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**PSYCHOMETRIC EVALUATION OF THE EARLY CHILDHOOD BEHAVIOR QUESTIONNAIRE VERY SHORT  
FORM IN LOW-INCOME  
WIC MOTHERS AND TODDLERS**

A Thesis in  
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by  
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## ABSTRACT

Prior research has revealed that aspects of temperament, defined as individual differences in regulation and reactivity, are related to child weight status. However, very little research has examined these associations among high-risk populations. 215 mothers with children 12-36 months old participating in the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) in Pennsylvania completed basic demographic information and the very short Early Childhood Behavior Questionnaire (ECBQ), which identifies three higher-order factors of temperament, Surgency, Negativity, and Effortful Control. Child weight and length were collected. Mothers completed the ECBQ and self reported weight and height. Mothers were primarily white (71%) and overweight (mean BMI 29.4). 36% of toddlers were above the 85th percentile on WHO weight for length measurements. Confirmatory factor analysis of the ECBQ very short form revealed a poor fit. Exploratory factor analysis was then conducted to determine the optimal model fit. Higher levels of Surgency and Effortful Control were associated with less frequent use of food to soothe, while higher levels of Negativity were associated with greater use. The ECBQ may serve as an acceptable measure of temperament in toddlers as young as 12 months, but additional work is needed to determine its efficacy and developmental appropriateness in diverse samples. Associations between toddler temperament and parent feeding styles in this WIC sample are consistent with findings from lower risk samples, which points toward its potential use as a universal tool in identifying an early risk factor for childhood obesity.

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## Chapter 1

### Introduction

The prevalence of childhood obesity in the United States has more than tripled in the last three decades, with over 12% of US children aged 2-4 considered obese ( $\geq 95^{\text{th}}$  percentile). Childhood obesity rates are even higher in low-income populations. Data from the Pediatric Nutrition Surveillance System (PedNSS), which includes a larger proportion of low income children, indicate that nearly one third of low-income children aged 2-4 years are overweight and 14% are obese (CDC, 2012). Numerous factors have been implicated in this health disparity. As a group, low-income mothers are heavier (Martin & Lippert, 2012) and have lower dietary quality than their higher income counterparts, which is related to lower quality diets in their children (Laster, et al., 2013). Children of low-income families are less likely to meet fruit and vegetable intake recommendations and more likely to consume greater amounts of low-quality food products, such as processed snacks and sugar-sweetened beverages (Laster, et al., 2013; Nackers & Appelhans, 2013). These differences may also shape the home food environment, so that behaviors such as serving breakfast daily, cooking, and eating meals together as a family are less likely to occur in low-income families (Swanson et al., 2011; Crombie et al., 2009). On a broader scale, environmental factors that impact diet quality, such as food access, have been shown to disproportionately affect low-income populations, which may also contribute to higher rates of obesity (Lindholm, 2011).

Federal funding through programs such as the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) aims to address these risk factors in low-income populations by providing supplemental foods, health care referrals, and nutrition education to women and their young children. To qualify, a pregnant or postpartum woman's household must be at or below the 185<sup>th</sup> percentile of the Federal poverty income guidelines, with a child or children up to age five, who are at nutritional risk. As of June 2013, approximately 8.6 million individuals in the United States participate in

WIC. A 27-state survey of WIC participation found that 17% (662,800) of women who qualified were not enrolled in the program, bringing the total proportion of women qualifying for WIC to 63% of those surveyed (CDC, 2013). The large proportion of the population affected by income restrictions points toward the importance of understanding more about this group.

Most research addressing obesity risk in young children has focused primarily on the context in which children are living, from home-level variables such as parenting style (Pinard, et al., 2012; Vollmer & Mobley, 2013) to community-level variables such as access to healthy foods (Lindholm, 2011; Rahman, Cushing, & Jackson, 2011). These broad factors are informative but often look at mean differences between groups, which may lose individual-level information that could help explain differences in outcomes. Grouping individuals together without accounting for the large variability among them diminishes the ability to identify relationships between specific behavioral tendencies, environmental contexts, and associated outcomes. Examining individual differences within these contexts offers insight into how the specific characteristics of the individual interact with the environment to either increase or decrease risk of unhealthy weight outcomes. Temperament, which refers to the individual differences in reactivity and regulation, offers one such characteristic observable early in life (Rothbart, Derryberry, & Posner, 1994).

#### *Defining temperament*

Gartstein and Rothbart (2003) presented one of the most commonly used and empirically validated structures of temperament, which centers on a hierarchical organization of lower-order factors subsumed under three higher-order factors (or superfactors): Surgency, Negativity, and Effortful Control. Surgency corresponds to high levels of positive reactivity and is indicated by higher ratings of impulsivity, high intensity pleasure, activity level, positive anticipation, and smiling and laughter and lower ratings of shyness. Negativity corresponds to high levels of negative reactivity and is indicated by higher ratings of sadness, discomfort, anger/frustration, and fear. Effortful Control corresponds to high

levels of regulation and is indicated by higher ratings of low intensity pleasure, inhibitory control, attentional focusing, and perceptual sensitivity.

Temperament is thought to have a biological basis and to be relatively stable across a lifetime (Buss & Plomin, 1975; Rothbart, Ahadi, & Evans, 2000). However, certain aspects of temperament do undergo developmental changes, starting out as more broad and global in nature then gradually becoming more distinct during the first years of life. Individuals maintain rank-order stability but often demonstrate mean-level instability as these traits mature (Putnam, Gartstein, & Rothbart, 2006). The traits themselves also emerge at different time periods. Even within the superfactors of temperament, the lower-order factors can differ in their developmental time course (Rothbart, Ahadi, & Evans, 2000). For instance, positive emotionality is rarely evidenced in the first couple months of life, only becoming clearer at 3 months of age (Rothbart, 1981). Fear and anger increase over the first year of life and then decrease later in toddlerhood and across childhood. Control over attentional processes and ability to inhibit dominant responses, indicators of Effortful Control, emerge later. The ability to exercise inhibitory control has been shown to increase from 18-36 months (Vaughn, Kopp, & Krakow, 1984), while control over attentional processes (i.e., the ability to focus or shift attention) increases from 2.5-4.5 years of age (Ruff & Lawson, 1990).

The large differences in the emergence of temperament factors highlight the need for a developmental perspective when assessing temperament. It is also important to understand if current measures can accurately assess temperament during transitional periods such as toddlerhood, when certain factors are fully emerged and others are just beginning to emerge.

### *Measuring child temperament*

Child temperament is typically measured in one of three ways: parent report questionnaires, structured interviewing, or home/laboratory observation (Rothbart & Goldsmith, 1985). These methods show only low to moderate correlation with one another suggesting that while they are measuring the

same constructs, there are substantial differences in what each contributes to the overall assessment of temperament. For instance, multiple studies have found that maternal reported temperament has little association with objective, home-based researcher observations (Seifer, Sameroff, Barrett, & Krafchuk, 1994). Moderate agreement is found between ratings of positive temperament traits, but negativity ratings diverge considerably (Stifter, Willoughby, & Towe-Goodman, 2008). The reaction elicited from the parent by the child's perceived temperament may have a far greater impact on child outcomes since it determines actual behavior. The parent's perception directly affects their behavior, which in turn has a direct effect on the child. This relationship centers on what the parent *perceives*, which regardless of whether or not it matches more objective measures of temperament, is the determining factor in parenting decisions. The parent also has extensive experience observing the child's temperament in a variety of contexts, which may help provide a more complete picture. Therefore, researchers may also select the method based on the particular perspective and associations they are interested in examining.

The Infant Behavior Questionnaire (IBQ) is a valid, widely used example of the survey approach to assessing temperament. It was designed to measure temperament in infants from 3 to 12 months, assessing the three superfactors along with 14 lower-order factors of temperament (Rothbart, 1981). Subsequently, the Childhood Behavior Questionnaire (CBQ) was designed to assess the same overarching superfactors of temperament and 15 lower-order factors in children age 3-7 years (Rothbart, Ahadi, Hershey, & Fisher, 2001). Using data from administration of the CBQ, in 2003, Gartstein and Rothbart released a revised version of the IBQ (IBQ-R) designed to include downward extensions of traits previously assessed only in older children upon indication that certain traits included in the CBQ but previously unexamined in the IBQ, such as high/low perceptual sensitivity and perceptual sensitivity, might also inform the development of temperament in infancy (Gartstein & Rothbart, 2003).

The Early Childhood Behavior Questionnaire (ECBQ) for toddlers age 18-36 months was developed to address the lack of an age-appropriate version of the Rothbart measure of temperament between the CBQ and IBQ-R as well as the potential change in temperament expression during the period (Putnam, Gartstein, & Rothbart, 2006). Short (SF, 107 items) and very short forms (VSF, 36 items) of the ECBQ were subsequently developed to provide an alternative to researchers wanting to obtain a broad assessment of temperament without the added time and participant burden of the 201-item standard form of the questionnaire (Rothbart, 2009). Mapping onto the three-factor model detailed above, the standard form measures the 18 discrete temperament traits subsumed under the three higher-order factors: Surgency, Negativity, and Effortful Control. Although items specific to all 18 traits are represented in the ECBQ-VSF, researchers sought to retain only the three higher-order superfactors in final scoring acuity (Putnam, Jacobs, Gartstein, & Rothbart, 2010). To achieve this goal, items demonstrating both high correlation with the intended superfactor and low correlation with the remaining two superfactors were selected for inclusion. Additionally, only items with a low percentage of respondents selecting the “does not apply” option were selected, as this and issues of correlation become increasingly important with shorter scales (Putnam & Rothbart, 2006). To date, no research has evaluated the factor structure and psychometrics of the ECBQ-VSF.

#### *Associations between temperament and weight outcomes*

The importance of being able to identify and study temperament early in life has become increasingly apparent as a growing body of literature reveals associations between temperament traits and health outcomes such as weight status both early and later in life (Anzman-Frasca, Stifter, & Birch, 2012; Bergmeier, Skouteris, Horwood, Hooley, & Richardson, 2013).

Associations between these higher-order factors of temperament and health outcomes such as weight status have been shown early in life in data from middle class populations. For example, cross-sectional and short-term studies have shown an association between Negativity and weight status,

though the association is less clear in longitudinal work (Anzman-Frasca, Stifter, & Birch, 2012; Bergmeier, Skouteris, Horwood, Hooley, & Richardson, 2013). In a short-term study of infants 6-12 months of age, Carey (1985) reported that those whose parents perceived their infant as more negative showed more rapid weight gain over the first six months of life, an association hypothesized to stem from the use of food to soothe frequent crying and fussing. These findings were replicated when examining weight outcomes from birth to six months in another sample of infants (Niegel, Ystrom, & Vollrath, 2007).

Longitudinal work, however, has produced mixed results, with some work supporting the above finding, showing that early life Negativity predicts weight status later in childhood (Slining, Adair, Goldman, Borja, & Bentley, 2009; Wells, et al., 1997), while other studies fail to find an association between these factors (Wright, Cox, & Couteur, 2011). Wells, et al. (1997) demonstrated that temperament characteristics measured at 12 weeks of age predicted adiposity levels 2.5 years later. Specifically, higher levels of Distress to Limitations and lower levels of Soothability—both lower-order factors of temperament subsumed under Negativity—predicted greater adiposity 2.5 years later. However, an eight year longitudinal study found no association between temperament measured at 6 weeks and 8 months and adiposity at 6-8 years (Wright, Cox, & Couteur, 2011). It has been hypothesized that these inconsistencies may be due to the breadth of behavioral and affective traits included within Negativity, so that different traits have different associations with weight outcomes (Anzman-Frasca, Stifter, & Birch, 2012). For instance, fear and sadness are quite different than anger and frustration, and the magnitude of these traits in an individual is likely to vary considerably. Parental response to different forms of Negativity is also likely to vary widely, with children whose Negativity presents itself as more aggressive crying and fussing likely being at higher risk for maladaptive feeding practices (Darlington & Wright, 2006).

Aspects of Effortful Control, particularly inhibitory control, have consistently been shown in older children to correlate with a higher BMI percentile. In a longitudinal study, girls with lower inhibitory control at age 7 had higher BMIs at all follow-up periods (9, 11, 13, and 15 years of age) (Anzman & Birch, 2009). Girls with lower inhibitory control at age 7 and parents who did not limit access to snacks had larger increases in BMI percentile from age 5-7, and those with lower inhibitory control showed greater increases in intake of palatable foods in the absence of hunger (Eating in the Absence of Hunger protocol; Fisher & Birch, 1999) when they had a parent who restricted snack access (Rollins, Loken, Savage, & Birch, 2013). This association may be due to an increased ability in individuals higher on this factor to self-regulate and inhibit dominant responses to an obesigenic environment. They also demonstrate the importance of the interaction between temperament and parenting practices. In preschool children (3-6y), BMI percentile, waist circumference, and emotional overeating were inversely related to indicators of Effortful Control (Pieper & Laugero, 2013). Fewer studies have examined this relationship in toddlers, but findings tend to support the same relationship shown in older children. In a longitudinal study, 2 year old toddlers with lower levels of Effortful Control—specifically emotional regulation and inhibitory control—were more likely to be classified as overweight at 5.5 years of age (Graziano, Calkins, & Keane, 2012).

Factors subsumed under the Surgency superfactor have also shown similar relationships with weight status. For instance, impulsivity measured in 3 month old infants correlated with weight status at 3 months, though in this same sample early impulsivity did not predict differences in weight status at later time points across the first year of life (Burton, Wells, Kennedy, Nicholl, Khakoo, & Fewtrell, 2011). Toddlers 18 months of age high in Surgency/Extraversion were more likely to be given caloric drinks at night, which may predispose them to risk of excess weight gain (Vollrath, Tonstad, Rothbart, & Hampson, 2011). Excitability and impulsivity may also play a role in the association between Surgency and weight status, but additional work is needed to better understand these relationships.

Very little work has focused on the associations between temperament and weight status in low-income populations. In a low-income sample of mothers and 30-40 month-old toddlers, higher maternal responsiveness was associated with fewer externalizing behavior problems and greater compliance in toddlers with a difficult temperament (defined as poor effortful control and high anger proneness, indicating problems with regulation and reactivity, respectively) (Kochanska & Kim, 2013). These findings may extend to the feeding context, but that remains to be studied. Given the additional environmental risk factors detailed above, the potential for parental behavior to offset that added risk makes it an important focus of additional research.

#### *Interactions between parenting behaviors and child temperament*

As evidenced by these findings, child temperament is closely linked with current—and in many cases, future—weight status outcomes. However, many of these findings show that parent responses to child temperament also influence these outcomes. It has been hypothesized that parents may use restrictive or controlling feeding practices for children perceived to have low Effortful Control (Webber, Hill, Cooke, Carnell, & Wardle, 2010). Parents with children high in Negativity are also more likely to use maladaptive feeding practices, such as the use of food to soothe, that teach children to ignore innate hunger and fullness cues and may predispose them to excess weight gain (Stifter, Anzman-Frasca, Birch, & Voegtline, 2011). A recent review article found that children high in frustration (aspect of Negativity), impulsivity (aspect of Surgency), and Effortful Control are more vulnerable to the adverse effects of negative parenting and that negative parenting behaviors are associated with even greater increases in these characteristics (Kiff, Lengua, & Zalewski, 2011). Most of the research to date has examined these links in infancy or later childhood, with little work focusing on the toddler years. It is important to focus on better understanding these relationships during the transitional toddler years when children start to gain more autonomy over their intake (e.g., choosing what or how much of certain foods to eat) yet parents maintain a large amount of control over the food and beverage choices provided. Temperament

traits alone are not deterministic in that all children with a certain temperament style will inevitably have worse outcomes. Parenting behaviors have the potential to moderate the relationship between child temperament and weight outcomes, diminishing or exacerbating the child's risk depending on the match between parenting style and child temperament.

## Chapter 2

Obesity rates in low-income populations are significantly higher than the general population as a whole. This is especially true in children, where 1 in 7 low-income children is obese (CDC, 2012). Despite this increased risk, this population remains understudied and many questions remain as to what mechanisms underlie this increased risk. Identifying these mechanisms and developing programs for prevention and treatment of excess weight gain early in life is of vital importance in this population.

Most of the research examining this relationship in low-income populations has focused on broad, environmental factors such as access to healthy foods and opportunities for physical activity. While these factors are informative and undoubtedly contribute to the increased risk in this population, assessment of individual factors, such as temperament, may help further explain differential outcomes in individuals exposed to the same environmental factors. Examining individual differences allows this variability that would otherwise be lost in looking at mean-level group differences to contribute to the understanding of this complex issue.

Temperament refers to individual differences in reactivity and regulation observable early in life and is considered to have a strong biological basis and to be relatively stable across time. These basic tenants of temperament are widely accepted, but there are multiple theoretical approaches to assessing the more finely detailed underlying structure of temperament. Gartstein and Rothbart (2003) presented one of the most commonly used and empirically validated structures of temperament, which centers on a hierarchical organization of lower-order factors subsumed under three higher-order factors (or superfactors): Surgency, Negativity, and Effortful Control. Surgency corresponds to high levels of positive reactivity and is indicated by higher ratings of impulsivity, high intensity pleasure, activity level, positive anticipation, and smiling and laughter and lower ratings of shyness. Negativity corresponds to high levels of negative reactivity and is indicated by higher ratings of sadness, discomfort, anger/frustration, and fear. Effortful Control corresponds to high levels of regulation and is indicated by

higher ratings of low intensity pleasure, inhibitory control, attentional focusing, and perceptual sensitivity.

In order to assess this structure, scales were developed for infants age 3-12 months (Infant Behavior Questionnaire; Gartstein & Rothbart, 2003), children age 3-7 years (Childhood Behavior Questionnaire; Rothbart, Ahadi, Hershey, & Fisher, 2001), and toddlers age 18-36 months (Early Childhood Behavior Questionnaire; Putnam, Gartstein, & Rothbart, 2006). The present study focused on assessing temperament in the toddler age group. The ECBQ is a validated 201-item parent report measure of temperament in toddlers. The very short form (ECBQ-VSF) of this measure was designed to offer researchers an efficient means of obtaining a broad assessment of toddler temperament, prioritizing the identification of the three higher-order factors of temperament while minimizing completion time and participant burden (Rothbart, 2009). There are currently no published data validating this shortened measure.

#### Specific Aims and Hypotheses

The primary goal of this study was to confirm the predicted factor structure of the very short form of the Early Childhood Behavior Questionnaire (ECBQ-VSF) and its ability to identify the three overarching, higher-order factors of temperament in low-income toddlers enrolled in WIC. The standard ECBQ is a validated, 201-item parent report scale, used to assess temperament in toddlers age 18-36 months (Putnam, Gartstein, & Rothbart, 2006). The 36-item very short form of this measure has been created to provide a broad overview of temperament among toddlers 18-36 months and to facilitate ease of administration as compared to the full version. The very short form of the ECBQ was designed to measure the three superfactors of child temperament: Surgency, Negativity, and Effortful Control, comparable to that shown in the very short form of the Infant Behavior Questionnaire (Gartstein & Rothbart, 2003). The broad overview of temperament it provides allows researchers with limited resources to quickly assess temperament in a way that remains theoretically informative. However, no

published data are available on the factor structure for the very short form of the ECBQ. This study provides data on the factor structure and scale validation with a low-income sample enrolled in WIC and will inform future use of this measure. Demonstrating the utility of the ECBQ-VSF in this population would allow researchers to quickly assess temperament and eventually tailor intervention accordingly.

*Specific Aim 1: Factor structure of the ECBQ-VSF*

The first aim of this study was to assess the factor structure of the ECBQ-VSF in a low-income WIC sample of 12-36 month old toddlers.

*Hypothesis 1.* It was hypothesized that items predicted to load onto each of the three superfactors would show high correlation with one another and comparatively lower correlation with items on the other two superfactors, allowing for adequate identification of the three superfactors of temperament among toddlers enrolled in WIC.

*Specific Aim 2: Validation of the ECBQ-VSF*

The second aim of this study was to present descriptive statistics on demographic and behavioral characteristics of a low-income sample for variables previously shown to be related to temperament. The goal was to determine how those measures are associated with the superfactors identified by this measure and use these data to provide evidence for the concurrent and discriminant validity of the ECBQ-VSF. Correlations between the obtained ECBQ factors and other variables, including child/parent weight status and feeding styles were examined to determine whether or not the ECBQ-VSF scales showed patterns of association previously seen between temperament and weight status outcomes. These findings provide preliminary data on scale performance and function, but further research is necessary to validate these findings and examine applicability to diverse samples.

*Hypothesis 2:* It was hypothesized that the superfactors identified by the ECBQ-VSF, particularly toddler Negativity and Effortful Control, would show associations with toddler weight status, consistent with findings from previous research with infants and older children from middle class samples. In

accordance with this past work, it was expected that higher toddler Negativity would be associated with higher weight for length z-scores, while higher Effortful Control would be associated with lower weight for length z-scores.

*Specific Aim 3: Performance of the ECBQ-VSF in toddlers as young as 12 months*

Currently the Infant Behavior Questionnaire (IBQ) is recommended for infants 3-12 months of age and the ECBQ for toddlers 18-36 months, with no validated measure covering the 12-18 month age range. The third aim of this study was to examine performance of the ECBQ-VSF in toddlers from 12 to 18 months to determine its ability to fill in the measurement gap for that age range. Data in this project were analyzed both including and excluding the 12-18 month age group to determine its potential ability to cover this measurement gap.

## Chapter 3

### Methods

#### *Participants and procedures*

During the fall of 2012, 550 surveys were distributed to 18 Pennsylvania WIC clinic directors, with 200 surveys allocated to urban clinics and 350 to rural clinics. Directors were instructed to have clinic staff approach any mother who entered their clinic that met the eligibility criteria (child between ages 1-3, English speaking, and 18 years or older) to see if they were interested in participating. After being consented, participants filled out a short survey that contained demographic information (age, marital status, education, etc.) and responsive feeding practices (see description below). The in-clinic survey took approximately 10 minutes to complete. All the allocated surveys were mailed to Penn State, and participants received \$5 Wal-Mart gift cards for completing the surveys. Out of the 550 surveys distributed, 452 surveys were returned from the 18 clinics, for an overall response rate of 82%.

Of the 452 participants who completed the short survey, 342 also completed a mailed survey. This longer survey took 30-45 minutes to complete. Overall study response rate was 62%. Participants who completed the longer survey were given a \$25 gift card to Wal-Mart. For the purpose of this study, we focused on the ECBQ-VSF, measured length/height and weight, and parent-reported use of food to soothe. Exclusions for these analyses were based on ECBQ age criteria and missing data (detailed below). 215 participants were included in the present analyses. All procedures were approved by The Pennsylvania State University Internal Review Board.

#### *Measures*

*Early Childhood Behavior Questionnaire-very short form (ECBQ-VSF).* The Early Childhood Behavior Questionnaire very short form is a 36-item measure of toddler temperament (Appendix A) developed in 2009 as an abbreviated form of the validated, 201-item Early Childhood Behavior Questionnaire (Putnam, Gartstein, Rothbart, 2006). The ECBQ-VSF was developed to provide

researchers an efficient method of assessing the three broad dimensions—or superfactors—of temperament: Surgency/Extraversion, Negative Affectivity, and Effortful Control. Parents read questions about specific child behaviors and respond with the frequency in which their child behaves in that way on a scale of 1 (Never) to 7 (Always) with an eighth “Does not apply” option if that item is not relevant for their child. Items that load highly on each subscale are as follows: Surgency, “When offered a choice of activities, how often did your child decide what to do very quickly and go after it?” “When told that loved adults would visit, how often did your child get very excited?”; Negativity, “When told “no”, how often did your child become sadly tearful?” “When s/he asked for something and you said “no”, how often did your child have a temper tantrum?”; Effortful Control, “When asked to wait patiently for a desirable item (such as ice cream), how often did your child wait patiently?” At present there are no published studies reporting the extent to which the factor structure of the very short form is consistent with these broad dimensions. Data examining the development of the very short form from administration of the full, 201-item measure indicate acceptable internal consistency between selected items (Surgency:  $\alpha = 0.72$ , Negativity:  $\alpha = 0.70$ , Effortful Control:  $\alpha = 0.72$ ) (Putnam, Jacobs, Gartstein, & Rothbart, 2009).

*Parent feeding practices, using food to soothe.* Parent use of food to soothe was assessed using the items pertaining to soothing from the Babies’ Basic Needs questionnaire for children 3-36 months old (Appendix B; Stifter, Anzman-Frasca, Birch, & Voegtline, 2011). In this measure parents indicate on a 5-point scale how likely they are to use food to soothe in a variety of public places, during scenarios at home, or in the case of certain maternal or child emotions (0=Never, 1=Rarely, 2=Sometimes, 3=Often, 4=Always). It has been shown that children’s ability to regulate energy intake may be influenced by parenting practices, particularly when food is used in non-eating contexts, such as to soothe a fussy infant or to manage behavior in older children (Birch, Davison, & Fisher, 2003; Birch & Fisher, 1998).

*Child and maternal anthropometrics.* Maternal and child height and weight were collected in person by WIC clinic staff. Weight for age and weight for length z-scores were calculated using the World Health Organization (WHO) growth charts (WHO Multicentre Growth Reference Study Group, 2006). The WHO charts represent growth standards for children growing in optimal circumstances and were created using epidemiological data collected from 1997-2003 at six sites across the world (Pelotas, Brazil; Accra, Ghana; Delhi, India; Oslo, Norway; Muscat, Oman; and Davis, California).

### *Statistical Analyses*

*Missing data.* For participants with < 10% ( $\leq 3$  items) missingness on the ECBQ, mean imputation was used to replace these missing data points in order to replicate previous work examining the very short forms of the IBQ-R (Putnam, Helbig, Gartstein, Rothbart, & Leerkes, 2013) and to maximize the number of complete cases. “Does not apply” responses on the ECBQ were also replaced with sample item means. These complete cases were then used for all analyses.

*Specific Aim 1: To confirm factor structure of the ECBQ-VSF using scoring guide provided by Putnam et al.*

Confirmatory factor analysis (Bentler & Bonett, 1980) was used to examine fit of these data to the three-factor model proposed in the scoring guide provided by Putnam et al., assigning 12 items each to the Surgency, Negativity, and Effortful Control subscales. Initial analyses were performed using the proc calis method in SAS (Statistical Analysis Software, version 9.2, 2009, SAS Institute Inc.). Fit indices indicating a good model fit are as follows: CFI > 0.90, RMSEA < 0.05, NFI > 0.90, RMR < 0.05 (Marsh, Balla, & McDonald, 1988). Subsequently, Amos Graphics (version 21, 2012, IBM Corp.) was used to allow latent factors to correlate following initial poor model fit, but model fit was still not achieved.

Due to the lack of acceptable fit of these data to the hypothesized factor analysis model, exploratory factor analysis was then used to explore alternative factor structures. Exploratory factor analysis is used to identify the underlying factor structure of a given measure, often when there are no a

priori hypotheses regarding structure or when expected structure fails to be confirmed (Floyd & Widaman, 1995). Numerous sources list recommendations for adequate sample size. One rule of thumb often cited is having at least five participants for every item (Gorsuch, 1997), with some sources recommending a more stringent 10 participants per item (Streiner, 1994). Alternately, the following absolute recommendations are also commonly used (N=50: very poor, N=100: poor, N=200: fair, N=300: good, N=500: very good, and N=1,000: excellent; Comrey & Lee, 1992). Analyses were performed using the proc mixed method in SAS (Statistical Analysis Software, version 9.2, 2009, SAS Institute Inc.). The high level of correlation between latent factors shown in the confirmatory factor analysis indicated a need for an oblique rotation method (oblimin; Carroll, 1957) to improve model fit and allow correlation between factors to reveal a more accurate picture of the factor structure.

*Specific Aim 2: To examine associations between variables previously shown to relate to temperament as a means of validating the ECBQ-VSF*

Pearson correlations between the temperament factors identified in these analyses and additional measures collected in this sample, including child weight status and parental use of food to soothe, were examined to validate the very short form of the Early Childhood Behavior Questionnaire.

*Specific Aim 3: To examine performance of the ECBQ-VSF in toddlers as young as 12 months*

As detailed above, current validated measures of temperament are recommended for ages 3-12 months (Gartstein & Rothbart, 2003) and 18-36 months (Putnam, Gartstein, & Rothbart, 2006). Due to the lack of specificity regarding which measure should be used between the ages of 12 and 18 months, two sets of parallel analyses were run on the ECBQ, the first including children 12-36 months (N=215), the second including only those 18-36 months (N=143). Significance levels of item factor loadings and associations with external, validated measures did not change regardless of whether or not the 12-18 month old participants were included in the sample. Therefore, all results detailed below refer to the full 12-36 month old sample.

## Chapter 4

### Results

Of 238 participants, 18 were excluded from final analyses for the following reasons: five were missing >25% of responses on the ECBQ and 18 had either missing or implausible toddler anthropometric data, leaving a final sample of 215 mother-toddler dyads.

#### *Descriptive statistics*

Demographic information for mothers and their children (N = 215) are presented in Table 4.1. Participants were predominantly White. On average mothers were age 28 with a child 23 months old (range: 12-36 months). 70% of mothers were overweight with a BMI greater than 25 kg/m<sup>2</sup>, with 43% of the sample considered obese with BMI greater than 30 kg/m<sup>2</sup>, meaning this population was heavier than the US population in general. Over one third of toddlers were at or above the 85<sup>th</sup> percentile for WHO weight for length measurements, and 18% were at or above the 95<sup>th</sup> percentile. On a scale of 0 to 7, average values for the three temperament superfactors were as follows: Surgency = 5.66 (2.17—7.0), Negativity = 3.18 (1.50—6.00), and Effortful Control = 5.10 (2.54—6.75).

*Specific Aim 1: To confirm factor structure of the ECBQ-VSF using scoring guide provided by Putnam et al.*

*Confirmatory factor analysis.* Initial confirmatory factor analysis revealed a poor fit to the proposed model (CFI = 0.46, RMSEA = 0.08, NFI = 0.33, RMSR = 0.10). Allowing the latent factors to correlate improved model fit only slightly (CFI = 0.50, RMSEA = 0.08, NFI = 0.36, RMSR = 0.10). This model is represented in Figure 4.1. Maximum likelihood standardized regression coefficients for each item, broken down by the three hypothesized latent factors, are detailed in Table 4.2. A large number of items loaded on multiple factors. In particular, items loaded on both the hypothesized Surgency and Effortful Control factors, preventing clear differentiation between these two dimensions. These two latent factors had a correlation of 0.54. Cronbach's alpha values did reveal an acceptable item-total level

of correlation between items for each of the three predicted factors (Surgency  $\alpha = 0.74$ , Negativity  $\alpha = 0.71$ , Effortful Control  $\alpha = 0.66$ ). However, these values may reflect the high level of correlation between the factors.

*Exploratory factor analysis.* Exploratory factor analysis indicated the model could contain two to six factors. Due to the high correlation between factors shown in the confirmatory factor analysis (Surgency-Effortful Control: 0.37), an oblique rotation method (oblimin) was used to allow this correlation and not force orthogonality. A three factor model was found to offer the best fit after examining model fit and factor loading parameters for each possible model. Factor loadings for this model are shown in Table 4.3. Four items failed to load (factor loading  $< 0.30$ ) on any factor while four other items loaded highly on more than one factor. The only two items assessing the lower-order factors of Shyness and Motor Activation (both predicted to load on Negativity) both failed to load on any factor. The other two items assessed Low Intensity Pleasure and Attentional Focusing (both predicted to load on Effortful Control) both lower-order factors that were represented by two items each in this measure. The other items representing these factors loaded on the expected factor. All but three Surgency items and three Effortful Control items loaded on factor 1, indicating high correlation between these two superfactors in this sample as demonstrated in the confirmatory factor analyses. Rather than identifying Effortful Control, the third factor in these analyses seems to center on activity level and impatience. The items that load highly assess energy level of the child (e.g., “During everyday activities, how often did your child seem full of energy, even in the evening?”), while those that load negatively assess patience level (e.g., “When asked to wait for a desirable item (such as ice cream), how often did your child wait patiently?”).

*Specific Aim 2: To examine associations between variables previously shown to relate to temperament as a means of validating the ECBQ-VSF*

*Toddler weight for length z-scores.* There were no significant associations between the three superfactors of temperament and the weight variables assessed in this sample (weight for length z-scores, weight for age z-scores, and BMI z-scores).

*Toddler temperament and use of food to soothe.* Each food to soothe item was dichotomized for these analyses to best represent the frequency with which parents use food or drink to calm or distract their child in a variety of settings and/or in response to a variety of child emotions. If a participant stated that soothing strategy was used “Never” or “Rarely” that item was given a score of zero, while “Sometimes”, “Often”, and “Always” responses resulted in a score of one. Participants reported using a total of 5.86 (SD = 4.26) food to soothe strategies on average. Higher levels of toddler Effortful Control ( $r = -0.35, p < 0.001$ ) and Surgency ( $r = -0.17, p = 0.01$ ) were significantly associated with less frequent use of food to soothe. In other words, parents who perceive their toddler to be better able to inhibit dominant responses and maintain attentional focus are less likely to use food to soothe, as are those who perceive their toddler to have higher positive reactivity and activity level. Toddler Negativity, conversely, was associated with greater use of food to soothe ( $r = 0.30, p < 0.001$ ), so that parents who perceived higher levels of anger, frustration, or fear in their toddlers were more likely to use food to soothe their toddler.

Table 4.1: Demographic information

<b>Toddler Characteristics</b> N = 215	
Age	22.7 months (7.5)
WHO weight for length ≥ 85 <sup>th</sup> %	36%
WHO weight for length ≥ 95 <sup>th</sup> %	18%
Race/Ethnicity	
Caucasian	64%
African American	16%
Latino/Hispanic	8%
Multiracial	12%
<b>Maternal Characteristics</b> N = 215	
Age	28 years (6.3)
BMI	29 (6.9)
% overweight (BMI ≥ 25)	70%
% obese (BMI ≥ 30)	43%
Race/Ethnicity	
Caucasian	73%
African American	16%
Latino/Hispanic	5%
Asian	2%
Multiracial	4%
Employment	
Full time	22%
Part time	21%
Student	43%
Unemployed	13%
Marital status	
Single	39%
Married	39%
Not married	13%
Divorced	8%

Figure 4.1: Confirmatory factor analysis structure for the ECBQ-VSF based on the scoring guide

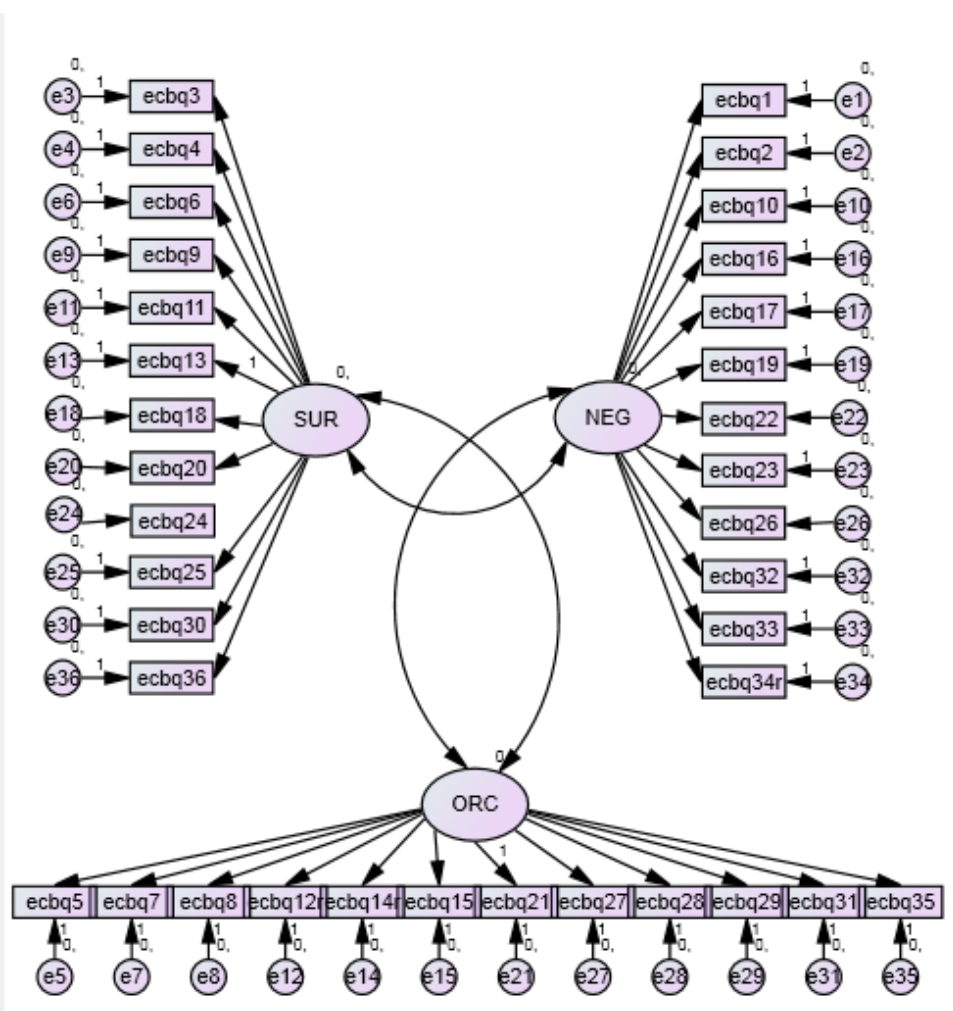


Table 4.2: Standardized Regression Coefficients of ECBQ Very Short Form (VSF)

VSF Item Number	ECBQ Scale	Surgency	Negative Affectivity	Orienting/Regulatory Capacity
3	Sociability	<b>.43</b>		
4	Impulsivity	<b>.47</b>		
6	High Intensity Pleasure	<b>.30</b>		
9	Positive Anticipation	<b>.59</b>		
11	High Intensity Pleasure	<b>.06</b>		
13	Impulsivity	<b>.49</b>		
18	Activity Level/Energy	<b>.36</b>		
20	Activity Level/Energy	<b>.37</b>		
24	Activity Level/Energy	<b>.18</b>		
25	Positive Anticipation	<b>.58</b>		
30	Sociability	<b>.45</b>		
36	Sociability	<b>.54</b>		
1	Shyness		<b>.21</b>	
2	Frustration		<b>.34</b>	
10	Motor Activation		<b>.31</b>	
16	Discomfort		<b>.37</b>	
17	Discomfort		<b>.56</b>	
19	Fear		<b>.53</b>	
22	Sadness		<b>.43</b>	
23	Sadness		<b>.57</b>	
26	Frustration		<b>.30</b>	

32	Fear		<b>.54</b>	
33	Soothability		<b>.59</b>	
34r	Soothability		<b>.28</b>	
5	Low Intensity Pleasure			<b>.24</b>
7	Attentional Focusing			<b>.47</b>
8	Attentional Shifting			<b>.53</b>
12r	Cuddliness			<b>.33</b>
14r	Attentional Focusing			<b>.06</b>
15	Attentional Shifting			<b>.44</b>
21	Inhibitory Control			<b>.37</b>
27	Inhibitory Control			<b>.39</b>
28	Low Intensity Pleasure			<b>.41</b>
29	Cuddliness			<b>.40</b>
31	Inhibitory Control			<b>.28</b>
35	Attentional Shifting			<b>.46</b>

Note: *Parameters in this model parallel those outlined in the ECBQ-VSF scoring guide.*

Table 4.3: Factor loadings for three factor model in exploratory factor analysis

VSF Item Number	ECBQ Scale	Factor 1	Factor 2	Factor 3
3	Sociability	.29	.16	-.25
4	Impulsivity	.45	.11	-.05
6	High Intensity Pleasure	.29	.11	-.04
9	Positive Anticipation	.59	-.01	.00
11	High Intensity Pleasure	.06	.39	.19
13	Impulsivity	.46	.01	-.07
18	Activity Level/Energy	.29	.47	-.04
20	Activity Level/Energy	.37	.33	.11
24	Activity Level/Energy	.14	.66	.03
25	Positive Anticipation	.57	.19	-.08
30	Sociability	.39	.01	-.12
36	Sociability	.46	.02	-.21
1	Shyness	.12	.02	.27
2	Frustration	-.12	.36	.18
10	Motor Activation	-.08	.14	.27
16	Discomfort	.02	.02	.41
17	Discomfort	.06	.03	.62
19	Fear	-.14	-.06	.53
22	Sadness	.07	.43	.29
23	Sadness	-.03	-.03	.60
26	Frustration	.05	.59	.08

32	Fear	-.02	.01	.54
33	Soothability	-.05	.24	.49
34r	Soothability	-.28	.21	.12
5	Low Intensity Pleasure	.24	-.05	.04
7	Attentional Focusing	.43	-.05	.12
8	Attentional Shifting	.46	-.04	-.02
12r	Cuddliness	.21	-.18	-.24
14r	Attentional Focusing	.08	.07	-.08
15	Attentional Shifting	.39	-.19	-.06
21	Inhibitory Control	.39	-.37	.21
27	Inhibitory Control	.31	-.56	.09
28	Low Intensity Pleasure	.38	.07	.01
29	Cuddliness	.40	.03	.11
31	Inhibitory Control	.23	-.26	.02
35	Attentional Shifting	.40	-.20	.03

## Chapter 5

### Discussion

This study aimed to confirm the factor structure for the ECBQ-VSF in a low-income sample of WIC moms and toddlers and to examine associations between the three identified higher-order factors of temperament and additional measures such as weight status. Confirmatory factor analysis failed to produce an acceptable fit for the expected structure, though internal consistency of the three factors predicted by the Putnam et. al scoring guide was acceptable, ranging from 0.64 to 0.73. Therefore, these preliminary results suggest this measure was able to identify the three superfactors of temperament as intended, even though the factor structure never reached acceptable fit levels.

Parallel measures of temperament would have been necessary to determine if the ECBQ-VSF truly identified the intended constructs. As such, that conclusion here can only be assumed. Subsequent exploratory factor analysis consistently revealed a three-factor structure. However, simple structure was not demonstrated in the item loadings, with multiple items loading on more than one factor despite orthogonality being the design goal, while others failed to load on any factor. The third factor identified in this sample, rather than representing Effortful Control, seems to represent activity level/impatience in these children, which indicates a need for further measurement work with the ECBQ-VSF.

It is unclear how to interpret the high level of correlation between items expected to load exclusively on either Surgency or Effortful Control. This finding could be driven by a number of phenomena. Although the ECBQ is currently recommended for ages 18-36 months, Effortful Control may only be starting to emerge developmentally in the lower end of this age range. Reexamining this association in different portions of the toddler age range (e.g., 1-2y and 2-3y) could help identify the developmental pattern of Effortful Control and its association with weight status. Unfortunately, this sample size did not allow for these analyses.

Despite poor confirmatory factor analysis findings, associations between the three temperament factors and one of the additional outcome variables of interest in this study used to provide concurrent and discriminant validity for the ECBQ-VSF—use of food to soothe—tended to support previous research. Use of food to soothe was lower in toddlers with higher levels of Effortful Control and Surgency and higher in those with higher levels of Negativity. Unexpectedly, weight status was not associated with temperament in this sample. Few studies have examined this association specifically in toddlers, and more work is needed to understand how these individual characteristics are related to weight status across the early years of life. The differing developmental emergence of temperament factors may help explain the lack of association during the transitional period of toddlerhood. Alternately, this short measure of temperament may be inadequate for identifying individual differences in temperament in enough detail to demonstrate correlations with other variables. Another explanation is that these factors may present themselves differently in low-income populations. Many questions regarding this association clearly remain unanswered.

The inconsistencies with past research found here highlight the need for a developmental perspective when assessing temperament. Gathering data at multiple time points across the age range in question could help clarify the time course of these associations. Because the underlying factors of temperament have been shown to emerge at different ages, examining temperament at one time point alone may not give the best picture of individual differences, especially if being used to predict future outcomes. Scoring on certain factors may be reflective of transitional temperament maturation and thus could be substantially different if assessed at an earlier or later time point.

This study has several limitations. While providing insight into an underrepresented population, these findings are specific to low-income individuals and as such are not generalizable to the entire population. Additionally, there are no data available on the BMI characteristics of the middle class sample with which the original ECBQ scale was developed. Given the consistent population differences

in overweight/obesity prevalence between income groups, the high rate of obesity in this current sample may be significantly different than the sample used to develop the ECBQ and its shortened forms, which could also contribute to the differences seen here in model fit. The sample size is fairly small, falling in the acceptable but not ideal range for use in factor analysis. A larger sample might provide a clearer picture fitting the predicted factor model. It has been noted, though, that it is more likely to find an acceptable model fit when a proposed model is compared to data from a small sample (Bentler & Bonett, 1980). Therefore, the lack of model fit here is telling. Additionally, although including 12-18 month olds in these analyses did not change any observed associations, it cannot be assumed that the same would hold true in a larger, more diverse sample. Further work is needed to determine the acceptability of using the ECBQ-VSF in toddlers younger than 18 months.

This study supports the use of the ECBQ-VSF to identify the three higher-order factors of toddler temperament in a low-income sample. Additional work is needed to better understand the associations between temperament and both short- and long-term health outcomes. Research looking at how modifiable environmental factors that interact with temperament, such as parenting style, can work to either exacerbate or diminish negative outcomes for the child offers promising intervention targets. Helping parents become aware of the potential risks of a certain child temperament while highlighting the impact responsiveness can have on their child's outcomes regardless of temperamental tendencies could help the risk of future overweight in many of these children.

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## Appendices

## Appendix A

**Early Childhood Behavior Questionnaire - Very Short Form**

Child's name: \_\_\_\_\_ Child's birthdate: Mo: \_\_\_\_\_ Day: \_\_\_\_\_ Yr: \_\_\_\_\_

Today's date: Month: \_\_\_\_\_ Day: \_\_\_\_\_ Yr: \_\_\_\_\_ Child's age: \_\_\_\_\_ Yrs, \_\_\_\_\_ Months

Relation to child: \_\_\_\_\_ Sex of child (circle one): Male Female

**INSTRUCTIONS: Please read carefully before starting.**

As you read each description of the child's behavior below, please indicate how often the child did this during the last two weeks by circling one of the numbers in the right column. These numbers indicate how often you observed the behavior described during the last two weeks.

<u>never</u>	<u>very rarely</u>	<u>less than half the time</u>	<u>about half the time</u>	<u>more than half the time</u>	<u>almost always</u>	<u>always</u>	<u>does not apply</u>
1	2	3	4	5	6	7	NA

The "Does Not Apply" column (NA) is used when you did not see the child in the situation described during the last two weeks. For example, if the situation mentions the child going to the doctor and there was no time during the last two weeks when the child went to the doctor, circle the (NA) column. "Does Not Apply" (NA) is different from "NEVER" (1). "Never" is used when you saw the child in the situation but the child never engaged in the behavior mentioned in the last two weeks. Please be sure to circle a number or NA for every item.

**When approached by an unfamiliar person in a public place (for example, the grocery store), how often did your child**

1. cling to a parent? 1 2 3 4 5 6 7 NA

**While having trouble completing a task (e.g., building, drawing, dressing), how often did your child**

2. get easily irritated? 1 2 3 4 5 6 7 NA

**When a familiar child came to your home, how often did your child**

3. seek out the company of the child? 1 2 3 4 5 6 7 NA

**When offered a choice of activities, how often did your child**

4. decide what to do very quickly and go after it? 1 2 3 4 5 6 7 NA

**During daily or evening quiet time with you and your child, how often did your child**

5. enjoy just being quietly sung to? 1 2 3 4 5 6 7 NA

**While playing outdoors, how often did your child**

6. choose to take chances for the fun and excitement of it? 1 2 3 4 5 6 7 NA

**When engaged in play with his/her favorite toy, how often did your child**

7. play for more than 10 minutes? 1 2 3 4 5 6 7 NA

8. continue to play while at the same time responding to your remarks or questions? 1 2 3 4 5 6 7 NA

**When told that loved adults would visit, how often did your child**

9. get very excited? 1 2 3 4 5 6 7 NA

**During quiet activities, such as reading a story, how often did your child**

10. fiddle with his/her hair, clothing, etc.? 1 2 3 4 5 6 7 NA

**While playing indoors, how often did your child**

11. like rough and rowdy games? 1 2 3 4 5 6 7 NA

**When being gently rocked or hugged, how often did your child**

12. seem eager to get away? 1 2 3 4 5 6 7 NA

**When encountering a new activity, how often did your child**

13. get involved immediately? 1 2 3 4 5 6 7 NA

**When engaged in an activity requiring attention, such as building with blocks, how often did your child**

14. tire of the activity relatively quickly? 1 2 3 4 5 6 7 NA

**During everyday activities, how often did your child**

15. pay attention to you right away when you called to him/her? 1 2 3 4 5 6 7 NA

16. seem to be irritated by tags in his/her clothes? 1 2 3 4 5 6 7 NA

17. become bothered by sounds while in noisy environments? 1 2 3 4 5 6 7 NA

18. seem full of energy, even in the evening? 1 2 3 4 5 6 7 NA

**While in a public place, how often did your child**

19. seem afraid of large, noisy vehicles? 1 2 3 4 5 6 7 NA

**When playing outdoors with other children, how often did your child**

20. seem to be one of the most active children? 1 2 3 4 5 6 7 NA

**When told "no", how often did your child**

21. stop the forbidden activity? 1 2 3 4 5 6 7 NA

22. become sadly tearful? 1 2 3 4 5 6 7 NA

**Following an exciting activity or event, how often did your child**

23. seem to feel down or blue? 1 2 3 4 5 6 7 NA

**While playing indoors, how often did your child**

24. run through the house? 1 2 3 4 5 6 7 NA

**Before an exciting event (such as receiving a new toy), how often did your child**

25. get very excited about getting it? 1 2 3 4 5 6 7 NA

**When s/he asked for something and you said "no", how often did your child**

26. have a temper tantrum? 1 2 3 4 5 6 7 NA

**When asked to wait for a desirable item (such as ice cream), how often did your child**

27. wait patiently? 1 2 3 4 5 6 7 NA

**When being gently rocked, how often did your child**

28. smile?	1	2	3	4	5	6	7	NA
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**While being held on your lap, how often did your child**

29. mold to your body?	1	2	3	4	5	6	7	NA
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**When a familiar adult, such as a relative or friend, visited your home, how often did your child**

30. want to interact with the adult?	1	2	3	4	5	6	7	NA
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**When asked to do so, how often was your child able to**

31. be careful with something breakable?	1	2	3	4	5	6	7	NA
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**When visiting a new place, how often did your child**

32. <u>not</u> want to enter?	1	2	3	4	5	6	7	NA
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**When s/he was upset, how often did your child**

33. cry for more than 3 minutes, even when being comforted?	1	2	3	4	5	6	7	NA
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34. become easily soothed?	1	2	3	4	5	6	7	NA
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**When you were busy, how often did your child**

35. find another activity to do when asked?	1	2	3	4	5	6	7	NA
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**When around large gatherings of familiar adults or children, how often did your child**

36. enjoy playing with a number of different people?	1	2	3	4	5	6	7	NA
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## Appendix B

## Parent feeding practices, using food to soothe

Parents spend a lot of time soothing/calming their child. We would like to know about when you are more or less likely to use food when your child cries/whines or to keep your child quiet.

0	1	2	3	4	5
Never likely	Rarely	Somewhat likely	Often	Always Likely	Does Not Apply

How likely are you to use food or drinks to calm or distract your child when you are...

1. In a doctor's waiting room		8. On the phone	
2. Shopping in a store		9. Doing household chores	
3. In church or other place of worship		10. Stressed	
4. In the car		11. Frustrated or upset	
5. Getting ready to leave the house		12. Tired	
6. Preparing meals		13. Busy	
7. Attending to another person or child		14. Other ( <i>specify</i> ): _____	

How likely are you to use food or drinks to calm or distract your child...

	Never Likely	Rarely	Somewhat Likely	Often	Always Likely	Does Not Apply
15. When your child wakes during the night						
16. To occupy your child until meal time						
17. Before naptime or bedtime						
18. When nothing else works to calm or distract my child						
19. When your child is "throwing" a tantrum						