Published in final edited form as:

Appetite. 2014 July ; 78: 139–146. doi:10.1016/j.appet.2014.03.025.

Surgency and Negative Affectivity, but not Effortful Control, are Uniquely Associated with Obesogenic Eating Behaviors among Low-Income Preschoolers

Christy Y.Y. Leung, Ph.D.¹, Julie C. Lumeng, M.D.^{1,2,3}, Niko A. Kaciroti, Ph.D.^{1,4}, Yu Pu Chen, M.S.¹, Katherine Rosenblum, Ph.D.^{1,5}, and Alison L. Miller, Ph.D.^{1,6}

¹Center for Human Growth and Development, University of Michigan, Ann Arbor, MI

²Department of Pediatrics and Communicable Diseases, University of Michigan, Ann Arbor, MI

³Department of Environmental Health Sciences, School of Public Health, University of Michigan, Ann Arbor, MI

⁴Department of Biostatistics, School of Public Health, University of Michigan, Ann Arbor, MI

⁵Department of Psychiatry, University of Michigan, Ann Arbor, MI

⁶Department of Health Behavior and Health Education, School of Public Health, University of Michigan, Ann Arbor, MI

Abstract

Despite increased attention to the role of temperament in children's obesogenic eating behaviors, there is a paucity of research examining whether different dimensions of temperament may be differentially associated with specific eating behaviors among preschool-age children. The purpose of the current study was to examine whether three temperament dimensions (surgency, negative affectivity, and effortful control) were uniquely associated with six obesogenic eating behaviors (caregiver-reported food responsiveness, enjoyment of food, emotional overeating, satiety responsiveness, and tantrums over food; and observed eating in the absence of hunger) among low-income preschool-age children, covarying home environment quality. Results showed that temperament dimensions were differentially associated with different eating behaviors. Specifically, preschoolers with higher surgency were more likely to overeat in response to external cues, have frequent desire to eat, derive pleasure from food, and eat in the absence of hunger. In contrast, preschoolers with higher negative affectivity were more likely to have tantrums over being denied food and less likely to eat in the absence of hunger. Effortful control was not uniquely associated with obesogenic eating behavior. Findings remained significant even when home chaos was accounted for, suggesting that child surgency and negative affectivity are

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Corresponding author: Alison L. Miller, Ph.D., Center for Human Growth and Development, 300 North Ingalls Street, 10th Floor, University of Michigan, Ann Arbor, MI 48109-5406, Phone: 734-763-0428, alimill@umich.edu.

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important to consider, independent of home environment. Results are discussed with regard to theoretical implications for the study of childhood obesity and for applied prevention implications.

Keywords

Surgency; Negative affectivity; Effortful control; Eating behaviors; Preschoolers

Introduction

Child obesity represents a significant public health concern in the United States. Low-income children are particularly at risk; nearly one in three low-income preschool-age children are overweight or obese (Center for Disease Control and Prevention, 2011). Obesogenic eating behaviors such as frequent desire to eat, external eating (i.e., eating in response to external, as opposed to internal cues), emotional overeating, eating beyond satiety and persistent tantrums over food have been consistently implicated in the development of childhood overweight or obesity (Agras, Hammer, McNicholas, & Kraemer, 2004; Braet et al., 2008; Jahnke & Warschburger, 2012). From a prevention perspective, it is important to consider factors that may contribute to children's obesogenic eating behaviors in order to develop strategies to address these eating behaviors early in development. Individual differences in children's eating behaviors, such as eating in the absence of hunger emerge as early as the preschool years (Fisher & Birch, 2002). Thus, preschool is an important developmental period for examining factors that may contribute to obesogenic eating behaviors.

Temperament has been suggested as a factor that may in part determine why some children are more likely than others to exhibit obesogenic eating behaviors (Anzman-Frasca, Stifter, & Birch, 2012; Bergmeier, Skouteris, Horwood, Hooley, & Richardson, 2013; Haycraft, Farrow, Meyer, Powell, & Blissett, 2011). Aspects of temperament that have been specifically proposed as potential influences on eating behaviors include impulsivity (Braet, Claus, Verbeken, & Vlierberghe, 2007; Silveira et al, 2012) and extraversion (Vollrath, Stene-Larsen, Tonstad, Rothbart, & Hampson, 2012); negative emotionality (Anzman-Frasca et al, 2012; Haycraft et al., 2011; Vollrath et al., 2012); and self-regulation, or effortful control (Anzman-Frasca et al, 2012; Pieper & Laugero, 2013). Rothbart describes these three broad dimensions of temperament as surgency, negative affectivity, and effortful control, and conceptualizes them as reflecting individual differences in reactivity and self-regulation that are biologically based and relatively stable across contexts (Rothbart, Ahadi, & Evans, 2000). Despite increased attention to the role of temperament, the pathways from each dimension of temperament to obesogenic eating behaviors among preschool-age children are not well-understood (Bergmeier et al., 2013). Moreover, no study has examined whether different dimensions of temperament may be differentially associated with specific eating behaviors in early childhood. Understanding the association of different dimensions of temperament with obesogenic eating behaviors could allow tailoring of interventions to children particularly at risk. Thus, the aim of the current study was to examine whether three temperament dimensions – surgency, negative affectivity, and effortful control – were

uniquely associated with six obesogenic eating behaviors in a sample of low-income preschool-age children, covarying home environment.

Dimensions of Children's Obesogenic Eating Behavior

Despite a lack of a conceptual framework or classification system to identify children's eating behaviors in the literature, based on previous findings, various dimensions of eating behaviors have been implicated in the development of childhood obesity. Food responsiveness measures food consumption in response to external cues such as the presence of good-tasting versus less-good-tasting food consumed in standard conditions (Wardle et al., 2001). Enjoyment of food captures appetitive drive, desire to eat, and general interest in eating (Wardle et al., 2001). Emotional overeating refers to tendency to seek immediate comfort through excessive eating in response to emotional arousal (Epel et al., 2001). Satiety responsiveness reflects ability to recognize internal satiety cues and reduce food intake to compensate for a preload of foods. Eating in the absence of hunger assesses food consumption beyond satiety in the presence of palatable foods (Birch, Fisher, & Davison, 2003; Fisher & Birch, 2002). Tantrums over food refer to persistent tantrums over being denied food (Agras et al., 2004). In the present study, a multi-method approach was used to assess these six eating behaviors, which included caregiver-reported food responsiveness, enjoyment of food, emotional overeating, satiety responsiveness, and tantrums over food; and observed eating in the absence of hunger.

Dimensions of Child Temperament: Surgency, Negative Affectivity, Effortful Control

Surgency is an "approach" dimension of temperament characterized not only by impulsivity, but also intense pleasure seeking, high activity level and low levels of shyness (Rothbart & Putnam, 2002). Surgency may increase individuals' susceptibility to obesogenic eating (Burton et al., 2011) because it may reflect a high appetitive drive and a tendency to seek pleasure from eating even in the absence of hunger. Some evidence in support of this view comes from studies of impulsivity, an aspect of surgency. Regardless of their socioeconomic status, adults and adolescents with heightened impulsivity were more likely to eat palatable foods and more inclined to satisfy their momentary craving for foods (Guerrieri et al., 2007; Hetherington, 2007; Ouwens, van Strien, & van Leeuwe, 2009). Increased impulsivity also contributed to failure to lose weight or maintain healthy weight over time in obese children, possibly due to impulsive overeating (Nederkoorn, Jansen, Mulken, & Jansen, 2007). Most studies have typically focused on impulsivity, but neglected other aspects of surgency such as a need for high-intensity pleasure-seeking, a high activity level and a short latency in approaching novelty. These surgency characteristics suggest high approach motivation, low shyness and high appetitive drive (Burton et al., 2011; Rothbart et al., 2001). Shyness, which is negatively related to surgent temperament, has been positively associated with reluctance to sample new foods (Pliner & Loewen, 1997). In contrast, children who are more surgent may experience eating as a highly rewarding, pleasurable activity and engage in obesogenic eating behaviors. The few studies that have examined surgency in relation to eating behavior were of older children, and also assessed only a single aspect of eating behavior (van den Berg et al., 2011; Vollrath et al., 2012). In the current study, low-income preschoolers with higher surgency were expected to engage in more eating behaviors that are specifically

conceptualized as reflecting appetitive drive, including food responsiveness, enjoyment of food and eating in the absence of hunger.

The negative affectivity dimension of temperament, which is characterized by mood instability, angry reactivity and dysregulated negative emotions (Shields & Cicchetti, 1997), may be associated with the use of obesogenic eating behaviors as a self-soothing strategy in response to emotional stress (Epel, Lapidus, McEwen, & Brownell, 2001). A recent study showed that children with loss of control eating were more likely to use maladaptive emotion regulation strategies in response to anxiety or anger; they were also prone to external and emotional eating (Czaja, Rief, & Hilbert, 2009). Nonetheless, associations between negative affectivity and dysregulated eating behaviors have been documented primarily among adults and adolescents (Epel et al., 2001). In children, findings are more mixed. Emotionally negative temperament traits including anger and frustration were positively associated with tantrums over being denied food in preschool-age children (Agras et al., 2004). In other studies of preschool- and school-age children, a more emotionally negative temperament was associated with both more emotional overeating as well as more food avoidant eating behaviors such as emotional undereating, food fussiness, satiety responsiveness, slowness in eating and less enjoyment of food (Haycraft et al., 2011). Thus, the associations between negative affectivity and obesogenic eating behaviors in children are relatively inconsistent. Based on the prior literature, we had two competing hypotheses. First, based on the literature that individuals who experience stress and negative emotions tend to increase their food intake (Groesz et al., 2012; Yeomans & Coughlan, 2009), we hypothesized that children who experience intense negative emotions and have difficulty regulating such emotions may seek immediate comfort through excessive eating. The alternative hypothesis is that, based on the literature that children with emotional temperament tend to show food avoidant eating behaviors (Haycraft et al., 2011), children with greater negative affectivity may not eat excessively. In summary, low-income preschoolers with higher negative affectivity were expected to engage in more or less obesogenic eating behaviors and the present study sought to test these competing hypotheses.

Effortful control is a temperament dimension indicated by the capacity to refrain from a desired or dominant behavior, while also maintaining attention on a task and resisting distraction (Rothbart & Putnam, 2002). A number of studies have implicated various aspects of effortful control in the development of overweight and obesity among children with different racial/ethnic and socioeconomic backgrounds. For example, children with less self-regulatory competence had higher body mass index (BMI) z-scores and more rapid weight gain from age 3 to 12 years (Francis & Susman, 2009). Children who showed limited ability to delay gratification at age 4 years were more likely to become overweight at age 11 years (Seeyave et al., 2009). Yet, these studies did not examine the associations between effortful control and obesogenic eating behaviors. Preschool- and school-age children with higher inhibitory control have been found to have greater ability to self-regulate energy intake (Pieper & Laugero, 2013; Tan & Holub, 2011). Given that inhibitory control, an aspect of effortful control, has been linked to attention and compliance, these individuals were probably better at redirecting their attention away from food temptations or complying with prohibitions against certain foods. Moreover, given that attention focusing is an aspect of

effortful control, children's ability to focus attention on their own satiety may be a mechanism through which effortful control relates to satiety responsiveness. Children who have a short attention span may be less likely to recognize satiety and more likely to engage in external eating (Faith & Hittner, 2010). In the present study, low-income preschoolers with lower effortful control were therefore expected to engage in more obesogenic eating behavior such as lower responsiveness to satiety.

Covariate: Home Environment Quality

Finally, previous studies have revealed that preschoolers are at greater risk for overweight when their caregivers fail to maintain their daily routines, implement appropriate control over children's behaviors, or provide sensitive support to address children's emotional needs (Anderson & Whitaker, 2010; Olvera & Power, 2010; Rhee, Lumeng, Appugliese, Kaciroti, & Bradley, 2006). Thus, in order to account for the fact that home environment may relate to child overweight, home environment quality (operationalized as level of chaos in the home) was considered as a covariate. Home chaos was included in the path models to examine specifically how individual differences in temperament may play a unique role in children's obesogenic eating behaviors, even accounting for the potential role of home environment.

In sum, the goal of the present study was to examine whether three temperament dimensions (surgency, negative affectivity, and effortful control) were uniquely associated with six obesogenic eating behaviors (caregiver-reported food responsiveness, enjoyment of food, emotional overeating, satiety responsiveness, and tantrums over food; and observed eating in the absence of hunger) among low-income preschool-age children, covarying home environment.

Method

Participants and Recruitment

Participants included 380 primary caregivers ($M = 29.09$ years, $SD = 6.95$; 91% mothers) and their preschool-age children ($M = 4.10$ years, $SD = 0.54$; 190 females) attending Head Start programs in mixed rural and urban areas of Michigan between 2009 and 2011. Head Start is a free, federally-funded preschool program for low-income children. Inclusion criteria were that all caregivers had less than a 4-year college degree and 16% of them did not complete high school. This sample was diverse in terms of race and ethnicity (see Table 1).

Other inclusion criteria were that the child was 3 or 4 years old at study enrollment and was born at 35 weeks gestation or more without significant perinatal or neonatal complications. The family was excluded if the child was a foster child, had significant developmental disabilities, significant medical problems or had food allergies, or the child and/or primary caregiver was/were non- English-speaking. Families were informed about the study during Head Start classroom open houses and through flyers in children's backpacks. They were compensated for returning an initial enrollment packet including a questionnaire and a signed written informed consent form. These families were then contacted by phone to

review eligibility criteria and to confirm complete understanding of the study and validate informed consent.

Procedure

Given high levels of low literacy within the participating population, questionnaires were administered orally to the caregivers and children's behavioral assessments/observations were conducted at the Head Start centers. All research assistants were highly trained in the study protocol implementation and questionnaire administration so that there was little variability across research assistants

Observed eating in the absence of hunger—Children's eating in the absence of hunger was measured immediately after breakfast at Head Start, using a method with acceptable reliability and validity (Birch et al., 2003). Given limitations of the community setting and Head Start regulations, we were unable to standardize the breakfast offered. However, breakfasts at Head Start are required to meet nutritional standards for caloric content and nutritional composition mandated by the US Department of Agriculture Child and Adult Care Food Program. Measuring eating in the absence of hunger following a typical meal in the school or home setting is an approach that has been used by others which has been proposed to increase ecological validity of the task (Hill et al., 2008; Wardle, Guthrie, Sanderson, & Rapoport, 2001). A research assistant observed and confirmed that children had eaten at the Head Start breakfast meal prior to the eating in the absence of hunger protocol. Children were given opportunities to have additional servings of breakfast and were asked if they were finished or if they would like more breakfast to encourage them to eat to satiety. Children who did not consume any food during the breakfast were not invited to proceed with the eating in the absence of hunger task that day based on concerns that children not eating may have reflected illness or substantial dislike of the food served for breakfast such that they would still be hungry when presented with the foods in the eating in the absence of hunger protocol. This approach has been used often in previous studies (e.g., Birch et al., 2003).

Immediately following breakfast, the research assistant asked the child to indicate whether s/he was "hungry," "in between" or "full" using three corresponding cartoon figures and proceeded with engaging the child in the eating in the absence of hunger task only when the child reported being "full" or "in between". Then, the research assistant invited the child to a separate room and for 10 minutes gave him or her free access to toys and pre-measured bowls of Trix® cereal (32 grams; 120 calories), mini Chips Ahoy® cookies (90 grams; 435 calories), fruit snacks (164 grams; 631 calories), Cheez-Its® (60 grams; 300 calories), pretzel sticks (36 grams; 129 calories) and Chicken in a Biskit® crackers (60 grams; 310 calories). Children were told, "You can play with any of the toys and eat any of the foods on this table. I'm going to do some work." After 10 minutes, the remaining food was weighed; this value was subtracted from the initial weight and total calories consumed were calculated based on manufacturer-provided calories per unit weight. A larger total number of calories consumed represented a higher degree of eating in the absence of hunger. Log-transformation was used for the total number of calories consumed outcome variable to satisfy the normality assumption.

Questionnaires

Child eating behaviors—In addition to observed eating in the absence of hunger, five other eating behaviors were measured using questionnaires. Caregivers completed the Children's Eating Behavior Questionnaire (CEBQ; Wardle et al., 2001), a validated and reliable questionnaire that assesses children's food approach behaviors including: food responsiveness (e.g., "my child is always asking for food"; five items; $\alpha = .84$), enjoyment of food (e.g., "my child loves food"; four items; $\alpha = .84$), emotional overeating (e.g., "my child eats more when anxious"; four items; $\alpha = .79$) and satiety responsiveness (e.g., "my child gets full easily"; five items; $\alpha = .73$), using a 5-point scale ranging from 1 (*never*) to 5 (*always*). Four subscale scores were computed by taking the mean of the corresponding items. Higher scores represent a greater prevalence degree of that particular eating behavior.

Caregivers reported food-related tantrums in the last four weeks in four questions adapted from prior work (Agras, et al., 2004): (1) "How often did your child ask you for something to eat or get him/herself something to eat?" which was rated on a 5-point scale (*never; one time; once a week; once a day; several times a day*); (2) "How often did you have to say no when your child wanted something to eat?", which was rated on a 4-point scale (*rarely/never; sometimes; often; almost always; or not applicable (if response to question 1 was "never")*); (3) "When you said no, how often did your child become upset?", which was rated on a 4-point scale (*rarely/never; sometimes; often; almost always; or not applicable (if response to either question 1 or 2 was "never")*); and (4) "When you said no, how frequently did your child have a tantrum?", which was rated on a 4-point scale (*rarely/never; sometimes; often; almost always; or not applicable (if response to either question 1 or 2 was "never")*). Based on these responses, each child was assigned into one of the three categories: 1 (*child never asks for food, asks for food less than once a day, or asks once or more than once a day and is never/rarely denied*), 2 (*child asks for food once or more than once a day, is sometimes/often/almost always denied, and rarely/never/sometimes becomes upset or tantrums*) or 3 (*child asks for food once or more than once a day, is sometimes/often/almost always denied, and often/almost always becomes upset or tantrums*).

Child temperament—The Children's Behavior Questionnaire (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001) was used to assess surgency and effortful control. Subscales contributing to surgency are activity level (e.g., "seems always in a big hurry"; seven items), high intensity pleasure (e.g., "likes going down high slides or other adventurous activities"; six items), impulsivity (e.g., "often rushes into new situations"; six items) and shyness (e.g., "acts shy around new people"; six items). Subscales contributing to effortful control are attention focusing (e.g., "when drawing or coloring in a book, shows strong concentration"; six items) and inhibitory control (e.g., "can easily stop an activity when s/he is told "no"; six items). Caregivers rated how well each item describes the child's reaction within the past six months on a 7-point scale ranging from 1 (*extremely untrue*) to 7 (*extremely true*). Surgency ($\alpha = .70$) and effortful control ($\alpha = .76$) scale scores were computed, as recommended by scale developers, by taking the mean of the corresponding subscales (shyness was reverse-coded). Higher scores represent higher levels of the corresponding temperament characteristics.

The negative lability subscale from the Emotion Regulation Checklist (ERC; Shields & Cicchetti, 1998) was used to assess negative affectivity. This subscale consists of 15 items reflecting a child's propensity to become upset and display negative emotions (e.g., "is easily frustrated"; "responds angrily to limit-setting"). Caregivers rated each item on a 4-point scale ranging from 1 (*rarely/never*) to 4 (*almost always*). A scale score was computed by taking the mean of these 15 items ($\alpha = .85$). Higher scores reflect more negative affectivity (four items were reverse-scored).

Covariate: home environment quality—To account for potential variability in eating behavior due to home environment and family-level processes, the 15-item Confusion, Hubbub, and Order Scale (CHAOS; Matheny, Wachs, Ludwig, Phillips, 1995) was used to measure the extent to which the child's home environment is characterized by a lack of routine, disorganization, confusion, and noise. Caregivers indicated whether each item (e.g., "it's a real 'zoo' in our home"), was true or false for their family. Seven items were reverse-coded before summing the total number of items endorsed by the caregiver ($\alpha = .80$). Higher scores represent a more disorganized, confused, and noisy home environment (i.e., greater home chaos).

Statistical analyses—Multivariate analysis accounting for inter-correlations among independent variables were implemented using path analyses to examine whether the three temperament dimensions (surgency, negative affectivity and effortful control) were uniquely associated with each of the six obesogenic eating behavior outcomes (food responsiveness, enjoyment of food, emotional overeating, satiety responsiveness, tantrums over food and eating in the absence of hunger), above and beyond home chaos. All three temperament dimensions and home chaos were included in each model. The covariance path between surgency and home chaos was excluded from the path analyses due to their non-significant zero-order correlation. A statistical model for the path analyses is presented in Figure 1. The marginal significant results of the Little's MCAR test showed some evidence that 8.90% of the data were not missing completely at random, $\chi^2(9) = 15.33$, $p = .08$. Thus, we imputed the missing data using Proc MI in SAS 9.3. All analyses were conducted in AMOS 7 using the maximum-likelihood estimation procedure. Multiple fit indices were examined to evaluate the model fit: the chi-square goodness-of-fit statistic, the comparative fit index (CFI), the root mean square error of approximation (RMSEA) and the standardized root mean residual (SRMR). A model is considered a good fit when χ^2 statistic is non-significant with a p -value $> .05$, CFI $> .90$, RMSEA $< .08$ and SRMR $< .06$ (Bentler, 1990; Hu & Bentler, 1999).

Furthermore, we examined potential interactions between surgency, negative affectivity and effortful control in explaining each of the six obesogenic eating behaviors, above and beyond home chaos, in a series of follow up analyses. Multiple linear regression analyses were conducted with the six obesogenic eating behaviors as the dependent variables, home chaos as the covariate, and surgency, negative affectivity and effortful control as the independent variables. To test the potential interaction effects, three interaction terms (surgency x negative affectivity, surgency x effortful control and negative affectivity x effortful control) were computed and entered in the corresponding regression models.

Surgency, negative affectivity and effortful control were mean-centered prior to computing the interaction terms in order to minimize potentially problematic multicollinearity (Aiken & West, 1991).

Results

Means, standard deviations and zero-order correlations among all variables are presented in Table 2. Correlations among eating behaviors were modest, with the strongest associations observed among CEBQ variables. The three dimensions of temperament were also modestly intercorrelated, with the strongest association observed between negative affectivity and effortful control ($r = -.61$). There were positive correlations between home chaos and three eating behaviors (i.e., food responsiveness, emotional overeating and tantrums over food). Home chaos was therefore included as a covariate in the path models.

All six path models fit the data well, $\chi^2(1) = 1.123, p = .289$; CFI = 1.000, RMSEA = 0.018; SRMR ranging from .0163 to .0167. Including all three temperament dimensions and controlling for home chaos, *higher* levels of surgency were significantly associated with *more* food responsiveness, $\beta = .14, z = 2.66, p < .01$, enjoyment of food, $\beta = .22, z = 4.11, p < .001$, and eating in the absence of hunger, $\beta = .26, z = 4.91, p < .001$. Moreover, *higher* levels of negative affectivity were significantly associated with *more* tantrums over food, $\beta = .24, z = 3.67, p < .001$, and *less* eating in the absence of hunger, $\beta = -.16, z = -2.44, p < .05$. However, effortful control was not significantly associated with any of the six eating behaviors (see Table 3 for all standardized path coefficients). These six path models were also tested in boys and girls separately and no substantial differences in the pattern of results were found between boys and girls. Furthermore, multiple linear regression analyses revealed that there were no significant surgency x negative affectivity, surgency x effortful control, or negative affectivity x effortful control interactions for any of the six eating behavior outcomes (all p 's $< .05$).

Discussion

The overall aim of the present study was to examine whether the three dimensions of temperament proposed as important for child eating behavior, specifically surgency, negative affectivity and effortful control, were uniquely associated with six obesogenic eating behaviors among low-income preschool-age children. Findings were that low-income preschoolers with higher surgency or negative affectivity, but not effortful control, were more likely to engage in certain obesogenic eating behaviors, above and beyond the effect of home chaos. Results are discussed with regard to theoretical implications for the study of childhood obesity, and for applied prevention implications.

Surgency

In support of the first hypothesis, low-income preschoolers with higher surgency were more inclined to overeat in response to external cues, have frequent desire to eat, derive pleasure from foods and eat in the absence of hunger. These findings complement and extend the current literature by examining the temperamental construct of surgency, rather than just impulsivity or a lack of self-control, in relation to the development of obesogenic eating

behaviors in early childhood. Temperamental surgency may manifest in the eating domain as an intense craving for food and sensitivity to food as a reward. Surgent preschoolers may simply be more insistent than others in reaching their goal and be more driven by seeking and attaining high-pleasure goals that involve food. In slightly older children, reward sensitivity and impulsivity both predicted overeating, suggesting that both aspects of surgency may contribute (van den Berg et al., 2011). Furthermore, surgency may shape parenting behavior: studies have found that parents of infants tended to feed their more surgent and externalizing children more often, and with more sweet foods (Vollrath, Tonstad, Rothbart, & Hampson, 2011). Parents typically continue to control what their preschool-age children are eating, although children this age may increase their requests for specific foods and become more effective at convincing parents to allow them to have them (e.g., sweets at the store; O'Dougherty, Story, & Stang, 2006). In the current obesogenic environment where large varieties of sweet and fatty foods are inexpensive, available and offered in large portion sizes (Epstein, Leddy, Temple, & Faith, 2007), surgent children of low-income families may be particularly vulnerable to obesogenic eating patterns and therefore early childhood obesity. Surgency may thus be an important, yet still relatively unexamined, factor in predisposing low-income preschool-age children to obesogenic eating behaviors. Considering surgency may be a key element in understanding early pathways to obesity for these children.

Negative Affectivity

In contrast to the patterns for surgency, low-income preschoolers who became easily upset, experienced intense emotions and had emotion regulation difficulties were more likely to have tantrums over being denied food, but less likely to eat in the absence of hunger. These results were in partial support of the second hypothesis. Negative affectivity has been associated with disordered eating behaviors in adults and adolescents (Epel et al., 2001), even though it is not clear that disordered eating (e.g., bingeing) functions to reduce the feelings of negative affect (Haedt-Matt & Keel, 2011). Although longitudinal work with infants has focused on the role of negative affectivity in feeding (e.g., Farrow & Blissett, 2006) and negative affect is proposed as a risk factor for overweight (Anzman-Frasca et al., 2012), studies of preschoolers have mostly examined BMI and obesity outcomes, without specifically considering different eating behaviors (Haycraft et al., 2011), as we did in the current study. Different temperament dimensions may confer obesity risk through different patterns of obesogenic eating behaviors. Negative affectivity may contribute to preschoolers' inability to modulate intense negative emotions and angry reactivity when being denied desirable food. Others (Haycraft et al., 2011) found associations of negative affectivity with greater responsiveness to satiety in children ages 3–8 years, which we did not find in our CEBQ measure, but may be reflected in the association between negative affectivity and less eating in the absence of hunger in the present study. Thus, these findings also suggest that the use of observation may give us different information about preschool-age children's responsiveness to satiety than caregiver-report questionnaire. Possibly, preschoolers with higher negative affectivity might be more likely to experience distress and/or anxiety during the observed procedure, which might contribute to more selective eating behaviors (Pliner & Loewen, 1997). In the present study, we found no unique relation between negative affectivity and emotional overeating. Perhaps children with an emotionally

negative temperament may be likely to experience intense aversive emotions and have difficulties regulating such emotions when they have to endure distress without emotional support in their immediate environment; these children might be vulnerable to emotional overeating when facing a chaotic, stressful home environment. Indeed, the present zero-order correlations revealed that both negative affectivity and home chaos were positively associated with emotional overeating.

Effortful Control

Effortful control reflects children's ability to self-restrain from a prohibited behavior, maintain attention and compliance to instructions as well as resist distractions or temptations (Rothbart & Putnam, 2002). These temperamental characteristics have been proposed as essential for young children to develop effective strategies to regulate their food intake and eating patterns (Anzman-Frasca et al., 2012; Jasinska et al., 2012; Tan & Holub, 2011), especially when they are experiencing stress or facing food temptations. Yet, in the current study, we found no direct association between effortful control and obesogenic eating behaviors in our path models. The relatively high negative correlation between negative affectivity and effortful control may have obscured the role of effortful control. It may also be due to the fact that we examined obesogenic eating behaviors concurrently and not prospectively. The associations between effortful control and obesogenic eating behaviors may emerge over time; the preschool years are a time of increasing independence and autonomy across domains of development (McClelland & Morrison, 2003). Thus, the role of effortful control specifically in relation to eating behavior may change across the preschool-to-middle childhood years. Indeed, the ability to delay gratification (an aspect of effortful control) at age 4 years is associated with obesity at age 11, even covarying prior weight status (Seeyave et al., 2009). It is important to note, however, that we did not examine effortful control specifically with regard to eating behaviors. Thus, although child surgency and negative affectivity may play a more important role than effortful control in the pathways to certain obesogenic eating behaviors during the preschool years, future studies should examine whether effortful control during the preschool years may predict children's eating behaviors later on. We also considered that effortful control may only exert effects on eating behavior in the context of high levels of surgency or high levels of negative affectivity. However, this hypothesis was not supported as none of the interaction terms were tested were significant. Thus, our results suggested that among preschool-age children, self-control was not significantly associated with obesity-promoting eating behavior, regardless of the child's level of temperamental surgency or negative affectivity. Further research is needed to better understand this lack of main or moderating effect of self-control in early childhood. It is also important to consider whether the effortful control-eating behavior association may emerge only in an environment where food temptations are present.

Home Environment Quality

Finally, although home environment quality was not the primary focus of the current study, we did find that low-income preschoolers who lived in a more chaotic home environment were more likely to engage in obesogenic eating behaviors such as external eating, emotional overeating and tantrums over food. Our home chaos measure likely served as

somewhat of a “placeholder” for many of the family processes and features of the home environment that may contribute to these associations as it is a brief self-report, rather than a more extensive measure of home environment quality such as the Home Observation for Measurement of the Environment (HOME) Scale (Bradley & Caldwell, 1979). It makes sense, however, that chaotic home environments without adequate parental involvement or responsiveness may impede children’s development of self-regulation in food intake. Young children have been shown to be more susceptible to overeating in response to external stimuli when their mothers endorse an indulgent feeding style and provide minimal guidance over their eating behaviors (Fisher, Birch, Zhang, Grusak, & Hughes, 2013). Moreover, children from families who tend to minimize emotions or who have low affective involvement tend to have lower emotional awareness, experience greater emotional distress and develop poorer emotional self-regulation (Eisenberg et al., 1999; Fabes, Leonard, Kupanoff, & Martin, 2001); these children may engage in overeating in response to negative emotions (Mellin, Neumark-Sztainer, Story, Ireland, & Resnick, 2002; Topham et al., 2011) and have tantrums over being denied food. Yet, some have found that family arguments at mealtime are associated with less child intake (Burnier, Dubois, & Girard, 2010), suggesting these associations are complex. Home environment quality can also include parental monitoring and structure, which have been shown to be important for children’s eating behaviors (e.g., Fisher et al., 2013). Given these many possible pathways related to aspects of the home environment, it was notable that our findings for surgency and negative affectivity remained even when home chaos was accounted for, suggesting that these child factors are important to consider, independent of home environment.

Limitations, Future Directions, and Implications

The following limitations of the present study should be noted. First, the cross-sectional nature of our design cannot allow us to infer the etiological significance of temperamental surgency, negative affectivity or effortful control in obesogenic eating behaviors among low-income preschool-age children. Some researchers have hypothesized that the linkages between temperament and eating behaviors may be driven by other factors, such as genetic characteristics or body weight that affect child temperament and eating (Anzman-Frasca et al., 2012; Hetherington, 2007; Miller et al., 2013; Wardle et al., 2008). Future longitudinal research on this topic is necessary.

Furthermore, caregiver-report was used as the only assessment of the predictor variables as well as many of the eating behaviors, which may have resulted in reporter bias. The use of observations could increase the ecological validity of child behavior assessments as well as the degree of chaos in the home. Other familial characteristics such as parent-child interactions, parental feeding practices and parental mealtime engagement have also been shown to be associated with young children’s eating behaviors (Burnier et al., 2010; Wu, Dixon, Dalton, Tudiver, & Liu, 2011). Future studies should consider these familial characteristics using observational measures and examine their interactions with child characteristics in predicting young children’s obesogenic eating behaviors.

Despite these limitations, however, the present study represents a significant step toward understanding how multiple dimensions of child temperament – particularly surgency,

negative affectivity and effortful control – relate to early obesogenic eating behaviors, which have in turn been implicated in the development of overweight/obesity among low-income preschool-age children. Importantly, information learned from the present study may contribute to interdisciplinary efforts between developmental scientists and practitioners to develop tailored, evidence-based early childhood obesity interventions. For example, young children who are characterized by high temperamental surgency or negative affectivity may have an increased risk for obesogenic eating; thus, implementing strategies that address individual differences such as impulsivity, intense pleasure seeking and difficulties with regulating emotions may increase intervention success. Furthermore, children with different temperamental characteristics may struggle with different types of obesogenic eating, so it is important to consider and assess different eating behaviors a child may display.

Acknowledgments

Funding Source: All phases of this study were supported by NIH grant #RC1DK086376

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Highlights

- Surgency was related to more food responsiveness, desire and eating without hunger
- Negative affect was related to more food tantrums but less eating without hunger
- Effortful control was not uniquely related to obesogenic eating behaviors
- No interactions between temperament dimensions for obesogenic eating behaviors
- Findings held when home environment quality (home chaos) was covaried

Figure 1. Statistical model testing the role of three temperament factors in obesogenic eating behaviors, above and beyond home chaos

Note. Six obesogenic eating behaviors including food responsiveness, enjoyment of food, emotional overeating, satiety responsiveness, tantrums over food and eating in the absence of hunger were tested individually in each model.

Table 1

Demographic Characteristics of the Sample

Characteristic	Statistic
Child Race and Ethnicity	
White, non-Hispanic	55.79%
Black, non-Hispanic	15.53%
Biracial/Multiracial, non-Hispanic	16.58%
Hispanic, any race	11.32%
Caregiver's Educational Level	
Did not complete high school	16.32%
Graduated from high school or equivalent	32.10%
Attended fewer than 2 years of college	40.00%
Earned two-year degree	11.58%

Table 2

Means, Standard Deviations, and Zero-Order Correlations

	1	2	3	4	5	6	7	8	9	10
1. Food Responsiveness	–	0.47***	0.55***	–0.16**	0.25***	0.19***	0.18***	0.16**	–0.16**	0.18***
2. Enjoyment of Food		–	0.16**	–0.50***	0.12*	0.03	0.18***	–0.04	0.03	–0.01
3. Emotional Overeating			–	0.08	0.18***	0.15**	0.05	0.15**	–0.08	0.14**
4. Satiety Responsiveness				–	0.00	0.01	–0.04	0.10	–0.06	0.07
5. Tantrums over Food					–	0.03	0.12*	0.28***	–0.19***	0.19***
6. Eating in the Absence of Hunger						–	0.24***	–0.01	–0.09	0.05
7. Surgency							–	0.30***	–0.35***	0.06
8. Negative Affectivity								–	–0.61***	0.38***
9. Effortful Control									–	–0.32***
10. Home Chaos										–
<i>M</i>	2.48	3.79	1.96	2.98	1.93	3.61	4.86	1.97	4.60	4.10
<i>SD</i>	0.89	0.78	0.70	0.69	0.84	1.64	0.78	0.49	1.02	3.26

* $p < .05$.

**

* $p < .01$.

* $p < .001$.

Table 3
Standardized Path Coefficients and z-Values of the Three Temperament Variables and Covariate

Outcome Variables	Temperament Variables						Covariate	
	Surgency		Negative Affectivity		Effortful Control		Home Chaos	
	β	z	β	z	β	z	β	z
Food Responsiveness	.14**	2.66**	.03	0.50	-.06	-0.87	.14**	2.62**
Enjoyment of Food	.22***	4.11***	-.06	-0.90	.08	1.24	.04	0.70
Emotional Overeating	.02	0.44	.12	1.81	.03	0.44	.10	1.88
Satiety Responsiveness	-.08	-1.41	.10	1.45	-.02	-0.23	.04	0.72
Tantrums over Food	.05	0.86	.24***	3.67***	.00	0.04	.09	1.61
Eating in Absence of Hunger	.26***	4.91***	-.16*	-2.44*	-.06	-0.99	.06	1.08

*
 $p < .05$.

**
 $p < .01$.

 $p < .001$.