

Emotional Over- and Undereating in Children: A Longitudinal Analysis of Child and
Contextual Predictors

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This research was funded by the Research Council of Norway, grant number 213793.

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Abstract

Eating more or eating less in response to negative emotions, called emotional over- and undereating, is common in children, but research on the etiology of these behaviors is in its infancy. Drawing on a large, representative community sample of Norwegian children followed up on a biennial basis from 6 to 10 years of age (analysis sample: n=802), child- and contextual predictors (i.e., child temperament, depression symptoms, serious life events, family functioning, parental sensitivity and structuring) of change in emotional over- and undereating were examined. Results revealed that low (temperamental) soothability and less parental structuring at age 6 predicted increased emotional *overeating* at age 10 and that lower family functioning at age 6 predicted more emotional *undereating* during the same period.

Keywords: emotional eating, eating behavior, overeating, undereating, temperament, family functioning

Eating behavior, including food choice and the amount eaten, may be influenced by negative emotions in particular (Macht, 2008). Emotional overeating involves eating more in response to negative emotions, but negative emotions can also instigate *less* eating, namely, emotional undereating (Wardle, Guthrie, Sanderson, & Rapoport, 2001). Emotional overeating is commonly seen in childhood, as only 35% of children were reported to never display such behavior (Steinsbekk, Barker, Llewellyn, Fildes, & Wichstrøm, 2017) – a number that corresponds to earlier research (e.g. Carper, Fisher, & Birch, 2000). Emotional overeating has been related to higher weight (Webber, Hill, Saxton, Van Jaarsveld, & Wardle, 2009), greater body dissatisfaction (Braet et al., 2008) and later eating pathology, including binge eating (Allen, Byrne, La Puma, McLean, & Davis, 2008) and bulimic behaviors (Pearson, Riley, Davis, & Smith, 2014). Emotional undereating, in contrast, has been associated with lower body mass index (Jansen et al., 2012), and some retrospective evidence suggests that emotional undereating may pose a risk for Anorexia Nervosa (Kim, Heo, Kang, Song, & Treasure, 2010).

Such adverse effects on health underscore the importance of understanding the etiology of these eating behaviors, but unfortunately, research on their precursors is lacking. Notably, the results of two recent twin studies showed that the shared family environment plays an important role in shaping both emotional over- and undereating (Herle, Fildes, Rijdsdijk, Steinsbekk, & Llewellyn, 2017; Herle, Fildes, Steinsbekk, Rijdsdijk, & Llewellyn, 2017). What the twin studies could not illuminate, however, were the specific non-genetic factors that might influence emotional over- and undereating. The present inquiry builds on these findings aiming to reveal which child- and contextual factors affect the development of emotional over- and undereating.

A Model of Emotional Over- and Undereating in Children

Psychosomatic theory is a widely known theory of emotional overeating in which individuals with obesity are assumed to perform poorly at distinguishing between arousal caused by hunger and negative emotions, as a result of classical conditioning processes in early life (Kaplan & Kaplan, 1957). Food, especially palatable food, can boost our mood, and some people may begin to rely on this mood-enhancing effect and consequently learn to eat when negative emotions arise (Dovey, 2010). Thus, eating reduces the intensity of negative emotions and eating becomes a way of coping with emotions. Psychological theories of emotional undereating are virtually non-existent. However, the most natural response to emotional distress is to eat *less* due to biological mechanisms: Gut activity decreases in the presence of emotional arousal, which suppresses hunger (van Strien & Ouwens, 2007). Given that emotional over- and undereating have some common etiology (Herle, Fildes, Steinsbekk, et al., 2017) and tend to be positively associated with each other (Herle, Fildes, Steinsbekk, et al., 2017; Wardle et al., 2001), it is reasonable to assume that overlapping etiological forces are at play in both eating behaviors.

Some past research (e.g., Steinsbekk, Belsky, & Wichstrøm, 2016; Steinsbekk, Bonneville-Roussy, Fildes, Llewellyn, & Wichstrøm, 2017) has examined how parental feeding and children's eating may influence each other, but there are virtually no longitudinal studies on emotional undereating. Research testing broader and more encompassing etiological models of the development of emotional over- and undereating is lacking. In accordance with an ecological developmental approach (Bronfenbrenner, 1986), we propose and test a model of child- and contextual factors of emotional over- and undereating in children. Both child and contextual factors are assumed to affect children's affective states and emotion regulation (Morris, Silk, Steinberg, Myers, & Robinson, 2007). Such child characteristics include children's temperament and symptoms of depression. Further, we judged it appropriate to examine potentially stressful contextual factors on three different

levels that might induce emotional over- and undereating: Serious life events, negative global family functioning and reduced parental sensitivity and structuring. The case for considering these child and contextual factors as predictors of change in emotional over- and undereating from age 6 to 10 will be outlined below.

Child Characteristics: Temperament and Symptoms of Depression

Common to models of temperament is the dimension of negative affectivity (Rothbart, Ahadi, Hershey, & Fisher, 2001), sometimes referred to as negative emotionality (Buss & Plomin, 1975). According to Rothbart's model of temperament, negative affectivity is an overarching concept composed of five components (i.e., sadness, fear, anger/frustration, discomfort and falling reactivity/soothability) (Rothbart et al., 2001). Because soothability is suggested to be of particular importance for emotion regulation (Rothbart & Sheese, 2007), this dimension may play a prominent role in emotional over- and undereating. Children *low* on this dimension are more reactive and need a longer time to recover from emotional arousal (Rothbart et al., 2001), thus putting greater demands on their emotion regulation capabilities compared to more soothable children. Children who are less able to soothe themselves may depend on a broader range of strategies to down-regulate their emotions, including emotional eating.

In accordance with such assumptions, cross-sectional evidence shows that greater negative affectivity correlates with both emotional overeating and emotional undereating in young children (Haycraft, Farrow, Meyer, Powell, & Blissett, 2011). Further, longitudinal research has shown that emotional reactivity predicts later emotional overeating in school-aged children (Harrist, Hubbs-Tait, Topham, Shriver, & Page, 2013; Steinsbekk, Barker, et al., 2017). However, broad temperamental constructs such as negative affectivity cover many fine-grained domains that may have differential impacts on eating. Indeed, prior research has indicated that subdimensions belonging to the same broad temperamental dimension may

correlate differently with children's adjustment. For example, infant sadness and fear both belong to the negative affectivity construct, yet they correlate differently with internalizing and externalizing behaviors (Gartstein, Putnam, & Rothbart, 2012). A small-scale study of temperament and eating in infants indicated that some fine-grained temperamental factors were related to feeding/eating, whereas others belonging to the same overarching factor were not (Gartstein, Potapova, & Hsu, 2014). To provide a deeper and more precise understanding of the temperament-eating relation that can inform theory and practice, we need to know which specific temperamental dimensions are important for children's eating. Such research is presently lacking. We thus add to past research by examining which dimensions of negative affectivity (i.e., soothability, anger, discomfort, fear and sadness) might be at play in the development of emotional over- and undereating. To our knowledge, no prior investigation has examined whether temperament is prospectively related to emotional undereating. Due to the assumptions noted above, we expect that low soothability is of particular importance with regard to emotional over- and undereating compared to the other aspects of negative affectivity and will thus predict increases in both eating behaviors four years later.

Symptoms of depression include feelings of sadness and anhedonia in addition to disturbances in appetite and weight (American Psychiatric Association, 2013), which provide a basis for expecting depression to affect emotional over- and undereating in children. However, empirical evidence is lacking. Notably, though, one study of 4-year-olds found that children's internalizing problems, which include symptoms of depression, were correlated with more emotional over- and undereating (Mackenbach et al., 2012). In adolescents, symptoms of depression are associated with emotional overeating (Hou et al., 2013; Pauli-Pott, Becker, Albayrak, Hebebrand, & Pott, 2013), a finding also seen in adults (Goldschmidt et al., 2014). To our knowledge, the present inquiry is the first to examine symptoms of depression in the development of emotional over- and undereating in children prospectively.

We hypothesize that symptoms of depression at age 6 will predict increases in emotional over- and undereating in children four years later.

Contextual Factors: Serious Life Events, Family Functioning and Parenting

It is well established that stress affects eating (Adam & Epel, 2007), and exposure to serious life events (i.e., potentially traumatizing events such as witnessing violence or death, enduring physical abuse) may particularly affect emotional over- and undereating because experiencing such serious life events has been shown to be detrimental to children's ability to regulate negative emotions (Cicchetti & Toth, 2005). Consistent with this claim, Michels et al. (2012) found that greater exposure to negative life events was cross-sectionally associated with more emotional overeating in school-aged children. However, this finding was not replicated in a later longitudinal study by the same research group (Michels et al., 2015). At the same time, retrospective studies chronicle links between severe stressors in childhood, such as (recalled) physical abuse and emotional neglect, and emotional overeating as adults (Michopoulos et al., 2015). There is also evidence documenting links between post-traumatic stress disorder and emotional overeating in adulthood (Talbot, Maguen, Epel, Metzler, & Neylan, 2013). We add to this scarce research base by examining serious life events as a predictor of increases in both emotional over- and undereating in children over time.

In addition to serious life events, which may occur only once, the overall climate in the home may represent a chronic stressor that potentially influences children's emotional state and thus their emotional eating. Family functioning is a multidimensional construct involving structural and organizational elements and interpersonal interactions in a family, including problem solving, communication, involvement, affective responsiveness and control (Epstein, Baldwin, & Bishop, 1983). Growing up in a household in which there exists low levels of collaboration and support and high levels of family conflict – between parents, between siblings, or between parents and children – is indeed associated with deficits in

emotional understanding (Repetti, Taylor, & Seeman, 2002) and less adaptive emotion regulation (Gallegos, Murphy, Benner, Jacobvitz, & Hazen, 2017) in children. Such difficulties in understanding and handling negative emotions may increase children's risk of engaging in more emotional over- and undereating over time. Evidence consistent with this assumption comes from cross-sectional research showing that low affective responsiveness of the family is associated with more emotional overeating in school-aged children (Topham et al., 2011). Further, pre-school-aged children whose parents have a more hostile relationship engage in more emotional undereating (Haycraft & Blissett, 2010), and parental control is associated with emotional overeating in adolescents (Snoek, Engels, Janssens, & van Strien, 2007). We therefore consider the potential influence of general family functioning on emotional eating, predicting that children from lower-functioning families will have greater increases in emotional over- and undereating over time.

Although particular patterns of parenting contribute to the overall family climate (Morris et al., 2007), parenting may also *specifically* affect the development of emotional over- and undereating. Both parental sensitivity (i.e., the ability to have clear perceptions of and appropriate responsiveness to the child's emotional expressions and needs) and parental structuring (i.e., the parent's ability to adequately guide and scaffold the child's activities and set appropriate limits for the child) (Biringen, Derscheid, Vliegen, Closson, & Easterbrooks, 2014) are considered to affect a range of child behaviors. Parental sensitivity in particular is shown to protect against emotional problems and promote emotion regulation in children (Biringen et al., 2014), whereas a lack of sensitivity is shown to predict more emotion dysregulation in toddlers one year later (NICHD Early Child Care Research Network, 2004). Given that both emotional over- and undereating can be seen as responses to distress, it is reasonable to assume that children of parents who are less sensitive will cope less effectively with stress and thus display more of both eating behaviors. In addition to sensitivity, parental

structuring may affect the development of emotional over- and undereating. Parental structuring may provide boundaries and rules about when and what to eat for their children. Thus, children of parents who structure adequately may simply have fewer opportunities for engaging in emotional overeating.

Although scarce, the existing empirical evidence on parenting and emotional over- and undereating provides some support for these claims. Parental support can be considered a variation of parental responsiveness and sensitivity (Morris et al., 2007), and cross-sectional research shows that parental warmth and support are associated with less emotional overeating in school-aged children (Topham et al., 2011), whereas adolescents who lack parental support are inclined to engage in emotional overeating (Snoek et al., 2007). It is also notable that women suffering from Anorexia Nervosa (retrospectively) report both a lack of parental support and emotional undereating in childhood (Kim et al., 2010). High levels of both parental sensitivity and structuring are crucial to the authoritative parenting style (Rhee, 2008), which is significantly related to less emotional overeating in children (Topham et al., 2011). Finally, one study showed that parental structure was correlated with less emotional overeating in school-aged children (Philips, Sioen, Michels, Sleddens, & De Henauw, 2014). To our knowledge, no prior study has investigated whether parental sensitivity and structuring specifically predict changes in emotional over- and undereating over time – an assumption tested in the present inquiry.

Interaction Effects Between Temperament and Contextual Factors?

Throughout the preceding discussion, the implication has been that children in general are affected by the conditions hypothesized to be associated with emotional over- and undereating. Yet there is evidence that children vary in their susceptibility to a diverse array of environmental influences, and that it may be children with more, rather than less, negative affectivity who are especially susceptible to environmental influences (Belsky & Pluess,

2009). Child factors that pose a risk (or benefit) may vary in their impact depending on the quality of family functioning or parenting. Thus, high family functioning and sensitive or structuring parenting may buffer against the impact of other risk factors (Masten & Shaffer, 2006). This line of reasoning suggests that low soothability in children may not necessarily pose a risk in instances of positive contextual factors (e.g., adequate family functioning). In other instances, such contextual factors may exacerbate the impact of alleged risk factors; highly emotionally reactive children who also live in a negative family environment may therefore be at the greatest risk for developing emotional dysregulation (Morris et al., 2007). There is also evidence that vulnerabilities in emotion regulation and depression in 9-10-year-olds were indeed moderated by characteristics of the family environment (Feng et al., 2009). Following the reasoning outlined above, serious life events, poor family functioning, and less-sensitive and less-structured parenting might particularly promote emotional over- and undereating in children who are difficult to soothe or have symptoms of depression – a hypothesis tested in the present inquiry.

The Current Study

In seeking to provide a better understanding of the etiology of emotional over- and undereating in childhood, we test an ecological model of child and contextual influences, drawing on a large, representative sample of Norwegian children followed biennially from 6 to 10 years of age. We evaluate whether child temperament, symptoms of depression, serious life events, family functioning, parental sensitivity and structuring predict changes in children's emotional over- and undereating. Given evidence that emotional over- and undereating have some common etiology (Herle, Fildes, Steinsbekk, et al., 2017), but that neither theory nor research identifies specific factors related to one but not the other form of emotional eating, we do not make specific predictions with regard to distinctive determinants of over- and undereating. We hypothesize that both eating behaviors will increase over time

when children score low on soothability, have more rather than fewer symptoms of depression, have experienced serious life events, are growing up in less well-functioning families, and have parents who are less sensitive and less structuring. We further hypothesize that the latter four contextual conditions will prove more influential among children who are difficult to soothe and children with symptoms of depression.

Methods

Participants and Procedure

Children born in 2003 and 2004 and their parents living in Trondheim, Norway, were invited to participate in the Trondheim Early Secure Study (TESS) by a letter sent to their homes (N=3,456). The letter included the Strengths and Difficulties Questionnaire (SDQ) version 4-16 (Goodman, Ford, Simmons, Gatward, & Meltzer, 2000). When attending the ordinary health check-up for 4-year-olds, the parents brought the completed SDQ form. Almost all children in the two birth cohorts appeared at the health-checkup (97.2%, n=3,358); therefore, the sample is in effect a community sample. A health nurse informed about the study and asked the parents to participate (n=3,016), and 2,475 gave written informed consent. The health nurse missed asking a total of 166 parents, who were thus excluded. Further, 176 were not eligible because they were not proficient in Norwegian. In order to increase sample variability and thus statistical power, children with higher scores on the SDQ were oversampled. This oversampling was accomplished by dividing SDQ total difficulty scores into four strata (cutoffs: 0-4, 5-8, 9-11, and 12-40), and the probability for selection increased with higher SDQ scores (.37, .48, .70, and .89 in the four strata, respectively). In all, 1,250 consenting families were drawn to participate. The Regional Committee for Medical and Health Research Ethics, Mid-Norway, approved the study.

The child and one of the parents visited the university clinic for testing and observation about two weeks after the health check-up, and follow-up was on a biennial basis.

Children's eating behavior was assessed from age 6 onwards. Therefore, the present study is based on data collected at age 6 ($n=797$, $M_{\text{age}}=6.72$ years, $SD=.17$), age 8 ($n=699$, $M_{\text{age}}=8.80$ years, $SD=.24$), and age 10 ($n=702$, $M_{\text{age}}=10.51$ years, $SD=.17$). The data collection took place from August 2009 to June 2011 (age 6), from August 2011 to June 2013 (age 8), and from August 2013 to June 2015 (age 10). Sample characteristics are presented in Table 1.

Attrition was selective according to predictors but *not* according to emotional over- and undereating at ages 6 and 8. Attrition at age 8 was higher among those with less sensitive parents ($OR=.67$, (95% CI, .46, .96), $p=.031$) and those who had experienced serious life events at age 6 ($OR=1.27$, (95% CI, 1.09, 1.48), $p=.002$). However, the combined effect of these variables was small (Nagelkerke proxy $R^2=.040$, Cox & Snell=.023). Attrition at age 10 was higher among children who had experienced serious life events ($OR=1.38$, (95% CI, 1.17, 1.62) $p<.001$) and children with higher levels of depression symptoms at age 6 ($OR=1.29$, (95% CI, 1.06, 1.58), $p=.013$). Again, the combined effect was small (Nagelkerke proxy $R^2=.045$, Cox & Snell=.025).

Measures

Emotional over- and undereating. The emotional overeating scale (e.g., "My child eats more when anxious") and the emotional undereating scale (e.g., "My child eats less when upset") of the parent-reported Children's Eating Behaviour Questionnaire (CEBQ) (Wardle et al., 2001) were used to assess children's emotional over- and undereating when they were 6, 8 and 10 years old. The responses were rated on a 5-point scale from "never" to "always". The internal consistency of the emotional overeating scale (4 items originally) was improved by removing one item ("My child eats more when s/he has nothing to do"), resulting in $\alpha=.81$, .80, and .79 at age 6, 8, and 10, respectively, in the present sample. This specific item was also originally shown to load poorly on the emotional overeating scale, but it was provisionally retained by the developers to provide better comparability with other scales

(Wardle et al., 2001). The emotional undereating scale (4 items) had acceptable reliability (age 6: $\alpha=.75$; age 8: $\alpha=.76$; age 10: $\alpha=.78$). The CEBQ has shown good test-retest reliability (Wardle et al., 2001) and has been validated against eating behavior observed in laboratory contexts (Carnell & Wardle, 2007).

Temperament was measured using the short form of the Children's Behavior Questionnaire (CBQ-SF) (Putnam & Rothbart, 2006) when the children were 6 years old. The falling reactivity/soothability subscale (i.e., how quickly the child recovers from emotional arousal, including both distress and excitement) includes items such as "When angry about something, s/he tends to stay upset for ten minutes or longer" and "Is easy to soothe when s/he is upset", and responses are rated from 1 ("Extremely untrue of your child") to 7 ("Extremely true of your child"). To improve the internal consistency of the original subscale (6 items), one item was deleted ("Changes from being upset to feeling much better within a few minutes"), resulting in $\alpha=.68$, which is comparable to the internal reliability originally reported by the developers of the short form of the CBQ (Putnam & Rothbart, 2006). Because we expected soothability specifically to predict emotional over- and undereating, a more detailed description of the four other subscales of the negative affectivity dimension (i.e. anger/frustration, discomfort, fear and sadness) can be found in the note to Table 4. Anger/frustration, discomfort, and fear had acceptable reliabilities ($\alpha=.82$; $\alpha=.74$; $\alpha=.72$, respectively), whereas the sadness subscale had an α of .49, and it was not possible to improve this scale by removing any items. It was nevertheless included because it is a component of negative affectivity.

Depression symptoms and serious life events were recorded by means of the Preschool Age Psychiatric Assessment (PAPA) (Egger et al., 2006) when the children were 6 years old. PAPA, which is a semi-structured psychiatric interview of parents, was administered by trained personnel using a structured protocol including both required and optional follow-up

questions. The PAPA assesses depression according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (American Psychiatric Association, 1994), and a variable for depression was created using symptom counts (i.e. a continuous variable). Blinded raters recoded a random sample of 9% of the interview audio recordings, and the resulting intra-rater reliability (ICC) was .90. To assess serious life events, parents were asked if their child had ever experienced any of 25 stressors that could potentially cause post-traumatic stress disorder (e.g., nearly drowning, witnessing violence or death, or enduring physical or sexual abuse). The number of events experienced were summed to create a serious life events score.

Family functioning was reported by parents using the general family functioning scale of the McMaster Family Assessment Device (FAD) (Epstein et al., 1983) at 6 years of age. This scale covers different aspects of the family (e.g., problem solving, communication, involvement, affective responsiveness) and comprises 12 items (e.g., “In times of crisis we can turn to each other for support”; “We can express feelings to each other”; $\alpha=.90$) rated on a 4-point scale from “strongly agree” to “strongly disagree”. Thus, a higher score indicates *lower* family functioning. The general family functioning scale has previously been shown to have high validity and test-retest reliability (Epstein et al., 1983).

Parental sensitivity and structuring were measured with the Emotional Availability Scale (EAS) (Biringen, 2008). Sensitivity concerns a parent’s ability to develop a healthy emotional connection with her or his child, whereas structuring refers to adequately guiding the child’s activities and setting appropriate limits for the child. When the children were 6 years old, parent-child interactions were videotaped during four successive 5-minute sequences (free play, child-led play, parent-led play and a clean-up task), and parental sensitivity and structuring were rated based on these observations. All raters were trained and certified as reliable by Biringen, one of the developers of the EAS. The intra-rater reliabilities (ICCs)

among blinded raters of a random sample of 10% of the videotapes were .71 for sensitivity and .70 for structuring.

Results

All analyses were performed in Mplus version 7.4 (Muthèn & Muthèn, 1998-2015). Due to the screen-stratified sample in this study, all analyses were conducted with probability weights to produce accurate population estimates. The probability weights corresponded to the number of children in the population in a specific stratum divided by the number of participating children in that stratum. To provide robust standard errors, we used a robust maximum likelihood estimator which is also robust to moderate deviations from multivariate normality. Because attrition was not selective according to emotional over- and undereating, data were assumed missing at random and was handled according to a full information maximum likelihood (FIML) procedure, in which analyses are run on all available data given that cases have values for the dependent variables. The analysis sample was thus $n=802$.

Descriptive Statistics

Estimated means, standard deviations and correlations among all study variables are presented in Table 2. The levels of emotional over- and undereating were comparable to those reported in prior studies (Svensson et al., 2011; Wardle et al., 2001). The overall perceived functioning of the family was generally good (note that 1.0 denotes a perfect score on all items), and the parents' sensitivity and structuring were also, on average, rated as approaching the high end of the scale. As seen in Table 2, more emotional overeating was associated with more emotional undereating at all time points, which has also been reported by others (e.g. Herle, Fildes, Steinsbekk, et al., 2017). Furthermore, both eating behaviors were associated with lower child soothability and lower family functioning, and lower parental structuring was correlated with emotional overeating prospectively. Notably, observed parenting (sensitivity

and structuring) was not associated with parent-reported family functioning, supporting the notion that these measures tap into different aspect of the family context (Table 2).

Predictors of Change in Emotional Over- and Undereating

To test whether soothability, depression, serious life events, family functioning, parental sensitivity and structuring predicted changes in emotional over- and undereating, we applied growth curve modeling within a structural equation framework. Two parameters were estimated: Intercepts were set at the start of the emotional over- and undereating trajectories, and the slopes were parameterized as yearly changes in emotional over- and undereating. Such a linear latent growth model fit the data well, $\chi^2=11.42$, $df=6$, $p=.076$, RMSEA=.034 (90% CI: .00, .063), CFI=.994, TLI=.986, SRMR=.025, and a non-linear growth where the final data point (age 10) was freely estimated did not fit the data any better, $\chi^2=9.82$, $df=4$, $p=.043$, RMSEA=.034 (90% CI: .007, .077), CFI=.994, TLI=.978, SRMR=.025, $\Delta\chi^2=2.01$, $df=2$, $p=.37$. A linear growth model was therefore retained. As already indicated in Table 2, this model confirmed that emotional undereating decreased over time, $M_{slope}=-.06$, $p=.37$, whereas emotional overeating remained constant, $M_{slope}=.003$, $p=.52$. There were substantial residual variances to be explained by the planned predictors, $s^2=.99$, $p < .001$, and $s^2=.85$, $p < .001$, for slopes in over- and undereating, respectively. In the extended predictor model, the slopes of emotional over- and undereating were regressed on soothability, symptoms of depression, serious life events, family functioning, parental sensitivity and parental structuring at age 6 as well as the intercepts of the two eating behaviors. Because neither gender nor body mass index (BMI) correlated with the level (see Table 2) or change over time (not reported) in emotional over- and undereating, these variables were not included as covariates in the model. The intercepts were allowed to correlate with each other and all of the predictors, and all of the predictors were allowed to correlate with each other, as were the two slopes (model fit: $\chi^2=19.85$ ($df=18$; $p=.34$); CFI=.998; TLI=.995; RMSEA=.01 (90% CI: <.001, .03);

SRMR=.02). As seen in Table 3, children who showed the greatest increase in emotional overeating from age 6 to 10 scored low on soothability and had less structuring parents at age 6, whereas those who came from less well-functioning families at age 6 had less decreases in emotional undereating over time.

To compare soothability with the other negative affectivity subscales, each of these subscales was added to the main model, thus replacing soothability, one at a time (i.e., 5 different models were tested). None of the other temperament subscales tested (i.e., anger/frustration, discomfort, fear and sadness) predicted emotional over- or undereating over time (see Table 4).

Finally, to test interactions between contextual factors and child soothability, we added the following interaction terms to the main model, one at a time (i.e., 4 different models were tested): (1) soothability X serious life events, (2) soothability X family functioning, (3) soothability X parental sensitivity, and (4) soothability X parental structuring. Although family functioning did not predict changes in emotional overeating as a main effect, there was a significant effect of the interaction between soothability and family functioning, and between soothability and parental sensitivity on emotional overeating only (see Table 3). Interactions between children's depression symptoms and contextual factors were tested in the same manner (i.e., four interaction terms were added to the main model, one at a time), but no such interaction effects emerged (see Table 3).

To explore the nature of the interactions between soothability and contextual factors, we first split the sample in three equal groups according to the level of family functioning. Simple slopes in these three groups are depicted in Figure 1. As shown, soothability did not impact emotional overeating in well-functioning families ($B=.004$; $p=.74$). However, in moderate functioning ($B= -.021$; $p=.016$) and especially in low-functioning families ($B = -.042$, $p = .001$), low soothability predicted increased emotional overeating. With respect to the

interaction between soothability and sensitivity, when parental sensitivity was low ($B=.003$; $p=.81$) or moderate ($B=-.018$; $p=.068$) there was no effect. However, when sensitivity was high, low soothability predicted more emotional overeating ($B=-.027$; $p=.010$). To explore this latter unexpected interaction further, we speculated that the reason why children who were low on soothability and whose parents were also highly sensitive engaged in more emotional overeating over time, was that their parents were also prone to be low on structuring. Although both sensitivity and structuring are important aspects of the authoritative parenting style (Rhee, 2008), it is possible to score high on sensitivity and low on structuring, and vice versa. Scoring high on both (i.e. authoritative parenting) is considered the most optimal parenting pattern, perhaps especially for children who are difficult to soothe, whereas high sensitivity-low structuring parents might use less adaptive regulation strategies to calm a child who is difficult to soothe. Therefore, we tested a model including a three-way interaction among soothability, parental sensitivity and structuring, while adjusting for all two-way interactions between these variables. However, this three-way interaction was not significant ($B= <.001$, $S.E.=.02$, $\beta=-.002$, $p=.98$).

Discussion

The main objective of the present study was to test a model of children's emotional over- and undereating, by evaluating whether child- and contextual factors (i.e., child temperament, depression, serious life events, family functioning and parental sensitivity and structuring) predicted changes in eating from age 6 to 10. Growth modeling analyses showed that lower soothability in children and lower parental structuring predicted increases in emotional *overeating* in children over time. However, soothability was associated with increased emotional overeating only in the context of moderate- and lower-functioning families, and when parents were particularly sensitive. Children from less well-functioning families had less decreases in emotional *undereating* over time. None of the other child and

contextual factors investigated (i.e., depression, serious life events and parental sensitivity) predicted increases in either emotional over- or undereating.

Predictors of Emotional Overeating: Temperament and Parental Structuring

Our results demonstrate that a specific aspect of children's negative affectivity, namely, low soothability, is responsible for increased emotional overeating in children. The other negative affectivity dimensions (i.e., anger/frustration, discomfort, fear, and sadness) did not predict more emotional overeating over time. Although examining such fine-grained temperament dimensions has been shown to be important in relation to children's adaptation (Gartstein et al., 2012) and infants' eating (Gartstein et al., 2014), no prior studies have investigated whether these temperament dimensions predict more emotional over- and undereating before. We thus extend past research that revealed cross-sectional and prospective associations between negative affectivity and emotional overeating in children (Harrist et al., 2013; Haycraft et al., 2011; Steinsbekk, Barker, et al., 2017). However, it should be noted that one of the subscales, sadness, had low internal consistency in the present study, and conclusions pertaining to this aspect of temperament must therefore be tentative. On a general basis, children with a difficult temperament (i.e., higher levels of negative affectivity and reactivity) are less likely to use constructive regulation strategies (Blair, Denham, Kochanoff, & Whipple, 2004). These global findings thus seem to pertain to eating. Although we did not examine mechanisms explaining the prospective link between soothability and emotional overeating, it is reasonable to point to the fact that children low on soothability need a longer time to recover from emotional arousal (Rothbart et al., 2001). Thus, they have more difficulty down-regulating negative feelings and may maintain emotional states requiring regulation. As a result, these children may turn to regulation strategies that may have immediate stress-reducing effects, such as eating (Dallman, 2010).

As further hypothesized, lower parental structuring predicted increased emotional overeating from age 6 to 10. These findings are in accordance with cross-sectional evidence showing negative associations between emotional overeating in children and parental structure (Philips et al., 2014) and authoritative parenting (i.e., a parenting style characterized by high levels of parental structuring and sensitivity) (Topham et al., 2011). We draw attention to two potential mechanisms that are not mutually exclusive. First, parents low on structuring may also be poor at setting limits and consistently applying rules about eating, such that food – particularly energy-rich, palatable food that is most often consumed when engaging in emotional overeating (Nguyen-Michel, Unger, & Spruijt-Metz, 2007) – is easily available for children to consume when experiencing negative emotions. Second, parents low on structuring may to a lesser extent than parents high on structuring prevent children from being exposed to repeated defeats and frustrations while also providing less scaffolding to the child's own emotion regulation attempts. Such mechanisms were not examined in the present study but should be addressed in future research.

Child depression symptoms, serious life events, family functioning and parental sensitivity did not predict changes in emotional overeating in our study. These findings are in contrast to past research demonstrating a positive association between emotional overeating and depression in children (Mackenbach et al., 2012) and adolescents (e.g. Hou et al., 2013), and between emotional overeating and negative life events (Michels et al., 2012), lower family functioning (Topham et al., 2011) and less parental support (Snoek et al., 2007). Notably, these prior studies were cross-sectional. We similarly found a cross-sectional correlation between lower family functioning and emotional overeating in our sample, but this association was not evident when family functioning was examined as a predictor of growth in emotional overeating over time, adjusting for the initial level (intercept). It should also be noted that the family functioning scale used in the Topham et al. (2011) study focused

exclusively on the affective responsiveness of the family, whereas the present study used the general family functioning scale which taps into broader aspects of family life. Thus, the mechanisms of influence may differ in the case of family functioning. Further, a longitudinal study showing no association between negative life events and emotional overeating in children one year later (Michels et al., 2015) corresponds to our results. Moreover, developmental differences between children and adolescents may be an important explanation for the lack of association between depression and emotional overeating. The potential impact of depression might not be evident until adolescence as the rate of depression considerably increases as children reach adolescence (Avenevoli, Knight, Kessler, & Merikangas, 2008). However, Mackenbach et al. (2012) did reveal a cross-sectional relation between emotional overeating and internalizing problems, but our findings indicate that no prospective relation exists. Notably though, in our study only emotional undereating at age 6 was positively correlated with symptoms of depression. The use of different measures of depression symptoms (i.e., the symptom checklist used in the Mackenbach et al. (2012) study versus the psychiatric interview used in the present study) could also account for the conflicting findings.

Emotional Overeating: Interactions

Low soothability did not predict increased emotional overeating in children who came from well-functioning families, indicating that the functioning of the family moderates the impact of other risk factors (Masten & Shaffer, 2006) – in this case, a difficult temperament. This result is not surprising considering that a positive family environment in general is important for fostering adaptive emotion regulation abilities in children and is even more important for highly emotionally reactive children (Morris et al., 2007). The possible mechanisms should be addressed in future studies.

Similar to the case of family functioning, we expected that children low on soothability would be at increased risk of emotional overeating when the level of parental sensitivity was *lower*. However, the present results showed that children low on soothability tended to engage in more emotional overeating when parental sensitivity was *higher*. This finding is surprising and has no ready explanation. Because our findings also showed that low parental structuring predicted more emotional overeating, we further tested whether highly sensitive parents at the same time were low on structuring, but found no evidence for such a moderation. It should be noted that on average, the parents in our Norwegian community sample scored near the high end of the sensitivity scale. In this context, one may speculate that the most sensitive parents in our highly sensitive sample who also have a particularly difficult-to-soothe child may be so alarmed by their child's distress that they use something that rapidly eases the child, such as food. However, considering the significance of the interaction ($p=.042$), there is a distinct possibility of a chance finding. Although there is some support for the notion that very high sensitivity may have some costs in the case of food and feeding, stemming from an earlier report that found high sensitivity to predict increased pickiness in children (Steinsbekk, Bonneville-Roussy, et al., 2017), the present soothability X sensitivity finding is in obvious need of replication before potential mechanisms are addressed.

Emotional Undereating: The Role of Family Functioning

The present study is the first to examine specific child- and contextual factors as potential determinants of emotional undereating. Our results show that children who live in less well-functioning families have a higher risk of emotional undereating over time than those living in better-functioning families. Although no prior study has examined the effect of family functioning on emotional undereating, our results support the study of Haycraft and Blissett (2010), showing that children whose parents had a more hostile relationship engaged

in more emotional undereating. Further, our finding is in agreement with a study of women suffering from Anorexia Nervosa who retrospectively reported both a lack of parental support and emotional undereating in childhood (Kim et al., 2010). The underlying mechanisms were not examined in the present study, but it is well known that poor family functioning and conflict are related to more emotional and behavioral problems in children (Hughes, Hedtke, & Kendall, 2008). Thus, children might be more likely to undereat in response to these negative emotions. Notably, however, symptoms of depression did not predict emotional undereating in the present inquiry. Building on this finding, one might assume that it is not the *level* of negative emotions that matters but rather how children handle these emotions once they occur. Because the family climate is shown to be important for the development of emotion regulation in children (Morris et al., 2007), children in less-functional families may not have developed optimal emotion regulation skills; thus, they might undereat because they lack strategies for dealing with negative emotions. In support of this view, one recent study found that conflict between parents was significantly associated with less adaptive emotion regulation in toddlers (Gallegos et al., 2017). Finally, it should be noted that we only detected a small effect of family functioning, and the practical relevance of this finding is thus uncertain. However, our study adds to the very limited knowledge on the development of emotional undereating in children.

Child depression symptoms, soothability, serious life events, parental sensitivity and parental structuring did not affect changes in children's emotional undereating during middle childhood in the present inquiry. Recall that lower levels of soothability were cross-sectionally correlated with more emotional undereating, which has also been reported by others (Haycraft et al., 2011). However, when we tested this association longitudinally, it did not persist. Similar to Mackenbach et al. (2012), we detected a small but significant cross-sectional correlation between child depression symptoms and emotional undereating, but

again, this association was not evident when tested longitudinally. Notable as well is that past research has focused almost exclusively on emotional overeating. Therefore, the empirical foundation of the present study had to be mostly based on studies on this eating behavior. Although emotional over- and undereating have some shared etiology, there are also substantial unique etiological factors (Herle, Fildes, Steinsbekk, et al., 2017). In accordance with this fact, the results of our multivariate analysis showed that different factors predicted emotional over- and undereating, respectively, indicating that they are separate phenomena, although some children are likely to display both. For that reason, future research on emotional undereating might benefit from searching in other directions than simply considering factors associated with emotional overeating.

Limitations

Although this study has many strengths, including a large population-based sample followed repeatedly and multivariate analyses, some limitations should be noted. First, the sole reliance on parent reports of eating behavior, temperament and family functioning may have inflated associations due to common methods. The impact of such respondent effects may have been reduced when adjusting for initial levels (intercepts) of emotional over- and undereating, but we cannot be certain it did not affect the results. Corroborating parent-completed questionnaires with laboratory measures of emotional over- and undereating would have been an advantage, but the latter are unfortunately too time-consuming and costly to include in large samples such as the present one. Furthermore, using multiple informants (e.g., teachers) would have been an advantage, but teachers rarely observe children's eating behavior and might therefore have difficulties reporting such behavior accurately. Moreover, we used a global measure of parent-child interactions because this study was embedded in the Trondheim Early Secure Study (TESS), which has a primary goal of examining children's mental health. Beyond the general parenting aspects (i.e., sensitivity and structuring)

investigated in the current study, it is possible that specific parent-child interactions around food influence the development of emotional over- and undereating; such food-specific parent-child interactions should be examined in future studies. Notable as well is that Norway, where the present study was conducted, has a relatively homogenous and well-educated population. Therefore, the findings may not necessarily generalize to more diverse populations with other eating practices. Finally, it is important to acknowledge that the effect of lower family functioning on emotional undereating was rather small. As a result, our finding should be replicated in other locations as well as in clinical samples of children more prone to emotional problems and regulation difficulties.

Conclusions

Emotional over- and undereating are common phenomena in childhood, and the current study aimed to test a model including child and contextual predictors of change in such eating behaviors from age 6 to 10. Lower temperamental soothability in children and lower parental structuring forecast greater increases in emotional overeating, whereas children whose families have lower overall functioning may tend to engage in more emotional undereating over time. These results broaden our knowledge of the etiology of emotional over- and undereating.

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Table 1

Sample characteristics at age 6

	%
<hr/>	
Gender of child	
Female	50.2
Male	49.8
Gender of parent informant	
Female	81.1
Male	18.9
Ethnic origin of biological mother	
Norwegian	93.0
Western countries	6.8
Other countries	0.3
Ethnic origin of biological father	
Norwegian	93.0
Western countries	6.5
Other countries	0.5
<hr/>	

Table 2

Descriptive statistics and bivariate correlations between all study variables in addition to gender and BMI

	Mean (SD)	Min/Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Emotional overeating 6 years	1.33 (.43)	1.00/3.33	-													
2. Emotional overeating 8 years	1.32 (.43)	1.00/4.00	.53***	-												
3. Emotional overeating 10 years	1.34 (.46)	1.00/3.33	.52***	.60***	-											
4. Emotional undereating 6 years	2.63 (.76)	1.00/4.75	.28***	.22***	.27***	-										
5. Emotional undereating 8 years	2.48 (.74)	1.00/4.50	.16***	.34***	.28***	.59***	-									
6. Emotional undereating 10 years	2.38 (.76)	1.00/4.75	.18***	.25***	.39***	.51***	.57***	-								
7. Child soothability	5.24 (.79)	1.60/7.00	-.15***	-.20***	-.23***	-.15**	-.14**	-.15***	-							
8. Child depression symptoms	.52 (.89)	0.00/5.00	.05	.08	.05	.11**	.04	.05	-.19***	-						
9. Serious life events	.99 (1.12)	0.00/6.00	.10	-.01	.04	.02	-.01	.04	-.002	.05	-					
10. Family functioning	1.67 (.41)	1.00/4.00	.21***	.23***	.20***	.12**	.15**	.16**	-.22***	.12**	-.04	-				
11. Parental sensitivity	3.45 (.52)	1.29/4.14	-.01	.004	-.03	.02	.02	.01	.02	-.03	.05	-.03	-			
12. Parental structuring	3.52 (.49)	1.28/4.14	-.04	-.10*	-.12*	.02	-.01	-.01	.04	-.03	.04	-.05	.74***	-		
13. BMI SDS	-.08 (.92)	-2.86/2.63	-.01	-.06	-.003	-.004	-.02	-.03	.12*	-.09	.08	.03	.001	.07	-	
14. Gender	1.52 (.50)	1.00/2.00	.07	.03	.001	.06	-.04	-.02	.09*	-.02	-.03	.03	-.06	.02	.01	-

Note. * $p < .05$; ** $p < .01$; *** $p < .001$

Table 3

Predictors of change in children's emotional over- and undereating from 6 to 10 years of age

	Correlations with intercept for emotional overeating	Correlations with intercept for emotional undereating	Change in emotional overeating (slope)					Change in emotional undereating (slope)				
	r	r	B	S.E.	95% CI	β	p-value	B	S.E.	95% CI	β	p-value
Child soothability	-.19***	-.18***	-.02	.01	-.03, -.01	-.26	.003	-.01	.01	-.03, .01	-.09	.27
Child depression	.06	.12*	.001	.01	-.01, .01	.01	.89	-.01	.01	-.03, .01	-.08	.29
Serious life events	.10	.03	-.001	.01	-.01, .01	-.02	.82	.006	.01	-.01, .02	.06	.32
Family functioning	.27***	.15**	-.01	.01	-.03, .02	-.04	.69	.04	.02	.003, .08	.15	.042
Parental sensitivity	-.001	.02	.03	.15	-.003, .05	.24	.08	.02	.02	-.02, .06	.09	.38
Parental structuring	-.06	.02	-.04	.02	-.06, -.01	-.32	.014	-.02	.02	-.07, .02	-.10	.32
SO X SLE	.07	-.001	.004	.01	-.01, .02	.37	.58	.01	.01	-.01, .03	.32	.55
SO X FF	.06	.02	-.04	.01	-.07, -.02	-.25	.001	-.004	.02	-.05, .04	-.01	.87
SO X SENS	-.01	-.06	-.02	.01	-.04, -.001	-.15	.042	.04	.02	-.004, .08	.14	.078
SO X STRUCT	.001	.03	-.02	.01	-.04, .01	-.11	.12	-.01	.02	-.06, .03	-.04	.57
DEP X SLE	.07	.05	.001	.01	-.01, .01	.03	.82	.002	.01	-.01, .02	.03	.80
DEP X FF	.01	.04	.01	.01	-.02, .04	.06	.48	.01	.02	-.04, .05	.02	.84
DEP X SENS	-.11*	-.04	.002	.01	-.02, .02	.02	.85	-.01	.02	-.05, .03	-.05	.57
DEP X STRUCT	-.08	.002	<.001	.01	-.02, .02	-.003	.97	-.03	.02	-.07, .004	-.13	.076

Note. Adjusted for initial levels of eating behavior (intercept) and all other study variables; SO=soothability; DEP=depression symptoms; SLE=serious life events; FF= family functioning; SENS=parental sensitivity; STRUCT=parental structuring; *p<.05; **p<.01; ***p<.001

Table 4

Negative affectivity subscales as predictors of emotional over- and undereating from 6 to 10 years of age

	Correlations with intercept for emotional overeating	Correlations with intercept for emotional undereating	Change in emotional overeating (slope)					Change in emotional undereating (slope)				
	r	r	B	S.E.	95% CI	β	p-value	B	S.E.	95% CI	β	p-value
Soothability	-.19***	-.18***	-.02	.01	-.03, -.01	-.26	.003	-.01	.01	-.03, .01	-.09	.27
Anger/frustration ^a	.14**	.21***	.01	.01	-.001, .02	.15	.076	.01	.01	-.01, .03	.08	.29
Discomfort ^b	.12*	.10*	.003	.01	-.01, .01	.05	.58	-.01	.01	-.03, .004	-.10	.15
Fear ^c	.04	.17***	.01	.004	-.003, .01	.10	.19	.001	.01	-.01, .02	.01	.87
Sadness ^d	.15**	.24***	.01	.01	-.01, .02	.08	.33	.01	.01	-.02, .03	.05	.49

Note. Tested in multivariate models; adjusted for all other predictors (i.e. depression, serious life events, parental sensitivity and structuring); * $p < .05$; ** $p < .01$; *** $p < .001$.

^aAnger/frustration, i.e. negative affectivity related to interruptions of on-going tasks or goal-blocking (6 items, e.g. “Has temper tantrums when s/he doesn’t get what s/he wants”); ^bDiscomfort, i.e. negative affectivity related to sensory qualities, for example intensity or sounds (6 items, e.g. “Is quite upset by a little cut or bruise”); ^cFear, i.e. negative affectivity involving unease, worry or nervousness related to anticipated distress or pain (6 items, e.g. “Is afraid of burglars or the boogie man”); ^dSadness, i.e. negative affectivity related to lowered mood and energy which is associated with disappointment and object loss (7 items, e.g. “Tends to become sad if the family’s plans don’t work out”).

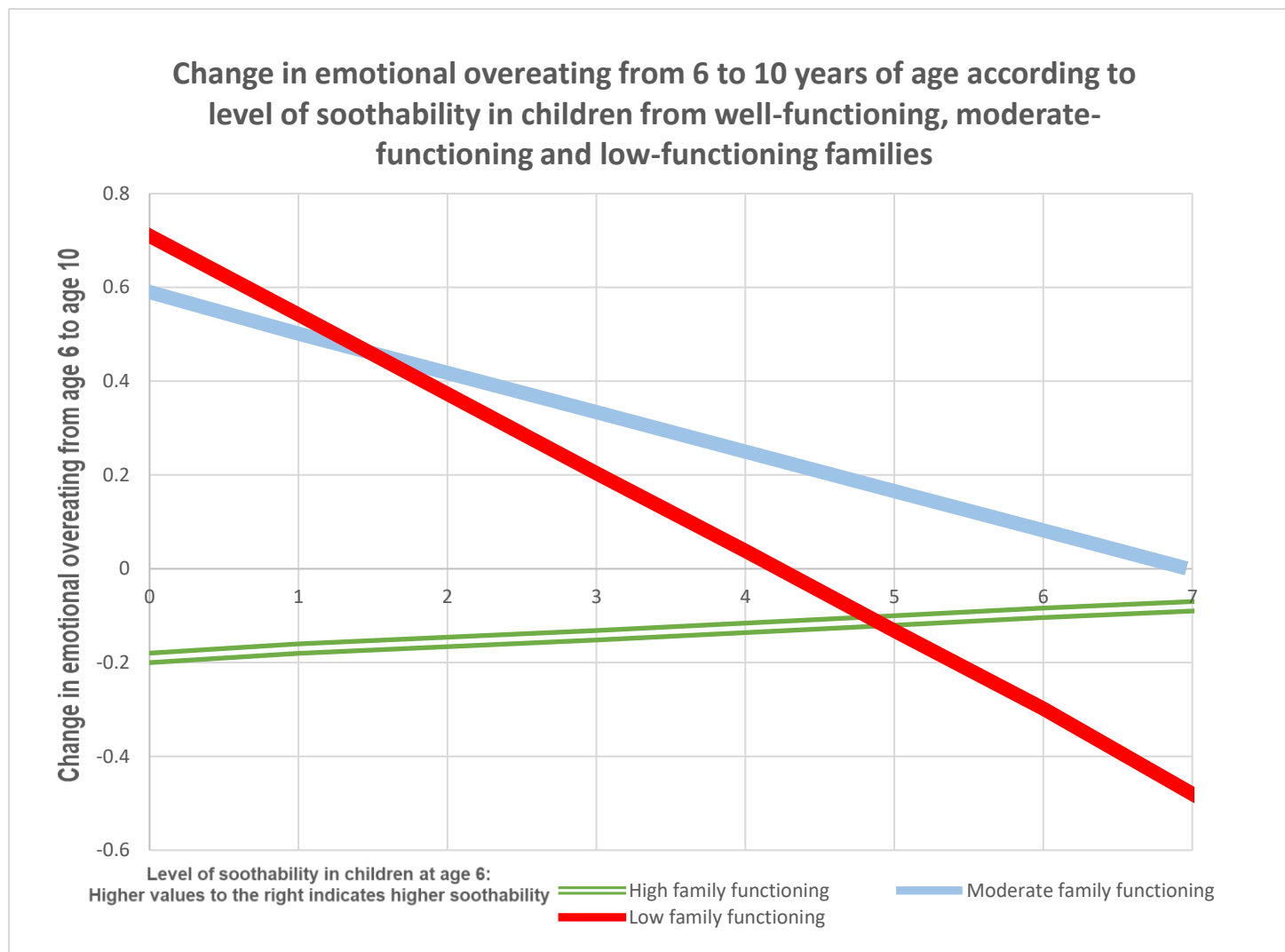


Figure 1. Simple slopes depicting change in emotional overeating from 6 to 10 years of age according to the level of soothability at age 6 in children from well-functioning, moderate-functioning and low-functioning families. A higher value on the x-axis indicates higher soothability, whereas a higher value on the y-axis indicates greater increases in emotional overeating.