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Unpacking the Temperament Weight Relationship: The Mediating Role of Food Preferences

A thesis

presented to

the faculty of the Department of Psychology

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Masters of Arts in Psychology

by

Sarah Berry

August 2013

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Keywords: temperament, weight, food preference, categorization, difficult temperament

ABSTRACT

Unpacking the Temperament Weight Relationship: The Mediating Role of Food Preferences

by

Sarah Berry

The current study examined the mediating role of possible food preferences on the temperament-weight relationship among 18-month-old toddlers. Parents of 37 typically developing toddlers completed the Early Childhood Behavior Questionnaire (ECBQ). During a lab visit toddlers' weight and recumbent length were measured and recorded. Toddlers also completed a sequential touching task to examine their ability to categorize a healthy group of foods and an unhealthy group of foods. The only temperament measure found to associate with both child weight status and food categorization was inhibitory control. Toddlers' food categorization was not found to mediate the relationship between inhibitory control and their weight status. The results of this study suggest that there is a continued need for a nonparent report measure of food preferences.

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CHAPTER 1

INTRODUCTION

Childhood obesity in the United States has continued to be a public health concern over the past few decades (Ogden, Carrol, Brian, & Flegal, 2012). The persistence of childhood obesity into adulthood represents a considerable public health problem (Charney, Goodman, McBride, Lyon, & Pratt, 1976; Serdula et al., 1993; Whitlock, Williams, Gold, Smith & Shipman, 2005), as it contributes to several negative adulthood health outcomes including elevated blood pressure (Freedman, Katzmaryzyk, Dietz, Srinivasan, & Berenson, 2009) and insulin resistance (Nathan & Moran, 2008). Furthermore, childhood obesity is associated with adult morbidity and mortality related to cardiovascular and other chronic diseases (Gunnell, Frankel, Nanchahal, Peters, & Davey-Smith, 1998). Given the pervasive nature of childhood obesity, it is important to identify early risk factors and possible interventions that may prevent or attenuate its onset.

Researchers have identified several early risk factors explaining variance in childhood overweight and obesity. These include maternal smoking during pregnancy (Stettler, Zemel, Kumanyika, & Stallings, 2002), maternal obesity (Li et al., 2005; Whitaker, 2004), higher birth weight (Parsons, Power, Logan, & Summerbell, 1999), lack of breast-feeding (Armstrong & Reilly, 2002), early introduction of solid foods (Kramer, Barr, Leduc, Boisjoly, & Pless, 1985), parental feeding styles (Johnson & Birch, 1994), and temperament (Agras & Mascola, 2005; Carey 1985; Darlington & Wright, 2006; Wu, Dixon, Dalton, Tudiver, & Liu, 2011).

The role of temperament appears especially noteworthy because it has been associated with weight gain in infancy (Carey, 1985; Darlington & Wright, 2006) and middle childhood (Carey, Hegvik, & McDevitt, 1988), and later with body mass in adulthood (Pulkki-Råback,

Elovainio, Kivimäki, Raitakari, & Keltikangas-Järvinen, 2005). Accordingly, researchers have become increasingly interested in links between temperament and obesity risk. Studies have examined toddler temperament-weight relationships with respect to parenting sensitivity (Wu et al., 2011), parental weight (Agras, Hammer, McNicholas, & Kraemer, 2004), and parental feeding behavior (Stifter, Anzman-Frasca, Birch, & Voegtline, 2011). Toddler temperament may contribute to toddler weight and weight gain through such mechanisms as breastfeeding (Owen, Martin, Whincup, Smith, & Cook, 2005), early introduction of solid foods (Wasser et al., 2011), and parent feeding behavior (Stifter et al., 2011). Influences of temperament on greater weight and weight gain have included the investigation of different temperamental typologies (i.e., infants categorized as difficult as opposed to easy) (Carey, 1985), as well as more narrow aspects of temperament such as the level and valence of specific behaviors such as the ability to soothe oneself (Wells et al., 1997). A closer examination of the influence of toddler temperament on these risk factors could lead to a better understanding of the temperament-weight relationship.

The preference for certain foods may also be a key factor underlying the link between toddler temperament and childhood obesity. Temperament may influence food preferences such that toddlers with certain temperamental profiles prefer certain types of food that lead to higher weight and weight gain. One study found an association between temperament at 18 months and obesogenic dietary patterns (Vollrath, Tonstad, Rothbart & Hampson, 2011). Vollrath et al. (2011) reported that 18-month-olds who were described by their mothers as having high distress-prone temperaments, were more likely to be fed sweet foods, and sweet drinks, particularly at night. The relationship between temperament and the feeding of sweet foods and drinks did not change even after controlling for weight at 1 year of age. Faith and Hittner (2011) reported that among girls temperament and eating patterns (reactivity to food, predictable appetite, and

distractibility at mealtime) at 1 year of age were related to greater increases in standardized weight and greater reports of overweight or obesity at 6 years of age. Specifically, girls reported by mothers to be high in soothability in infancy were more likely to be overweight or obese at 6 years of age than girls reported to be less soothable in infancy (Faith & Hittner, 2011).

In the following sections research is reviewed on the relationships between toddler temperament and both food preferences and childhood obesity. I begin with a brief description of the multidimensional nature of temperament, focusing on three of its broad dimensions. A definition of difficult temperament is proposed relative to these three broad dimensions. I then review literature linking temperament to weight, weight gain, and obesity in infancy and childhood. The role food preferences may play in the reactivity of temperament in infancy and childhood is then discussed as it relates to weight. Finally, I propose empirically testable hypotheses about how food preferences may partially mediate the relationship between temperament and obesity.

Temperament

Although several definitions of temperament exist (e.g., Goldsmith et al., 1987), they all converge on the notion that temperament represents a consistent and stable pattern of behavior across time and context (Rothbart & Goldsmith, 1985). The most comprehensive description of temperament is probably that of Rothbart and Derryberry (1981), who defined temperament as comprising individual differences in reactivity and self-regulation arising from the biological makeup of an organism. Reactivity includes the behavioral processes through which toddlers respond to their environment, including the emotion, motor, and sensory systems; whereas self-regulation involves the behavioral processes by which toddlers modulate the initial reactivity through attentional processes (Rothbart & Derryberry, 1981).

Three major constructs of temperament include the affective, activational, and attentional core of personality and personality development (Rothbart & Bates, 2006). Affective measures include the positive and negative emotional aspects of temperament as well as emotional response and regulation. The activational construct measures the motor responses and regulations to the environment. The attentional construct measures the control of responding and allocation of attention to the environment (Rothbart & Bates, 1998).

Putnam, Garstein, and Rothbart (2006) have characterized these individual differences in reactivity and self-regulation as reflecting three overarching superdimensions, specifically, Negative Affectivity, Surgency-Extraversion, and Effortful Control. However, each of these superdimensions collectively comprises the operation of a number of lower level, or “fine-grained” temperament dimensions. Negative Affectivity is the level of distress or negative emotion that is exhibited as a stable reaction through the display of discomfort, fear, motor activation, sadness, perceptual sensitivity, shyness, soothability, and frustration. Surgency-Extraversion is the level of reactively exhibiting positive emotion and engagement through impulsivity, activity level, high-intensity pleasure, sociability, and positive anticipation. Effortful Control is the self-regulated response to external stimuli and is shown through inhibitory control, attention shifting, low-intensity pleasure, cuddliness, and attention focusing.

Links with Weight

The study of temperament as a predictor of weight holds strong importance when considering that such a relationship could lead to a lifelong predictor of and, therefore, a screening tool for the prediction of overweight and obesity from early childhood. Researchers have suggested some linkages between infant and childhood temperament and weight and/or later weight gain in infancy (Davis, 2007), childhood (Anzman & Birch, 2009; Wells et al.,

1997), and adulthood (Pulkki-Råback et al., 2005). Davis (2007) reported negative correlations between temperament and infants' frequency of formula intake and total daily formula intake. Infants with difficult temperaments, defined by Davis to be low in adaptability, high in mood, low in distractibility, and low in manageability, were fed more frequently and consumed more formula. These infants were not reported to have gained more weight compared to infants labeled as easier in temperament (Davis, 2007). However, in another study examining infant temperament and weight at 12 weeks and childhood weight at 2-3.5 years of age, infant temperament was reported to predict later body composition and behavior (Wells et al., 1997). Wells et al. (1997) reported infants easily soothed as having leaner childhood skinfold thickness and a higher activity level, while infants labeled as high in distress to limitations had higher percentages of fat. Anzman and Birch (2009) also reported a significant negative association between inhibitory control among 7-year-old girls and BMI at ages 7, 9, 11, and 15. Girls with low inhibitory control, as reported by the Childhood Behavior Questionnaire (CBQ; Rothbart, Ahadi Hershey, & Fisher, 2001), had higher reported BMI. Further support for a relationship between early temperament and later weight is reported in Pulkki-Råback et al. (2005) who reported temperament at 6 to 12 years of age to relate to body-mass index (BMI) at ages 24 to 30. Specifically, high emotionality in childhood predicted increased BMI in adulthood (Pulkki-Råback et al., 2005).

One characterization of certain subdimensions of temperament, originally labeled by Thomas and Chess (1977) as difficult temperament, has been examined for relationships with weight and weight gain. A positive association between difficult temperament and rapid weight gain has been reported during the first 5 months of life (Niegel, Ystrom, & Vollrath, 2007). Niegel et al. (2007) reported a small positive overall association between difficult temperament

and rapid early weight gain, with girls showing a significant association between the two. Infant difficultness was reported by mothers using seven items of the difficult subscale of the Infant Characteristic Questionnaire (ICQ; Bates, Freeland, & Lounsbury, 1979).

Further into the first year, Carey (1985) reported that infants categorized by mothers as having difficult temperaments gained the most weight-for-length percentile points between 6 and 12 months of age. Difficult infants were reported by Carey to be low in rhythmicity and approach and predominantly negative or intense. The most prominent subdimension of infants reported to have rapid weight gain was negative mood (Carey, 1985).

Other research has reported similar findings. Darlington and Wright (2006) found weight gain between birth and 8 weeks of age to be fastest among infants labeled as high in negative emotion and most distressed during frustrating situations. Distress during frustrating situations was defined by such behaviors as fussing and crying during periods of constraint (e.g., waiting for food, being dressed or undressed, and being in a confining place or position). Wells et al. (1997) reported that 12-week high distress to limitations was associated with higher fat percentages at 2-3.5 years of age. In older children Agras et al. (2004) found that at 5 years of age temperament mediated the relationship between parent overweight and child overweight, as measured by BMI, with children highly emotional in temperament being more likely to be overweight at 9.5 years of age than children without this temperamental profile (Agras et al., 2004).

Carey et al. (1988) also reported relationships between weight outcomes in later childhood and temperamental difficulty in early childhood. Specifically, weight-for-height gains between 4-5 and 8-9 years of age were significantly correlated with temperament subdimensions related to difficult temperament. From the Behavioral Style Questionnaire (BSQ; McDevitt &

Carey, 1978) and the Middle Childhood Temperament Questionnaire (MCTQ; Hegvik, McDevitt, & Carey, 1982) difficult temperament was computed with rhythmicity, approach, adaptability, intensity, mood, and persistence. In particular, high scores on activity, intensity, withdrawal, and distractibility and low scores on rhythmicity, adaptability, and persistence, along with negative scores in mood predicted more rapid weight-for-height gains (Carey et al., 1988).

Finally, Wu et al. (2011) found significant associations between difficult infant temperament and weight in later childhood, at least for children of mothers low in sensitivity. Specifically, difficult temperament measured at 6 months of age was related to higher risks for being overweight-or-obese during school age with both sensitive and insensitive mothers. However, a combination of insensitive mothers and difficult children showed significantly higher BMI percentiles than difficult children with sensitive mothers (Wu et al., 2011).

One area that has received much attention is the role mothers play in contributing to the relationship between temperament and weight that may also be linked to mother feeding practices. Stifter et al. (2011) explored the relationship between child weight status and the use of food to soothe infant or toddler distress. Mothers who reported using food to soothe had heavier children, especially among children rated as high in temperamental negativity (i.e., anger, fear, sadness, and discomfort; Stifter et al., 2011). Similarly, Davis (2007) reported that infants with difficult temperament at 3 months of age were fed more frequently and consumed more formula than infants with less difficult temperament; although, in this study, infants with difficult temperament were not reported to gain more weight compared to infants with easier temperament. Later in childhood, Vollrath et al. (2011) reported that 18-month-olds described by their mothers as having high distress-prone temperaments were more likely to be fed sweet foods and sweet drinks, particularly at night. The relationship between temperament and the feeding of

sweet foods and drinks was not changed even after controlling for weight at 1 year of age (Vollrath et al., 2011). Thus, particular interest should be placed on the type of foods being used to soothe, or preferred by, distressed infants because of the relationship such foods may play in weight gain.

Feeding Behavior and Weight

Food preferences influence food selection that may in turn promote overweight and obesity (Birch, 1999). The Feeding Infants and Toddlers Study reported that infants and toddlers are not consuming enough fruits and vegetables and are consuming too many sweet and salty energy dense foods, which are being introduced too early into their diets (FITS; Fox, Reidy, Novak, & Ziegler, 2006). The FITS study suggests current feeding practices are resulting in diets that can promote excessive weight gain and childhood overweight in the first few years of life. Studies examining feeding practices and weight in infancy and toddlerhood have focused mainly on the influence of parental feeding practices on feeding behavior rather than what infants and toddlers prefer to eat (Faith, Scanlon, Birch, Francis, & Sherry, 2004; Mahrshahi, Battistutta, Magarey, & Daniels, 2011; Worobey, Lopez, & Hoffman, 2009); although, parental feeding practices have been suggested to influence childhood eating styles and food preferences (Birch, 1998; Birch, Fisher, & Davidson, 2003) that may in turn influence weight later on in childhood (Faith et al., 2004).

Faith et al. (2004) reported in a comprehensive literature review that 19 of 22 reviewed studies revealed one significant association between parental feeding style and child eating or child weight status. When parental feeding restrictions were reported a positive association with child eating and weight status was also more likely to be reported. Mahrshahi et al. (2011) reported in a study of 612 infants with a mean age of 4.3 months that rapid weight gain was

significantly related to feeding infants on a schedule compared to maternal feeding of infants on demand, as based on infant cues. Also in the first year of life, Worobey et al. (2009) reported greater number of feeding times per day along with lessened sensitivity to satiety cues by mothers was significantly related to weight gain from 6 to 12 months. The American Heart Association stated controlled maternal feeding style during infants' transition from liquid-based to solid foods may increase the risk of obesity in childhood (AHA et al., 2006). By 18 months of age children may begin to have an influence over the choice of foods and drinks offered or consumed (Birch & Fisher, 1998). Although there is no developed measure of food preference at this age, the flavors of foods and drinks being offered may in turn influence infants' acceptance or preference of certain foods in childhood (Snethen, Hewitt, & Goretzke, 2007). Understanding how infants influence parental feeding style may lead to a better understanding of the development of preferences for certain foods that lead to weight gain.

Linking Temperament and Feeding Behavior

Temperament in infancy is increasingly being examined as an influencing factor of feeding behavior in children (Forestell & Mennella, 2012; Stifter et al., 2011; Wasser et al., 2011). Mothers' perceptions of infant temperament may lead to the early introduction of foods, a decrease in offering new foods, and less acceptance of new foods. While food preference of infants or toddlers is not often examined without the use of parent report measures (Birch, 1982), suggested exposure to foods through parental feeding behaviors influences food preference (Birch & Marlin, 1982; Wardle, Herrera, Cooke, & Gibson, 2003). Temperaments influencing role on parental feeding behavior in turn may lead to feeding certain types of foods. Research on feeding behavior and temperament has included parental feeding of certain foods (Wasser et al.,

2011) and children's willingness to eat or avoidance of certain food types (Forestell et al., 2012; Haycraft, Farrow, Meyer, Powell, & Blissett, 2011; Pliner & Loewen, 1997).

One childhood temperament influence on parental feeding is high distress to limitations as well as high activity level as measured by the Infant Behavior Questionnaire (IBQ-R; Garstein & Rothbart, 2003). Both of these dimensions have been reported to be significantly related to the introduction of solid foods before 4 months of age (Wasser et al., 2011). Wasser et al. (2011) also reported a significant association between early introduction of juice and higher ratings of low intensity pleasure in infants. Infant temperament has also been shown to relate to the acceptance of certain foods (Forestell et al., 2012). Infants who scored higher on the approach dimension of the Infant Temperament Scale (Carey & McDevitt, 1978) ate significantly more green beans, ate for a longer time, and showed fewer lip raises and nose wrinkles, which were rated by mothers as signs of disgust (Forestell et al., 2012).

Haycraft et al. (2011) have also reported relationships between temperament and eating behaviors. In 3- to 8-year-old children, more food avoidant behavior as well as less of a willingness to try new foods was associated with emotionality, as measured on the Emotionality Activity Shyness temperament instrument (EAS; Buss & Plomin, 1984). Also using the EAS (Buss & Plomin, 1984), as well as a scale measuring Reaction to Food from the Colorado Childhood Temperament Inventory (Rowe & Plomin, 1977), children's unwillingness to ingest unfamiliar foods was reported to relate to temperament (Pliner & Loewen, 1997). Pliner and Loewen (1997) reported children between the ages of 5-11 rated high in emotionality and high in negative reactions to foods, were also more unwilling to ingest unfamiliar foods.

Food preferences in infants and children have been shown to increase with repeated exposure (Birch & Marlin, 1982; Wardle et al., 2003). Exposure to new foods needs to occur 8 to

15 times before infants may acquire a taste for them (Carruth, Ziegler, Gordon, & Barr, 2004). Yet, certain temperamental profiles may lead to fewer offerings of new foods. Infants often termed ‘fussy’, although no such standard definition exists (Rothbart, 2004a), may be offered new foods less often or become distraught when eating foods less preferred by them according to their taste preferences. Temperamental dimensions characterizing what mothers describe as ‘fussy’ and that include the acceptance or rejection of foods have included distress to limitations (Wasser et al, 2011), approach (Forestell et al., 2012), and emotionality (Haycraft et al., 2011; Pliner & Loewen, 1997). Infants whose temperaments are rated by mothers as fussy during novel feeding situations, may be more likely to show signs of distress or negative emotionality that leads to the feeding of foods preferred more by infants. A closer examination of the types of foods fed to infants categorized as temperamentally fussy, or difficult, may lead to a better understanding of infant weight and later weight gain.

Literature Gaps

Few studies have examined the association between the temperament-weight relationship and feeding behavior or feeding preference in young children. The earliest report of the assessment of a feeding behavior (food preference) without the use of parent report measure was conducted with 2-year-old children using a varied number of frequencies of exposure to novel foods (Birch & Marlin, 1982). When given novel foods 25, 20, 10, 5, or 2 times, food preference was measured by the children’s choices of the more familiar foods when given trial choices within 10 days after the familiarization trials. Food exposure has been shown to positively influence food preference and consumption in infancy and childhood (Birch, 1999; Birch & Marlin, 1982; Wardle et al., 2003).

The types of foods infants are exposed to have been shown to be influenced by their temperaments (Vollrath et al., 2011; Wasser et al., 2011). The feeding of sweet foods and drinks was reported to be significantly higher in infants who were more internalizing in temperament (Vollrath et al., 2011). Wasser et al. (2011) also reported the early introduction of juice at 4 months of age and mother reported higher ratings of low intensity pleasure in infants. These reported influences of temperament on food exposure and preference leads to the feeding of foods that may lead to future weight gain. The types of food exposure by parents have been shown to influence weight and future weight status (Faith et al., 2004; Mhrshahi, Battistutta, Magarey, & Daniels, 2011; Worobey, Lopez, & Hoffman, 2009). While studies have suggested the importance of examining the influence of temperament-food exposure relationships on future weight status (Forestell et al., 2012; Stifter et al., 2011; Vollrath et al., 2011), no such study has examined the influential role food preferences serve in the temperament- weight relationship. An examination of the role food preferences play in the temperament-weight relationship may lead to a prediction of certain temperament typologies that lead to preferences to foods that influence higher weight or weight gain.

Hypotheses

The purpose of the study is to examine the relationship between infant or toddler temperament and weight outcomes and to test further whether any such relationship is mediated by food preferences. The report of significant correlations between weight and subdimensions of temperament related to infants described as difficult in temperament (Agras et al., 2004; Carey, 1985; Carey et al., 1988; Darlington & Wright, 2006; Davis, 2007; Niegel et al., 2007; Pulkki-Råback et al., 2005; Wells et al., 1997; Wu et al., 2011) is the basis for Hypothesis 1.

H1 Toddlers with more difficult temperaments will have higher weight-for-length standardized (WLZ) scores. Difficult temperament is defined in the current study by summary temperament ratings characterized by high discomfort, high sadness, low soothability, high frustration, low inhibitory control, and low attention focusing.

H2 I hypothesize that toddlers defined by the current study to have more difficult temperament will prefer more foods from an unhealthy category as opposed to a healthy category of foods.

H3 Finally, I hypothesize that the relationship between difficult temperament and weight will be mediated by the preference for unhealthy foods (See Figure 1).

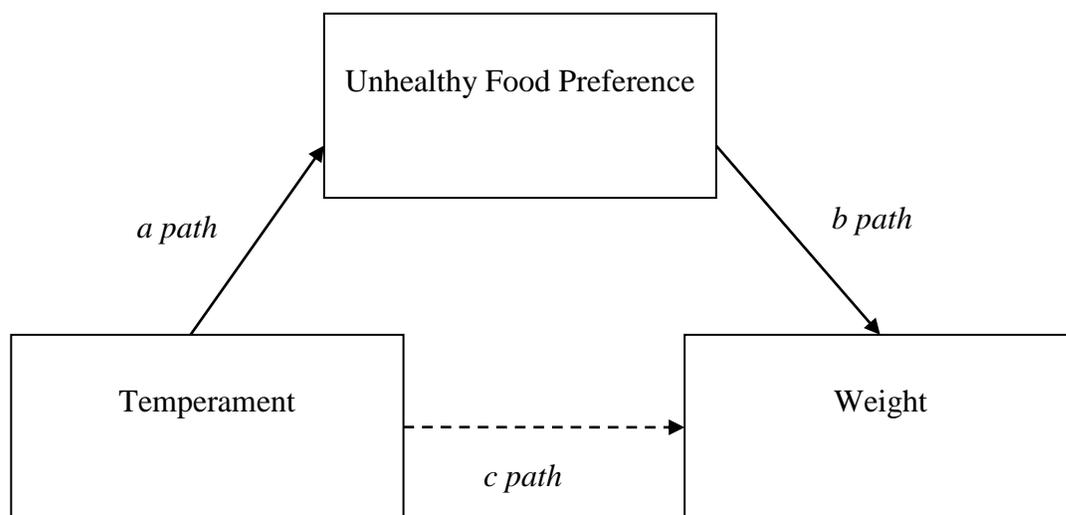


Figure 1. Proposed Mediating Role of Unhealthy Food Preferences

CHAPTER 2

METHODS

Participants

Participants included an archival sample of 37 toddlers from a longitudinal study in the East Tennessee State University Program for the Study of Infancy (PSI). Among participants 34 were White, 2 Hispanic, and 1 Other. The education level of parents of participants was 1 high school graduate, 1 trade, technical, or vocational, 9 completed some college or a 2-year college, 15 were 4-year college graduates, and 11 completed graduate school. Parents of participants were recruited via birth announcements published in newspapers in the region surrounding a mid-sized southeastern university. All parents of toddlers approaching 18 months of age whose addresses and phone numbers were published in area directories were contacted by letter and phone requesting their participation. Public advertisement including educational access cable television, local physicians' waiting rooms, and verbal recruitment through word of mouth also served as recruitment tools.

Materials

Toddlers along with their parent(s) were introduced to the PSI lab and a seat at a testing table across from the experimenter where the majority of the experiment was conducted. A wooden wardrobe next to the experimenter held the testing materials that were only brought out during the allotted time for the food preference procedure. Audio and video recording were used via two color cameras in opposite corners of the room and a microphone hanging from the middle of the ceiling. A control room with two main operators of the video and audio recordings were adjacent to the lab testing room.

Temperament

Parents were asked to complete the Early Childhood Behavior Questionnaire (ECBQ; Putnam, Jones, & Rothbart, 2002) before their first visit to the lab. The ECBQ is comprised of 201 items reflecting 18 fine-grained dimensions of toddlers' temperament. The ECBQ is appropriate for use with toddlers 18 to 30 months of age. The ECBQ assesses the overarching superdimensions of Negative Affectivity, Surgency-Extraversion, and Effortful Control and their subdimensions: discomfort, fear, motor activation, sadness, perceptual sensitivity, shyness, soothability, frustration, impulsivity, activity level, high-intensity pleasure, sociability, positive anticipation, inhibitory control, attention shifting, low-intensity pleasure, cuddliness, and attention focusing as described above. The ECBQ shows acceptable internal consistency and has been used to assess broad dimensions of toddler temperament (Putnam, Jones, & Rothbart, 2002).

Parents were asked to complete the ECBQ using observations of toddlers' responses or expected responses to a variety of situations over the past 6 months. Completion required parents to choose on a Likert-scale from 1 to 7, with 1 representing "extremely untrue of your child," 4 representing a neutral response of "neither true or untrue about your child," and 7 representing "extremely true of your child," whether they would expect to observe, or have observed, certain responses from their toddlers. Parents who feel they could not appropriately assess toddlers' responses may choose 'N/A' for any item. Difficult temperament was defined as high discomfort, high sadness, low soothability, high frustration, low inhibitory control, and low attention focusing.

Within the broader factor of negative affectivity, the dimensions of discomfort, sadness, frustration, and reversed soothability define toddlers' overall responses to the environment

through negative emotions (Putnam et al., 2006). I reasoned that high levels on these dimensions contribute to temperamental difficulty to the extent that they make parenting challenging for parents. Similarly, low levels of attention focusing and inhibitory control, which Putnam and colleagues group under the effortful control factor, were thought to require high levels of parental monitoring, thus also contributing to temperamental difficulty. Although most of the above mentioned difficult temperament dimensions are self-explanatory (e.g., sadness, frustration, attention focusing), inhibitory control and discomfort may need further clarification. Inhibitory control reflects a child's ability to inhibit a dominant response in order to carry out action towards a nondominant response, and discomfort reflects a child's response to his or her environment through behaviors showing an overall lack of comfort (Rothbart, 2004b).

Categorization of Food Preferences

The sequential touching procedure was originally designed to measure infant's preverbal ability to distinguish objects in two taxonomic categories by spontaneous object-grouping through their sequential touching behaviors (Mandler & Bauer, 1988). Past studies have used objects in a single superordinate category such as "dogs" and "horses" (Bauer, Dow, & Hertsgaard, 1995; Mandler & Bauer, 1988). In the present study toddlers were presented with four replica food objects from each of two food categories, specifically reflecting healthy and unhealthy foods. The four replicas reflecting healthy foods included an apple slice, banana, a bunch of grapes, and a serving of peas; whereas the four replicas reflecting unhealthy foods included a chocolate chip cookie, a chocolate doughnut, a strawberry ice cream cone, and a box filled with french fries. The sequential touching task was used as a means to identify both whether children could distinguish healthy foods from unhealthy foods and to gauge preference for one over the other.

The sequential touching procedure involves presenting children with a tray containing all eight food exemplars, with objects from each of the two categories distributed randomly on the tray. Standard protocol for administering the sequential touching task was followed, with the tray presented to the toddlers for 2.0 minutes and the only instructions being, “I have some things for you here, what can you do with these things, can you fix these things up?” These simple instructions are preferred so as to avoid giving children any specific suggestions about what to do with or how to group the objects on the tray.

Scoring of children’s sequential touching behaviors is accomplished via the TouchStat Monte Carlo computer program (Dixon, Woodard, & Merry, 1998; Dixon, Price, Watkins, & Brink, 2007). TouchStat uses a Monte Carlo Modeling program that uses permutation testing to determine exact probabilities of specific event sequences with respect to a reference set of all possible event sequences (Dixon et al., 1998; Dixon et al., 2007). Intracategory touch sequences are counted as categorical selections when the probability of a sequence of intracategorical touches exceeds the sampled permutation test expectations. Toddlers whose intracategory touch sequences exceed the permutation test expectations were labeled as categorizers, with toddlers whose intracategory touches did not exceed the permutation test expectations being labeled as noncategorizers. Preference for the unhealthy or healthy category can then be determined based on whether children demonstrate chance-exceeding intracategorical touch sequences in one versus the other category.

Weight-for-Length Standardized (WLZ) scores

The recumbent length for weight of toddlers was calculated using recumbent length measurements taken from the marking of head and feet of toddlers laying on rollout paper, and weight measurements were recorded from a Tanita brand weighing scale. Weight-for-length

standardized (WLZ) scores were computed using the World Health Organization's weight-for-length z-scores (De Onis, 2006).

Procedure

Informed consent was obtained by mailing a self-addressed, stamped envelope along with the informed consent document to be signed and returned to the lab before scheduling a visit to the PSI lab. After an informed consent was returned and received by the PSI, parents of participating toddlers were mailed the ECBQ along with other questionnaires of the larger PSI study. The ECBQ and other questionnaires were completed and returned at or before the lab visit.

Upon completion of the sequential touching task, and other tasks included in the larger PSI study, parents and toddlers were asked to participate in length and weight measurements. Parents were asked to help comfort toddlers who were measured the same as being measured during a medical checkup. Toddlers were helped to lie down on a longer than actual length strip of butcher paper while measurements of the head and feet were marked twice for accuracy with only a single measurement recorded. Toddlers' feet were set at a 90 degree angle and heads positioned to look at a 90 degree angle at the ceiling.

Weight for toddlers was measured and recorded. Toddlers were asked to stand on the scale unaided and hold still until the weight numbers were obtained. Toddlers were asked and helped to step off the scale and repeat the procedure. An average was taken from the two measurements except in the instance of a difference of .3 kg between the two recordings, whereas a third weight was recorded and the average of all three recorded. If toddlers became distressed, or could not stand unaided, parents held the toddlers during weight measurement and the difference between parent weight and parent/toddler weight was recorded.

CHAPTER 3

RESULTS

Descriptive Statistics

Descriptive statistics were generated for each of the proposed temperament dimensions and WLZ (see Table 1). Frequencies were generated for the food noncategorizer, unhealthy categorizer, healthy categorizer, and no preference categorizer groups at the $p=.10$, $p=.15$, $p=.20$, and $p=.25$ level (see Table 2). I followed this procedure because an initial effort to identify categorizers using the recommended .10 cut-off level (Mandler & Bauer, 1988) produced a relatively low number of toddlers identified as categorizers. To increase the number of categorizers, I decided to employ a less stringent cut-off value. To this end, I employed cut-off values, in sequence, of $p = .15$, $p = .20$, and $p = .25$. Although increasing, the cut-off value in this way also increased the probability of generating false positives, that is, identifying children as categorizers who were not; it also has the benefit of identifying children who are categorizers who would have been excluded using more restrictive criteria. Due to the exploratory nature of this investigation, I decided to conduct analyses using both the recommended cut-off values and the less restrictive cut-off values. In any case, logistic regression requires that there be at least 10 cases for each group (Lemeshow & Hosmer, 1982); however, the only way to obtain 10 cases per group for the logistic regression was to use the less restrictive cut-off values. Correspondingly, although originally the plan was to include all four categorizer groups, due to the small sample size I decided to collapse the three different groups of categorizers into a single categorizer group. Therefore, categorizers included the no preference, unhealthy, and healthy categorizers, with all other participants assigned to the noncategorizer group. This procedure

generated sufficiently large cell sizes to permit the logistic regression analyses, but only when the $p = .25$ cut-off level was employed.

Table 1

Descriptive Statistics for Temperament & WLZ (N=37)

Variable	M	SD
WLZ Scores	-0.32	1.08
WLZ Percentile	0.40	0.29
attention focusing	3.69	1.26
discomfort	1.87	0.81
frustration	3.69	0.90
inhibitory control	3.53	1.03
sadness	2.98	1.03
soothability	5.76	0.60

Table 2

Frequency Statistics for Noncategorizer, Unhealthy, Healthy, & No Preference (N=37)

	Noncategorizer	No Preference	Unhealthy	Healthy
$p = .10$	27	2	6	2
$p = .15$	23	3	9	2
$p = .20$	19	5	10	3
$p = .25$	17	6	11	3

Hypothesis 1

In order to test the hypothesis that toddlers with more difficult temperaments would have higher WLZ scores, zero-order correlations between the proposed temperament subdimensions representing difficult temperament and the WLZ measures were calculated and can be found in Table 3. Evaluation of the correlational values shows that, in general, difficult temperament, with

the exception of inhibitory control, did not significantly correlate with WLZ. The exception was that inhibitory control was significantly positively correlated with WLZ, revealing that toddlers with higher inhibitory scores also tended to have higher WLZ scores. Although this association was statistically significant, the direction of the association was opposite the expected direction.

Table 3

Zero-order Correlations of WLZ, Categorization, & Temperament

	att	dis	fru	inh	sad	sooth	WLZ
attention focusing							
discomfort	.09						
frustration	-.09	.34*					
inhibitory control	.04	-.16	-.59**				
sadness	.02	.34*	.66**	-.27			
soothability	-.03	-.44**	.06	-.16	-.09		
WLZ	-.02	.02	-.22	.35*	-.19	.20	
categorization	-.17	.09	.21	-.33*	.00	-.04	-.18

* $p \leq .05$, ** $p \leq .01$

Hypothesis 2

The second hypothesis was that toddlers rated high on dimensions reflecting temperamental difficulty would prefer foods from the unhealthy category and would, therefore, be more likely to categorize foods from that category. However, as noted above, very few toddlers demonstrated single-category categorization for either food type. Consequently, this hypothesis was modified to determine whether there was any association between children's temperamental profiles and their likelihood of engaging in categorization of food items. Point biserial correlations were calculated to test the second hypothesis that aspects of temperamental difficulty would be associated with children's ability to categorize healthy vis-à-vis unhealthy foods. Table 3 shows only one significant association between inhibitory control and

categorization, $r_{pb} = -.33$, $p = .05$, revealing that toddlers with high inhibitory control were more likely to be noncategorizers. As with Hypothesis 1, this direction of this correlation was opposite the predicted direction because high inhibitory control was expected to associate with better food categorization.

Hypothesis 3

Finally, to address the third hypothesis that food categorization mediated the relationship between temperament and infant weight status, Baron and Kenny's (1986) method for mediation was used. Specifically, Baron and Kenney's method allowed for the assessment of whether group membership (categorizer versus noncategorizer) served as a mediator of the temperament-weight relationship. An Ordinary Least Squares (OLS) regression was conducted and revealed a significant association for the direct relation between inhibitory control and WLZ (*c path*, $\beta = .351$ $p=.04$). A logistic regression analysis was then conducted to obtain the parameter estimate and standard error of the relation between inhibitory control and categorization (*a path*, $\beta = .539$, $B = -.618$, $SE = .338$, $p=.07$). The results indicated a marginal negative relationship between inhibitory control and food categorization, such that with each point decrease on the inhibitory control scale, toddlers were 54% more likely to belong to the categorizer group. Note that because logistic regression was conducted here, a beta weight of less than 1.00 indicates a negative association between the predictor and outcome variables.

To carry out the mediation analysis, another logistic regression analysis was conducted with WLZ serving as the outcome measure, and being regressed on the two predictor variables: categorization status (*b path*) and inhibitory control (*c prime path*). Recall that inhibitory control was the only temperament dimension significantly associated with both food categorization and WLZ. When both predictor variables were included in the regression analysis, I found that

categorization was not a significant predictor of WLZ ($\beta = -.028, B = -.059, SE = .367, p = .872$). On the other hand, inhibitory control continued to marginally significantly predict WLZ ($\beta = .342, B = .352, SE = .180, p = .06$; see Figure 2). The results of the regression analysis conducted with WLZ regressed on inhibitory control is distinct from Hypothesis 1 because it examines the relation between temperament and WLZ while controlling for categorization. Iacobucci (in press) recommends dividing the parameter estimates for the a and b paths by their respective standard errors (z_a & z_b) to find the product of z_a and z_b and the standard error: $\sqrt{z_a^2 + z_b^2 + 1}$. However, I chose not to proceed with this procedure because the a & b parameters were not significant. In sum, results indicated that categorization did not serve to mediate the association between inhibitory control and WLZ.

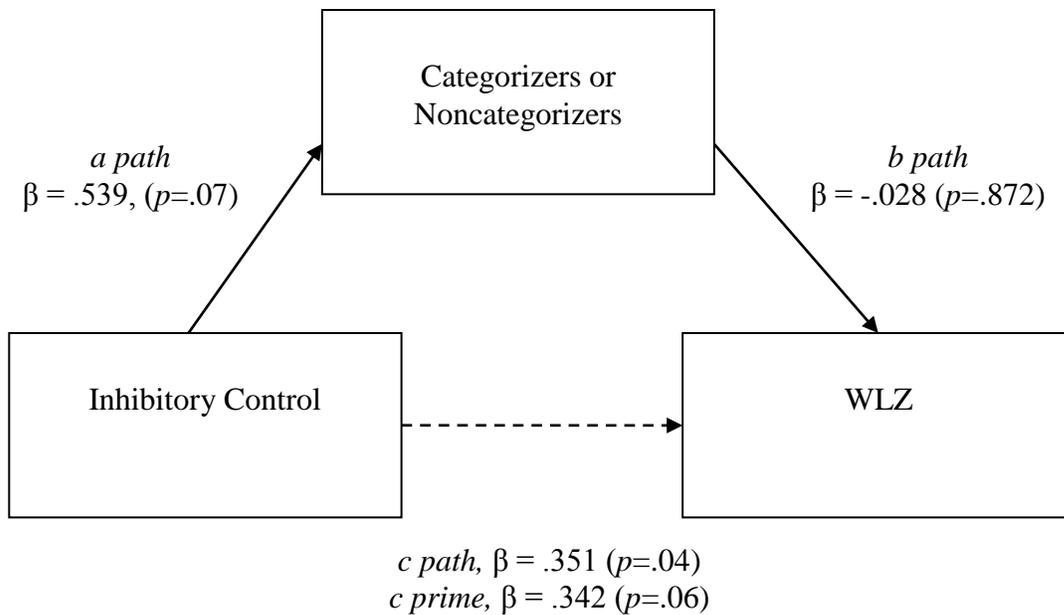


Figure 2. Mediating Role of Unhealthy Food Preferences

CHAPTER 4

DISCUSSION

The purpose of the present investigation was to test whether toddlers' food preferences mediated the relationship between temperament and weight status. Therefore, a measure of children's food type preference that was not confounded with parent feeding practices or parental control was used. Subsequently, it appeared that the measure would not necessarily index children's food preferences per se but at best would index children's understanding of the difference between healthy and unhealthy foods. Hence, the mediation hypothesis was revised to test whether children's understanding of food quality would mediate the temperament-weight relationship. Three specific hypotheses involving interrelationships among three variables – toddlers' temperament, toddlers' weight-for-length measurements, and toddlers' understanding of food quality – were tested. The results of the investigation and implications for future research are discussed in the context of the individual hypotheses.

Hypothesis 1 Implications and Future Directions

Hypothesis 1 predicted an association between toddler temperament dimensions thought to characterize temperamental difficulty and WLZ. Although there was not a significant relationship between the majority of temperament dimensions and weight status, one of the temperament measures, inhibitory control, did emerge as significantly associated with WLZ. As noted above, inhibitory control is measured by the ability to inhibit a dominant response in order to initiate a nondominant response (Rothbart, 2004b). It was initially expected that children high in inhibitory control would have been better at inhibiting excessive food intake and so should have had relatively low WLZ scores. However, the direction of this relationship was opposite the expected direction, revealing that higher inhibitory control was associated with higher WLZ.

Thus, toddlers with a greater ability to inhibit a dominant response were more likely to have higher WLZ scores. Higher inhibitory control does not reflect temperamental difficulty because these toddlers are more likely to regulate their responses to environmental cues that distract from the target response.

Although it is unclear why in the present investigation the direction of this effect was contrary to expectations (Anzman & Birch, 2009; Graziano, Clakins, & Keane, 2010), it is possible that the relationship between inhibitory control and weight is not developed sufficiently at 18 months to reflect the direction of association reported in past research. It could be, for example, that the considerable development in other components of temperament taking place in the second half of the second year may begin to regulate inhibitory control during this time frame. Executive attention, for example, undergoes considerable development in the second year and beyond (Rothbart & Posner, 2006) and is thought to moderate many other temperamental dimensions, including inhibitory control, over developmental time. Past research has reported significant negative associations between inhibitory control at 2 years of age and overweight or risk for overweight at 5.5 years (Graziano et al., 2010). Also reporting significant negative associations at a later age, Anzman and Birch (2009) reported inhibitory control among 7-year-old girls to be significantly negatively associated with their BMI at 7, 9, 11, and 15 years of age, raising the possibility that lower inhibitory control may have produced higher BMI. Future research should address not only the unique effects of individual dimensions of temperament on later weight outcomes but also their joint and interactive effects.

Similarly, it is possible that the links between temperament and weight may only emerge over time. Past research that examined infants from birth to 12 months of age reported significant relations between early difficult temperament and later weight and weight gain in childhood and

adolescence (Anzman & Birch, 2009; Carey, 1985; Darlington & Wright, 2006; Niegel et al., 2007; Pulkki-Råback et al., 2005; Wells et al., 1997; Wu et al., 2011). It may be that the present investigation did not detect significant associations between the difficult temperament dimensions and WLZ because these associations had not yet developed. Davis (2007) reported similar unexpected, nonsignificant associations between weight at 3 months of age and difficult temperament at the same age, although difficult temperament was linked to a higher frequency of feeding. It may be that the influence of temperament on factors encouraging higher weight and weight gain (e.g., feeding frequency) develop over time and lead to higher weight at a later time point than at the time of the temperament measurement.

Parental sensitivity may also influence the link between difficult temperament and both weight and weight gain. Wu et al. (2011) reported that significantly higher BMI percentiles (measured during school age) were found among children with difficult temperament (measured at 6 months) but only among those children with insensitive mothers as opposed to those with sensitive mothers. Thus, parental sensitivity may moderate the link between temperament and later weight outcomes. It was not possible to test this hypothesis in the present study because measures of parental sensitivity were not included in data collection.

Hypotheses 2 Implications and Future Directions

To test Hypothesis 2, toddlers' understanding of the differences between healthy and unhealthy foods was expected to relate to temperament. This hypothesis was partially supported but in the opposite direction as expected. With respect to the link between temperament and children's categorical understanding of food quality, correlational analyses revealed that only inhibitory control was associated. However, the direction of this relationship suggested that

children with *lower* inhibitory control engaged in marginally significantly more food quality categorization.

It is important to recall that to generate a sufficient sample size of categorizers, Mandler and Bauer's (1988) group membership cut-off criterion of $p = .10$ was adjusted to $p = .25$. The number of toddlers grouped as categorizers compared to the number of toddlers grouped as noncategorizers were very few. It is possible that because the p value was relaxed more participants were included in the categorizer group who ought not to be included. If the cut-off criterion had not been adjusted, fewer participants would be grouped as categorizers and therefore the relation with inhibitory control could potentially be nonsignificant or opposite in direction. On the other hand, if the relaxed criterion had admitted children to the categorizer group, the noise to signal ratio should have increased, rendering significant correlations less likely. It may be that a cut-off criterion of $p = .25$ represents a useful balance of conservative versus liberal cut-off values.

The finding that lower inhibitory control associated with food categorization is interesting in that it may shed some light on how toddlers with less inhibitory control may have greater understanding of the difference between healthy and unhealthy food categories. To the best of my knowledge, no studies have examined food categorization of toddlers and its relationship to temperament. One study did examine the relationship between temperament and the feeding of sweet foods, sweet drinks, and feeding caloric drinks at night (Vollrath et al., 2011). In that study, Vollrath and colleagues reported significant associations between the above mentioned feeding patterns and three broad dimensions of temperament at 18 months of age (i.e., Internalizing, Externalizing, Surgency).

Odds-ratio analyses in Vollrath et al. (2011) also indicated significantly greater odds of unhealthy feeding patterns among mothers reporting fewer years of education. This finding suggests that the educational level of parents may play a role in the types of foods and drinks offered to children and so should probably be controlled for when examining feeding behaviors and temperamental typology. If greater unhealthy food exposure is especially likely among less educated parents of toddlers, parents in the present investigation, who were generally highly educated, may not have provided their children with especially heterogeneous food options. The type of food exposure provided by parents, and thus children's knowledge of both healthy and unhealthy food types, should be further explored among samples of highly educated parents to examine for an influential relationship between temperamental typology and food exposure in homogeneous samples.

Hypothesis 3 Implications and Future Directions

Hypothesis 3 proposed that children's understanding of the difference between healthy and unhealthy foods may mediate the relationship between toddler temperament and their weight status. To the best of my knowledge, this is the first study to report on the association between the toddler temperament-weight relationship and the understanding of food types by toddlers. However, a mediation regression analysis showed no such mediation effect. Due to the nonsignificant effects between toddlers' ability to categorize the foods and both temperament and WLZ, the overall mediation hypothesis was not supported.

This finding is not surprising when more closely examining past reports of associations between food and weight. Typically, reports of such associations include aspects of feeding and diet that include parental control (Faith et al., 2004; Mhrshahi et al., 2011; Worobey et al., 2009). Mhrshahi et al. (2011) reported a significant association between rapid weight gain and

feeding on a parentally controlled schedule as opposed to feeding on an infant demand schedule. Worobey and colleagues (Worobey et al., 2009) similarly reported a significant relationship between early infant weight gain and the parental control of number of feeding times per day. One possibility for why no relationship was found between food categorization ability and weight status in the present investigation is that parental control of diet is still too great of an influence at this age. Parental control at this age may override any temperamental contributions to toddler weight and weight gain. Future studies should examine the understanding of different food types and the association with weight at a later age while possibly controlling for parental feeding styles.

A couple of studies have reported similar nonsignificant effects between infant temperament and weight outcomes after examining the relationship between infant temperament and feeding behavior. For example, Vollrath et al. (2011) found significant associations between temperament and feeding measures at 18 months of age but found no associations between temperament and weight measured at 12 months of age. Another study reported significant associations between difficult temperament at 3 months of age and the frequency of feeding and the consumption amount of formula (Davis, 2007). However, these frequently fed infants with difficult temperament were reported not to weigh significantly more than infants with easier temperament. As suggested previously in the discussion of Hypothesis 1, Davis's findings of no relationship between temperament and weight status may be a function of the early age of the children in his sample, perhaps the age of assessment of the children in his sample was too early to allow for the full manifestation of any temperament-feeding behavior effects on children's weight.

Strengths and Limitations

A major strength of the present investigation was the measurement of toddlers' abilities to distinguish between healthy and unhealthy food categories. To the best of my knowledge no previous study has examined the relationship between a toddlers' understanding of food quality (i.e., healthy and unhealthy) and either temperament or weight status. In addition, while the categorization task had been previously conducted successfully with children at preverbal ages (Mandler & Bauer, 1988), no such study examining food knowledge or feeding behavior has been conducted without the use of parental report. Although the hypothesis that understanding of food quality would be related to weight status was not supported, this preliminary investigation still sheds some light on how food categorization may be linked to temperament, at least at 18 months of age.

Another strength included the examination of the three variables, temperament, weight, and food categorization, within a single mediation analysis. Past research included the examination of temperament, weight, and feeding behavior (Davis, 2007; Vollrath et al., 2011), but not in a simultaneous exploration of how each of the variables relate to each other. Although food categorization failed to mediate the temperament-weight relationship, the overall exploration of the relationship between the three variables nevertheless revealed significant associations between the inhibitory control dimension of temperament and both WLZ and food categorization.

The current study had limitations that need to be addressed in future research. Future research should include a larger number of participants from a more diverse population. The current study consisted of parents representing a small range of parental education levels, with most parents reporting education levels at the 4-year college level or greater. As a result, the

effects of factors linked to educational level, such as parental feeding control or maternal sensitivity, may have attenuated the possible links between temperament, weight status, and children's understanding of food quality. Also, past research suggests the need for the examination of age at a later time point and should be considered when examining weight as an outcome of the temperament-food relationship.

An important limitation of this exploratory study lies in the original proposal of the categorization measure as a measure of food preference. It is unclear whether children's categorization of unhealthy versus healthy foods implies any preference for either type of food. In one study even after mothers reported food-frequency dietary choices for their infants, it was still unclear what proportions of foods were preferred and actually consumed (Vollrath et al., 2011). Further, even high food-frequency does not necessarily imply that children prefer those foods, although research on food exposure would suggest that over time preference may increase (Birch & Marlin, 1982; Wardle et al., 2003). The current study was an attempt to address the influence of child food selection and preference without the report of parental influence; however, the actual food preference of children was probably not addressed in the current methodology. A measure of food preference at an earlier age needs to be designed to better explain the association between temperament, weight, and actual food preference of infants and toddlers. A measure examining food preference at an early age may include a number of frequency exposures as in, Birch and Marlin (1982) to determine if actual choice of foods is based on exposure, which has been shown to positively influence preference (Birch, 1999; Birch & Marlin, 1982; Wardle et al., 2003).

Conclusions

In conclusion, this study provided some support for a temperament weight relationship, and, to the best of my knowledge, proposed the first measure of children's understanding of food quality without the use of parent report, on a temperament-weight relationship at an early age. Examining how temperament influences what infants and toddlers understand about what they eat may lead to a better understanding of how temperament is influencing weight.

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