeling is likely to influence long-term eating behaviors by way of displaying frequent and consistent eating norms. Longitudinal studies that examined children who determined the amount of, and choice in, food intake concluded that as these children transitioned from adolescence to adulthood, they displayed more stable, healthy, and long-lasting dietary behavior patterns (Larsen et al., 2015; Sleddens et al., 2014).

Development of Self-Regulatory Abilities

An exploration of authoritarian and modeling parental feeding behaviors suggests that in early childhood, parental figures must balance conveying and implementing feeding norms with a child's need for autonomy. As such, one product of parental feeding behavior outcomes is the ability to self-regulate (Birch et al., 1980). Self-regulation is a regulatory process that includes various physiological, cognitive, emotional, and behavioral processes that encourage goal-driven behavior that is adaptive to situational demands (Birch et al., 2007). Authoritarian feeding behaviors adversely affect the development of children's self-regulation because they teach children to look to the parents—an external cue—as a signal for consumption rather than reliance on their own hunger and satiety signals (Larsen et al., 2015; Powers et al., 2006). This alters food responsiveness, which refers to an individual's likelihood to consume if given the opportunity—regardless of levels of hunger—and is directly influenced by the concept of eating in response to external cues (Powers et al., 2006). Food responsiveness that is shaped by authoritarian feeding behaviors disrupts the formation of agency and instills harmful responses that ignore internal hunger and satiety signals from the body. In other words, the development of metabolic processes to discern hunger and satiety signals and respond appropriately depend on self-regulation (Birch et al., 2007; Birch & Fisher, 1998; Jasinka et al., 2012).

Moreover, authoritarian parental feeding behaviors that harness food to address emotional needs can also confound children's self-regulation, as developmentally stunting dietary behaviors that are reinforced by parental emotional feeding behaviors may elicit emotional overeating in response to negative moods, which are associated with increases in obesogenic eating behaviors (Blissett et al., 2010; Guerrieri et al., 2008; Larsen et al., 2015).

In developing self-regulatory abilities, the first three stages of development, from birth to 36 months, are integral to the formation of self-regulation and autonomy acquisition (Liu et al., 2013). In the first stage, hunger and satiety are first experienced, and a child uses these cues to develop hunger awareness. In the second stage, attachments to parents are formed, enabling communication through observations of feeding behaviors (Liu et al., 2013). In the third stage, a child begins to discover a sense of autonomy, creating the space for independent feeding and eating habits to solidify; it is in this stage—considered the period of early childhood—where parental modeling of food practices and consumption behaviors are adopted and mimicked by the child (Liu et al., 2013). The positive effect of parents using modeling feeding behaviors during this influential stage has been evinced substantially in the scientific field, where research repeatedly found that parents who model healthy feeding practices and allow their child to control their food intake, frequency, amount, and preference greatly foster the child's self-regulation development (Bandura, 2004; Birch et al., 1980; Larsen et al., 2015; Liu et al., 2013; Sleddens et al., 2014). The mode of modeling enables parents to convey feeding behaviors while giving children agency to make decisions regarding their health, building belief in their self-efficacy, and self-regulate their adoption of observed parental feeding behaviors (Bandura, 2004; Larsen et al., 2015).

Self-efficacy is a self-conscious emotion that involves cognitive appraisals, which fundamentally require physiological awareness—a self-regulatory pre-requisite influenced by early childhood parental feeding behaviors (Birch & Fisher, 1998; Lazarus et al., 2019). Through a cognitive lens, self-efficacy directly influences health functioning because if an individual believes they have control in setting and achieving health goals, and confidence in strategies to actualize them, then they can have agency over eating habits and health outcomes (Bandura, 2004). The cognitive appraisal of relevance here is called self-referential appraisal, which is noted to emerge in the latter stages of emotional development because it requires well-developed self-regulation to self-reflect and self-evaluate (Lazarus et al., 2019). Self-regulation enables self-efficacy in the context of food consumption because it empowers individuals to appraise their physiological needs to determine an appropriate outcome (e.g. continue or terminate food intake) that aligns with their health goals (Lazarus et al., 2019; Schreiber et al., 2012). An encompassing meta-analysis across 28 studies found a significant relationship between parental modeling and healthy, self-efficacious food consumption in children—an effect that was consistently homogenous and positive (Birch et al., 1980). The relationship between modeling and encouraged self-efficacy also mediated the effect of modeling on healthier food consumption, indicating that increased opportunities for self-efficacy development were associated with healthier decision-making in pursuit of health goals (Birch et al., 1980). The findings from this meta-analysis do not include studies on young adults—a large, frequent gap in the literature—but do suggest a salient notion: the ability to appropriately address hunger and satiety cues relies on reinforced patterns of consumption that require self-regulation in feeding behaviors—a development that is facilitated by parental modeling in early childhood (Birch et al., 1980; Larsen et al., 2015; Liu et al., 2013; Sleddens et al., 2014).

It is important to note here that food modeling specifically affects child temperament as well, which is defined as “innate behavioral style, including emotional reactions and patterns of self-regulation” (Larsen et al., 2015). Child temperament, though not of chief importance in this paper, is shaped by self-regulation and instills dietary patterns that remain throughout one’s lifespan. This again is linked to dietary behavior, as individuals in early childhood who exhibit difficult temperaments have shown associations with obesogenic diets in later life (Blissett et al., 2010; Doan et al., 2022; Guerrieri et al., 2008).

A study by Lazarus et al. found that children who form higher levels of self-regulatory abilities in early childhood are associated with better emotional well-being, health outcomes, and higher response inhibition—a cognitive control construct (Lazarus et al., 2019). In the context of this paper, cognitive control constructs refer to the mental faculties, like response inhibition, that are used in the process of intentionally regulating physiological responses to adapt to situational demands while suppressing inappropriate behaviors (Dixon, 2015; Hakun & Findeison, 2020). Response inhibition refers to an individual's ability to quell inappropriate or rash emotional responses to novel, uncertain, and/or valenced situations (Rollins et al., 2016). Obesogenic diets in later life have further been correlated to lower levels of response inhibition, which has additionally been cited as a self-regulatory dimension of temperament (Rollins et al., 2016). Impaired response inhibition, then, denotes a lack of suppressive ability with the regulation of emotion and behavior, and the impairment of these qualities has been significantly associated with poor self-regulation (Jasinka et al., 2012; Rollins et al., 2016; Schreiber et al., 2012). Unlike modeling, restrictive parental feeding behaviors lead to response inhibition deficits in children because authoritarian forms of feeding behavior impede self-regulatory development.

The Impact of Self-Regulation on Emotion Regulation

The development of self-regulation involves and directly influences the development of emotion regulation, highlighting the importance of exhibited parental feeding behaviors as it plays a key role in strengthening or weakening emotion regulation (Morris et al., 2007). Emotion regulation is the process in which an individual can respond to situations with adaptive and suitable responses through the modulation of choice and expression of emotions (Morris et al., 2007). Apt regulation of emotional responses necessitates cognitive awareness and the ability to choose applicable self-regulation strategies to shape an appropriate emotional and behavioral response (Hall et al., 2021; Morris et al., 2007). Response inhibition is a crucial element of this cognitive control process in that it determines the success with which an individual can plan and implement an action—in this case, an emotional goal (Allan et al., 2011; Guerrieri et al., 2008). As such, the function of response inhibition informs the broader cognitive construct of inhibitory control. A large part of accomplishing self-regulation is the ability to control and inhibit impulsive behaviors fueled by emotion, especially when the emotion experienced is negative (Hall et al., 2021; Schreiber et al., 2012).

An individual's capacity to regulate socially appropriate responses is derived from their propensity to address novel or stressful events, and the perception of this ability is germane to self-efficacy (Morris et al., 2007). The development of self-regulation is critical to providing support against emotional and behavioral problems that can arise and perpetuate throughout adolescence and adulthood (Morris et al., 2007). Much of a child's development of self-regulation is an outcome of parental modeling of feeding behaviors because the observation of parental food intake, approaches to food, and agency concerning consumption, all serve as objects of learning for the child (Morris et al., 2007).

The influence of food modeling on child temperament through this observation has also been shown as having a significant effect on emotion regulation as shaped by self-regulation (Larsen et al., 2015; Morris et al., 2007; Rollins et al., 2016). Parental feeding behaviors that offer opportunities for self-control and physiological awareness in the context of food consumption enable self-regulation and therefore influence the development of emotion regulation. Parental feeding behaviors which provide structure (e.g. modeling) rather than restriction are associated with better self-regulation because the promotion of autonomy enables the development of emotion regulation (Morris et al., 2007; Rollins et al., 2016). Multiple studies have shown that structured parental feeding behaviors were positively associated with adaptive emotional behavior regulation in adulthood and higher levels of academic achievement and performance (Morris et al., 2007; Rollins et al., 2016; Sleddens et al., 2014).

Deficits in emotion regulation arise when healthy emotion regulation is not fostered in early childhood development as a result of authoritarian and restrictive parental feeding behaviors impeding self-regulation (Hall et al., 2021). Difficulty in regulating negative emotions is known as emotional dysregulation and is linked to high reactivity with unfavorable health consequences (Morris et al., 2007). Individuals high in reactivity tend to experience amplified levels of negative emotions, such as anger, frustration, and sadness, with research emphasizing the connection between high negative reactivity and impulsive decision-making (Lazuras et al., 2019; Liu et al., 2013; Morris et al., 2007). A meta-analysis conducted by Morris et. al found that outcomes of authoritarian parental feeding behaviors were associated with poor self-regulation later in life, which augmented emotion dysregulation and risk of behavioral problems (Morris et al., 2007).

Poor development of self-regulation regulation can create maladaptive emotion regulation strategies in adulthood, which conflict with health goals—especially during periods of emotional distress—and may be associated with poor inhibition signals (Schreiber et al., 2012). Failure to achieve health intentions because of conflict with self-regulation goals and emotion dysregulation may elicit negative emotional states, causing individuals to believe that the gap between intention and desired behavior is insuperable—and this friction is associated with low inhibitory control and has a direct effect on subsequent health (Jasinka et al., 2012; Schreiber et al., 2012). This is where self-efficacy—a by-product of modeling parental feeding behaviors—exerts significant influence because it enables cognitive reappraisal—the ability to re-construe one's thoughts and actions about an outcome that elicits a negative emotional state and instead, use self-regulation strategies to refocus on goals through control of impulses that grant immediate relief (Lazarus et al., 2019; Schreiber et al., 2012). Thus, when parental feeding behaviors like modeling cultivate robust self-regulatory abilities in children, this empowers the adoption of appropriate emotion regulation strategies, like cognitive reappraisal, to mitigate impulsive behavior.

Cognitive Control

An individual's ability to effectively self-regulate can control impulsive dietary behaviors by choosing and enacting appropriate strategies in response to negative emotional states (Jasinka et al., 2012; Lazuras et al., 2019). Impulsivity is defined as one's "tendency to think, control, and plan insufficiently" (Guerrieri et al., 2008). In this paper, it is often coupled with response inhibition as they are closely related cognitive control constructs for inhibitory control and because they are both individual character traits. Impulsivity and response inhibition both include the inability to regulate thoughts and emotions and inhibit urges (Guerrieri et al., 2008). Numerous studies have drawn connections between distressing events and heightened impulsivity due to self-regulatory failure (Allan et al., 2011; Jasinka et al., 2012; Lazuras et al., 2019; Schreiber et al., 2012). Interestingly, a study by Lazarus et al. analyzed results from several self-report questionnaires (Abbreviated Impulsiveness Scale, the Emotion Regulation Questionnaire (ERQ), Short Self-Regulation Questionnaire (SSRQ), and the Self-Disgust Scale), and found that low scores on the SSRQ positively predicted self-disgust and impulsivity (Lazuras et al., 2019). Self-regulatory failure produces maladaptive self-focused emotion cognitions, like self-disgust and self-hatred, which, in turn, elicit negative feelings directed to the self and result in impulsive behaviors (Lazuras et al., 2019).

With this consideration, impulsivity in relation to dietary behavior may lead to the use of food to address negative emotional states (rather than hunger) through one's interactions with food (Rollins et al., 2016; Schreiber et al., 2012). An individual's inclination to this association can be linked to authoritarian parental feeding behaviors that use food to manipulate behavioral outcomes, which may instill the notion of food as a reward (Guerrieri et al., 2008; Larsen et al., 2015; Schreiber et al., 2012). Impulsivity has been positively correlated with adverse outcomes like unhealthy food choices and overeating, which suggests that reward-mediated parental feeding behaviors, specifically, may influence the relationship between impulsivity and poor dietary practices (Jasinka et al., 2012).

A recent study that investigated decision-making and risk-taking behavior through the Cambridge Gambling Task and Barratt Impulsivity Scale found that impulsive behavior is an outcome of expected reward, meaning that those who engaged with significantly high levels of impulsive behavior believed it to provide some kind of reward or emotional relief in an attempt to change a negative emotional state (Schreiber et al., 2012). Authoritarian parental feeding behaviors that use food as a reward or to modify children's behavior impede their self-regulation and may cause them to engage in impulsive eating behaviors in adulthood in an attempt to elicit the same reward to alleviate distress (Schreiber et al., 2012). When parental feeding behaviors use food to manipulate behavioral outcomes they convey a harmful perception that marries food and reward, so individuals engaging in self-dysregulation are more likely to act impulsively to gain instant relief.

Two methods of authoritarian parental feeding behaviors, instrumental and emotion feeding, are linked to higher impulsive behaviors because they are associated with reward sensitivity (the likelihood to choose more rewarding stimuli, such as a sweet treat) and deficient response inhibition (Guerrieri et al., 2008). A study conducted by Guerrieri et al. revealed that children with reward sensitivity in the context of food are more impulsive and experience less successful response inhibition signals (Guerrieri et al., 2008). Though there is little research on this relationship in adulthood, another study by Guerrieri et al. found a similar connection between reward-sensitive individuals and impulsivity in young adults as well, indicating that although early childhood parental feeding behaviors form this relationship, this association continues into adulthood (Guerrieri et al., 2007).

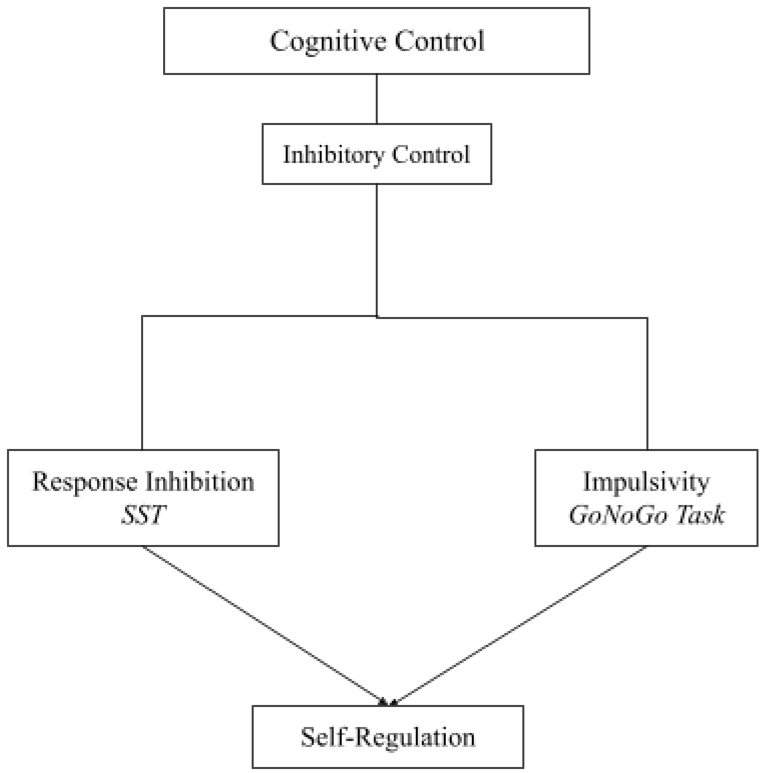
An additional study by the same team of researchers found that more reward-sensitive children dysregulated their food intake significantly more than less reward-sensitive children because they were less successful at response inhibition as measured through a Stop Signal Task (Guerrieri et al., 2007). As seen through overeating habits in adulthood, unsuccessful response inhibition is furthered by poor self-regulation (Hall et al., 2021; Jasinka et al., 2012; Lazarus et al., 2019). This evidence implies that reward sensitivity from authoritarian parental feeding behaviors could be a causal mechanism for engaging in impulsive behavior (Guerrieri et al., 2008). In a study conducted by Jasinka et al., heightened impulsivity and impaired response inhibition were independently positively associated with unhealthy eating practices as measured through the Food Choice Task, so the paired effect of these constructs may enhance adverse dietary behaviors through poor food decision-making (Jasinka et al., 2012).

The mode through which parental feeding behaviors are expressed (authoritarian and modeling) influences the development of self-regulation through the shaping of a child's dietary behavior, which serves to either optimize cognitive control (e.g. greater response inhibition and less impulsivity) or hinder it (e.g. weaker response inhibition and higher impulsivity).

Current Study

Given that weak inhibitory control is informed by unsuccessful response inhibition and heightened impulsivity, poor self-regulation appears to be linked to weaker cognitive control (Figure 1) (Allan et al., 2011; Jasinka et al., 2012). The effect of impaired response inhibition and heightened impulsivity are positively associated with multiple aspects of unhealthy eating, such as overeating in response to self-dysregulation (Jasinka et al., 2012). In previous studies, young adults with inhibitory control problems arising from deficits in response inhibition and impulsivity exhibited significantly lower consumption of healthy foods and higher consumption of less healthy snack foods (Jasinka et al., 2012). Taken together, these notions suggest that weaker cognitive control is directly associated with self-regulatory ability and that the degree of cognitive control impairments may determine food decision-making behavior in adults. It is this potential relationship on which the study is centered.

Figure 1. Model of the relationship between the predictive cognitive control variables and self-regulation.



In this review of literature, seldom studies explored the relationship between cognitive control—as molded by early childhood parental feeding behaviors—and future food decision-making in young adults. This study is novel in that it will examine how cognitive control, as specifically defined through response inhibition and impulsivity, plays a key role in influencing the assessment of taste and nutritional value as an indicator of potential food choice (Allan et al., 2011). This study aims to fill a gap in dietary literature, that is, to investigate if cognitive control, as a proxy for early childhood parental feeding behaviors, can predict dietary decision-making in adults. Because previous research states that cognitive control is associated with self-regulation, and given that this regulatory dimension is formed by early childhood parental feeding behavior, this study can indirectly look at the link between parental feeding behavior and food decision outcomes in young adults.

I hypothesize that cognitive control, as measured through a Stop Signal Task and GoNoGo task, will predict self-regulatory ability and food decision-making in hungry young adults, such that this relationship will be more predictive when cognitive control is weaker. I anticipate that higher cognitive control scores on both cognitive control tasks—signifying more incorrect trials—will be positively correlated to lower SSRQ scores (Hypothesis 1). Furthermore, I predict that this negative relationship will correspond to lower ratings on the Food Rating Task (lower perceived taste & nutritional value for food items) to evince that low regulatory ability and the likelihood of perceiving healthy foods as less tasty and unhealthy foods as tastier are positively correlated, which, by proxy, associate parental feeding practices (authoritarian vs modeling) and with adult dietary behavior (Hypothesis 2).

Through this study, broad implications for cognitive control and self-regulation as treatments for cognitive control failures, aiding in adiposity prevention through cognitive means, can be achieved.

Methods

Participants

The participants tested for the study were a sample of 50 college students between the ages of 18-23 (*M* = 20.5, *SD* = 1.27) currently enrolled at one of the five undergraduate Claremont Colleges during the time of the study. However, data for 9 participants were excluded due to a computer error, thus the data from 41 participants were used for the models. Of these 41 participants, 68% were from Claremont McKenna College, 14% were from Scripps College, and 17% were from Pomona College. No current students from Pitzer College or Harvey Mudd were participants in this study. The demographics of the sample were made up of White (48.8%), Asian (26.8%), Black or African American (4.9%), Two or more races (9.8%), and Other (9.8%).

82.9% of participants identified as female, 9.8% identified as male, and 7.3% identified as other. Participants were required to be fluent in spoken and written English and 100% of participants indicated fluency. In this sample of 41 undergraduates, 4.9% indicated a clinical diagnosis of Attention Deficit Disorder (ADD), 2.4% were clinically diagnosed with Attention Hyperactivity Disorder (ADHD), 4.9% were clinically diagnosed with Bipolar Disorder, and 87.8% indicated no clinical diagnosis. Despite the presence of impulse control disorder diagnoses (ADHD & ADD) in the sample, these participants were not excluded from the study to maintain generalizability of results. Participants were recruited through social media and the colleges' Cognitive Science and Psychology departments and were compensated for their time with a $5 Amazon e-gift card.

Materials and Design

Pre-Study Forms

In this experiment, participants were asked to complete an online health and demographics form related to race, gender identity, and age (Appendix A). In the health section of the questionnaire, the participants were asked to report any psychiatric diagnoses or disorders, if applicable. Participants were additionally asked to rate their hunger levels (*1 = Not Hungry at All* to *10 = Very Hungry*) prior to the start of the computer tasks.

Stop-Signal Task (Guerrieri et al., 2008; Stoet, 2017)

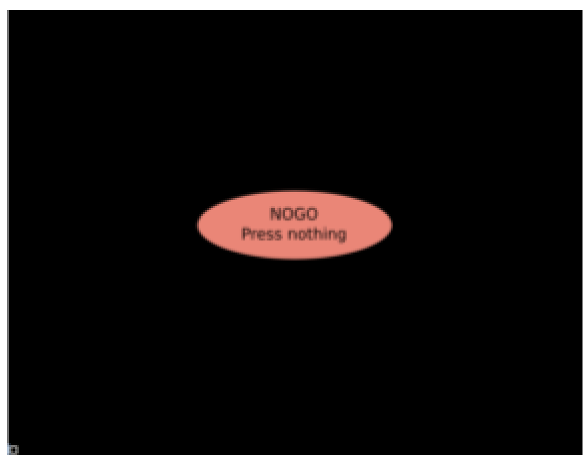
The Stop-Signal Task (SST) was used to measure response inhibition as an indicator of cognitive control. The SST consisted of two concurrent tasks: a go and a stop task. In this study, the SST was a computerized task where 75% of trials were go-tasks and 25% were stop-tasks. In the go-tasks, participants learned to press a key as quickly as possible that corresponded to the direction of a green arrow within a white circle. A left-pointing arrow corresponded with the B key and a right-pointing arrow corresponded with the N key on the computer keyboard. The stimulus was presented for 750 ms. During stop-tasks, the stop signal was displayed when the white circle surrounding the green arrow instead turned red. The red circle tells the participants to inhibit the response learned during the go-tasks on that trial by not pushing either the B or N key in response to the stimulus. In stop-tasks, the latency between the go-signal (presentation of a green arrow within a white circle) and the stop-signal (presentation of a green arrow within a red circle) was 250 ms. The SST involved 60 presentations comprised of two blocks of 30 trials each, with one initial practice block of 20 trials—a similar set-up to past studies utilizing SST in adults. Response inhibition is measured by the number of incorrect responses during the stop-tasks (e.g. pressing either the B or N key when the stop signal is displayed). In this study, only incorrect responses were assigned a numerical value (TrialWrong =1, TrialCorrect = 0), so higher scores on the SST indicated weaker response inhibition. This computer task was administered using PsyToolKit software (Stoet, 2017).

Figure 2. Screen grabs of the go-task (left image) and stop-task (right image).

GoNoGo Task (Stoet, 2017)

The GoNoGo task was used to measure impulsivity as an indicator of cognitive control. In this task, the words “Go” or “NoGo” were shown on a computer screen in 500 ms increments. Participants were told to press the spacebar as fast as possible if the word “Go” was displayed and to refrain from pressing the spacebar if the word “NoGo” was displayed. The trials consisted of 75 presentations where *Go* trials comprised 80% of the task and *NoGo* trials comprised 20% of the task. Impulsivity is measured by the number of incorrect responses during the *NoGo* trials (e.g. the spacebar is pressed when the word “NoGo” is displayed). The error status of participant responses (TrialCorrect = 0, TrialWrong = 1) was added to determine GoNoGo scores. The higher the GoNoGo score, the more impulsive a participant was. This computer task was administered using PsyToolKit software (Stoet, 2017).

Figure 3. Screen grabs of the Go trial (left image) and the NoGo trial (right image).

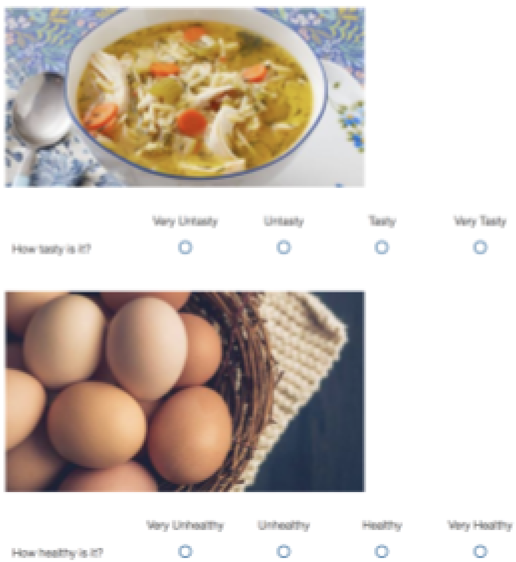


Food Rating Task (Jasinka et al., 2012)

The Food Rating Task was a computerized task used to measure perceived nutritional value in informing future food decision-making. The Food Rating Task in this study is a modified version of the Food Choice Task without the decision block found in the latter. The decision block was excluded given the resource and time constraints of this study. The Food Rating Task involves two blocks: a taste-rating block and a healthiness-rating block. For each trial, one food item was displayed on the screen alongside a block-specific question and a block-specific response scale (Figure 4). The question asked in the taste-rating blocks was "How tasty is it?" for each food item and participants indicated their response by selecting the following values on a scale: (*Very Untasty = 1*), (*Untasty = 2*), (*Tasty = 3*), or (*Very Tasty = 4*). For the healthiness-rating block, the question posed to the participants was "How healthy is it?" about the presented food item. Participants responded on the following scale: (*Very Unhealthy = 1*), (*Unhealthy = 2*), (*Healthy = 3*), or (*Very Healthy = 4*). Taking the average of both rating scales for each food item, each individual was classified into a food-category based on their subjective ratings: Untasty–Unhealthy (1), Tasty–Unhealthy (2), Untasty–Healthy (3), Tasty–Healthy (4). Because the Food Rating Task measures foods based on palatability and health value, individuals' average score from both scales was a reliable marker of overall perceived nutritional value. Thus, higher average ratings for each food item indicated higher perceived nutritional value. Perceived nutritional value was deemed an indicator of future food decision-making behavior because participants' ratings and choices using visual food representations are associated with tangible eating behaviors when measured the day of or in the future, granting this measure external validity (Barakchian et al., 2021). The task presented 28 food items (7 items in 4 categories) and all participants proceeded to rate all items in each block (Appendix B1). The food items were chosen based on previous studies that had objectively categorized the health of certain foods as Definitively Healthy, Healthy, Unhealthy, and Definitively Unhealthy (Oduru et al., 2022; Vydiswaran, et al., 2018). To remove experimenter bias, the study chose 7 food items from the literature for each of the 4 healthy categories

(Appendix B2). Each trial across each block was randomized (food item order changed) for each participant and between participants. All food images used in the Food Rating Task were obtained from Google Images.

Figure 4. Example randomized block-specific question and a block-specific response scale for food items 14 (top) and 8 (bottom).



Short Self-Regulation Questionnaire (Lazarus et al., 2019; Carey et al., 2004)

The Short Self-Regulation Questionnaire (SSRQ) was used to assess an individual's self-regulatory capacity. The SSRQ is a shorter version of the Self-Regulation Questionnaire (SRQ) and contains 31 items (Appendix C). The SSRQ measures three main domains of self-regulation: goal-setting and monitoring (e.g. "I usually keep track of my progress toward my goals"), self-control (e.g. "I am able to resist temptation"), and intentional thinking of actions/behavior (e.g. "Before making a decision, I consider what is likely to happen if I do one thing or another"). Participants respond to each item on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). The sum of the scores in each domain is calculated to produce a total sum score, where higher scores indicate greater self-regulatory ability. The SSRQ was administered using Qualtrics.

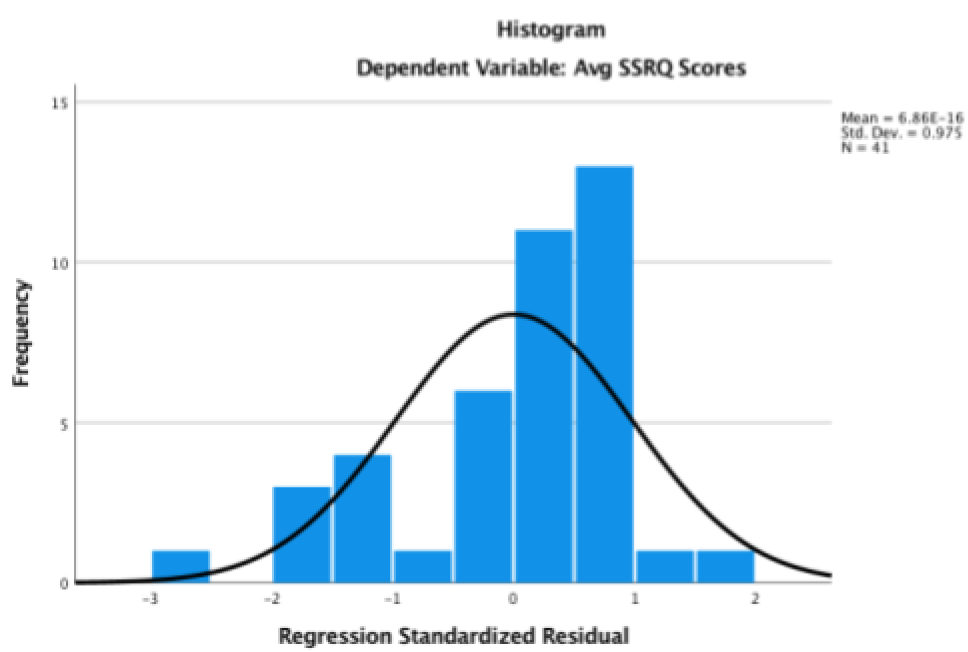
Procedure

Prior to the start of the study, participants were told to not eat or drink (with the exception of water) for at least 2 hours to induce hunger and increase the value of and responsiveness to the food-item stimuli (M = 5.29, SD = 2.47). Participants were given a description of the study prior to the informed consent process but were not told the purpose of the study to reduce possible self-selection biases (e.g. participants with potential eating disorders electing not to participate), thereby increasing the likelihood of a more representative population sample of young adults. Participants were individually tested in person in an isolated room in one of two locations, the Edmunds testing room on Pomona’s campus or the Berger Institute testing room on CMC’s campus. Participants were required to fill out the pre-study forms, including the informed consent form, to be eligible. Participants were briefed on the study as measuring response inhibition and impulsivity, but the experimenter did not specify what the tasks were measuring to maintain internal validity. Participants were given instructions for the following computerized tasks: the SST to measure response inhibition, the Go/NoGo task to measure impulsivity, and the Food Rating Task to assess perceived nutritional value on future food decisions. Instructions were read out loud by the experimenter and displayed on the computer screen before participants proceeded to the next task. After completion of the computerized tasks, participants were asked to complete one online questionnaire, the SSRQ, to evaluate regulatory ability. Following the conclusion of the study, the experimenter provided participants with a comprehensive explanation of the purpose of the study and its measures. The experiment took approximately 20 minutes to complete.

Results

Correlation, multiple regression, and multinomial regression analyses were run to determine if scores on the GoNoGo task and SST correlated with predicted scores on the SSRQ. Collected data was analyzed for missing values and significant outliers; none were detected so the analyses were able to proceed. Cronbach's alpha for the 31 items in the SSRQ was checked and found to be highly reliable (α = .907). The assumption of normality was met with skewness and kurtosis values between +/- 1 and +/- 1, respectively, which validated the b-coefficient tests. The histogram for the differences between the observed and predicted SSRQ values based on the GoNoGo task and SST variables was bell-shaped, suggesting a normal distribution of scores which additionally meets the assumption of normality (Figure 5).

Figure 5. Histogram for average SSRQ variable indicating a normal distribution of scores.



The Pearson correlation coefficient analysis displayed in Table 1 indicated a significant negative relationship between performance on the GoNoGo task and the SSRQ scores, *r*(40) =

-.450, p = .002. The results of the correlation analysis between performance on the SST and SSRQ scores showed that this relationship was not significant, $r(40) = -.096$, $p = .276$. The correlation between the two predictor variables, the GoNoGo task and SST, was additionally evaluated and was found not to be correlated, $r(40) = .116$, $p = .234$. As a result, subsequent regression analyses displayed in Table 2 assessed the relationship between the SSRQ scores and the two predictor variables, the GoNoGo task and SST. As the strongest predictor variable of the SSRQ scores, the first of our models was built on participant performance on the GoNoGo task. A multiple regression analysis was run to test if the GoNoGo scores significantly predicted scores on the SSRQ. Model 1 revealed that GoNoGo scores account for 20.2% of the variance in SSRQ scores, $R^2 = .20$, $F(1, 39) = 9.884$, $p < .01$. The next predictor variable, scores on the SST, was then added to the multiple regression analysis and the two models were compared. Model 2 revealed that the addition of SST scores into the model marginally increased the amount of variance explained in SSRQ scores from 20.2% to 20.4%, $R^2 = .20$, $F(2, 38) = 4.872$, $p < .05$. Based on the results in Model 2, it was found that performance on the GoNoGo task was the strongest predictor of SSRQ scores ($\beta = -.450$, $p < .01$), while performance on the SST did not on its own significantly predict SSRQ scores ($\beta = -.044$) unless coupled with the GoNoGo task ($\beta = -.445$, $p < .01$).

Table 1

Descriptive Statistics and Correlations for Study Variables

	N	M	SD	1	2
1. GoNoGo	41	2.34	2.16		

2.	SST	41	12.27	3.99	.116	
3.	SSRQ	41	3.56	0.52	-.450**	-.096

Note. ** $p < .01$ (1-tailed). GoNoGo = average incorrect scores on the GoNoGo Task out of 75 trials. SST = average incorrect scores on the Stop Signal Task out of 60 trials. SSRQ (31-item) = average score on the self-report measure, 1-5 scale.

Table 2

Multiple Regression Examining Predictors of SSRQ Scores

	B	SE	*t*	β	R^2	*F*	df	ΔR^2
Model 1					.202	9.884**	39	
Intercept	3.556	.074	47.985***					
GoNoGo	-.109	.035	-3.144**	-.450				.202**
Model 2					.204	4.872*	38	
Intercept	3.553	.075	47.127***					
GoNoGo	-.108	.035	-3.051**	-.445**				
SST	-.006	.019	-.301	-.044				.002

Note. * $p < .05$, ** $p < .01$, *** $p < .001$. GoNoGo = average incorrect scores on the GoNoGo Task out of 75 trials. SST = average incorrect scores on the Stop Signal Task out of 60 trials. SSRQ (31-item) = average score on the self-report measure, 1-5 scale.

Table 3 displays the results of a multinomial logistic regression that was conducted as an exploratory analysis to investigate the relationship between the predictors and perception of nutritional value for individuals based on their subjective ratings as classified by each category (Untasty-Unhealthy, Tasty-Unhealthy, Untasty-Healthy, Tasty-Healthy). This test assessed the likelihood of an individual falling into one of the food-categories based on their GoNoGo and SST scores as an indicator of dietary assessment and future food decision-making behavior. Category classification was determined based on each individual's ratings of a food item on a Tasty scale, 1-5, and a Healthy scale, 1-5. The reference group in the analysis was the Untasty-Unhealthy category, and accordingly, each predictor had parameters for each food-category. Item 6 was excluded from the multinomial logistic regression analysis given that all participants fell into the same category, Tasty-Healthy, so there was only one valid value in the model with an intercept term; no model could be fitted with this data. The reduced model examined each predictor individually and found that the GoNoGo task significantly predicted food-category classification for item 4 ($\chi 2$ (8, N = 41)= 25.011, $p < .01$), item 5 ($\chi 2$ (24, N = 41) = 74.027, $p < .001$), item 7 ($\chi 2$ (8, N = 41) = 15.886, $p < .05$), item 15 ($\chi 2$ (24, N = 41) = 896858.530, $p < .001$), item 20 ($\chi 2$ (26, N = 41) = 38.564, $p < .001$), and item 27 ($\chi 2$ (8, N = 41) = 21.469, $p < .01$), which indicated that lower scores on the GoNoGo task yielded a significant likelihood of food-category classification for these food items. Similarly, the second variable, the SST task, significantly predicted the food-perception category for item 7 ($\chi 2$ (16, N = 41) = 29.353, $p < .05$) and item 27 ($\chi 2$ (16, N = 41) = 27.919, $p < .05$) (Table 3). However, the overall model with both predictors was insignificant, therefore GoNoGo and SST scores were not predictive of which specific food-category an individual could be ascribed to. The parameter estimates shown in Table 3 indicate that neither the GoNoGo nor SST scores had significant predictive power in any food-choice category. The addition of the two predictor variables to the model that contained only the intercept was found to be significant for only item 4, $\chi2$ (24, N = 41) = 41.254, $p < .05$ for individuals in the Tasty-Healthy category. For all other food items, the inclusion of the SST and GoNoGo scores in the model was insignificant and did not improve the fit between the model and data. Therefore, the exploratory analysis failed to find any significant relationship between the predictors and the likelihood of food-category classification as a measure of dietary assessment and consequent future food decision-making behavior for both healthy and unhealthy food items.

An additional exploratory analysis was performed to investigate if an association was present between scores on the SSRQ and food-category classification to determine if self-regulatory ability was also predictive of healthy and unhealthy nutritional value assessment. No significant results were found for this model for any of the food items. As such, all parameter estimates for the predictor variable were insignificant in each food-category.

Table 3

Multinomial Logistic Regression Examining Predictors of Ratings from the Food Rating Task

	Model 2				**Reduced Model**						
					GoNoGo			SST			Parameter Estimates
	-2 Log Likelihood	X^2	df	p	X^2	df	p	X^2	df	p	*p*
Item 1	.714	8.688	24	.998	5.027	8	.755		16		
Tasty-Healthy											*.772*
Item 2	9.263	28.436	24	.242	14.102	8	.079	21.115	16	.174	
Tasty-Healthy											*.997*
Item 3	131.387		48			16			32		
Untasty-Healthy											*.964*
Tasty-Healthy											*.908*
Item 4	4.159	41.254	24	.016*	25.011	8	.002**	24.238	16	.084	
Tasty-Healthy											*.995*
Item 5	50.440	16.126	72	1.000	74.027	24	.000***		48		
Tasty-Unhealthy											*.935*
Untasty-Healthy											*.762*
Tasty-Healthy											*.944*
Item 7	7.877	35.651	24	.059	15.886	8	.044*	29.353	16	.022*	
Tasty-Healthy											*.996*
Item 8	13.290	27.093	24	.300	12.539	8	.129	21.857	16	.157	
Tasty-Healthy											*1.000*

Item 9	27.450	49.273	72	.981	13.454	24	.958	29.653	48	.983	
Tasty-Unhealthy											*.994*
Untasty-Healthy											*.941*
Tasty-Healthy											*.734*
Item 10	18.176	62.819	72	.772	20.871	24	.646	41.666	38	.729	
Tasty-Unhealthy											*1.000*
Untasty-Healthy											*.998*
Tasty-Healthy											*.998*
Item 11	14.807	78.988	72	.268	29.106	24	.216	50.777	48	.365	
Tasty-Unhealthy											*.999*
Untasty-Healthy											*.978*
Tasty-Healthy											*.985*
Item 12	4.394	53.704	48	.265	24.103	16	.087	37.283	32	.239	
Untasty-Healthy											*1.000*
Tasty-Healthy											*1.000*
Item 13	213.000		72			24			48		
Tasty-Unhealthy											*.885*
Untasty-Healthy											*.892*
Tasty-Healthy											*.819*
Item 14	81.030		72			24			48		
Tasty-Unhealthy											*.904*
Untasty-Healthy											*.978*
Tasty-Healthy											*.788*
Item 15	29.466	52.158	72	.962	896858.530	24	.000***	29.938	48	.981	
Tasty-Unhealthy											*.631*
Untasty-Healthy											*.991*
Tasty-Healthy											*.690*
Item 16	2.773	25.168	48	.997	8.376	16	.937	18.045	32	.978	
Untasty-Unhealthy											*.999*
Tasty-Unhealthy											*.998*
Item 17	14.761	75.867	72	.355	26.719	24	.318	57.075	48	.173	
Tasty-Unhealthy											*.827*
Untasty-Healthy											*.990*
Tasty-Healthy											*.968*
Item 18	30.643	28.784	72	1.000		24		25.734	48	.996	
Tasty-Unhealthy											*.990*
Untasty-Healthy											*.981*
Tasty-Healthy											*.425*
Item 19	1.387	28.986	48	.986	9.560	16	.889	14.538	32	.997	
Tasty-Unhealthy											*.989*
Tasty-Healthy											*.998*
Item 20	3.008	28.817	48	.987	38.564	16	.000***	12.447	32	.999	
Tasty-Unhealthy											*1.000*
Tasty-Healthy											*.999*
Item 21	41.029	27.700	72	1.000	5.309	24	1.000	11.202	48	1.000	
Tasty-Unhealthy											*.846*
Untasty-Healthy											*.956*
Tasty-Healthy											*.848*
Item 22	19.288	32.198	48	.961	11.924	16	.749	15.268	32	.995	
Tasty-Unhealthy											*.469*
Tasty-Healthy											*.118*
Item 23	20.236	75.509	72	.366	25.064	24	.374	40.452	48	.772	
Tasty-Unhealthy											*.995*
Untasty-Healthy											*.997*
Tasty-Healthy											*.989*
Item 24	61.389		48		13.219	16	.657		32		
Tasty-Unhealthy											*.407*
Tasty-Healthy											*.994*
Item 25	1.386	15.983	48	1.000	8.376	16	.937	9.535	32	1.000	
Untasty-Unhealthy											*.999*
Tasty-Healthy											*1.000*
Item 26	8.553	48.191	48	.465	15.785	16	.468	35.360	32	.312	
Tasty-Unhealthy											*.995*
Tasty-Healthy											*1.000*
Item 27	9.260	35.642	24	.059	21.469	8	.006**	27.919	16	.032*	
Tasty-Unhealthy											*.997*
Item 28	56.746		48		101.126	16	.860		32		
Tasty-Unhealthy											*.429*
Tasty-Healthy											*.996*

Note. * $p < .05$, ** $p < .01$, *** $p < .001$. The predictive power of GoNoGo and SST scores on food-category classification (Untasty–Unhealthy, Tasty–Unhealthy, Untasty–Healthy, Tasty–Healthy), 1-4 scale.

Discussion

This study aimed to explore the possible relationship between cognitive control and self-regulatory ability in influencing perceived nutritional value as a predictor of future food decision-making in young adults. The process of recognizing and appropriately responding to hunger and satiety cues is determined through cognitive control—shaped by parental feeding behaviors—and the degree to which impulsivity and response inhibition predicted self-regulatory ability was investigated to understand dietary behavior. Because individuals' levels of response inhibition and impulsivity have been previously determined to reflect early childhood parental feeding behavior, I explored if measuring cognitive control as a proxy for authoritarian versus modeling parental feeding behavior could significantly predict future dietary behavior in young adults (Bandura, 2004; Birch et al., 1980; Larsen et al., 2015; Liu et al., 2013; Sleddens et al., 2014). Based on the supporting evidence from Hypothesis 1 and prior research, high scores on either the GoNoGo task or combined task model (GoNoGo + SST) were deemed reflective of authoritarian parental feeding behaviors. Conversely, low scores were deemed reflective of modeling parental feeding behaviors. In looking at both cognitive control on self-regulation and cognitive control on dietary assessment of food items in tandem, I attempted to find a relationship between early childhood parental feeding behaviors (from significance in Hypothesis 1) and adult dietary decision-making through perceived taste and nutritional value (from significance in Hypothesis 2).

For the first hypothesis, I hypothesized that the two measures of cognitive control, the GoNoGo task (impulsivity) and SST (response inhibition), would predict self-regulatory ability as measured through the SSRQ. Specifically, I hypothesized that this relationship would be more predictive when cognitive control was weaker for both constructs, indicating significantly worse self-regulation (Hypothesis 1). As such, both the GoNoGo task and SST were analyzed for correlation with the SSRQ. Performance on the GoNoGo task and the SSRQ were found to be statistically significant, where the higher the score on the GoNoGo task (more incorrect responses), the lower the score on the SSRQ (worse self-regulatory ability). In support of my hypothesis, this finding suggests that impulsivity predicts one's ability to self-regulate, with this correlation being stronger the more impulsive an individual is. This finding supports prior research that has found significant connections between heightened impulsivity—as measured in both impulse control tasks and impulse questionnaires—and self-regulatory failure (Allan et al., 2011; Jasinka et al., 2012; Lazuras et al., 2019; Schreiber et al., 2012). Given that reward-mediated parental feeding behaviors that use food to manipulate behavioral outcomes have been linked to impulsivity, this significant finding implies that authoritarian parental feeding behaviors may negatively influence the development of self-regulation (Guerrieri et al., 2008; Jasinka et al., 2012; Schreiber et al., 2012). Literature cites the parental feeding behavior of modeling as mitigating impulsivity because modeling has been shown to increase children's awareness and addressing of hunger and satiety cues, thus the significant relationship between the GoNoGo task and SSRQ scores in the positive direction supports the connection between modeling and improved self-regulatory ability (Jasinska et al., 2012).

Unlike the GoNoGo task, the SST was not found to be a significant predictor of scores on the SSRQ. Because high-scoring individuals (more incorrect responses) demonstrated no predictive power on SSRQ scores, response inhibition had no effect on self-regulatory ability. This suggests that the cognitive control process of response inhibition cannot be concluded to have any significant relationship with an individual's ability to self-regulate in either a positive or negative direction. This finding contradicts two studies by Guerrieri et al. which found a significant relationship between response inhibition deficits in a series of SST tasks and self-dysregulation measured by a Restraint Scale and a Door Opening Task (Guerrieri et al., 2007; Guerrieri et al., 2008). Moreover, Guerrieri et al. revealed that children who experienced authoritarian parental feeding behaviors (instrumental, emotion, and reward-mediated) performed significantly worse on a SST, but because this finding was not replicated in the current study, authoritarian parental feeding behaviors, by way of effect on response inhibition, cannot be said to predict self-regulation.

This finding is surprising for two reasons. Numerous past studies have often coupled impulsivity and response inhibition as similar measures given that both cognitive control processes include the inability to regulate thoughts and actions and inhibit urges (Allan et al., 2011; Guerrieri et al., 2008; Jasinka et al., 2012). As neuroscience research has shown, both cognitive control constructs are implicated in the same regions of the brain in cognitive reasoning and executive functioning tasks, so it is possible to reason that both the GoNoGo tasks and SST would exert a similar influence on SSRQ scores (Schreiber et al., 2012). Yet, the results from the model that included the combined effect of the SST and GoNoGo task on SSRQ scores displayed that in this study, the inclusion of response inhibition when coupled with impulsivity only exhibited predictive power on self-regulatory ability due to the strength of the relationship between impulsivity and self-regulation—the addition of response inhibition was overall negligible in predicting individuals' self-regulation. The second reason why this is surprising is that it once again contradicts a study by Jasinka et al., where greater impulsivity and response inhibition together—as well as independently—were shown to have a positive relationship with poor regulation of dietary behavior (Jasinka et al., 2012).

A possible explanation for this discrepancy is that despite falling under the same cognitive control construct of inhibitory control, both tasks may not measure equivalent cognitive mechanisms. In a recent meta-analysis conducted by Littman and Takács, contradictory evidence in a review of multiple studies points to the possibility of the GoNoGo task and SST actually measuring two distinct inhibitory processes with marked differences in cognitive mechanisms (Littman & Takács, 2017). Schachar et al. propose that the GoNoGo task measures action restraint, which relies on the decision to respond or not to a stimulus; on the other hand, the SST captures action cancellation, which instead refers to response suppression because the default action is to respond (Schachar et al., 2007). In measuring two different cognitive mechanisms (restraint vs cancellation), Schachar et al. found that a longer latency period is likely required in the SST in order to be comparable to measurements in the GoNoGo task because, unlike action restraint, action cancellation necessitates more signaling in the suppression of an already initiated response (Schachar et al., 2007). In the current study, the SST was discernibly harder than the GoNoGo task due to timing. Not only did participants have less time to respond in the SST, but the timing between the go and stop signal was two times shorter than in the GoNoGo task (250 ms in the SST as opposed to 500 ms in the GoNoGo task). By measuring inhibitory control times for both tasks, Raud et al. hypothesized that if the two tasks indeed shared the same cognitive mechanism, it would be reflected in analogous temporal dynamics before and during the latency signal. However, the researchers found that the SST and GoNoGo task utilized entirely different time-variant functional networks, resulting in contrasting inhibitory control time-courses that indicated that the tasks measured two separate cognitive mechanisms (Raud et al., 2020). More research is needed to settle this scientific debate, but in a future study, assumptions of equivalent mechanisms for these tasks should be approached with caution and require sufficient scientific support.

For the second hypothesis, I predicted that the relationship between weaker cognitive control and poor self-regulation would correspond to a lower rating on the Food Rating Task (lower perceived taste and nutritional value for food items) to evince that low regulatory ability and the likelihood of perceiving healthy foods as less tasty and unhealthy foods as tastier are positively correlated (Hypothesis 2). An exploratory analysis was conducted to see if scores on either cognitive control tasks—as a proxy for early childhood parental feeding behavior—could predict future food decision-making behavior (high scores on either the GoNoGo task or combined task model = authoritarian parental feeding behaviors, low scores on either the GoNoGo task or combined task model = modeling parental feeding behaviors). With this premise, each individual was classified into one of 4 food-categories (Untasty-Unhealthy, Tasty-Unhealthy, Untasty-Healthy, Tasty-Healthy) based on their average rating on a tastiness-block and healthiness-block to identify subjective perceived taste and nutritional value for each food item. Classification into any food-category was considered to be a sufficient indicator of future dietary behavior because past research has repeatedly demonstrated that individuals' ratings and choices of intangible food representations (e.g. pictures of food), are associated with their real eating behaviors "when measured on the same day or in the future", thereby validating the indicator in this study (Barakchian et al., 2021; Foerde et al., 2105; van Meer et al., 2019). It should be noted, however, that this study is the first of its kind to make and base an analysis on this assumption, so findings should be interpreted with caution.

The second hypothesis addressed the possibility of a predictive relationship between GoNoGo and SST scores to food-category classification such that high task scores (more incorrect responses) and low SSRQ scores would correspond to a lower average rating on the Food Rating Task as a result of perceiving healthy foods as less tasty. Similarly, I investigated if high task scores and low regulatory ability would correspond to a lower average rating on the Food Rating Task as a result of perceiving unhealthy foods as tastier; both of these averages presented as the same number, thus parameter estimates by individual food-category allowed for proper identification of predictive classification. Overall, there was no significant connection between heightened impulsivity and impaired response inhibition with either unhealthy or healthy perceived taste and nutritional value, so classification into a food-category was not predicted by high scores on both tasks. Consequently, neither the degree of impulsivity nor response inhibition was significantly predictive of future food decision-making behavior. Although previous longitudinal studies have found a significant association between children whose parents utilized modeling and healthier dietary behavior in adulthood, the current study did not provide evidence that early childhood parental feeding behaviors (as seen through GoNoGo and SST scores) were predictive of dietary decisions in adulthood (Larsen et al., 2015; Sleddens et al., 2014). A potential reason for this discrepancy is that these studies were able to track participants over the course of many years from childhood to adulthood and in doing so, were able to directly identify early childhood parental feeding behavior without using a proxy—as the current study has done—and observe the long-term dietary effects exhibited in adulthood. It is possible that using GoNoGo and SST scores as a proxy weakened the strength of the study's data, and thus obscured any significant associations between early childhood parental feeding behaviors and food decision-making behavior in adulthood from being found.

The outlier to these insignificant findings was item 4, an image of broccoli, where the combined model of both the GoNoGo task and SST significantly predicted the likelihood of individuals falling into the Tasty-Healthy category. Although this was the only item of 28 that elicited any significance in the model, it merits an examination. Low scores on the GoNoGo task and SST are reflective of parental modeling of feeding behaviors, which relies on the observation of parental consumption and approaches to food as objects of dietary learning for the child (Morris et al., 2007). Raggio and Gambaro found that modeling the enjoyment of eating vegetables in early childhood was shown to enhance healthy eating behavior because children believed healthy food to be enjoyable to consume. For broccoli specifically, researchers have noted that increased exposure to models consuming broccoli positively increased children's perceived taste and intake of broccoli significantly (Edwards et al., 2022; Raggio & Gambaro, 2018). It can reasonably be concluded then, that greater exposure to vegetables from parents' consumption requires that food items be frequently present in the household; interestingly, broccoli is one of the cheapest green vegetables on the market after romaine lettuce and cabbage, and is a staple in most healthy diets cross-culturally (Daniel, 2020). Studies have shown that across economic backgrounds, the low cost of broccoli has enabled the healthy item to be a fridge staple more so than other healthy green vegetables like asparagus or brussels sprouts where exposure is more limited due to higher costs (Daniel, 2020). Thus, a potential explanation for the exception of significance seen in item 4 for the Tasty-Healthy food-category may be that broccoli is unique due to its low cost, allowing for parental modeling of this vegetable intake to occur with a higher frequency. This would increase children's observation of consumption and encourage an enjoyment of taste that carries into adulthood, thereby instilling a greater association between high perceived taste and health ratings for broccoli in a significant portion of the population sample.

The limitations of the current study should be taken into consideration when interpreting and generalizing the findings. As mentioned earlier, the substantial difference in difficulty between the SST and GoNoGo task rendered the interpretation of scores for response inhibition and impulsivity, respectively, to be incongruous with each other despite being considered equivalent measures of inhibitory control. Another limitation of the study was the small sample size. Most studies in the literature review had a population size of approximately 100-200 participants in order to see significant results and comparisons, so the findings in this study cannot be generalized with a degree of certainty. Additionally, participants who indicated diagnosed impulse control disorders, such as ADHD, were not excluded from the current study in order to maintain a sample size that could still be analyzed—a consequence of an erroneous deletion of data from 9 other participants. This inclusion of participants could have resulted in skewed findings given that similar research excluded such participants to minimize potential statistical outliers (Cusick & Georgieff, 2022; Davis et al., 2006). The experiment was also conducted in two different locations on two different campuses, so environmental conditions were not standardized despite efforts to maintain methodological rigidity. It is possible that a particular setting was less conducive to task performance and had an unintended effect on SST and GoNoGo scores, which may have affected the results and subsequent examination of significant association in the analyses.

This study poses interesting directions for future research, especially within the context of food availability on the development of taste preferences. The significant relationship between food-category classification and cognitive control for broccoli in the current study suggests that economic factors in a household may be a significant determinant in food decision-making behavior in adulthood. Incorporating economic background in future studies may allow us to assess how the acquisition of taste preference for healthy foods differs between high- and low-income budgets spent on food (Daniel, 2020; Smed & Hansen, 2016). This avenue for future research could explore if the relationship between healthy food decision-making and cognitive control presents significance if moderated by economic background and consequent availability of more or less healthy foods in early childhood.

Conclusion

This study has shown that impulsivity predicts an individual's ability to self-regulate, with this prediction being stronger the more impulsive an individual is. Further, this finding allowed the connection between early childhood parental feeding behaviors and self-regulation to be made in supplementation with evidence from past research, where we found authoritarian parental feeding behaviors to predict low self-regulation—our strongest prediction—and modeling parental feeding behaviors to predict high self-regulation. On the other hand, the cognitive control construct of response inhibition, which is often coupled with impulsivity as measuring inhibitory control in the literature, was shown to have no effect on self-regulatory ability. This suggested that impulsivity and response inhibition may assess different cognitive measures of inhibitory control, and this finding contributes to the current scientific debate on their mechanistic equivalence. The study additionally revealed that heightened impulsivity and impaired response inhibition did not predict either unhealthy or healthy perceived taste and nutritional value for food items, so early childhood parental feeding behaviors were not found to be predictive of future dietary decisions in adulthood. The findings from the study highlight the implications of parental demonstrations of feeding behaviors in early childhood on the development of self-regulation sustained through adulthood, and may also be useful in future investigations of early childhood parental influences on dietary choices and behavior in adulthood.

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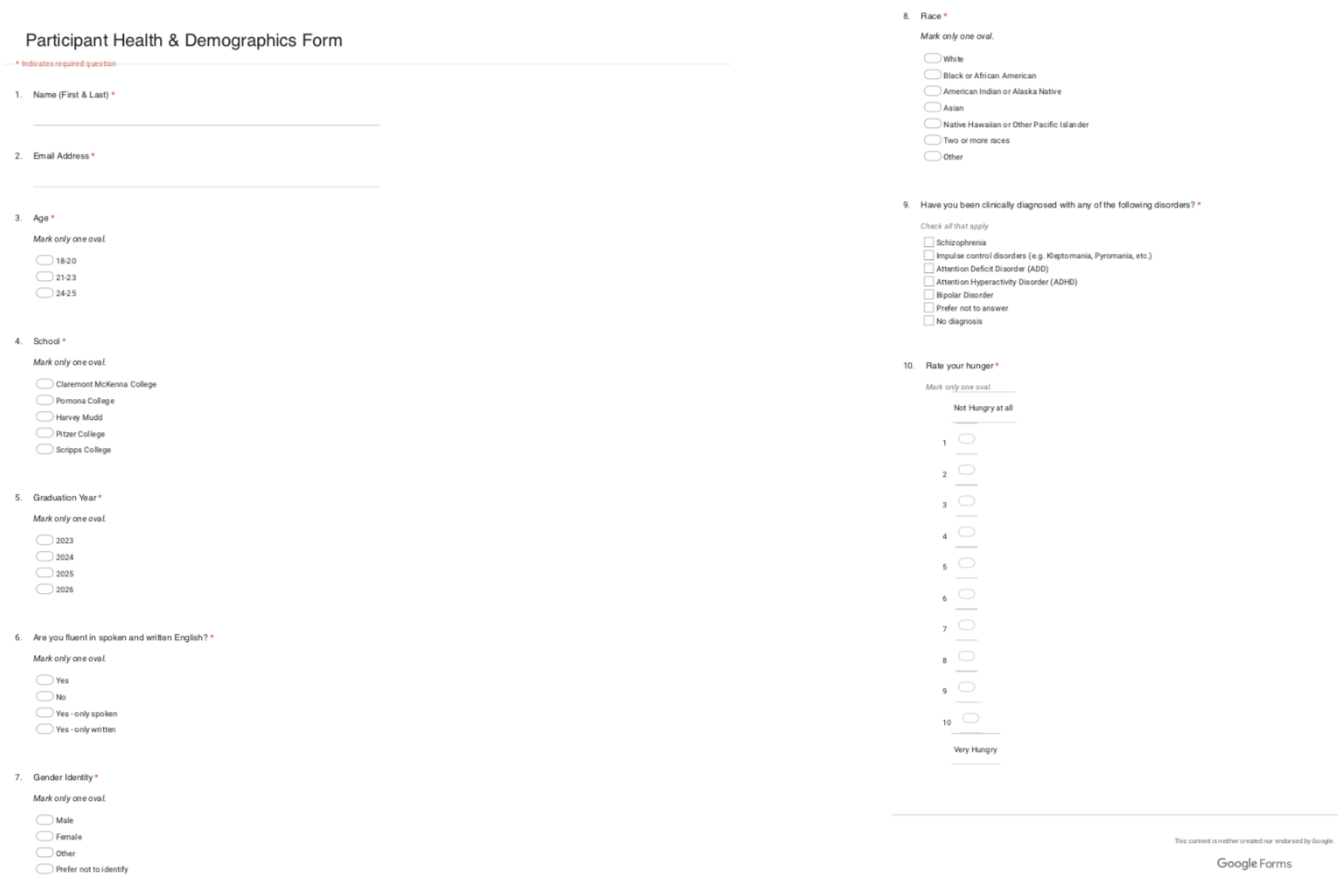
Appendix A

Pre-Study Forms

This appendix details the health and demographics form completed by all participants prior to the start of the study.



Participant Health & Demographics Form

* Indicates required question

1. Name (First & Last) *

2. Email Address *

3. Age *

Mark only one oval.

- 18-20
- 21-23
- 24-25

4. School *

Mark only one oval.

- Claremont McKenna College
- Pomona College
- Harvey Mudd
- Pitzer College
- Scripps College

5. Graduation Year *

Mark only one oval.

- 2023
- 2024
- 2025
- 2026

6. Are you fluent in spoken and written English? *

Mark only one oval.

- Yes
- No
- Yes - only spoken
- Yes - only written

7. Gender Identity *

Mark only one oval.

- Male
- Female
- Other
- Prefer not to identify

8. Race *

Mark only one oval.

- White
- Black or African American
- American Indian or Alaska Native
- Asian
- Native Hawaiian or Other Pacific Islander
- Two or more races
- Other

9. Have you been clinically diagnosed with any of the following disorders? *

Check all that apply.

- Schizophrenia
- Impulse control disorders (e.g. Kleptomania, Pyromania, etc.)
- Attention Deficit Disorder (ADD)
- Attention Hyperactivity Disorder (ADHD)
- Bipolar Disorder
- Prefer not to answer
- No diagnosis

10. Rate your hunger *

Mark only one oval.

Not Hungry at all

1
2
3
4
5
6
7
8
9
10

Very Hungry

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Google Forms

Appendix A. Participant Health and Demographics Form

Appendix B

Measures of the Food Rating Task

This appendix consists of the food items shown in the Food Rating Task. The first table identifies the food corresponding to each item number. The second table displays the health classification of the 28 chosen food items in the following categories: Very Unhealthy, Unhealthy, Healthy, Very Healthy (Oduru et al., 2022 & Vydiswaran, et al., 2018).

Item 1: Apples	*Item 8: Eggs*	*Item 15: Steak*	*Item 22: Cake*
Item 2: Salad	*Item 9: Chicken*	*Item 16: Fries*	*Item 23: Chocolate*
Item 3: Fish	*Item 10: Rice*	*Item 17: Tacos*	*Item 24: Bacon*
Item 4: Broccoli	*Item 11: Sandwich*	*Item 18: Popcorn*	*Item 25: Ice cream*
Item 5: Pumpkin	*Item 12: Chipotle*	*Item 19: Garlic Bread*	*Item 26: Nachos*
Item 6: Strawberries	*Item 13: Potatoes*	*Item 20: Pizza*	*Item 27: Starbucks*
Item 7: Carrots	*Item 14: Soup*	*Item 21: Pasta*	*Item 28: Burger*

Appendix B1. The 28 food items in the Food Rating Task

Very Unhealthy	**Unhealthy**	**Healthy**	**Very Healthy**
Burger	Pasta	Soup	Salad
Starbucks	Pizza	Potatoes	Apples
Nachos	Garlic Bread	Chipotle	Fish
Ice Cream	Popcorn	Sandwiches	Broccoli
Bacon	Tacos	Rice	Pumpkins
Chocolate	French Fries	Turkey	Strawberries
Cake	Steak	Eggs	Carrots

Appendix B2: Chosen food items for the Food Rating Task categorized by health.

Appendix C

Self-Regulation Questionnaire & Rating Scale

This appendix shows the questions asked in the Self-Regulation Questionnaire the corresponding rating scale for each question. The SSRQ which was used to measure participants' self-regulatory capacity.

1	**2**	**3**	**4**	**5**
Strongly Disagree	**Disagree**	**Unsure**	**Agree**	**Strongly Agree**

1. ____ I usually keep track of my progress towards my goals.
2. ____ I have trouble making up my mind about things.
3. ____ I get easily distracted from my plans.
4. ____ I don't notice the effects of my actions until it is too late.
5. ____ I am able to accomplish goals I set for myself
6. ____ I put off making decisions.
7. ____ It's hard for me to notice when I've "had enough" (alcohol, food, sweets).
8. ____ If I wanted to change, I am confident that I could do it.
9. ____ When it comes to deciding about a change, I feel overwhelmed by the choices.
10. ____ I have trouble following through with things once I've made up my mind to do something.
11. ____ I don't seem to learn from my mistakes.
12. ____ I can stick to a plan that's working well.
13. ____ I usually only have to make a mistake one time in order to learn from it.
14. ____ I have personal standards, and try to live up to them.
15. ____ As soon as I see a problem or challenge, I start looking for all possible solutions.
16. ____ I have a hard time setting goals for myself
17. ____ I have a lot of willpower.

18. ____ When I'm trying to change something, I pay a lot of attention to how I'm doing.
19. ____ I have trouble making plans to help me reach my goals.
20. ____ I am able to resist temptation.
21. ____ I set goals for myself and keep track of my progress.
22. ____ Most of the time I don't pay attention to what I'm doing.
23. ____ I tend to keep doing the same thing, even when it doesn't work
24. ____ I can usually find several different possibilities when I want to change something
25. ____ Once I have a goal, I can usually plan how to reach it.
26. ____ If I make a resolution to change something, I pay a lot of attention to how I'm doing
27. ____ Often I don't notice what I'm doing until someone calls it to my attention
28. ____ I usually think before I act.
29. ____ I learn from my mistakes.
30. ____ I know how I want to be.
31. ____ I give up quickly.

Appendix C: Self-Regulation Questionnaire & Rating Scale