The Interdependent Nature of Mother's and Children's Temperament and Approach to Food and its Impact on Weight

by

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ABSTRACT

Obesity is associated with many well-established health risks as well as high annual public health costs. Intervening in the trajectory of obesity becomes significantly more difficult after a child has reached obesity. Therefore, it is crucial to understand the processes that influence weight early in life. Parents serve as one of the main influences on child health, have a significant impact on the weight of their offspring, and are often incorporated into childhood obesity prevention programs. However, the mutual influence that parents and children have on each other is not accounted for. Using an Actor-Partner Interdependence model, the current study 1) examined the effect of children's and mother's temperament (e.g., negative affectivity, effortful control, and impulsivity) on their own weight as well as the weight of the other dyad member, 2) explored the effect of the interaction between mother and child temperament on both members' weight, 3) assessed the effect of mother's approach to food on mother and child weight, and 4) investigated how temperament might moderate the relationships between mother's approach to food and mother and child weight. The sample consisted of 220 mother-child dyads. Children ranged from 4 to 6 years of age. Mothers completed self-report questionnaires on their own temperament and approach to food as well as their child's temperament. Weight measures were assessed in the laboratory for both mother and child. Results indicated children's impulsivity was related to their mother's higher weight. The interaction between mother and child temperament was not significantly associated with weight. However, the interaction between child impulsivity and mother's approach to food was significant; the effect of the mother's approach to food on her own weight depended on their child's impulsivity behaviors. Specifically, mothers' approach to food on her own weight was nonsignificant when her child showed higher levels of impulsivity. The association of mother's approach to food with her own weight was stronger when her child exhibited average to low impulsivity levels. This investigation of the influence of mother and child on each other's weight is well-placed for translation into later obesity preventative and intervention efforts for family systems.

DEDICATION

To my friends, lab family, and cohort members who have shaped my growth, lightened my worries, and enjoyed many Taco Tuesdays.

To my father, mother, and brother for providing a strong foundation of love, support, and curiosity from which I can safely explore and for shaping me into the person I am today.

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Introduction

With nearly one-third of America's youth classified as overweight or obese ($\geq 85^{th}$ percentile of the CDC growth charts) (Ogden, Carroll, Kit, & Flegal, 2014), childhood obesity is a national health problem that has reached epidemic levels. Weight-associated health problems (Lobstein, Baur, & Uauy, 2004), along with the associated economic burden (Finkelstein, Fiebelkorn, & Wang, 2004), are also increasing at alarming rates. In fact, over 112,000 deaths per year have been attributed to obesity (Lifshitz, 2008). If this epidemic continues unhindered, this generation of children will live sicker and die younger than previous generations (Olshansky et al., 2005). Furthermore, research has shown that once a child has overweight, they are more likely to continue to have increased weight during adolescence, and in turn are at even higher risk of having obesity in adulthood (Cunningham, Kramer, & Narayan, 2014; Dehghan, Akhtar-Danesh, & Merchant, 2005; Lifshitz, 2008). Furthermore, because the risk of adult obesity is greater for children with higher levels of obesity (Guo, Chumlean, & Roche, 2002; Serdula, Ivery, Coates, Freedman, Williamson, & Byers, 1993; Singh, Mulder, Twisk, Van Mechelaen, & Cinapaw, 2008), and intervening in the trajectory of obesity becomes significantly more difficult after a child has reached obesity (Buscot et al., 2018; Fildes et al., 2015; Stuart & Panico, 2016), it is crucial to understand the processes that influence weight early in life.

Not surprisingly, there is substantial research on predictors of childhood obesity. However, to our knowledge, no studies have examined the effect a child has on their parents' weight. This may be an important factor influencing the maintenance of adult weight. This is especially important as parent-child relationships are inherently dyadic, yet weight research using a dyadic approach is not widely used. Examining weight in this way may allow for a more complete understanding of how the family system may impact obesity, can provide key information on which dyads are most at risk for obesity, and allow the tailoring of obesity intervention and prevention efforts.

Theoretical and Conceptual Understanding of Weight

The theoretical framework for this study draws upon the developmental, behavioral, cultural, and obesity literatures. The developmental systems theory, which refers to a group of theories that propose bidirectional relationships between multiple variables, often across multiple levels of organization (Damon & Lerner, 2008), encompasses these frameworks and broadly informs the proposed study's model. All developmental systems theories share several defining features that provide a firm foundation for theoretical and conceptual models hypothesizing associations between variables from any one level of organization to variables from other levels. First, developmental systems theories typically reject dichotomizations or reductionistic divisions of development in order to adopt a holistic approach to understanding associations between variables across development (Damon & Lerner, 2008). This approach avoids oversimplifying the relationship between variables. Instead, it highlights the importance of considering all possible associations among variables that could contribute to a specific outcome (i.e., the impact of the interaction between parent and child temperament on both members' weight) (Damon & Lerner, 2008).

Developmental systems theories also suggest that there are multiple levels of organization within human development, from the most basic level (consisting of genetic, biological and physiological variables) to more complicated levels (may include person-level, family-level, community-level, societal-level, and cultural- and chronological-level variables) (Damon & Lerner, 2008). An important aspect of developmental systems theories is the idea that all levels of organization are integrated or fused in some way, such that there is unification and bidirectional links among the different levels of organization that contribute to specific outcomes and human development as a whole (Damon & Lerner, 2008). The final facets of developmental systems theories relate to temporality, plasticity, and diversity or individual differences in development. Specifically, these models acknowledge the role of time and chronology in human development (Damon & Lerner, 2008), implying that specific traits and characteristics may change within individuals over time. This change is described as plasticity in human development. Additionally, levels of plasticity may vary across the lifespan as the context of ongoing development may provide different opportunities for developmental changes (Damon & Lerner, 2008). Finally, plasticity can change not only within individuals across the lifespan, but also across individuals and across the developmental system which creates diversity in human growth and outcomes (Damon & Lerner, 2008).

Examples of the developmental systems theory include Bronfenbrenner's ecological systems model (Figure 1) (Bronfenbrenner, 1992; Bronfenbrenner & Morris, 2006), the associated ecological models of health (Figure 2) (Institute of Medicine Staff, 2001) and childhood obesity (Figure 3) (Birch & Ventura, 2009), and the Family-Collaborative Ecosystemic Model (FEM, Table 1) (Goetz & Caron, 1999). At its most general level, the ecological systems model highlights the importance of both proximal (i.e., those experienced directly by the individual, like the microsystem) and distal (i.e., those experienced by the individual indirectly, like the exosystem) contexts on individual outcomes, with the influence of these variables changing over time (Bronfenbrenner, 1992; Bronfenbrenner & Morris, 2006; Molfese et al., 2010).

The ecological model of health (Institute of Medicine Staff, 2001) adapts Bronfenbrenner's model to bridge the gap between health and health policy. This model shows that not only do the social and physical environments affect health outcomes, but genetics also influence biological and behavioral health factors. Again, this model highlights that all levels that influence an individual are continuously changing due to their bidirectional influences on each other. The ecological model of childhood obesity adapts the ecological framework to fit childhood obesity specifically, making it the clearest connection to the current study (see Figure 3). This depiction suggests that weight is influenced by food intake and energy expenditure (common targets for obesity interventions) (Bartholdy, Dalton, O'Daly, Campbell, & Schmidt, 2016; Birch & Ventura, 2009; Dehghan, Akhtar-Danesh, & Merchant, 2005; Jasinska et al., 2012; Schmitz & Jeffery, 2000), but that these patterns are found within the larger context of family and environment. Finally, the Family-Collaborative Ecosystemic Model (Goetz & Caron, 1999) views obesity through an integration of family systems theory, ecosystems theory, and biopsychosocial theory. As the name suggests, family systems theory posits that families cannot function independently; when one member alters behavior, it impacts the other members (Kaplan, Arnold, Irby, Boles, & Skelton, 2014). As such, the family provides the primary setting to promote and support (weight-related) development. In addition, the FEM incorporates biopsychosocial theory by highlighting the connection between the body, mind and social relationships and emphasizes the reciprocal influence across the ecosystem continuum. Table 1 shows a grid that translates the FEM into a clinically useful tool that highlights the multi-level nature of life.

Inherent in these models is that child health, specifically weight, is not simply an individual choice, but is complex and determined by bidirectional relationships among the ecosystem continuum, as well as the family system, and body-mind-relationship connection. While there are extensive and important overlaps between these four models, a main difference separates the ecological systems models from the FEM. This is the focus on the family unit.

The FEM focuses on finding and addressing balance or imbalance between levels; in particular, the FEM states that obesity can be seen as a failed attempt at establishing balance in the interactions found within a family. What these models imply for obesity prevention and intervention research is that these efforts may be more effective if they are focused across multiple contexts/levels that influence weight. Current interventions exist across the different levels of the ecological framework (individual: food intake, energy expenditure; microsystem: parenting style, food availability; exosystem: building more exercise facilities, advertising health risks) (Schmitz & Jeffery, 2000). Although the models all include bidirectional relationships, the vast majority of the literature focuses on the child and factors that influence the child (only one half of a relationship/interaction). The current study serves to extend the current model of obesity by focusing on an aspect of context that is currently missing from the literature: the influence of the child on the mother (the second half of a relationship/interaction).

General Risk Factors for Obesity for Parents and Child

Given these models of obesity, weight should be understood within these ecological frameworks. The following section outlines findings on individual risk factors (i.e., genetics, gender, temperament, approach to food) as well variables that explore the broader context of obesity risk (i.e., parent factors, environment, interactions between dyads). By understanding what research exists, we will have a clearer picture of what part(s) of the models are missing from the literature.

Genetics. Genetically, it has long been known that obesity runs in families. This has been supported by findings that link body fat indices of biological parents and offspring more closely than that of adoptive parents and children (Lifshitz, 2008). Heritability estimates of adiposity vary widely across studies, however, ranging from 45-90% (Bayoumi et al., 2007; Bo, Cavallo-Perin, Scaglione, & Pagano, 1997; Elder et al., 2014; Forbes, Sauer, & Weitkamp, 1995; Hanisch, Dittmar, Höhler, & Alter, 2004; Hsu et al., 2005; Malis et al., 2005; Maes et al., 1997; Nguyen Howard, Kelly, & Eisman, 1998; Rice et al., 1997; Samaras et al., 1999; Samaras et al., 1997; Schousboe et al., 2004). Ethnicity also affects risk for obesity as Hispanic children are the most overweight racial/ethnic group in the U.S. (CDC, 2005; Ogden et al., 2014). Furthermore, more than one hundred genetic variants have been found to be associated with obesity through adipogenesis, energy intake, lipolysis and energy expenditure (Moleres, Martinez, & Marti, 2013). Polymorphisms of the serotonin and dopamine system genes have been of particular focus within the obesity literature (Sookoian et al., 2007; Sookoian, Gianotti, Gemma, Burgueño, & Pirola, 2008; Levitan et al., 2017; Silveira et al., 2016; Wickrama, O'Neal, & Lee, 2013). For example, the short variant of the serotonin transporter gene (*5-HTTLPR)* has been associated with higher weight (Sookoian et al., 2007; Sookoian, Gianotti, Gemma, Burgueño, & Pirola, 2008) and research has found a stronger link between community adversity and unhealthy body mass index (BMI) trajectories among adolescents with more sensitive dopamine and serotonin system alleles (Wickrama, O'Neal, & Lee, 2013). In addition, girls carrying the 7R allele of DRD4 consumed more fat when living in adverse socioeconomic conditions (Silveira et al., 2016) and had higher risk for obesity when raised by a caregiver with low sensitivity (Levitan et al., 2017). Finally, DRD2 A1 allele carriers showed higher rates of emotional eating when exposed to adverse parenting (van Strien, Snoek, van der Zwaluw, & Engles, 2010). Taken together, the existing research findings suggest that genetics are one factor in the development and maintenance of obesity.

Environment. While there is strong support for a genetic component to obesity, environment has also been linked to increased obesity risk. For example, it is well known that childhood economic status can have long-term impacts on health, including weight outcomes. Children in low socio-economic-status (SES) environments have higher BMIs at age 2 (Klebanov, Evans, & Brooks-Gunn, 2014), as well as higher obesity rates and accelerated weight gain during school age years (Singh, Kogan, Van Dyck, & Siahpush, 2008; Wells, Evans, Beavis, & Ong, 2010) than children from higher SES backgrounds. The effect of SES on weight continues into adulthood (Drewnowski et al., 2014; McLaren, 2007) with lower SES linked to higher obesity risk. In addition, individuals from low SES environments, specifically food insecure environments (i.e., settings where the availability of nutritionally adequate foods are uncertain) (Kaiser et al., 2002), may also be more vulnerable to the negative weight implications of obesogenic environments.

Research has shown that feeding patterns and approaches to food differ based on food security status (Bronte-Tinkew, Zaslow, Capps, Horowitz, & McNamara, 2007; Kaiser et al., 2002), yet individuals who are food insecure have been shown to maintain these unhealthy eating behaviors despite change in food availability (Perez, 2016). Thus, the research evidence converges and suggests that environments across the lifespan play an important role in the development and maintenance of obesity.

Gender. Importantly, there are also gender differences in risk for obesity. Specifically, being female doubles the chance of having overweight, and women are more likely than men to have obesity (Hallam, Boswell, DeVito, & Kober, 2016). Furthermore, a meta-analysis found consistent differences in BMI scores, weight gain, and body composition based on gender, such that girls showed higher BMI scores, more weight gain, and greater percent body fat before and after the onset of puberty compared to boys (Wisniewski & Chernausek, 2009). Research also suggests that eating pathology is seen more often in females (White et al., 2015) and that women may show more unhealthy approaches to food (Larsen, van Strien, Eisinga, & Engels, 2006).

There is also research suggesting that weight varies for men and women depending on whether they are in low or high SES environments. Contextual theory posits that difficult social and environmental conditions may exacerbate obesity risk in females but not males (Seamans, Robinson, Thorpe Jr., Cole, & LaVeist, 2015; Suglia, Duarte, Chambers, & Boynton-Jarrett, 2012). This could be, in part, due to the fact that men in low SES environments are more likely to have physically demanding jobs compared to women and high SES men (Zhang & Wang, 2004). Another potential alternative is that women are more susceptible to social adversity within their environments when compared to men with subsequent influence on health. A recent longitudinal study found that women's weight increased more rapidly over the 15-year study when they experienced higher levels of childhood stress compared to lower childhood stress; stress levels did not impact the weight of men (Liu & Umberson, 2015).

Risk Factors to Obesity Central to the Current Study

Temperament. Based on observations that hunger and satiety cues are influenced by stress and socioemotional factors, research is now focusing on how individual differences in temperament, a construct that is apparent early in life and is relatively stable across the lifespan, relate to eating and subsequent obesity (Graziano, Kelleher, Calkins, Keane, & Brien, 2013; Shiner et al., 2012). In fact, there is extensive literature exploring the relationship between temperament and weight in infants, children, and adults. Based on descriptions of temperament from several perspectives, temperament has been defined as consisting of "early emerging basic dispositions in the domains of activity, affectivity, attention, and self-regulation, and these dispositions are the product of complex interactions among genetic, biological, and environmental factors across time" (Shiner et al., 2012).

Affectivity and weight. A large focus of the literature exploring associations between temperament and weight focuses on the domain of negative affectivity. Negative affectivity is the propensity toward feeling and/or expressing negative emotions and distress (Rothbart & Bates, 2006). The earliest study identified (Carey, 1985) examined 200 infants recruited from a middle-class private practice. The goal of this study was to determine whether difficult infants (those low on rhythmicity, approach, and adaptability and high on negative mood and intensity) gained weight at a faster pace than infants with non-difficult temperaments. Results supported this idea, such that infants rated as more difficult on the Infant Temperament Questionnaire showed more rapid weight gain between six and twelve months of age. Interestingly, the only dimension of difficult temperament that was statistically significant was negative mood, which suggests that negative mood was driving the results (Carey, 1985). Darlington and Wright (2006) had similar findings. They assessed weight gain from birth to eight weeks in 75 infants recruited from local health care clinics and found a positive association between rapid weight gain and distress to limitations, a measure of anger proneness (i.e., an aspect of negative emotionality; Darlington & Wright, 2006). Similarly, two longitudinal studies found a positive relationship between infant negativity and weight outcomes. Specifically, distress to limitations (measured using the Infant Behavior Questionnaire) in 30 twelve-week-old Australian infants predicted percent body fat at three years of age (Wells et al., 1997). Distress to limitations (measured with the Infant Behavior Questionnaire-revised) measured at three-, six-, and nine- months, as well as the Early Childhood Behavior Questionnaire at twelve- and eighteen-months predicted increased skinfold thickness measures at all subsequent time points as well as increased weight-for-length z scores at twelve months (Slining, Adair, Goldman, Borja, & Bentley, 2009).

Looking at older children, Carey, Hegvik, and McDevitt (1988) followed a group of 138 children from four to five years of age to the age of eight or nine in order to study the hypothesis that rapid weight gain would be related to difficult temperament. Using the Behavioral Style Questionnaire, the researchers found a positive longitudinal relationship between eight out of nine difficult temperament characteristics in three-year-olds and weight-for-height gain four and a half years later (Carey et al., 1988). In a similar study, negative affectivity was measured six times between the ages of four to five and fourteen to fifteen years in 2975 children. Results suggested that children who had higher rates of negative affectivity in early childhood gained more weight by the age of fourteen or fifteen (Sutin, Kerr, & Terracciano, 2017). In the same way, Pulkki-Råback, Elovainio, Kivimäki, Raitakari, and Keltikangas-Järvinen (2005) used the three youngest age cohorts (six, nine, and twelve) derived from a population-based sample of Finns; the total sample included 681 participants who were twenty-four, twenty-seven, and thirty at follow-up. Results from this study suggest that high emotionality predicted increased BMI.

This research suggests that temperament, specifically the domain of negative affectivity, may be a risk factor for weight gain. This finding could be explained in several ways. First, individuals who approach and/or react to situations in a more negative way may be less flexible about changing their behaviors, including behaviors related to eating, leading to higher weight. Second, increased levels of negative affectivity may be associated with more stressful social interactions due to difficult reaction styles; eating may be used as a coping strategy, and eating in the absence of hunger has been shown to be a risk factor for obesity (Blissett, Haycraft, & Farrow, 2010). Third, children with more difficult temperaments may elicit certain responses from their caregivers, including extra feedings, to help both individuals cope with the expression of negative emotions. This interaction would increase current weight, but may also teach children to use food to cope with their emotions leading to a long-term pattern that would increase risk for obesity (Carey et al., 1988; Haycraft et al., 2011; Pulkki-Råback et al., 2005; Zeller et al., 2008).

Importantly, there are several studies that contradict the previous findings. For example, in a study of 1029 infants, a measure of negative affectivity assessed with the Infant Behavior Questionnaire at 6 weeks of age did not predict weight gain, skinfold measures, or bioelectrical impedance at 6-8 years (Wright, Cox, & Le Couteur, 2011). Furthermore, results from 1957 five-month-olds suggested that infant difficultness from the Infant Characteristics Questionnaire, does not predict BMI trajectories from 5 months to 8 years (Pryor et al., 2011). Haycraft, Farrow, Meyer, Powell, and Blissett (2011) also did not find a relationship between parent-reported child body mass index (BMI) and negative emotionality in 241 three to eight-year-old participants using the EAS Temperament Survey. Other scientists attempted to evaluate child temperament as a predictor of child body mass index by studying 201 preschool children between the ages of two and five using mother-reported child weight and the Short Temperament Scale. The expected associations between child temperament and child BMI were not found within this sample (Bergmeier, Skouteris, Horwood, Hooley, & Richardson, 2014). Explanations that may account for these discrepancies are explored below; however, further research is needed in this area to better elucidate the relationship between negative affectivity and weight.

Self-regulation and weight. The relationship between weight and self-regulation, another aspect of temperament, has also been the focus of extant research. Self-regulation includes voluntary and involuntary levels of control. These levels of control include effortful control and impulsivity. Effortful control is voluntarily influenced and includes attention regulation (the ability to shift and focus attention as needed), activation control (the ability to perform and action when there is a strong tendency to avoid it), and inhibitory control (the ability to inhibit a dominant response in order to activate a subdominant response; Rothbart & Bates, 2006; Murray & Kochanska, 2002). Impulsivity is an aspect of involuntary control that involves rushing into or through an activity without giving it much thought (Eisenberg et al., 2007). In 53 three-month-old infants from postnatal wards of London hospitals, measures of surgency/extraversion on the Infant Behavior Questionnaire, an early link to impulsivity, predicted growth from birth to three-months of age (Burton et al., 2011). Seeyave et al. (2009) collected data from 966 kids from the larger National Institute of Child Health and Human Development Study of Early Child Care and Youth Development (NICHD-SECCYD) at ages four and eleven. Their ability to delay gratification was measured using the self-imposed waiting task at age four. If the child waited the full seven minutes before eating any of their preferred food, they passed. Children who failed the test were more likely to have overweight at age eleven. Using participants from the same NICHD-SECCYD study, Francis and Susman (2009) looked at data from 1061 children between the ages of three and twelve. At three years of age, participants completed a self-control procedure where the goal was to not touch a favored toy for 150 seconds. At the age of five, participants completed the same delay of gratification procedure although kids were grouped based on whether they waited for three and a half minutes. Children who exhibited low self-regulation in both procedures had significantly higher BMIs at all points of the study as well as the most rapid gains in BMI from three to twelve.

Similarly, Graziano, Calkins, and Keane (2010) studied whether early, generalized self-regulation deficits or a more focal deficit within the eating domain placed children at risk for becoming obese later in life. Participants for this study included fifty-seven children from a larger ongoing longitudinal study recruited from childcare centers, county health department and local women, infants, and children program. At two years of age they completed several lab assessments of self-regulation: sustained attention (time spent watching video), emotion regulation (prize in a box they couldn't open and highchair), and reward sensitivity (box with present: how much they touched in two minutes). Follow-up took place at five and half years of age. Regulation skills in toddlerhood were predictive of both normal variations in BMI development and pediatric obesity. Specifically, toddlers with poor emotion regulation skills and lower inhibitory control skills/higher reward sensitivity were more likely to be classified as overweight at five and a half (Graziano et al., 2010).

In 2013, Graziano, Kelleher, Calkins, Keane, and Brien expanded on this study to include 195 children from the age of two to the age of ten. Results of regulation and obesity were consistent with their past study; in fact, for everyone standard deviation increase in poor self-regulation, the likelihood of having overweight/obesity at age ten increased by seventy-four percent (Graziano et al., 2013). These results are consistent with a study by Nederkoorn, Braet, Van Eijs, Tanghe, and Jansen (2006) who used two behavioral paradigms to test whether obese children (thirty-two kids, mean age of thirteen, from obesity residential treatment center) are more impulsive than their non-obese counterparts (thirty-one kids, mean age thirteen). The first task, the door opening task, was based on the motivational approach to impulsivity research (sensitivity to reward and intolerance for delay of reward; mediated by two systems, the behavioral activation and inhibition systems), while the second task, the stop signal task, was based on the inhibition approach to impulsivity (necessary for executive functions and contributes by creating a delay in which to think before acting). In addition, a self-report measure of impulsivity was used. Results from this study suggest that children with obesity opened significantly more doors than controls and had significantly longer response times, indicating that kids with obesity were more sensitive to reward and unable to inhibit ongoing motor responses. Furthermore, individuals with obesity characterized as binge eaters gambled longer than non-bingers and kids with the least amount of inhibitory control were least successful at losing weight during treatment. These results are novel because the tests were generalized, not just restricted to food items, indicating that children with obesity may have a more general problem with impulsivity/lack of regulation. Braet, Claus, Verbeken, and Van Vlierberghe (2007) continued work in this area by studying fifty-six children with overweight and fifty-three children with normal weight between the ages of ten and eighteen. Using the Matching Familiar Figure Test and a child interview, the researchers found that the children with overweight responded in a more impulsive way. Several brain imaging studies suggested that overeating in adult samples is associated with reactivity in regions of the brain associated with attention when presented with food cues (Stice, Lawrence, Kemps, & Veling, 2016). Further examination of brain-imaging studies suggests that when shown high-calorie foods, individuals with obesity show less response in brain regions that have been implicated in inhibitory control compared to individuals with normal weight (Stice et al., 2016).

When taken together, these findings suggest that self-regulation deficits are not merely consequences of obesity but may be risk factors that emerge in early life. These factors of self-regulation could impact eating behaviors and weight as the ability to shift attention away from stressors in order to focus on more positive thoughts may allow individuals to inhibit their impulse to eat (Compas, Connor-Smith, & Jaser, 2004; Eisenberg et al., 2004), while the ability to engage in physical activity even when there is low desire may help balance energy intake. Finally, impulsivity is an aspect of involuntary control that involves rushing into or through an activity without giving it much thought (Eisenberg et al., 2004). Individuals with impulsivity give into their desires and are pulled into an activity without thinking based on the potential rewards. This could be how people high in impulsivity are responding to food. All of these factors may impact weight.

However, it is also important to highlight the discrepant literature. Tan and Holub (2011) found that parent-reported general inhibitory control was *not* related to the BMI percentiles of sixty-three children between the ages of three and nine. Faith and Hitner (2010) also found discrepant results in a study examining regulation at one year of age and obesity risk at six years of age in 487 children. Interestingly, lower attention span was related to greater obesity risk, as expected, but only in males; in female children, attention span and obesity risk were not related. Considerations that may explain these different findings are laid out below; importantly, research needs to continue to explore the relationship between self-regulation and weight in order to clarify this relationship.

Explanations for Conflicting Findings. Important methodological components could be responsible for the discrepant findings explored above. For example, there are four compelling theories of temperament, each with their own general definitions, dimensions, and measures of temperament (Shiner et al., 2012). Many of the studies' findings of an association between weight and temperament used measures of temperament from Rothbart. Of the studies that didn't find this association, one used the EAS Temperament Survey (a measure of temperament for the model given by Buss and Plomin) and one used the Short Temperament Scale (a measure based on the model of temperament developed by Thomas and Chess). None of the other studies used these measures; it is possible that the model/constructs these measures capture are different than those from other measures used.

Other important method considerations are the differences between outcomes using objective versus subjective methods. Specifically, when using objective measures of attention in children (Francis & Susman, 2009; Seeyave et al., 2009) and adults (Stice et al., 2016) outcomes supported an association between attention and weight. However, when using parent-report from the Colorado Childhood Temperament Inventory, the association was not as expected. This might suggest that the objective tasks and subjective measures are capturing different constructs; it might also indicate that this particular subjective measure does not have convergent validity. Special care should be taken when comparing results from different measures. Another method consideration is age. While temperament is relatively stable over time, it often isn't substantially stable until the preschool years, as it takes time for the control systems to develop (Shiner et al., 2012). Therefore, the discrepant results from studies measuring temperament in infancy should be interpreted with caution. Measurement of weight should also be considered. There is no single universally recommended method to assess body composition (Duren et al., 2008). Each available modality has its own pros and cons, although studies suggest that BMI, waist circumference, and the waist-stature ratio are more related to each other than to percentage of body fat (Flegal, et al., 2008) leading to weight misclassifications

(Shah & Braverman, 2012). Therefore, it has been suggested that multiple assessment techniques be used in order to achieve greater power in examining and characterizing adiposity (Duren et al., 2008). Many methods were used in the literature described above which may have also limited the ability to compare results across studies.

Finally, the contexts of an individual's experiences may influence how temperamental traits are expressed. Several studies have included moderators that change the relationship between temperament and weight outcomes. Specifically, the relationship between temperament and weight has been found to be moderated by parenting style (Wu, Dixon Jr., Dalton III, Tudiver, & Liu, 2011; Zeller, Boles, & Reiter-Purtill, 2008), parent feeding style (Boles, Reiter-Purtill, & Zeller, 2013; Rollins, Loken, Savage, & Birch, 2014), and approach to food (Tate, Trofholz, Rudasill, Neumark-Sztainer, & Berge, 2016). Thus, other variables should be considered when exploring the relationship between temperament and weight in order to have a more complete understanding of the mechanisms behind risk for obesity.

Approach to food. Within the obesity literature, unhealthy approaches to food have also been proposed as risk factors that may contribute to the development and maintenance of overweight among children and adults (Schembre, Greene, & Melanson, 2009; Wardle, Guthrie, Sanderson, & Rapoport, 2001). For children, there are eight aspects of eating style that have been found to impact weight. Food responsiveness and enjoyment of food are similar measures that capture a child's tendency to eat in response to food in their environment. Desire to drink exhibits children's preference to carry drinks around with them, usually of the sugared variety. Emotional overeating is the tendency to overeat, in the absence of hunger, when confronted with negative emotions (Wardle et al., 2001). These four behaviors have all been associated with increased weight in children (Blissett, Haycraft, & Farrow, 2010; Braet & Van Strien, 1997; Carnell, & Wardle, 2007; Carnell, & Wardle, 2008; de Lauzon et al., 2004; James, Thomas, Cavan, & Kerr, 2004; Ludwig, Peterson, & Gortmaker, 2001; Santos et al., 2011; Sleddens, Kremers, & Thijs, 2008; Utter, Scragg, Schaaf, Fitzgerald, & Wilson, 2007; Wardle et al., 2001; Wardle, Marsland, Sheikh, Quinn, Fedoroff, & Ogden, 1992). Satiety responsiveness measures a child's ability to respond to internal hunger and satiety cues. Slowness in eating is an aspect of eating that is usually seen near the end of a meal when a child begins to slow their rate of consumption as they become full and lose interest in their food; however, it can also be seen throughout the meal if the child lacks enjoyment or interest in their food. Food fussiness is also known as being a picky eater and is often associated with the consumption of an inadequate variety of foods. Emotional undereating is the decrease in eating in response to negative emotions. The latter four approaches to food have been found to have an inverse relationship with weight (Barkeling, Ekman, & Rössner, 1992; Carnell, & Wardle, 2007; Carnell, & Wardle, 2008; Cecil et al., 2005; Dovey, Staples, Gibson, & Halford, 2008; Geliebter & Aversa, 2003; Hayes et al., 2016; Santos et al., 2011; Sleddens, Kremers, & Thijs, 2008; Viana, Sinde, & Saxton, 2008).

In adults, approach to food has revolved around three main theories (psychosomatic, externality, and restraint) and has led to four aspects of eating style that have been found to impact weight (Schembre, Greene, & Melanson, 2009). Psychosomatic theory focuses on the aspect of emotional (over)eating, the theory of externality focuses on eating in response to external cues regardless of actual satiety, and the restraint theory posits that external and emotional eating are due to dieting. This theory has been broken into two parts: compensatory restraint (i.e., the intentional limitation of food consumption after an episode of overeating) and routine restriction (i.e., habitual restriction of energy intake in order to control weight). Higher levels of external and emotional eating and lower levels of compensatory and routine restraint have been associated with higher weight (Blissett, Haycraft, & Farrow, 2010, Schembre & Geller, 2011; Schembre, Greene, & Melanson, 2009; Vandeweghe, Verbeken, Vervoort, Moens, & Braet, 2017).

There is little research exploring the relationship between temperament, approach to food, and weight. However, the existing research does support an association. For example, preschoolers with higher surgency, an indicator of impulsivity, were more likely to eat in response to external cues, have frequent desire to eat, derive pleasure from food, and eat in the absence of hunger. Preschoolers with higher levels of negative affectivity were more likely to have tantrums over being denied food and less likely to eat in the absence of hunger (Leung et al., 2014). Moreover, one study found that children with difficult temperament were at higher risk of being overweight due to emotional eating compared to easy temperament children, while difficult temperament children who were fussy eaters had lower risk of being overweight (Tate et al., 2016). A similar pattern emerges with adults, where high negative emotionality and low effortful control is associated with disordered eating (Burt, Boddy, & Bridgett, 2015). Thus, across children and adults, difficult temperaments are associated with unhealthy approaches to food. These relationships should be further explored.

Parental risk factors for obesity. Parents serve as one of the main influences on child health (Lindsay, Sussner, Kim, & Gortmaker, 2006) and have been shown to have significant impact on the weight of their offspring. For example, there is a strong association between parental weight and child risk for obesity, such that parents with obesity are more likely to have children with overweight/obesity (Classen & Thompson, 2016; Jääskeläinen et al., 2011; Johannsen, Hohannsen, & Specker, 2006; Næss, Holmen, Langaas, Bjørngaard, & Kvaløy, 2016; Serlachius et al., 2016; Whitaker, Jarvis, Beeken, Boniface, & Wardle, 2010).

Parents' approach to food. A parent's own approach to food may contribute to obesity risk in their children. Research has found that maternal food intake is associated with children's food intake and eating patterns from a young age (Beydoun & Wang, 2009; Patrick & Nicklas, 2005). Moreover, when families were placed in a childhood obesity prevention program and parents were trained to increase their consumption of fruits and vegetables or to decrease their consumption of high-fat/high-sugar foods, children showed similar changes in food consumption to that of their parents (Epstein et al., 2001). It is also possible that mothers who are less aware of their own internal satiety cues, and who consume food for reasons beyond hunger, may be less responsive to the fullness cues given by their toddlers (Hodges et al., 2013) leading to children who eat more in response to external and emotional cues (Wardle et al., 2001).

To date, little research has explored the direct connection between a parent's use of external eating, emotional eating, and/or restriction on their child's own approach to food and subsequent weight. However, based on modeling and social learning theory (Bandura, 1977), it is reasonable to believe that children with parents who have an unhealthy approach to food will not only show similar eating behaviors, but will also show higher current weight compared to children with parents who have healthier approaches to food. This idea is supported by research that found dietary disinhibition behaviors (i.e., overeating in the absence of hunger) in mothers predicted food consumption and overweight in daughters (Cutting, Fisher, Grimm-Thomas, & Birch, 1999).

Feeding environment created by parents. Feeding environment (i.e., structured meals, interaction during eating vs. television watching) is also shown to have a significant influence on a child's food consumption patterns and weight (Patrick & Nicklas, 2005; Thompson, 2013), and is another way parents may impact their child's weight. Research shows that mothers with obesity reported lower levels of structure/routine during mealtimes, lower levels of social interaction throughout meals, and higher rates of watching television (Thompson, 2013) suggesting that this form of interaction may influence the weight of children. This is consistent with data suggesting that time spent eating as a family and time spent watching television also have a significant impact on a child's food consumption patterns (Patrick & Nicklas, 2005) which may dramatically influence weight.

Parent feeding style. Furthermore, higher levels of different feeding styles (i.e., reward, restriction, pressure to eat) are shown to have a significant influence on children's weight gain (Birch & Fisher, 2000; Clark, Goyder, Bissell, Blank, & Peters, 2007; Haycraft & Blissett, 2008; Johannsen, Johannsen, & Specker, 2006; Lindsay et al., 2006; Powell, Frankel, & Hernandez, 2017; Thompson, 2013; Wardle, Sanderson, Guthrie, Rapoport, & Plomin, 2002). Furthermore, different feeding styles, like the use of food as a reward or to control behavior (Powell, Frankel, & Hernandez, 2017; Thompson, 2013; Wardle et al., 2002), limiting the quantity and quality of foods in order to restrict eating (Birch & Fisher, 2000; Clark et al., 2007; Haycraft & Blissett, 2008; Johannsen, Johannsen, & Specker, 2006; Lindsay et al., 2006), and pressuring children to eat more during mealtimes (Clark et al., 2007; Haycraft & Blissett, 2008) are shown to have a significant influence on children's weight, such that higher levels of these feeding styles are associated with higher weight in children. Areas that are less domain specific, like general parenting style, have also been shown to impact children's weight. Specifically, authoritative homes tend to have children with lower weight than homes with other styles (i.e., authoritarian, permissive/indulgent, uninvolved/neglectful) (Gerards et al., 2012; Golan & Crow, 2004; Rhee, 2008; Sleddens, Gerards, Thijs, De Vries, & Kremers, 2011; West, Sanders, Cleghorn, & Davies, 2010).

Interactions between parent and child. Although parents are in control of how they parent and feed their children, much of these behaviors may be influenced by the child's temperament. These interactions, in turn, could be associated with eating behaviors and weight early on. For example, youth with obesity and difficult temperaments are at increased risk for problematic parental feeding behaviors and mealtime functioning (Boles, Reiter-Purtill, & Zeller, 2013). Specifically, past research has linked children high in impulsivity and negative affectivity with receiving and consuming more carbohydrates and sweet drinks during a day (Skogheim & Vollrath, 2015) and parents of difficult temperament children showed elevated use of restriction and pressure to eat (Horn, Galloway, Webb, & Gagnon, 2011; Tate et al., 2016); all of which may shape obesogenic eating behaviors. This was supported by a study reporting that in response to parents' use of restriction, children with low inhibitory control and higher approach behaviors (i.e., food responsiveness, enjoyment of food, desire to drink, emotional overeating), showed greater increases in food intake (Rollins et al., 2014). When looking at parenting style, indulgent parents reported lower negative affectivity for their children, who were more likely to have higher weights than other children (Hughes, Shewchuk, Baskin, Nicklas, & Qu, 2008), while children with difficult temperament, when combined with mothers with low warmth, also show increased odds of obesity (Zeller, Boles, & Reiter-Purtill, 2008).

Gaps in The Literature

Clearly, there is strong support for child temperament, in conjunction with parental factors, impacting child weight. But the relationship between a parent and child is bidirectional. It is plausible that parental factors, in combination with child temperament, will have a similar impact on parent weight, such that parents with an unhealthy approach to food and a child with a difficult temperament may show the highest weight. Yet there is no research exploring this relationship. When looking at the attention deficit/hyperactivity disorder (ADHD) literature, however, a disorder that is associated with increased impulsivity and decreased effortful control (Haydicky, Shecter, Wiener, & Ducharme, 2015), findings suggest that parents of children with ADHD show higher levels of parenting stress which is associated with higher levels of conflict in the home, and more punitive and controlling parenting practices (Haydicky et al., 2015), as well as higher rates of depression and anxiety (Bernard-Bonnin et al., 2004). This is notable because stress is a risk factor for emotional eating (Greeno & Wing, 1994), controlling parenting styles have been associated with increased food consumption

(Gerards et al., 2012; Golan & Crow, 2004; Rhee, 2008; Sleddens, Gerards, Thijs, De Vries, & Kremers, 2011; West, Sanders, Cleghorn, & Davies, 2010), and a symptom for depression and anxiety is overeating (APA, 2013). These findings would suggest then, that a child with high impulsivity and low effortful control may influence parent weight.

It is also important to consider that parents, like children, also differ in temperament and that the mix between parents' and children's temperaments may have a strong impact on the weight of both parent and child. The "goodness-of-fit" concept speaks directly to this idea. Developed by Thomas and Chess in 1977, the "goodness-of-fit" concept was described as what "results when the properties of the environment and its expectations and demands are in accord with the organism's own capacities, characteristics, and style of behaving" (McClowry, Rodriguez, & Koslowitz, 2008). This model suggests that a particular trait may not be problematic on its own but may lead to conflict and later behavior problems when there is a mismatch between the trait and the characteristics of a particular environment (Rettew, Stanger, McKee, Doyle, & Hudziak, 2006). For example, although high levels of negative affectivity in children have been associated with higher weight, the combination of high negative affectivity in the child and parent may result in even higher weight for both members than would be expected for each independently.

There is no prior research that explores the impact of this relationship on weight, although one study indicated that higher levels of parental impulsivity have been associated with higher weight in children (Sleddens, ten Hoor, Kok, & Kremers, 2016). When looking at outcomes beyond weight, there are a number of studies suggesting parent temperament (i.e., hostility) in combination with child temperament (i.e., negative affectivity) has an impact on child maladjustment (Braungart-Rieker, Garwood, & Stifter, 1997; Lengua & Kovacs, 2005; Morris et al., 2002). Specifically, interactions between child and parent temperament have been shown to predict higher levels of externalizing, internalizing, and attention problems even after controlling for the effects of the same dimensions acting independently (Rettew et al., 2006). Because of the relationship between externalizing problems and weight (Eisenberg et al., 2009; Skogheim & Vollrath, 2015), this relationship is expected for the interaction between child and parent temperament and weight.

Current Study and Hypotheses

The childhood obesity literature has highlighted the need for identifying child and parent factors that predict childhood obesity so that targeted prevention efforts for at-risk groups may be implemented. A wide variety of programs attempting to prevent children from reaching overweight have been developed across different settings with most focusing on one or two proximal risk factors (Birch & Ventura, 2009; Gerards, Sleddens, Dagnelie, De Vries, & Kremers, 2011; Schmitz & Jeffery, 2000). However, the current prevention programs do not consider the developmental nature and interactional quality of the parent-child dyad that is reflected in the “goodness-of-fit” framework and fail to consider how the match or mismatch between parent and child temperament impacts food choice, healthy eating practices, and influences weight. To address this gap in the literature, the current study examined the association of parents’ and young children’s temperament, as well as their approach to food, with each other’s current weight.

Aim 1: Temperament and approach to food with weight. The first aim of this study was to examine how mothers’ and young children’s temperament may contribute to each other's current weight, while accounting for the interdependent nature of their relationship (see Figure 4). Consistent with much of the past research, we hypothesized that temperamental traits such as lower rates of effortful control in addition to higher rates of negative affectivity and impulsivity in both mothers and children would be associated with higher weight in mothers and children, respectively. We also hypothesized that mother's temperament traits would be related to child's weight; conversely, child's temperament traits would influence mother's weight. The interaction between mother and child temperament traits was also explored in order to determine what combination(s) of mother and child temperament traits is the strongest predictor of weight in the mother, child, or both dyad members.

Due to the young age of the children in this study (4-6 years) and previous research highlighting the influence of parents' modeling of dietary choices and eating patterns on their child's food choices and weight (Beydoun & Wang, 2009; Epstein et al., 2001; Patrick & Nicklas, 2005), only mother's approach to food was explored in the current study. We hypothesized that more unhealthy approaches to food in mothers would be associated with higher weight in both mother and child (see Figure 5).

Aim 2: Interaction between temperament and approach to food. Given Aim 1, we expected that temperament traits would impact weight. We also expected that approach to food would impact weight. Additionally, we hypothesized that the effect of mother's approach to food on weight may be different depending on one's own and the partner's temperament traits (see Figure 6). In this case, actor and partner effects of the moderation were hypothesized to be different for both mother and child weight.

For the aam_1 path, we expected that across levels of approach to food, mothers would show consistently high weight when coupled with high levels of impulsivity, high levels of negative affectivity, and low levels of effortful control. However, when mothers had low/average levels of impulsivity, low/average levels of negative affectivity, and average/high levels of effortful control, we expected that their weight would increase as they showed more unhealthy approaches to food. We expected a similar pattern for the pam_1 path, such that mothers would show consistently high weight when coupled with children who had high levels of impulsivity, high levels of negative affectivity, and low levels of effortful control no matter what their own approach to food is. However, when their children had low/average levels of impulsivity, low/average levels of negative affectivity, and average/high levels of effortful control, we expected that higher weight would be associated with more unhealthy approaches to food. For the apm_2 path, we expected that children would have the lowest current weight when mothers had the healthiest approach to food, regardless of their own temperament traits. However, child weight would increase as mothers showed more unhealthy approaches to food; specifically, children with high levels of impulsivity, high levels of negative affectivity, and low levels of effortful control would show the highest weight while children with low levels of impulsivity, low levels of negative affectivity, and high levels of effortful control would show the lowest weight. For the ppm_2 path, we expected that across levels of approach to food, children would show consistently high weight when coupled with mothers who had high levels of impulsivity, high levels of negative affectivity, and low levels of effortful control. Furthermore, children with mothers who reported the healthiest approaches to food and low levels of impulsivity, low levels of negative affectivity, and high levels of effortful control were expected to show the lowest current weight, while children with mothers who reported the most unhealthy approaches to food and low levels of impulsivity, low levels of negative affectivity, and high levels of effortful control were expected to show the highest current weight. Given that temperament is established before approach to food, it was conceptualized as the moderator in this model.

Finally, it is important to note, that the intent of this study is not to place sole responsibility or blame on either the mother or child, but merely to highlight that parents and children do not exist in isolation. They respond to each other as well as other environmental and social factors. Understanding the scope of this influence may help to improve the efforts to prevent and treat childhood obesity, such that they could lead to modifiable parent and/or child factors. For example, practitioners could utilize these findings to assist parents in understanding their child's temperament as well as their own and how this influences their typical response patterns. This knowledge could lead to an understanding of the importance of temperament match or mismatch that clinicians could use when helping parents to defuse, rather than escalate, difficult parent/child interactions (i.e., enhance the fit within the parent-child dyad) which would provide a family environment that fosters healthy practices related to weight.

Method

Participants

The current study was a secondary data analysis from a larger study examining self-regulation and emotional eating in children. The sample includes 220 mother (M_{age} = 32.02 years, SD_{age} = 6.43, 29.1% divorced or separated; 66.8% low-income) and child (these are biological children; M_{age} = 4.78 years, SD_{age} = 0.84; 50% female) dyads recruited from the community. Inclusion criteria included both mother and child being fluent in English, no child traumatic brain injury, no significant child physical disability that would prevent lab task completion, and having a child between the ages of 4-6. The racial and ethnic composition of the sample was 69.5% Caucasian, 21.8% African American, 4.5% Asian, and 2.3% Native American; 33.2% identified as Hispanic.

Procedure

When dyads first arrived at the lab, parental informed consent and child assent procedures were completed. Next, height, weight and percent body fat were assessed for both mother and child. The child was given a standard snack consisting of dry cereal (i.e., Cheerios), bottled water, and a fruit cup (these foods were selected based on FDA approved guidelines). After the snack, the child participated in a battery of tasks examining effortful control, executive function, and impulse control. To heighten the likelihood that children felt motivated to perform well on the tasks, children were told that they would earn stickers toward a prize for completing the tasks. Children earned stickers and silly bands throughout the 2-hour lab visit and a toy from the treasure chest at the end. Children were videotaped during the entire visit to the lab. While the children completed the tasks, their mothers completed several questionnaires as well as a continuous performance task. At the end, mothers were debriefed and compensated $50 for the lab visit.

Measures

Socioeconomic Status. Income classification was determined by monthly income and the number of people in the household supported by the monthly income. The majority of the sample classified as low-income (66.8%) (United States Census Bureau, 2016).

Temperament measures. Developmentally appropriate and well-validated measures that assess similar constructs for both adults and children were utilized. Mothers completed the Adult Temperament Questionnaire-short form (ATQ) (Rothbart, Ahadi, & Evans, 2000) consisting of 4 subscales related to negative affectivity (fear, sadness, discomfort, and frustration) and 3 subscales related to effortful control (activation control, attentional control, and inhibitory control). Scores on each scale can range from 1 to 7 with higher scores indicating higher levels of each trait. Examples of the negative affectivity items include, "Sometimes, I feel a sense of panic or terror for no apparent reason", "I sometimes feel sad for longer than an hour", "I find loud noises to be very irritating," and "It doesn't take very much to make me feel frustrated or irritated." Examples of the effortful control items include, "I can keep performing a task even when I would rather not do it", "When I am trying to focus my attention, I am easily distracted", and "Even when I feel energized, I can usually sit still without much trouble if it's necessary." In community samples, the alpha coefficients for the negative affectivity subscales ranged from .62 to .77 (Wiltink, Vogelsang, & Beutel, 2006). Within this sample, the alpha coefficient for the negative affectivity composite was .70. The alpha scores within the same samples for the effortful control subscales ranged from .60 to .76 (Wiltink, Vogelsang, & Beutel, 2006), while for this sample was .80. Mother's impulsivity was measured using the impulse control difficulties subscale from the Difficulties in Emotion Regulation Scale (DERS) (Gratz & Roemer, 2004). An example item includes "When I'm upset, I lose control over my behaviours." Scores can range from 1 to 5, with higher scores indicating higher levels of impulsivity. Cronbach's alpha for this subscale was .86 in a sample of 357 adults (Gratz & Roemer, 2004); within this sample the alpha coefficient was .88.

Child temperament was measured using parent-report on the Child Behavior Questionnaire (CBQ) (Rothbart, Ahadi, Hersey, & Fisher, 2001) consisting of four subscales related to negative affectivity (fear, sadness, discomfort, and anger/frustration subscale scores), two subscales related to effortful control (inhibitory control and attentional focusing), and one subscale related to impulsivity. Subscale scores can range from 1 to 7 with higher scores indicating higher levels of each temperament trait. Examples of negative affectivity items include, "Gets angry when told s/he has to go to bed", "Is likely to cry when even a little bit hurt", "Is afraid of loud noises", and "tends to become sad if the family's plans don't work out". Cronbach's alpha for the CBQ on a nationally representative sample ranged from .70 to .81 (Rothbart et al., 2001); within this sample the reliability for the negative affectivity composite was .81. Examples of the effortful control items include, "Can easily stop an activity when s/he is told no" and "Will move from one task to another without completing any of them". The alpha reliability for the CBQ on the same representative sample was .77 for inhibitory control and .68 for attentional focusing (Rothbart et al., 2001); within this sample Cronbach's alpha for the composite was .82. An example of the impulsivity item is "Usually rushes into an activity without thinking about it." The alpha coefficient for this subscale was .76 (Rothbart et al., 2001) and in this sample was .64.

Approach to food. Mothers' approach to food was measured via self-report using ten items from two subscales (external eating and emotional eating) of the Weight-

Related Eating Questionnaire (WREQ), a reliable and valid measure of eating behaviors (Schembre, Greene, & Melanson, 2009). Scores on each scale can range from 1 to 5 with higher scores indicating higher levels of each trait. Examples of the items include, “if I see others eating, I have a strong desire to eat too” and “I tend to eat more when I am anxious, worried, or tense.” Cronbach’s alpha for the WREQ in a sample of 621 community members ranged from .67 to .91 (Schembre & Geller, 2011). Within this sample, reliability scores ranged from .76 to .92.

The external eating and emotional eating subscales were transformed into z-scores and then averaged together to form a composite approach to food score. Positive scores indicated more unhealthy eating behaviors (i.e., higher levels of external and/or emotional eating) whereas negative numbers indicated healthier eating behaviors (i.e., lower levels of external and/or emotional eating).

Weight-related indicators. This study utilized two anthropometric measures of body composition: body mass index (BMI) and percent body fat. Height was assessed for each mother and child to the nearest .5cm using a stadiometer (Holtain), and body weight was assessed to the nearest .1kg using an electronic scale (Weight Tronix). BMI was calculated using the BMI formula: (weight (kg) / $[\text{height (m)}]^2$). Percent body fat was measured using skinfold measurements at four sites: biceps, triceps, subscapular, and suprailiac. Assessment was conducted on the right side of the body and was recorded to the nearest 1mm using standard procedures (Lohman, Roche, & Martorell, 1988). All research assistants were extensively trained and conducted over 100 skinfolds.

Assessing weight presents many challenges due to the imperfect nature of the measures. Following the recommendations of Duren (Duren et al., 2008), multiple assessment techniques were used together in order to more fully examine weight in this study. Weight categories (underweight, suggested weight, overweight, obese) were calculated individually for BMI and percent body fat using developmentally appropriate cut-off scores. In adults, BMI levels below 18.5 are associated with underweight, BMI levels between 18.5 and 24.9 are associated with suggested weight, BMI above 25 is associated with overweight, while BMI levels of 30 and greater indicate obesity (CDC, 2015[a]). In children, BMI is not a straightforward index because of growth. Therefore, BMI percentile scores were derived from their BMI based on their age and sex group. Percentiles below the 5th percentile were underweight, between 5th and 85th were at suggested levels, above 85th had overweight, and above the 95th had obesity (CDC, 2015[b]). Weight categories for body fat will be calculated using the appropriate body fat percentile charts for adults (Gallagher et al., 2000) and children (Laurson, 2011). Weight categories such as the percentage of individuals that are suggested weight, were provided for descriptive purposes only and were not used in data analyses.

Data Analyses

Analyses were carried out in Mplus version 8 (Muthén & Muthén, 2017) using robust maximum likelihood and full information maximum likelihood estimation in order to handle non-normal and missing data. First, preliminary analyses were conducted to examine all distributions of variables for non-normality and outliers; transformation techniques were utilized as needed. Then, the main hypotheses were examined. Given that cross cultural differences have been found in the prevalence of obesity, and Hispanic parents are more likely to use food as a reward as well as encourage larger amounts of food throughout the day (Hughes et al., 2006), ethnicity was controlled for in this study.

Additionally, children in low SES environments show higher BMIs than children from high SES environments (Klebanov, Evans, & Brooks-Gunn, 2014); this effect continues into adulthood (Drewnowski et al., 2014; McLaren, 2007). As such, SES was another covariate in the current study. Finally, gender was controlled for in this study as research suggests women are more likely than men to have overweight (Hallam, Boswell, DeVito, & Kober, 2016), as well as show higher BMI scores, more weight gain, and greater percent body fat before and after the onset of puberty compared to boys (Wisniewski & Chernausek, 2009).

For the main hypotheses' outcome variable, a more conservative approach was used to define current weight of the mother and child. For these analyses, weight was a composite of both BMI and percent body fat; each indicator of weight was transformed into z-scores and then averaged together to form a continuous composite score for current weight. Positive scores indicated higher than average current weight whereas negative numbers indicated lower than average current weight. This process allowed us to account for weight using multiple indicators.

Aim 1: Temperament and approach to food with weight. Using dyadic, structural equation modeling (SEM), the first step of this aim was tested within the Actor–Partner Interdependence Model (APIM) (Cook & Kenny, 2005); this will be referred to as the basic APIM. These are statistical methods that make it possible to examine how an individual simultaneously and independently relates to their own outcome as well as to their partner's outcome. This model included two manifest exogenous variables (temperament trait for mother and child), one manifest covariate (SES), and two manifest endogenous variables (weight for mother and child). First, the association between child temperament and their current weight was estimated. The APIM denotes this as an 'actor effect' (see line A_2 in Figure 4). Second, the association between mother temperament and child weight was estimated. This link between the effect of mother's temperament trait on child's current weight is termed the 'partner effect' (see line P_2 in Figure 4). The actor and partner effects for mother's weight can be seen in lines A_1 and P_1 in Figure 4. The second step was to examine the effect of the match or mismatch of mother and child temperament traits on the actor and partner effects for current weight. To do so, the interaction between the child's and mother's temperament was specified; this will be referred to as the moderated APIM. Because the moderated APIM was specified within a moderated structural equation framework, conventional SEM fit indices were not available (Chow, Claxton, & van Dulmen, 2015). Therefore, to compare the relative fit of the basic APIM (with no interaction term) and the model that includes an interaction, a log-likelihood ratio test or χ^2 test (χ^2 = -2 [log likelihood for basic model – log likelihood for moderated model]) was used.

Additionally, the mother and child temperament variables were correlated with each other to control for the association between this interdependent data. Further, the residuals of mother and child weight were specified to be correlated because interdependence between partners is still present after interpersonal influence has been controlled (Kenny, Kashy, & Cook, 2006). This model was run separately for each temperament trait (i.e., negative affectivity, effortful control, impulsivity).

To understand how mother's approach to food may influence child and mother weight, dyadic SEM was used with approach to food as a predictor (Figure 5). This model included one manifest exogenous variable (mother's approach to food), one manifest covariate (SES), and two manifest endogenous variables (weight for mother and child). Again, the residuals of mother and child weight were specified to be correlated to account for the interdependence between mother and child.

Aim 2: Interaction between temperament and approach to food. To understand how temperament may impact the relationship between mother's approach to food and current weight as a moderator, the basic strategy for testing patterns with SEM within an APIM with moderation (APIMoM) (Garcia, Kenny, & Ledermann, 2015) was utilized. Within this context, temperament was a mixed moderator (i.e., varies between and within dyads). As such, there was one predictor with two moderators leading to potentially four interaction effects (Garcia, Kenny, & Ledermann, 2015) that can be seen in Figure 6: 1. mother's approach to food moderated by mother's actor effect (aam_1), 2.mother's approach to food moderated by mother's partner effect (ppm_2), 3. mother's approach to food moderated by child's actor effect (apm_2), and 4. mother's approach to food moderated by child's partner effect (pam_1).

Results

The results section is organized into four parts: data preparation, missing data, descriptives, and actor-partner interdependence models.

Data Preparation

Data were inspected for potential outliers using the outlier labeling rule (Hoaglin & Iglewicz, 1987). One extreme value from child impulsivity, five extreme values from child BMI, three extreme values from child percent body fat, seven extreme values from adult impulsivity, and one adult BMI score were removed from analyses. Potential influence on outcome variables using DFFITS, DFBETAS, and studentized deleted residuals was inspected for each case. Cases with values above thresholds recommended in the literature (e.g. DFFITS=1, DFBETAS=1, studentized deleted residuals=3; Neter, Wasserman, & Kutner, 1989) were inspected further; cases were removed only if values were suspect. Following outlier/influential data removal, mother impulsivity was slightly kurtotic (descriptive statistics for all study variables are displayed in Table 2) and were square-root transformed. All analyses were conducted using the original and transformed variables; the conclusions remained the same across both variables, so all analyses are presented using the original variable for ease of interpretation.

Missing Data

There were 220 mother-child dyads; cases that were missing data were handled in all analyses with full information maximum likelihood estimation (FIML) in Mplus version 8 (Muthén & Muthén, 2017). In addition to the outliers that were removed, two children were missing gender (0.9%), four children were missing SES (1.8%), one child was missing an effortful control score (0.4%), one child was missing negative affectivity (0.5%), fifteen children were missing BMI percentile scores (6.8%), and nine children were missing percent body fat scores (4.1%).

In addition to the outliers that were removed from adult variables, fifteen mothers were missing negative affectivity scores (6.8%), fifteen mothers were missing effortful control scores (6.8%), ten mothers were missing impulsivity scores (4.5%), fifteen mothers were missing external eating scores (6.8%), fifteen mothers were missing emotional eating scores (6.8%), 24 mothers were missing BMI scores (10.9%), and 25 mothers were missing percent body fat scores (11.4%).

Descriptives

Sample demographics are presented in Table 3. Of note, when the sample is categorized into different weight categories, the breakdown of weight varies depending on which indicators are being examined. This lends support for a more conservative approach to weight measurement and categorization. Importantly, 32.3% of mothers and 12.7% of children in the current sample have obesity using BMI cutoffs. This fits with population norms that indicate 35.65% (95% CI, 31.35%-38.7%) of women ages 20-59 years old and 13.05% (95% CI, 10.2%-16.5%) of children ages 2-11 years old have obesity (Ogden et al., 2014).

Group differences in study variables were examined across ethnicity (i.e., Hispanic vs. non-Hispanic). There were no significant differences found for child gender, mother's approach to food, mother's BMI and composite weight score, SES, mother's or child's negative affectivity, effortful control, impulsivity, and percent body fat. Significant differences were found for child's BMI percentile ($t(198) = 2.116$, $p = .036$) and child's composite weight score ($t(198) = 2.161$, $p = .032$), where Hispanic children were more likely to have a higher BMI percentile and corresponding composite weight score.

Correlations are displayed in Table 4 and were computed to assess if the relationship between variables were in the expected directions. Mother's temperament variables were significantly correlated, with higher negative affectivity and impulsivity associated with lower effortful control, and higher negative affectivity associated with higher impulsivity. Generally speaking, child temperament variables were also significantly correlated in the expected directions. One exception to this was that negative affectivity was unrelated to impulsivity. Of all the temperament measures, only child's impulsivity was related to their own weight. Mothers with unhealthy approaches to food were related to mothers with higher negative affect and lower effortful control scores.

Actor-Partner Interdependence Models

Gender and ethnicity were not significant covariates in any model and were trimmed from analyses to produce more parsimonious models. Results remained the same with and without gender and ethnicity included.

Aim 1: Temperament and approach to food with weight. For the first model, mother's and child's negative affectivity was used to predict their own and each other's weight (when controlling for SES). Unstandardized path coefficients, along with standard errors are presented in Table 5. The model fit the data well,[1] yet there were no significant actor or partner effects. The interaction term was also non-significant. The χ^2 test indicated that the basic model had a worse fit compared to the model with the interaction term, and therefore should be rejected (χ^2 (2) = 85.578, p < .001).

When effortful control was used (controlling for SES; see Table 6), there was adequate model fit. Again, there were no significant actor or partner effects, the interaction term was non-significant, and the χ^2 test indicated that the model with the interaction term had a better fit (χ^2 (2) = 69.668, p < .001).

When impulsivity was explored (controlling for SES), the model did not fit the data well (see Table 7). Children with higher impulsivity levels were more likely to show

[1] Because results were run with robust maximum likelihood, the chi-square difference test of nested models cannot be used as the difference between the nested models is not chi-square distributed (Muthén & Muthén, 2017). However, results did not change from maximum likelihood test so fit indices are reported from maximum likelihood testing in order to compare models.

higher current weight (actor effect). Conversely, higher levels of impulsivity in mothers was associated with their own lower weight (actor effect). Importantly, children with higher impulsivity levels were significantly related to their mother's increased current weight (partner effect). The χ^2 test indicated that the APIM with moderations had a better fit (χ^2 (2) = 89.596, p < .001). The interaction was not significant, however, the child's partner effect remained significant.

When approach to food was assessed, there were as many estimated parameters as there were sample statistics. Therefore, the fit was necessarily perfect (i.e., Maximum Likelihood Chi Square (MLCS) = 0, RMSEA = 0, CFI = 1, TLI = 1, SRMR = 0), and it was not possible to test the fit of this saturated model. In this model ($r_{child\ and\ mother\ weight}$ = 0.187, p = 0.008), mother's approach to food was significantly associated with mother's weight (b = 0.176, SE = 0.070, p = .012) but not child's weight (b = 0.164, SE = 0.063, p = .858) when controlling for SES.

Aim 2: Interaction between temperament and approach to food. In the basic model of negative affectivity, mother's approach to food, and weight, mothers showed a significant actor effect such that mother's with higher levels of negative affectivity were associated with *lower* current weight (see Table 8). Additionally, mothers with more unhealthy approaches to food (i.e., higher levels of external and/or emotional eating) were significantly associated with higher weight. Neither interaction was significant in the moderated model, and the difference between the Basic APIM and the APIMoM was not significant, χ^2 (4) = 7.666, p > .05. In other words, there was no difference between the two models and the basic model (without the interactions) should be retained. Similarly, approach to food was significant in the basic model with effortful control.

Moreover, neither interaction was significant in the moderated model. The χ^2 test indicated that the basic model should be retained (χ^2 (4) = 6.210, $p > .05$).

In the basic model including impulsivity (see Table 8), there were two significant actor effects showing that higher levels of impulsivity in children and lower levels of impulsivity in mothers were associated with their own higher current weight. Of note, higher levels of impulsivity in children were significantly associated with higher current weight in mothers. Additionally, mother's approach to food was significantly related to her own weight. Importantly, the χ^2 test indicated the APIMoM had a better fit (χ^2 (4) = 29.654, $p < .001$). In this model (see Table 9), the interaction between child impulsivity and mother's approach to food was significant; the effect of the mother's approach to food on her own weight depended on her child's impulsivity behaviors. Simple slopes for this interaction are shown in Figure 7. Inspection of the simple slopes showed that the effect of mother's approach to food on her own current weight was nonsignificant when her child showed higher levels of impulsivity (one standard deviation above average; b = 0.250, SE = 0.190, p = 0.188). In contrast, the effect of mother's approach to food on her own current weight was stronger when her child exhibited average (b = 0.421, SE = 0.164, p = .010) and low impulsivity (one standard deviation below average; b = 0.591, SE = 0.169, $p < .001$) levels.

Upon further inspection of Figure 7, post hoc comparisons were conducted and indeed, the association of child impulsivity and mother's weight was nonsignificant when the mother had a less healthy approach to food (one standard deviation above average; b = 0.085, SE = 0.073, p = 0.242). Furthermore, the association of child impulsivity and mother's weight did differ when the mother had average (b = 0.228, SE = 0.070, p =

0.001) and healthy (one standard deviation below average; $b = 0.371$, $SE = 0.111$, $p = 0.001$) approaches to food.

Finally, post hoc analyses were conducted to explore whether the interaction between child impulsivity and mother's approach to food on mother's weight differed depending on child's gender. Results indicated significant interactions for both boys ($b = -0.157$, $SE = 0.073$, $p = 0.030$) and girls (-0.157, $SE = 0.073$, $p = 0.030$). This indicated a consistent effect across gender.

Discussion

While APIM is not a novel statistical technique, the obesity literature has yet to take advantage of this analytic model which is important because the nonindependence found in dyad data (i.e., data of mothers and their children) complicates the traditional data analysis methods (Galovan, Holmes, & Proulx, 2017). Furthermore, the use of APIM makes it possible to examine how an individual simultaneously and independently relates to their outcome as well as to their partner's outcome (Cook & Kenny, 2005) leading to a more complete understanding of weight within a family system. Using a sample of mother-child dyads that fit population norms for BMI (Ogden et al., 2014), results from the current study replicate current literature by suggesting children's temperament influences their own weight. A novel contribution from the current study is the finding that children's temperament is also associated with their mother's weight. These findings are in concordance with developmental systems theories which indicate that changes within and between individuals occur at multiple levels of organization (Damon & Lerner, 2008); specifically, individuals impact other family members.

Aim 1: Temperament and Approach to Food with Weight

Consistent with past research, it was hypothesized that temperamental traits such as lower effortful control, higher negative affectivity, and higher impulsivity in both mothers and children would be associated with higher weight in mothers and children, respectively. It was also hypothesized that temperament traits of the mother would be related to child weight while child temperament traits would be related to mother's weight. However, after accounting for the dyad and controlling for SES, this hypothesis was only partially supported by the current data.

In the current study, child and mother negative affectivity and effortful control were unrelated to their own or each other's current weight. While discrepant from our hypotheses, most research finding associations between measures of negative affectivity and effortful control with weight do so by predicting rate of weight gain later in childhood or adulthood from temperament measures gathered in infancy or early childhood (Darlington & Wright, 2006; Francis & Susman, 2009; Graziano, Calkins, & Keane, 2010; Graziano et al., 2013; Pulkki-Råback, Elovainio, Kivimäki, Raitakari, & Keltikangas-Järvinen, 2005; Sutin, Kerr, & Terracciano, 2017; Seeyave et al., 2009; Wells et al., 1997). It is possible that these studies are capturing a developmental process such that infants/children with less effortful control and more negative affectivity are eliciting certain responses from their caregivers that may teach them to consume food regardless of internal satiety cues leading to increased weight gain over time. The current study is comparing measures of temperament and mean level weight from the same timepoint, a major difference from the previous literature. The non-significant child actor effects from the current study are similar to other cross-sectional studies that found no relationship between negative affectivity and general effortful control measures with weight (Bergmeier, Skouteris, Horwood, Hooley, & Richardson, 2014; Haycraft, Farrow, Meyer, Powell, & Blissett, 2011; Hughes, Power, O'Connor, & Fisher, 2015).

Additionally, research finding longitudinal support for *general* effortful control and weight used behavioral measures (Francis & Susman, 2009; Graziano, Calkins, & Keane, 2010; Graziano et al., 2013); parent-report measures may assess different constructs from these behavioral tasks. Interestingly, a cross-sectional study did find that *eating* specific self-regulation was associated with child BMI (Hughes et al., 2015). Taken together, another possible explanation for these findings is that when children are younger, their parents make most of the food decisions for them, so non-eating self-regulation skills and negative affectivity may not be as important in explaining their current weight.

Within the developmental literature, temperament is widely assessed in infants, children, and adolescents, but rarely in adults. As such, there is little research exploring how adult negative affectivity and effortful control may be related to their own weight. Of the little research that exists, objective brain imaging studies linked food-specific cues to brain regions implicated in inhibitory control and attention (Stice et al., 2016). It is possible that self-reported general effortful control measures are capturing a different construct. Additionally, the non-significant mother actor effect for effortful control from the current study is similar to one of the few studies to explore the relationship between self-reported temperament and weight-related outcome in adults which found that severe weight cycling was associated with reactive aspects of temperament (i.e., impulsivity) but not regulative aspects of temperament (i.e., effortful control) (de Zwaan, Engeli, &

Müller, 2015). The null negative affectivity actor effect in adults might also be explained by conflicting findings on eating in response to distress; some research shows that negative affect leads to overeating (Cardi, Leppanen, & Treasure, 2015; Macht, 2008) while other studies suggest that negative affect leads to undereating (Macht, 2008; Stone & Brownell, 1994). If both phenomena were present in this sample, it is possible they cancelled each other out to show no association between negative affectivity and weight in adults. However, this seems unlikely based on the scatterplot of mother's negative affectivity and weight, there is less variability in weight for those high in negative affectivity compared to those of average negative affectivity levels.

Finally, as temperament forms the core of personality (Hampson, 2012), there are strong links between negative affectivity and effortful control with the personality traits of neuroticism and conscientiousness, respectively (Rothbart, Ahadi, & Evans, 2000). Personality research has found that adults who score higher in conscientiousness tend to have lower BMI, lower risk of obesity, and gain less weight over time (Kim, 2016; Sutin & Terracciano, 2016; Sutin & Terracciano, 2017). Neuroticism has also been associated with higher BMI and risk of obesity in adulthood (Magee & Heaven, 2011; Sutin & Terracciano, 2016; Sutin & Terracciano, 2017). This may suggest that underlying temperament traits have less association with current weight than does an individual's personality and current mood which has a unique effect on an individual's ability to adjust to a given environment.

As for the non-significant partner effects, because mothers are making their own food choices, it is possible the child's negative affectivity and general ability to regulate their own emotional and behavioral reactivity have little impact on their mother's food choices and/or current weight. This is counter to the ADHD literature discussed previously that suggests reducing child symptoms of inattention and impulsivity results in more positive parenting outcomes (Herbert, Harvey, Roberts, Wichowski, & Lugo-Candelas, 2013), a relationship that was expected for similar temperament traits and weight. It is possible that impulsive behaviors are driving these findings. Additionally, at the young age of the current child sample, it is possible that other parent factors (i.e., feeding style, feeding environment, parenting style) (Clark, Goyder, Bissell, Blank, & Peters, 2007; Gerards et al., 2012; Haycraft & Blissett, 2008; Patrick, & Nicklas, 2005; Sleddens, Gerards, Thijs, De Vries, & Kremers, 2011; Thompson, 2013) have stronger impact on child weight than mother's negative affectivity and effortful control.

Analyses with the temperament trait of impulsivity showed some interesting results. First, there were no actor or partner effects of impulsivity on child's current weight, but SES was a significant covariate. At this age, it is possible that SES is a stronger predictor of weight than a child's level of involuntary control (i.e., rushing into or through an activity without giving it much thought; Eisenberg, Hofer, & Vaughan, 2007), especially since mothers are likely making most food choices for the children. Specifically, children of low SES were associated with higher weight than children from middle to high SES environments. This fits with previous research findings (Klebanov, Evans, & Brooks-Gunn, 2014).

Similarly, there is no impulsivity actor effect for mothers. The partner effect indicates that, independent of the mother's own impulsivity and after accounting for the child's weight and controlling for SES, mothers who had children with higher rates of impulsivity displayed higher weight than mothers with children lower in impulsivity.

This has important implications for obesity prevention and intervention as it indicates that child impulsivity might have important effects on mother's weight. This finding is similar to research that suggests increased severity of child autism symptoms and ADHD symptoms show higher levels of stress and depression (Benson, 2006; Bernard-Bonnin et al., 2004; Haydicky et al., 2015); both are risk factors for higher weight.

Finally, the interactions between child and mother temperament traits were explored; they were not significant in any model. It is possible that the age of the children led to these null findings. There is some research that suggests that mother-child conflict decreases in young children compared to father figure-child conflict and control groups (Weaver, Shaw, Crossan, Dishion, & Wilson; 2015); this could suggest that the mismatch between mother and child temperament traits might also decrease at this age, especially as they relate to weight. Additionally, it is possible that approaching this interaction *across* temperament traits (i.e., mother's negative affectivity x child's impulsivity) rather than *within* temperament traits (i.e., mother's negative affectivity x child's negative affectivity) may lead to different results. For example, mothers with higher levels of negative affectivity might show higher weight if their child exhibits higher levels of impulsivity. Furthermore, exploring temperament using a person-centered approach could also elucidate the relationship between temperament and weight. Previous research has supported the idea that the impact of negative affect on emotional eating is higher for highly impulsive participants compared to participants low in impulsivity (Bekker, van de Meerendonk, & Mollerus, 2004). Future research should explore these questions.

However, all models fit significantly better when the interaction was included. This suggests that the larger model for obesity might benefit from accounting for the mix between parent and child traits. Accounting for this interaction fits in with the developmental systems theories which account for all possible associations among variables that could contribute to a specific outcome (Damon & Lerner, 2008).

Finally, it was hypothesized that mothers with more unhealthy approaches to food (i.e., higher scores for external and/or emotional eating) would be associated with higher weight in both mothers and children; results were partially supported. Consistent with previous research, mother's approach to food was significantly associated with mother's current weight across all models; specifically, more unhealthy approaches to food were linked to higher current weight. Given a mother's role in feeding young children, it is interesting that mother's approach to food was not related to child weight in any model. While discrepant from our hypothesis, research finding an association between parent food choice and child weight do so using older children (i.e., up to 18 years of age; Beydoun & Wayng, 2009; Epstein et al., 2001) and objective measures of approach to food (i.e., consumption of fruits and vegetables, overall dietary quality). It may be that other factors (i.e., feeding style, feeding environment, parenting style) (Clark, Goyder, Bissell, Blank, & Peters, 2007; Gerards et al., 2012; Haycraft & Blissett, 2008; Patrick, & Nicklas, 2005; Sleddens, Gerards, Thijs, De Vries, & Kremers, 2011; Thompson, 2013) are more important to child weight at this age than mother's approach to food.

Aim 2: Interaction Between Temperament and Approach to Food

Hypotheses from Aim 1 remained consistent for Aim 2; additionally, we hypothesized that the effect of mother's approach to food on weight may be different depending on the mother's and/or child's temperament traits. Like Aim 1, these hypotheses were partially supported. The mothers' actor effect for negative affectivity was significant, although in the opposite direction from original hypothesis. This indicates that mothers with *lower* levels of negative affectivity have higher current weight. Although unlikely, these unexpected results might be explained by conflicting findings on eating in response to distress; some research shows that negative affect leads to overeating while other studies suggest that negative affect leads to emotional *under*eating (Macht, 2008; Stone & Brownell, 1994). Additionally, it is possible that the current sample of mothers is dealing with depression. Symptoms of a depressive episode include, "Significant weight loss when not dieting…, or decrease…in appetite nearly every day" (APA, 2013) which could be impacting the relationship between negative affectivity and mothers' current weight. However, given that the average negative affectivity score for mothers is relatively low, and negative affectivity is a temperament trait that predicts risk for many anxiety and stress-related disorders (Bould et al., 2014), this explanation also seems unlikely.

An alternative explanation could be that mothers reporting low negative affectivity do so because they are regulating their emotions with food which in turn leads to higher weight. Research exploring the affect regulation model of bulimia nervosa (binge-only, purge-only, and binge/purge) indicated that facets of negative affectivity (i.e., fear, hostility, sadness) increase prior to and decrease following bulimic behaviors (Berg et al., 2013). However, this is improbable because research also indicates that negative affectivity, particularly guilt, increases following binge behaviors (Berg et al., 2013).

Given that mother's negative affectivity and approach to food are correlated, the addition of the significant actor effect in Aim 2 could also be due to multicollinearity.

This problem occurs when independent variables are highly correlated with one another and leads to unreliable regression coefficients and large standard errors because there is very little unique information available to base the value on (Cohen, Cohen, West, & Aiken, 2003). However, the correlation between mother's negative affectivity and approach to food is relatively low ($r = .326$), the standard error is relatively small, and the variance inflation factor (i.e., a measure of multicollinearity where scores greater than 10 provides evidence of serious multicollinearity; Cohen et al., 2003) was equal to one; taken together this suggests that multicollinearity is not a major concern in this model.

A more likely explanation for this unexpected result can be found in our sample. When looking at the high (one standard deviation above average) and low (one standard deviation below average) negative affectivity groups, the relationship between negative affectivity and weight is positive; this indicates that higher negative affectivity was associated with higher weight, as predicted. However, for mothers with average negative affectivity, there was a negative relationship. Therefore, it appears that the sample with average negative affectivity is obscuring the expected positive relationship and driving results.

In the impulsivity model, the child's actor effect indicated that higher levels of impulsivity were associated with higher weight. This fits with prior research that links impulsivity traits to food cue reactivity and greater risk of overeating (van den Akker, Stewart, Antoniou, Palmberg, & Jansen, 2014). However, mother's impulsivity actor effect is opposite from expectations (i.e., lower impulsivity levels were associated with higher weight) which is inconsistent with the existing literature.

A key difference between our sample and the existing literature is the use of the DERS as a measure of impulsivity. In previous research exploring the relationship between impulsivity and weight conducted in children (Francis & Susman, 2009; Graziano et al., 2010; Graziano et al., 2013; Seeyave et al., 2009; Nederkoorn et al., 2006), behavioral tasks (such as the door opening and stop signal tasks) are used to measure impulsivity; both tasks are related to impulsivity and impulsive disorders like ADHD to measure impulsivity (Nederkoorn et al., 2006). These tasks assess impulsivity as response perseveration (i.e., the tendency to continue a response set for reward despite punishment), as well as choice reaction time and stop delay (Nederkoorn et al., 2006). One study in children used the hyperactivity/impulsivity subscale from the Disruptive Behavior Disorder Rating Scale (Nederkoorn et al., 2006); in this measure, teachers answer nine questions with higher scores indicating higher impulsive behaviors. Example questions include: "often interrupts or intrudes on others (e.g., butts into conversations or games)", "often blurts out answers before questions have been completed", "often has difficulty awaiting turn" (Pelham, Gnagy, Greenslade, & Milich, 1992). In adults, observational studies, experimental studies, and brain imaging techniques have found that food-related impulsivity and general impulsivity are higher in individuals with obesity and binge eating disorder (Schag, Schönleber, Teufel, Zipfel, & Giel, 2013). The current study used the DERS which is composed of items reflecting difficulties remaining in control of one's behaviors when experiencing negative emotions (Gratz & Roemer, 2004). For example, "When I'm upset, I have difficulty controlling my behaviours", "When I'm upset, I become out of control", and "I experience my emotions as overwhelming and out of control." It could be that impulsivity in the context of emotion regulation is more than just impulsive eating.

Importantly, the interaction between child impulsivity and mother approach to food was associated with mother's weight across child gender. This lends support for the interaction of mother and child traits to impact weight outcomes. In this model, findings supported the hypotheses. Specifically, regardless of their own approach to food, mothers showed consistently higher weight when children showed higher (i.e., one standard deviation above average) rates of impulsivity. More unhealthy approaches to food were associated with higher weight in mothers when children showed lower (i.e., one standard deviation below average)/average levels of impulsivity. Past research shows that when children are high in external behaviors (i.e., impulsivity), parents show higher levels of stress (Benson, 2006; Bernard-Bonnin et al., 2004; Haydicky et al., 2015). It seems possible that when children exhibit higher levels of impulsivity, mother's typical approach to food is overridden and mothers cope with this stress in ways that are conducive to higher weight like avoidance- and/or emotion-focused coping (Billings & Moos, 1981; Mayhew & Edelman, 1989; Popkess-Vawter, Brandau, & Straub, 1998; Shatford & Evans, 1986) rather than positive reframing, or thinking about problems as challenges that might be overcome (Podolski & Nigg, 2001) which has been shown to decrease distress. However, at low and average levels of impulsivity, it seems likely that mothers are better able to cope with their children's behaviors, and therefore, their own approach to food is more related to their current weight.

Implications of Study Findings

Although several the hypotheses generated for the current study were not supported by significant results, there are many strengths of the current study which serves as the first step towards exploring the interdependent nature of obesity risk. These findings highlight the importance of accounting for the inherent relationships of variables within families. Moreover, the impact that a child has on a mother is an important factor to consider in the maintenance of weight. This finding suggests that weight is impacted by a complex relationship between child and mother variables which indicates that variables from the individual and microsystem levels of organization are shaped by each other in such a way that influences weight across similar levels of organization. This is in direct alignment with developmental systems theories which state that all levels of organization are integrated in some way (Damon & Lerner, 2008). These positive findings indicate that assessing weight and other health outcomes from a developmental systems framework can provide valuable information towards a more complete understanding of weight.

More specific for prevention programs, findings suggest that after adjusting for the interdependent nature of temperament traits and weight, impulsivity is an important factor associated with current weight for mothers and children. Therefore, children with impulsivity levels at least one standard deviation above average would likely benefit from programs that incorporate skills that reduce impulsivity. The current study results also provide important implications for the impact of children on their mothers. As such, mothers of children with higher levels of impulsivity would also benefit from their children reducing impulsivity levels. Moreover, these mothers would likely benefit by understanding their typical response patterns and learning healthy coping strategies that attenuate the impact of their children's behaviors on their own emotions and behaviors. Furthermore, mothers of children with average or below average levels of impulsivity would benefit from adopting a healthier approach to food (i.e., less external and emotional eating). There is promising research that suggests targeting food cue reactivity and satiety sensitivity can decrease loss of control and overeating episodes, food responsiveness, and power of food (Boutelle, Knatz, Carlson, Bergmann, & Beterson, 2017). In all these ways, the current study can help provide a family environment that fosters healthy practices related to eating and weight.

Limitations and Future Research

Using Bronfenbrenner's ecological systems model as a guide (Bronfenbrenner, 1992), the current study includes variables from the individual level (i.e., gender, age, temperament, approach to food to mother), microsystem (i.e., dyad member's temperament, approach to food to child), and macrosystem (i.e., SES, ethnicity). The model of obesity risk within a developmental, behavioral, cultural, and ecological framework would also be served by including additional variables across levels of organization. Specifically, in line with developmental systems theories (Damon & Lerner, 2008), variables should be across multiple levels of the organization (i.e., person-level, family-level, community-level, societal-level, and cultural- and chronological-level variables) and should account for the unification and bidirectional links among the different levels of organization that contribute to weight. There are many potential moderators (i.e., parent feeding style, parenting style, parental mental health, access to recreation facilities, neighborhood safety) that are not included in the current model which is a challenge for the current study. Parent feeding style has been shown to impact child weight (Birch & Fisher, 2000; Clark, Goyder, Bissell, Blank, & Peters, 2007; Haycraft & Blissett, 2008; Johannsen, Johannsen, & Specker, 2006; Lindsay et al., 2006; Powell, Frankel, & Hernandez, 2017; Thompson, 2013; Wardle, Sanderson, Guthrie, Rapoport, & Plomin, 2002). However, this variable was not utilized in the current model because the measure used to assess this construct is variant across ethnic groups and child gender (Perez et al., 2018). Additionally, variables from the ecological model of health (Institutes of Medicine Staff, 2001) such as genetics and health (i.e., insulin levels, sleep variables) and functioning (i.e., heart rate variability) variables, could add deeper understanding of influences on weight and well-being within a developmental systems lens. It is conceivable that additional variables are impacting the relationship, especially when this model is viewed within the larger context of obesity risk; this should be explored more fully in future research.

Additionally, it is possible that the relationships explored in the current study appear differently across development. For example, when children age and become more independent in their feeding and recreational behaviors, the match or mismatch between parent and child temperament traits may likely be more noticeable, and therefore a more significant variable in the model of weight for both mother and child. This study should be replicated at different ages. It should also be replicated for the current ages. Temperament is typically defined as showing some stability across time by the preschool years; yet some evidence exists that also suggests change in these traits in all developmental periods (Shiner, 2015). Although there were no significant correlations between child age and other study variables, we did not examine age in the current study and it could be beneficial to examine these relationships separately for 4-, 5-, and 6-year-olds in the current study. It should also be conducted longitudinally as the cross-sectional nature of the data poses a challenge as it limits the ability to draw causal conclusions. Furthermore, these ideas address the issue of plasticity in human development broached by developmental systems theories which says that specific traits and characteristics may change within a particular individual as time passes (Damon & Lerner, 2008). A more nuanced exploration of these variables across time will provide deeper understanding of how ongoing development may provide different opportunities for change in weight.

The current study only explores the relationships between temperament traits, approach to food, and weight between mother and child. While it will be important that future research examine child impulsivity and mother's approach to food on mother's weight and test if our findings replicate, the Family-Collaborative Ecosystemic Model, which is based in family systems theory, posits that families cannot function independently; when one member alters behavior, it impacts the other members (Goetz & Caron, 1999; Kaplan, Arnold, Irby, Boles, & Skelton, 2014). This idea continues to address plasticity, which is not just an individual process. Plasticity can change across individuals and across the developmental system (Damon & Lerner, 2008). As such, expanding the model from the current study to include other caregivers, siblings, and extended family may provide an even richer understanding of how the family provides the primary setting to promote and support weight-related development.

Future research would also do well to explore weight through a developmental systems lens while accounting for gender and ethnicity. In the current study, neither child gender nor child ethnicity were significant covariates. This indicates that neither variable was significantly related to mother or child weight. Given previous research (Hallam, Boswell, DeVito, & Kober, 2016; Hughes et al., 2006; Wisniewski & Chernausek, 2009), it seems likely that these child variables will begin to influence child and/or mother weight at some point within the developmental trajectory. Longitudinal studies would do well to pinpoint at what point weight is differentially impacted by these important individual and macrosystem variables. It would also be interesting to compare the match and mismatch of gender and/or ethnicity between child and family member to see if this similarity or difference serves as a protective or risk factor for increased weight or other health outcomes. Additionally, this study relied on parent self-report data, and future research should consider the inclusion of behavioral tasks that assess similar temperament and approach to food constructs. A multi-method approach would diminish parental bias from self-report. Finally, while there were enough dyads in the current study to achieve adequate power to detect actor and partner effects, it is possible that there was not enough power to detect all significant interactions. This should be accounted for in future studies.

While the current study is an important first step toward building a longitudinal model of obesity risk within a developmental, behavioral, cultural, and ecological framework, there are exciting next steps required for this long-term goal. For example, given that mother's temperament did not moderate the association between mother's approach to food and mother's current weight, along with the significant correlation between these two variables, it is possible that mother's approach to food is a mediator between mother's temperament and mother's weight. Additionally, based on modeling and social learning theory (Bandura, 1977), it is reasonable to believe that children with parents who have an unhealthy approach to food will show similar eating behaviors; as such, mother's approach to food may be a predictor of child's approach to food which will have a direct impact on child's weight. Based on the current findings, it seems plausible that child's temperament would moderate the relationship between mother's approach to food and mother's weight as well as child's approach to food and child's weight. This model would serve to replicate findings from the present study but would also extend current findings with the addition of child's approach to food. This fits with developmental systems theory which encourages the consideration of all possible associations among variables that could contribute to an outcome (Damon & Lerner, 2008). Moreover, this model could be tested across time which is an important addition to the current study and another important aspect of developmental systems theory which acknowledges the role of time and plasticity in human development (Damon & Lerner, 2008).

Conclusion

Previous research has focused almost exclusively on how child factors influence their own weight or how parent factors influence child weight. Collectively, the results from the current study have highlighted that parents and children do not exist in isolation. They respond to each other as well as other environmental and social factors. This study has provided an initial framework within the obesity literature to account for how their temperament or approach to food relates to weight. Accounting for the bidirectional nature of these relationships will allow for the development of prevention programs that target the different variables within systems that may place children *and* parents at greater risk for the development and maintenance of obesity.

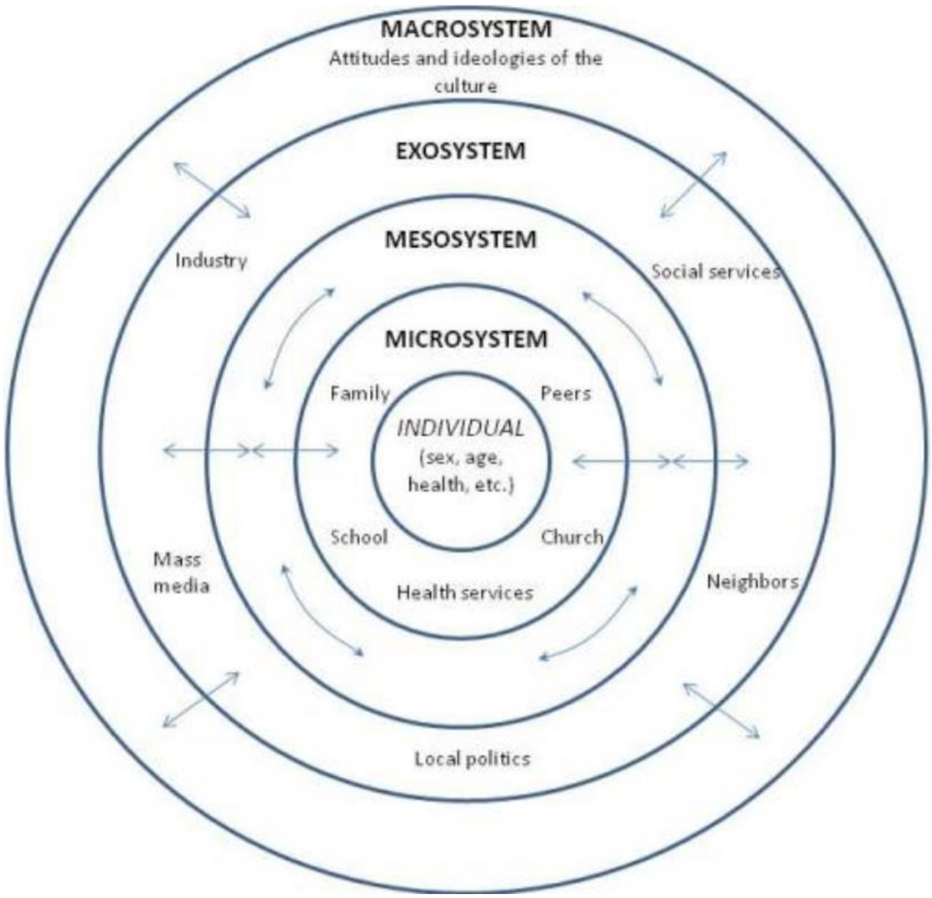

Figure 1. Bronfenbrenner's Ecological Systems Model (Bronfenbrenner, 1992; Bronfenbrenner & Morris, 2006).

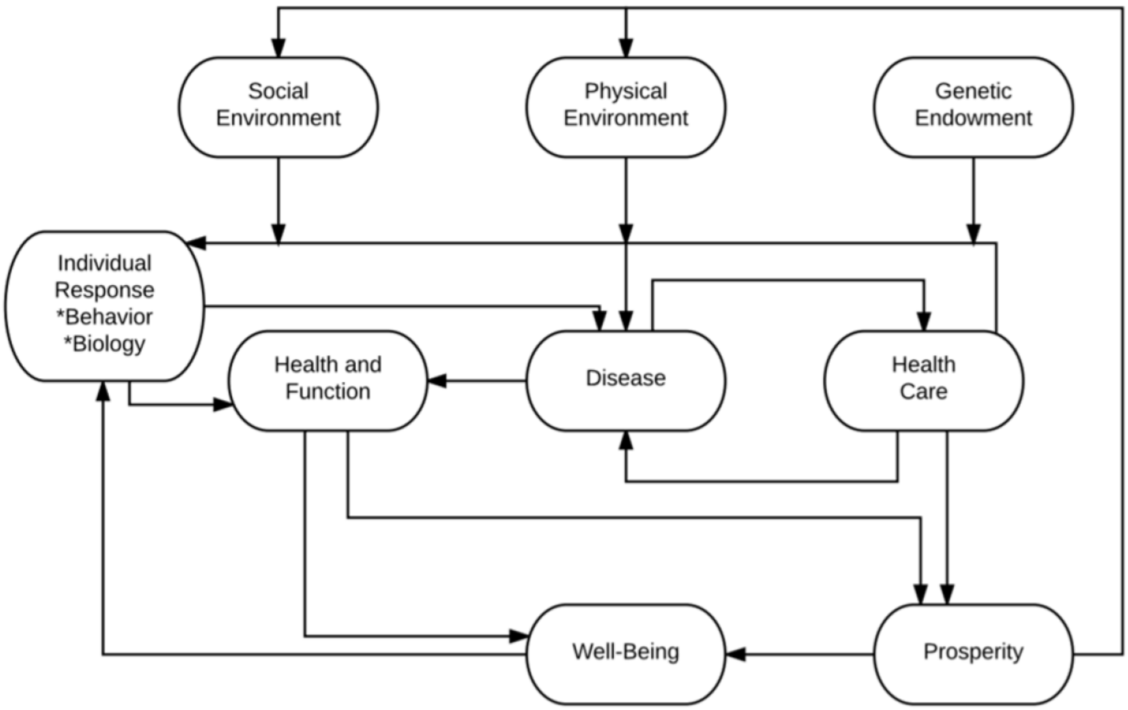

Figure 2. Ecological Model of Health (Institute of Medicine Staff, 2001).

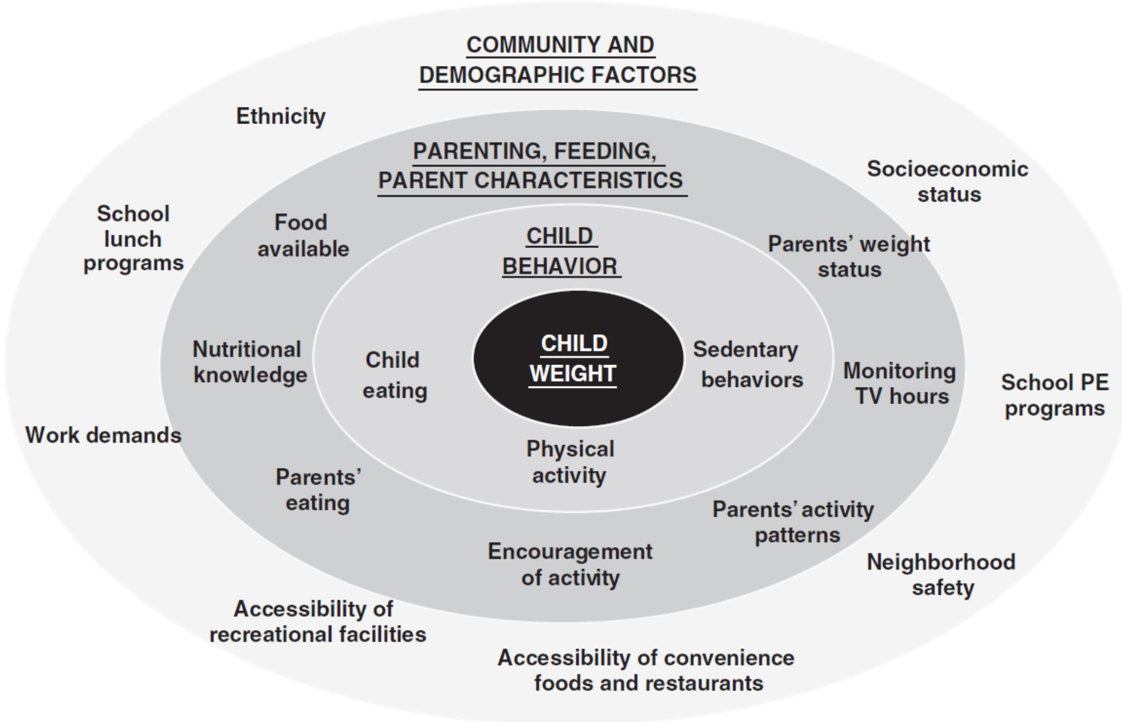

Figure 3. Ecological Model of Childhood Obesity (Birch & Ventura, 2009).

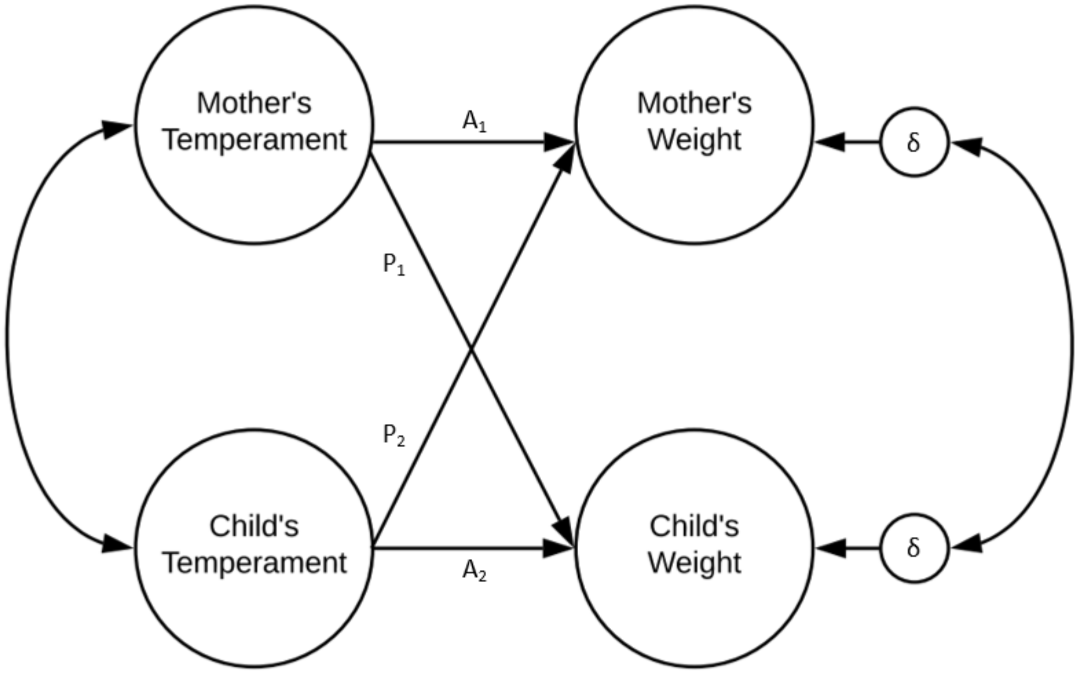

Figure 4. Actor-Partner Interdependence Model.

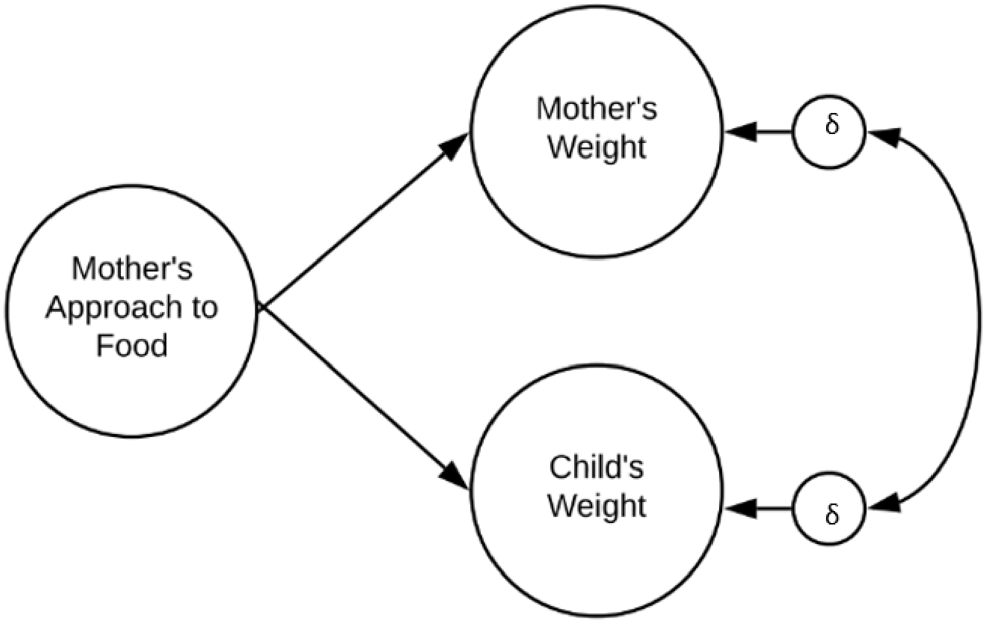

Figure 5. Approach to Food with Weight.

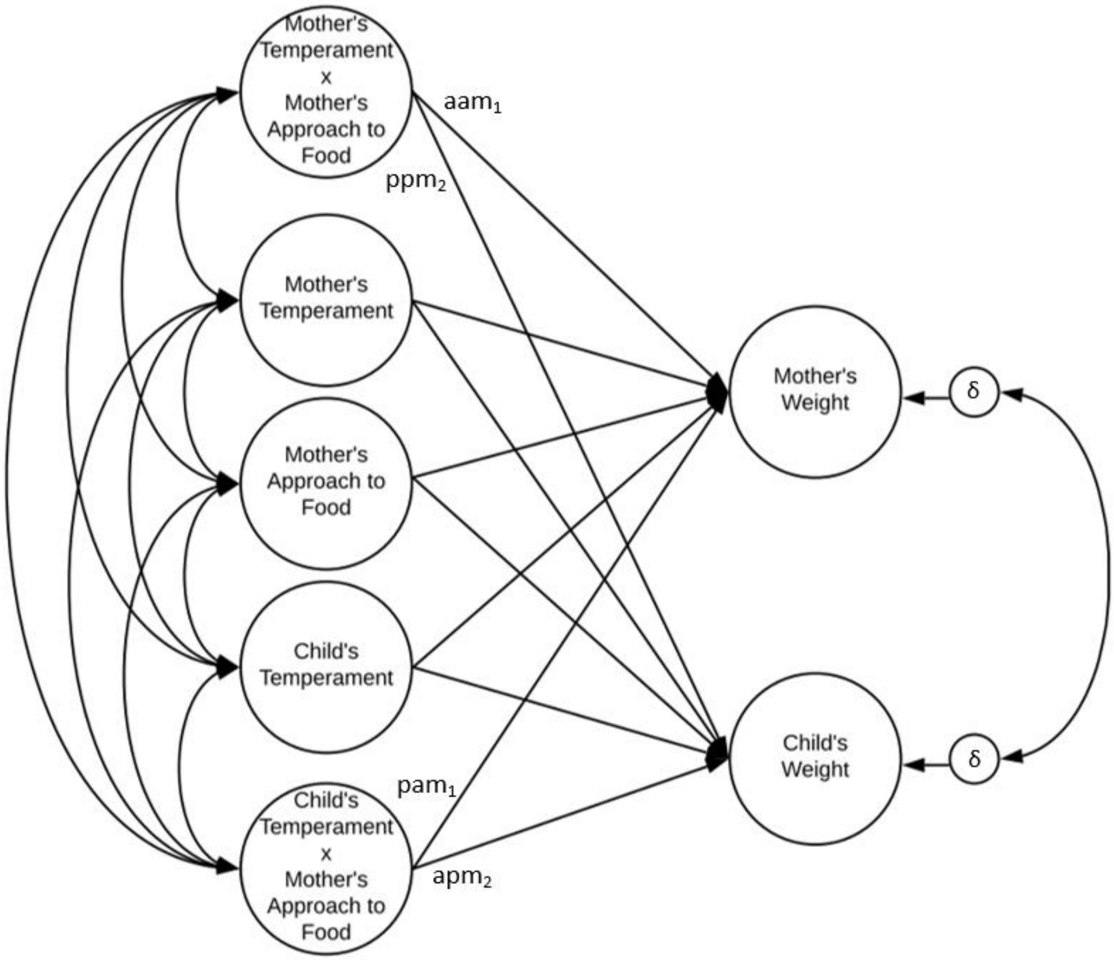

Figure 6. Actor-Partner Interdependence Moderation Model.

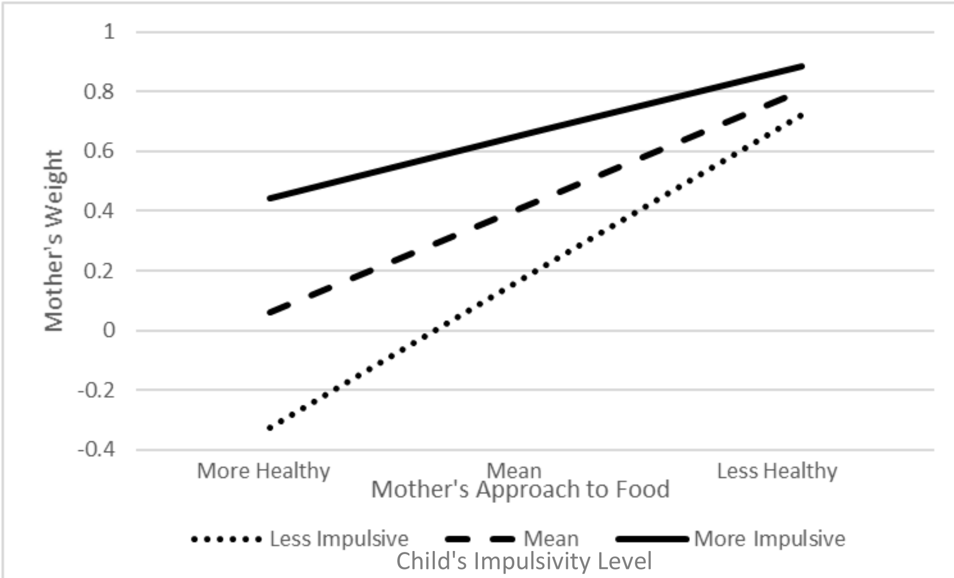

Figure 7. Simple Slopes for the Interaction Between Mother's Approach to Food and Child's Impulsivity Level on Mother's Weight.

Table 1. The Ecosystemic Biopsychosocial Grid: An Illustration of the Levels Evaluated in FEM (30).

GOAL: (Determined by collaborative discussion)				
Existential/Spiritual				
Culture				
Community				
Social Network				
Prof/Pt/Family Relationship				
Family				
Dyadic				
Psychological				
Biomedical				
Material				
	Obstacles	Resources	Solutions	Targets

Prof = Health Care Professional; Pt = Patient.

Table 2. Original Descriptive Statistics of Study Variables

	N	Mean	SD	Range	Skew	Kurtosis
Mother						
Negative Affectivity	205	3.92	0.68	1.90 – 6.25	0.29	1.28
Effortful Control	205	4.82	0.81	2.47 – 6.53	-0.37	-0.02
Impulsivity	203	9.48	4.23	6.00 – 26.00	1.87	3.62
External Eating	205	2.27	0.95	1.00 – 5.00	0.69	-0.34
Emotional Eating	205	2.02	1.12	1.00 – 5.00	1.03	0.06
BMI	195	29.13	7.87	16.80 – 57.70	1.00	0.96
Body Fat	195	35.77	9.75	7.30 – 57.30	-0.18	-0.40
Weight Composite	195	0.00	0.98	-2.24 – 2.92	0.39	-0.22
Approach to Food	205	0.00	0.88	-1.12 – 2.76	0.84	-0.02
Child						
Negative Affectivity	219	4.30	0.82	1.99 – 6.45	0.00	0.09
Effortful Control	219	4.74	0.97	2.00 – 6.44	-0.35	-0.14
Impulsivity	219	4.55	1.05	1.17 – 7.00	-0.18	0.14
BMI Percentile	200	65.60	28.46	<1 – 99.90	-.713	-0.71
Body Fat	208	22.28	5.69	3.00 – 43.00	0.12	2.21
Weight Composite	200	-0.02	0.90	-2.34 – 3.06	0.52	0.86

Table 3. Sample Demographics

	N (%)	M (SD)	Range
Child Age			
4	107 (48.6%)		
5	55 (25%)		
6	58 (26.4%)		
Child Gender			
Male	109 (49.5%)		
Female	109 (49.5%)		
Child Ethnicity			
Hispanic	73 (33.2%)		
Non-Hispanic	147 (66.8%)		
Child Race			
Caucasian	153 (69.5%)		
African American	48 (21.8%)		
Asian	10 (4.5%)		
Native American	5 (2.3%)		
Age of Mother	217	31.94 (6.43)	20-49
Socioeconomic Status[a]			
Low Income	147 (66.8%)		
Middle Income	57 (25.9%)		
High Income	12 (5.5%)		
Weight of Mother	BMI	Body Fat	
Obese	71 (32.3%)	66 (30%)	
Overweight	51 (23.2%)	52 (23.6%)	
Suggested Weight	66 (30%)	62 (28.2%)	
Underweight	6 (2.7%)	15 (6.8%)	
Missing	26 (11.8%)	25 (11.4%)	
Weight of Child			
Obese	28 (12.7%)	48 (21.8%)	
Overweight	41 (18.6%)	86 (39.1%)	
Suggested Weight	127 (57.7%)	69 (31.4%)	
Underweight	4 (1.8%)	5 (2.3%)	
Missing	20 (9.1%)	12 (5.5%)	

[a]Middle- and High- Income Individuals were combined into one group for analyses.

Table 4. Correlations of Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12
1. Ethnicity	1.0											
2. Gender	.010	1.0										
3. SES	.024	-.068	1.0									
4. M-NA	-.022	.041	.040	1.0								
5. M-EC	.130	.069	-.010	-.493**	1.0							
6. M-Imp	-.122	-.023	.092	.463**	-.578**	1.0						
7. C-NA	.021	-.001	.077	.309**	-.347**	.252**	1.0					
8. C-EC	-.010	.222**	-.068	-.119	.343**	-.221**	-.228**	1.0				
9. C-Imp	.093	-.154*	.064	-.005	-.077	.101	.029	-.419**	1.0			
10. M-Weight	-.033	.027	.009	-.138	.063	-.121	.001	-.010	.190**	1.0		
11. C-Weight	-.152*	.028	-.013	-.075	-.092	-.086	.061	-.129	.184**	.181*	1.0	
12. M-Approach	.004	.000	-.063	.326**	-.326**	.091	.130	-.079	.027	.137	-.019	1.0

Note: Ethnicity: -.5 = Hispanic, +.5 = Non-Hispanic; Gender: -.5 = Male, +.5 = Female; SES: -.5 = Low SES, +.5 = Middle and High SES; M-NA = Mother's Negative Affectivity; M-EC = Mother's Effortful Control; M-Imp = Mother's Impulsivity; C-NA = Child's Negative Affectivity; C-EC = Child's Effortful Control; C-Imp = Child's Impulsivity; M-Weight = Mother's Weight; C-Weight = Child's Weight; M-Approach = Mother's Approach to Food; $*p < .05$; $**p < .01$

Table 5. Aim 1: APIM of Negative Affectivity and Weight in Mother/Child Dyads

	Basic APIM		APIM with Moderations	
	Mother's Weight	Child's Weight	Mother's Weight	Child's Weight
SES Covariate	-0.199 (0.137)	-0.229 (0.129)	-0.204 (0.139)	-0.251 (0.134)
Actor Negative Affectivity	-0.209 (0.104)	0.104 (0.081)	-0.055 (0.524)	0.637 (0.430)
Partner Negative Affectivity	0.063 (0.084)	-0.142 (0.095)	0.201 (0.449)	0.446 (0.447)
Actor x Partner Negative Affectivity	---	---	-0.034 (0.110)	-0.134 (0.103)
Correlation of Weight	0.166 (0.072)*		0.170 (0.072)*	
Correlation of Negative Affectivity	0.296 (0.067)***		0.284 (0.070)***	
Model Fit				
χ^2 (*df*)	0.479 (2)		---	
RMSEA	0.000		---	
CFI	1.000		---	
TLI	1.627		---	
SRMR	0.012		---	
Log Likelihood H0 Value (Free Parameters)	-972.814 (16)		-930.025 (18)	

Note. The estimates are unstandardized βs, with standard errors in parentheses. *$p < .05$; **$p < .01$; *** $p < .001$; SES: -.5 = Low SES, +.5 = Middle and High SES

Table 6. Aim 1: APIM of Effortful Control and Weight in Mother/Child Dyads

	Basic APIM		APIM with Moderations	
	Mother's Weight	Child's Weight	Mother's Weight	Child's Weight
SES Covariate	0.089 (0.094)	-0.185 (0.129)	-0.184 (0.142)	-0.202 (0.133)
Actor Effortful Control	0.089 (0.094)	-0.088 (0.073)	0.481 (0.361)	-0.187 (0.354)
Partner Effortful Control	-0.034 (0.068)	-0.045 (0.079)	0.372 (0.342)	-0.135 (0.337)
Actor x Partner Effortful Control	---	---	-0.084 (0.071)	0.019 (0.067)
Correlation of Weight	0.178 (0.0071)*		0.183 (0.072)*	
Correlation of Effortful Control	0.341 (0.079)***		0.342 (0.079)***	
Model Fit				
χ^2 (*df*)	3.363 (2)		---	
RMSEA	0.056		---	
CFI	0.791		---	
TLI	0.268		---	
SRMR	0.035		---	
Log Likelihood H0 Value (Free Parameters)	-1043.580 (16)		-1008.746 (18)	

Note. The estimates are unstandardized βs, with standard errors in parentheses. **p* < .05; ***p* < .01; *** *p* < .001

Table 7. Aim 1: APIM of Impulsivity and Weight in Mother/Child Dyads

	Basic APIM		APIM with Moderations	
	Mother's Weight	Child's Weight	Mother's Weight	Child's Weight
SES Covariate	-0.243 (0.141)	-0.260 (0.134)	-0.255 (0.143)	-0.287 (0.139)*
Actor Impulsivity	-0.037 (0.014)*	0.172 (0.055)**	0.033 (0.065)	0.141 (0.138)
Partner Impulsivity	0.194 (0.066)**	-0.028 (0.016)	0.333 (0.163)*	-0.047 (0.068)
Actor x Partner Impulsivity	---	---	-0.015 (0.014)	0.004 (0.015)
Correlation of Weight	0.134 (0.072)		0.135 (0.074)	
Correlation of Impulsivity	0.092 (0.068)		0.093 (0.069)	
Model Fit				
χ^2 (*df*)	8.108 (2)		---	
RMSEA	0.119		---	
CFI	0.728		---	
TLI	0.050		---	
SRMR	0.048		---	
Log Likelihood H0 Value (Free Parameters)	-1389.446 (16)		-1344.648 (18)	

Note. The estimates are unstandardized βs, with standard errors in parentheses. **p* < .05; ***p* < .01
SES: -.5 = Low SES, +.5 = Middle and High SES

Table 8. Aim 2: Basic Model of Temperament Traits, Approach to Food, and Weight in Mother/Child Dyads

	Negative Affectivity		Effortful Control		Impulsivity	
	Mother's Weight	Child's Weight	Mother's Weight	Child's Weight	Mother's Weight	Child's Weight
SES Covariate	-0.283 (0.133)*	-0.244 (0.135)	-0.266 (0.136)	-0.183 (0.134)	-0.313 (0.137)*	-0.276 (0.139)
Actor Temperament	-0.325 (0.109)**	0.111 (0.086)	0.177 (0.098)	-0.096 (0.074)	-0.043 (0.014)**	0.177 (0.056)**
Partner Temperament	0.053 (0.083)	-0.153 (0.103)	-0.042 (0.064)	-0.059 (0.084)	0.196 (0.064)**	-0.029 (0.016)
Mother's Approach to Food	0.255 (0.077)**	0.015 (0.073)	0.228 (0.070)**	-0.039 (0.070)	0.203 (0.064)**	0.003 (0.064)
Correlation of Weight	0.170 (0.070)*		0.192 (0.071)**		0.139 (0.073)	
Correlation of Temperament	0.284 (0.069)***		0.342 (0.079)***		0.092 (0.068)	
Log Likelihood H0 Value (Free Parameters)	-928.857 (18)		-1008.365 (18)		-1352.877 (18)	

Note. The estimates are unstandardized βs, with standard errors in parentheses. $*p < .05$; $**p < .01$; $***\ p < .001$
SES: -.5 = Low SES, +.5 = Middle and High SES

Table 9. Aim 2: APIMoM of Temperament Traits, Approach to Food, and Weight in Mother/Child Dyads

	Negative Affectivity		Effortful Control		Impulsivity	
	Mother's Weight	Child's Weight	Mother's Weight	Child's Weight	Mother's Weight	Child's Weight
SES Covariate	-0.310 (0.134)*	-0.240 (0.136)	-0.280 (0.139)	-0.189 (0.134)	-0.319 (0.137)*	-0.278 (0.141)
Actor Temperament	-0.306 (0.115)**	0.111 (0.087)	0.169 (0.099)	-0.092 (0.075)	-0.049 (0.015)**	0.199 (0.060)**
Partner Temperament	0.066 (0.086)	-0.159 (0.106)	-0.035 (0.067)	-0.062 (0.087)	0.228 (0.070)**	-0.032 (0.016)
Mother's Approach to Food	0.865 (0.464)	-0.068 (0.367)	0.048 (0.425)	-0.169 (0.347)	1.155 (0.335)**	0.147 (0.292)
Mom Temp x Mom Approach	-0.029 (0.105)	0.037 (0.079)	0.059 (0.092)	0.036 (0.074)	-0.020 (0.014)	0.009 (0.013)
Child Temp x Mom Approach	-0.110 (0.079)	-0.016 (0.079)	-0.020 (0.059)	-0.008 (0.058)	-0.161 (0.070)*	-0.050 (0.051)
Correlation of Weight	0.171 (0.071)*		0.190 (0.072)**		0.130 (0.073)	
Correlation of Temperament	0.284 (0.070)***		0.342 (0.079)***		0.093 (0.069)	
Log Likelihood H0 Value (Free Parameters)	-925.024 (22)		-1005.060 (22)		-1338.050 (22)	

Note. The estimates are unstandardized βs, with standard errors in parentheses. *$p < .05$; **$p < .01$; *** $p < .001$
SES: -.5 = Low SES, +.5 = Middle and High SES

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APPENDIX 1

UNIVERSITY APPROVAL FOR HUMAN SUBJECTS TESTING

EXEMPTION GRANTED

Marisol Perez La Mar
Psychology
-
Marisol.Perez@asu.edu

Dear Marisol Perez La Mar:

On 10/13/2016 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	The Influence of Negative Affectivity and Effortful Control on Child Emotional Eating and Weight
Investigator:	Marisol Perez La Mar
IRB ID:	STUDY00005096
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• Marisol Perez CITI Certificate part 1, Category: IRB Protocol; • IRB application for secondary data analysis, Category: IRB Protocol; • CITI Certificate Tara Ohrt, Category: IRB Protocol; • Marisol Perez CITI Certificate part 2, Category: IRB Protocol;

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (4) Data, documents, or specimens on 10/13/2016.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator

Cc:
Tara Ohrt