Published in final edited form as:

Fam Process. 2018 September ; 57(3): 707–718. doi:10.1111/famp.12326.

A model-based cluster analysis of maternal emotion regulation and relations to parenting behavior

Anne Shaffer¹, Monica Whitehead¹, Molly Davis¹, Diana Morelen², and Cynthia Suveg¹

¹Department of Psychology, University of Georgia, Athens, GA

²Department of Psychology, East Tennessee State University, Johnson City, TN

Abstract

In a diverse community sample of mothers ($N = 108$) and their preschool-aged children ($M_{age} = 3.50$ years), the current study conducted person-oriented analyses of maternal emotion regulation (ER) based on a multi-method assessment incorporating physiological, observational, and self-report indicators. A model-based cluster analysis was applied to five indicators of maternal ER: maternal self-report, observed negative affect in a parent-child interaction, baseline respiratory sinus arrhythmia (RSA) and RSA suppression across two laboratory tasks. Model-based cluster analyses revealed four maternal ER profiles, including a group of mothers with average ER functioning, characterized by socioeconomic advantage and more positive parenting behavior. A dysregulated cluster demonstrated the greatest challenges with parenting and dyadic interactions. Two clusters of intermediate dysregulation were also identified. Implications for assessment and applications to parenting interventions are discussed.

Keywords

emotion regulation; parenting; person-centered analysis; cluster analysis

Emotion regulation (ER) has not historically been studied in the context of parenting, largely because research on the “determinants of parenting” (Belsky, 1984) has been less commonly explored than the outcomes of parenting for children. However, it is arguable that successful and sensitive parenting inherently requires good self-regulation, as most parenting tasks (e.g., scaffolding, redirection, limit-setting) require parents to engage in adaptive regulation in order to promote the regulation of others (Crandall, Deater-Deckard, & Riley, 2015; Rutherford, Wallace, Laurent, & Mayes, 2015). Recent empirical research has demonstrated that mothers’ capacities to regulate their emotions, as well as their difficulties with ER, are not only tied to their own parenting behaviors (e.g., Lorber, 2012; Mazursky-Horowitz et al., 2015; Shaffer & Obradovi, 2017) but are also linked to their children’s psychosocial functioning (e.g., children’s own regulation, internalizing behavior problems; Buckholdt, Parra, & Jobe-Shields, 2014; Han & Shaffer, 2013). Continued investigation of the nature of maternal ER and its implications for family functioning can contribute to this burgeoning literature.

Emotion regulation in adulthood has been defined as strategies used to increase, sustain, or decrease internal and external aspects of emotional responses. Emotional responses comprise subjective feelings, observable behaviors, and physiological responses, and regulation includes both conscious/voluntary and unconscious processes (Gross, 2001). Currently, there are many ways to measure ER (e.g., self- and informant-reports, psychophysiological assessments, behavioral observations) and concordance across different levels of analysis is inconsistent (Calkins & Dedmon, 2000; Davis, Suveg, & Shaffer, 2015). These divergent findings make it difficult to decipher how individual components of the broader ER construct fit together to inform us about key psychosocial processes for parents and children. However, each measurement approach can provide unique pieces of information that, when combined, can bolster our knowledge of ER, and multi-method assessments using multiple levels of analysis are critical to move this field forward (Zeman, Klimes-Dougan, Cassano, & Adrian, 2007). Given the widespread implications of maternal ER within the context of the family system, it is important to better understand how individual differences in mothers' ER across levels of analysis translate to the family climate broadly and youth socioemotional adjustment specifically. In this study, we examine how differences in mothers' ER across multiple levels of analysis relates to parenting behaviors.

Extant empirical studies of parental ER as a predictor of parenting are limited; however, it is arguable that successful and sensitive parenting inherently requires good self-regulation, as parents who are better able to regulate their own emotions are likely able to attune to their children's needs and engage more fully in effective parenting strategies (Dix, 1991). There are many reasons to expect that ER would be a central contributor to effective parenting behaviors, due to the nature of most parenting tasks (e.g., scaffolding, redirection, limit-setting) as regulatory, and thus requiring good self-regulation in order to promote the regulation of others. According to a model of parental meta-emotion philosophy developed by Gottman and colleagues, parents' thoughts and feelings about emotions (including their ability to regulate their own emotions) influence parenting behaviors, and parenting behaviors influence child outcomes (e.g., child ER, child mental/physical health; Gottman et al., 1996). Other theoretical work focusing on predictors of emotion socialization (i.e., parenting behaviors aimed to respond to, and teach about, children's emotional experiences) has underscored the influential role of parents' own emotion regulation (e.g., Eisenberg, Cumberland, & Spinrad, 1998; Morris, Silk, Steinberg, Myers, & Robinson, 2007). As such, a better understanding of characteristics that support or undermine positive parenting practices has many important implications for intervention and prevention efforts aimed at bolstering parental mental health and supporting youth development.

To date, most empirical studies of ER predictors of parenting are variable-centered, examining bivariate and multivariate associations of parental (primarily maternal) ER with various parenting behaviors. For example, self-reports of poor maternal ER predict ineffective disciplinary behaviors (Lorber, 2012) as well as maternal rejection and lower maternal warmth (Sarita, Grusec, & Gençöz, 2013). Maternal self-reported emotion dysregulation has also been associated with more self-reported engagement in unsupportive emotion parenting behaviors (Jones, Brett, Ehrlich, Lejuez, & Cassidy, 2014; Mazursky-Horowitz et al., 2015) and lower levels of observed positive/collaborative parent-child interactions (Shaffer & Obradović, 2017). Furthermore, Morelen and colleagues reported

that both observed and self-reported maternal emotion dysregulation were associated with poorer child ER abilities via unsupportive emotion parenting practices (Morelen, Shaffer, & Suveg, 2016).

As ER becomes better studied as a multifaceted and multilevel process, there is a need to investigate how the various levels function together (Cicchetti & Dawson, 2002; Cole, Martin, & Dennis, 2004) particularly as different regulatory systems (e.g., biological and behavioral systems) do not necessarily activate in tandem (Keenan, 2000). Person-centered methods (Magnusson, 2003) are well-suited to these types of questions by allowing researchers to examine how multiple facets of ER co-exist and co-vary within individuals, rather than how each dimension of ER separately relates to parenting and child outcomes. For example, Zalewski and colleagues (Zalewski, Lengua, Wilson, Trancik, & Bazinet, 2011) used latent profile analyses as a person-centered approach to characterize preadolescent children's ER across multiple modalities (i.e., physiological, behavioral, and self-reported ER). The authors noted that such analytic techniques are particularly salient in the study of relations among emotion systems, when information about how systems function together may yield more useful data than the consideration of ER indicators individually or in a variable-centered way. Zalewski and colleagues further noted the value of person-centered analyses for not only identifying potential profiles regarding how different emotion systems work together, but also for determining the relative prevalence of each profile in order to better understand typical and atypical developmental processes. Recently, person-centered analyses were also used to identify different ER profiles among adolescents, using data derived from self- and parent-reports of different regulatory strategies (Otterpohl, Schwinger, & Wild, 2015). Of note, while recent research has explored multifactorial assessment of maternal ER using variable-based analyses (Deater-Deckard, Li, & Bell, 2016) no research to date has used person-centered analyses to study multi-level assessments of maternal ER, particularly in relation to observed parent-child interactions.

The primary goal of the current study was to identify potential ER profiles based on a multi-method assessment of maternal ER in a diverse sample of mothers and their preschool-aged children. Given the exploratory nature of this research, no specific group profile characteristics were predicted a priori, although we expected that we would find enough sample variability to result in at least two distinct clusters. We applied a model-based cluster analysis (Mclust; Fraley & Raftery, 2006) to five indicators of maternal ER: maternal self-report of ER difficulties, observed negative affect in a parent-child interaction, baseline respiratory sinus arrhythmia (RSA), and RSA suppression across two laboratory tasks. Self-report ER measures provide mothers' own perceptions of their regulatory abilities and difficulties, an important but subjective view on ER abilities. Mothers' abilities to engage in adaptive ER strategies may translate to fewer expressions of negative emotions (e.g., Lorber, 2012), suggesting that the frequency of observed maternal negative affect may be a useful observational variable. Finally, research has highlighted the importance of studying regulatory processes at a physiological level, often through the use of respiratory sinus arrhythmia (RSA) data (e.g., Calkins & Dedmon, 2000; Hastings, Nuselovici, Utendale, Coutya, McShane, & Sullivan, 2008), which provides information on parasympathetic nervous system activation (Porges, Doussard-Roosevelt, & Maiti, 1994). RSA reflects abilities to respond to, or engage with, situational challenges without activating (or by

inhibiting) the sympathetic nervous system (Obradovi , 2012). Resting RSA captures one's preparedness to respond to environmental stressors, whereas RSA reactivity measures changes in RSA from baseline to a challenge task, often considered reflective of one's ability to self-regulate (e.g., modulate emotions and attention) in response to a stressor (for a review, see Beauchaine, 2001). RSA suppression (i.e., decreases in RSA in response to a challenge), in particular, allows for increases in active regulation during stress whereas RSA augmentation, or RSA increases in response to a challenge, is associated with calm, attentive states). Thus, the present study examined RSA suppression during both a stressor task and during a mother-child interaction task in order to better understand how mothers' physiological regulation during individual stressors and challenging dyadic interactions tasks plays a role in parenting behaviors and parent-child interactions.

Following the identification of groups using model-based cluster analyses, our secondary goal was to compare the maternal ER profiles on measures of observed parent and dyadic (parent-child) behavior. This secondary goal sought to identify profiles of risky and adaptive maternal ER. We expected that these measures would differentiate profiles that describe adaptive and maladaptive ER across physiological, behavioral, and self-reported indicators and identify which profiles are associated with positive or negative indicators of parenting and dyadic behaviors.

Method

Sample

Participants included 108 biological mothers ($M = 30.68$ years, $SD = 6.06$) of preschool-aged children ($M = 3.50$ years, $SD = 0.51$ 61% boys) who were recruited through fliers posted at local businesses and Head Start centers. The study required that mothers and children were fluent in English and that mother-child dyads had lived together for at least the past two years. Exclusion criteria included pregnancy, which could influence physiological indices, and/or child developmental disabilities that would impede communication.

Nearly half (47%) of the mothers identified as Black/African American; 43% indicated they were European American; the remainder identified as Hispanic/Latino, Asian, or another category. Income varied widely: approximately 40% had a total household income of less than \$20,000; 20% were between \$20,000 and \$39,999; 10% were between \$40,000 and \$59,999; 13% were between \$60,000 and \$79,999; and 18% had a total income above \$80,000. Less than half (48%) of mothers reported they were currently married or engaged; 43% indicated they had never been married; and 9.50% were separated, divorced, or widowed. Most (70%) participants had earned an education beyond a high school diploma.

Procedures

Research assistants conducted phone screenings with mothers and, if eligibility criteria were met, the mother was mailed a measures packet to complete before the lab visit. At the lab visit, mothers provided consent as well as permission for their child to participate, and children provided assent. Mothers and children participated in a series of video-recorded behavioral observation tasks. The present study relied on data from two tasks, which have

previously been used to elicit maternal stress reactivity (Suveg, Shaffer, & Davis, 2016): A maternal speech task and an Etch-a-Sketch interaction task. For the speech task, mothers had two minutes to prepare a video-recorded speech on their parenting philosophy and five minutes to deliver the talk, which they were told would be evaluated by parenting experts; this procedure was modeled after the Trier Social Stress Test (Kirschbaum, 2010). The Etch-a-Sketch task required the dyad to collaboratively draw a picture of a house using an Etch-a-Sketch (each using only one knob) in 4 minutes. The task was designed to be slightly stressful due to demands for dyadic cooperation, time pressure, and accuracy (thus potentially eliciting negative affect). Mothers were compensated \$100, and children chose a small prize as incentive. All study procedures were approved by, and conducted in accordance with, the sponsoring university's IRB.

Measures

Maternal emotion regulation—Maternal ER was measured via multiple methods comprising maternal self-report, observed behavior, and psychophysiological reactivity. The Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) is a 36-item self-report measure that provides a summary assessment of mothers' overall ER difficulties via a total score (higher scores indicate *greater* ER difficulties; $\alpha = .93$). Mothers rated the extent to which each item (e.g., "When I am upset, it takes me a long time to feel better,") applied to them using a 1–5 point Likert-type scale. Observed maternal negative affect (NA) was coded from video recordings of the Etch-a-Sketch task. The maternal NA coding scheme (adapted from Calkins, Smith, Gill, & Johnson, 1998) captures the mother's expressed anger and frustration as demonstrated via facial expressions, body posture, verbalizations, and/or tone of voice. Each mother was assigned a summary score on a 5-point Likert scale from 1 (no NA) to 5 (very high/pervasive NA), with acceptable inter-rater reliability ($ICC = .78$).

RSA data for mothers were collected using MindWare BioLab 3.0.6 software, and the data were analyzed using MindWare HRV 3.0.17 software (MindWare Technologies, Ltd., Gahanna, OH) in 30s epochs following recommendations of the Society for Psychophysiological Research committee on heart rate variability (Berntson et al., 1997). For further details regarding physiological data collection and cleaning, see Suveg, Shaffer, and Davis (2016). Baseline RSA was the average obtained during 4 minutes sitting quietly before laboratory procedures began. Following procedures outlined in other studies (e.g., Calkins, Graziano, Berdan, Keane, & Degnan, 2008), we calculated RSA suppression by subtracting mothers' mean RSA values during the tasks from their mean baseline RSA values. Positive change scores indicated a decrease in RSA from baseline to the speech/Etch-a-Sketch task and thus greater RSA suppression.

Parent and dyadic behaviors—Parent and dyadic behaviors were measured via observations of the Etch-a-Sketch task. Coding was completed by trained raters, and inter-rater reliability estimates are reported for each scale. Three macro-level summary codes drawn from the Minnesota Longitudinal Study of Parents and Children (Sroufe, Egeland, Carlson, & Collins, 2005) assessed behaviors based on 5-point Likert scales (1 = very low to none; 5 = very high): *Structure and limit-setting* ($ICC = .70$) was a global code that reflected how adequately the mother established her expectations for child behavior during the

interaction (regardless of child compliance). *Collaboration* (ICC = .69) was a global code that assessed evidence of the mother's and child's willingness to work together effectively. *Maternal encouragement of child self-regulation* (kappa = .85) was a frequency code that assessed instances of maternal support of child regulation, such as offering guidance when the child is upset, validating or labeling the child's emotions, expressing confidence in the child, and helping to generate problem-solving strategies if the child is frustrated.

Analytic Plan—A model-based cluster analysis was conducted using the maternal ER measures because this analysis is able to compare a different number of solutions simultaneously, can be used with small samples sizes, and utilizes a goodness-of-fit index (Mun, von Eye, Bates, & Vaschillo, 2008; Mun, Windle, & Schainker, 2008). Model-based cluster analysis was developed as an improvement to traditional cluster analyses by allowing tests and comparisons of the fit of a number of cluster solutions using the Bayesian Information Criteria (BIC) as an indicator of the relative fit of each of the cluster solutions (Mun et al., 2008a). There is no standard guidance to determine a minimum sample size necessary to conduct a cluster analysis (Dolnicar, 2002). One author has suggested a minimum of 2^k participants, where k is the number of variables used to identify the clusters (Formann, 1984). Following this rule, a minimum sample size of 32 is needed, which the sample size of this study exceeds.

Regarding missing data, 35 mothers had partially missing RSA data and 11 mothers were missing all RSA data. Missing RSA data occurred as a result of technological difficulties, a child not participating in a task, and rigorous data editing methods. Nine mothers had unavailable or unusable behavioral observation data, likely a result of a video camera malfunctioning or the child not participating in a task, which caused the task to end prematurely. Two mothers had incomplete self-report forms (i.e., DERS). A nonsignificant p -value for Little's MCAR test, $\chi^2(18) = 10.59, p = .91$, indicated that data were not missing in a non-random way and that multiple imputation was appropriate for handling missing data (Cheema, 2014). Multiple imputation was conducted for the maternal ER variables using 10 imputations (Graham, Olchowski, & Gilreach, 2007).

Results

Model-Based Cluster Analysis

The *Mclust* package in *R* software (Fraley and Raftery, 2006) was used to conduct the cluster analysis. Five measures of maternal ER were entered: one measure of mother-reported emotion dysregulation (DERS), one measure of observed maternal negative affect, and three measures of physiological functioning (baseline RSA, RSA suppression during the speech task, RSA suppression during the Etch-a-Sketch task). The best-fitting model was a four-cluster solution with an episoidal distribution, variable shape, equal volume, and coordinate axes orientation indicating that the clusters have different within-cluster variability and that the relations between the ER measures differ between clusters. The best-fitting model had a BIC value of -1735.57 . The second best-fitting model included a BIC value of -1801.93 , a difference of 66.36 from the first model. Further evidence for the four-cluster solution was provided by the mean posterior probability for cluster membership; the

probability that each case belonged to its identified cluster was as follows: .98, .99, .98, and .97 respectively.

Standardized z scores were calculated for each measure within each cluster to examine conceptual differences between clusters (see Figure 1 and Table 1). Labels for the clusters were created by examining these differences; we also followed the naming conventions used by Zalewski et al. (2011) in their similar study with a youth sample, including the term “responsive” to indicate that mothers showed a notable response to the stressor tasks. Relative levels of each ER indicator are measured as z scores (where sample mean = 0) and cluster differences are described relative to the rest of the sample; for brevity, not all cluster differences are reviewed in the text but all are presented in Figure 1. Cluster 1 (“*Well-Regulated*,” $n = 65$, $M_{\text{age}} = 32.13$, $SD_{\text{age}} = 6.08$) describes mothers who had average levels of self-reported emotion dysregulation, average RSA baseline and suppression, and low observable negative affect. Cluster 2 (“*Responsive-Regulated*,” $n = 14$, $M_{\text{age}} = 28.21$, $SD_{\text{age}} = 5.90$) describes mothers who exhibited average RSA suppression and moderately elevated negative affect. Cluster 3 (“*Responsive-Expressive*,” $n = 10$, $M_{\text{age}} = 27.29$, $SD_{\text{age}} = 4.03$) describes mothers who exhibited elevated RSA baseline and suppression (during the Etch-a-Sketch task) and high observed negative affect but did not self-report elevated emotion dysregulation. Cluster 4 (“*Dysregulated*,” $n = 19$, $M_{\text{age}} = 29.06$, $SD_{\text{age}} = 5.57$) included mothers who exhibited elevated RSA suppression across tasks, high observable negative affect, and elevated self-reported emotion dysregulation.

Profile Differences

Maternal race, marital status, and education differed across clusters (see Table 1 for Fisher’s exact tests). Specifically, within the *Well-Regulated* cluster, there was a larger percentage of European American participants, mothers who identified as married or engaged, and mothers who reported higher levels of education.

Four one-way ANOVAs were conducted on observational measures of parenting and child behavior, with Tukey’s post hoc tests as applicable (see Table 1). The ANOVA for maternal structure and limit-setting was significant, $F(3, 95) = 4.91$, $p = .003$; *Well-Regulated* mothers exhibited higher structure/limit setting compared to *Dysregulated* mothers ($p = .007$, $d = 0.99$). Next, the ANOVA for dyadic collaboration revealed differences between clusters, $F(3, 95) = 7.29$, $p < .001$, such that dyads with *Well-Regulated* mothers exhibited more dyadic collaboration than dyads with mothers in the *Responsive-Regulated* ($p = .03$, $d = 0.94$), *Responsive-Expressive* ($p = .03$, $d = 1.10$), and *Dysregulated* ($p = .002$, $d = 1.13$) clusters. Lastly, an ANOVA for maternal encouragement of self-regulation was significant, $F(3, 95) = 4.66$, $p = .005$; *Well-Regulated* mothers were more encouraging of self-regulation compared to *Dysregulated* mothers ($p = .01$, $d = 0.90$).

As mother’s race, marital status, and education significantly differed among clusters, a composite risk variable was created to serve as a covariate, by dichotomizing and summing each variable (see Davis, Suveg, & Shaffer, 2015). Post hoc ANCOVAs were conducted to examine cluster differences in parenting after accounting for these contextual variables. The ANCOVA for dyadic collaboration was significant, $F(3, 89) = 4.53$, $p = .007$. Post hoc tests revealed that dyads with *Well-Regulated* mothers demonstrated more

collaboration than dyads with mothers in the *Dysregulated* cluster ($p = .05$, $d = 1.08$). Other analyses were nonsignificant after including the risk composite covariate.

Discussion

The purpose of the current study was to adopt a person-centered approach for characterizing maternal ER using multiple methodologies. Although the construct of ER is now widely defined to include multiple levels of analysis, relatively few studies of ER consider multiple indicators (i.e., physiological, behavioral, and self-report) simultaneously. Further, those that do incorporate different measures usually employ variable-focused, rather than person-focused, analyses. Via model-based cluster analyses, we were able to examine how multiple indicators of maternal ER (i.e., baseline RSA and RSA suppression, self-reported emotion dysregulation, and observed negative affect) co-occur within individuals and relate to observed parenting and dyadic behavior.

Four clusters of maternal ER emerged from the analyses. The first cluster, termed *Well-Regulated*, showed average baseline and suppression values of RSA, and displayed slightly below-average levels of observed negative affect (NA). This cluster comprised the majority of the sample (60.2%). Two clusters, comprising relatively fewer participants, both seem to reflect profiles of stress responsivity that may confer risk to parenting behaviors and parent-child interactions. The *Responsive-Regulated* cluster (13.0% of sample) displayed somewhat above average levels of NA in mother-child interactions; however, mothers in this group reported average levels of ER difficulties on self-report. These mothers also experienced somewhat elevated RSA suppression on the speech task and lower baseline RSA, relative to the rest of the sample. The *Responsive-Expressive* cluster (9.2% of the sample) demonstrated very elevated levels of observed NA, very elevated RSA suppression in the parent-child interaction task, and elevated baseline RSA. This cluster reported low levels of ER problems on the DERS, possibly reflecting low insight or impression management. The *Dysregulated* cluster (17.6% of sample) evidenced relatively high rates of observed NA and self-reported ER difficulties, as well as somewhat elevated levels of baseline RSA and RSA suppression. In terms of sociodemographic differences, mothers in the *Well-Regulated* cluster were more likely to report indicators of social/cultural privilege.

A secondary aim of the study was to determine how the clusters differed on various parent and dyadic behaviors. With a very large theoretical and empirical literature regarding the interrelations between parenting behavior and child psychosocial adaptation, there is comparatively less emphasis on parental characteristics that predict parenting and parent-child interactions (Abidin, 1992; Belsky, 1984; Dix, 1991). Parents' abilities to regulate their own emotional experiences and responses are plausibly tied to effectiveness in many parenting behaviors and responses to children's needs (e.g., Jones et al., 2014; Shaffer & Obradovi, 2017). The most consistent differences were between the *Well-Regulated* and *Dysregulated* clusters, with mothers and dyads in the *Dysregulated* cluster exhibiting poorer structure and limit-setting, lower dyadic collaboration, and less encouragement of child self-regulation. The differences in observed collaboration remained significant after controlling for demographic risk factors. These effects may be most robust because successful dyadic collaboration reflects a higher degree of mother-child synchrony and positivity. This

synchrony reflects a mutual regulatory process which may be more closely tied to effective maternal self-regulation. It may also be the case that dyadic collaboration is less strongly associated with demographic variables such as parent education; post hoc analyses indicated that dyadic collaboration scores had smaller mean differences than did the other observation scores between families based on maternal education (i.e., high school diploma or less vs. some college or greater). Of note, the inclusion of these demographic risk factors as a composite control variable was a very stringent statistical test, as these analyses work to covary the effects of SES variables very closely tied to parenting stress and competence, and which are likely influential effects for real families (Newcombe, 2003). As such, the results of the ANOVAs and ANCOVAs should be considered together in terms of generalizability to families from diverse backgrounds.

The findings of the current study must also be interpreted in the context of methodological limitations. The small sample size tempers the ability to generalize findings, although our smaller cluster sizes are consistent with previous research on ER profiles (e.g., Zalewski et al., 2011). Conclusions regarding causality and direction of effects cannot be drawn definitively with cross-sectional data. Relatedly, our observational measures of parent behavior are dependent on, and to a large degree inextricable from, child behavior during the tasks. While our observational scales are coded such that cooperative child behavior is not required in order for parents to receive optimal scores on encouragement of self-regulation or structure and limit setting, these mutual influences can be hard to tease apart and represent a direction for future study.

Our findings that *greater* RSA suppression was associated with indicators of poorer ER and less optimal parenting are inconsistent with some previous research noting associations between *less* RSA suppression and increased harsh parenting (e.g., Mills-Koonce et al., 2009; Sturge-Apple, Jones, Martin, & Davies, 2017). In explaining these findings, it is worth noting that we did not have measures of harsh or intrusive parent behaviors in our study, and lower scores on our positively valenced parent observational scales do not necessarily indicate the presence of harsh parenting behavior. In addition, the nature of the “stressor” tasks should be considered. Although similar tasks have been used in previous research, particularly when measuring RSA reactivity (e.g., Rottenberg et al., 2007), it is worth noting that these tasks are analogous to many common interactions with preschool-aged children and therefore are not highly threatening. While we did not obtain subjective ratings from mothers, it is likely that not every mother experienced the tasks as stressful (i.e., not all mothers evidenced RSA suppression during the speech task); however, variations in emotional appraisal are consistent with the working definition of ER provided by Gross (2001). Previous research has noted that RSA suppression may not be necessary or adaptive in “safe” environments, and RSA suppression responses in this laboratory context may reflect dysregulation via unnecessary parasympathetic activation (Hastings et al., 2008).

This study provides both methodological and conceptual advances to research on maternal ER and its relations to parenting behavior. This study is rare in its employment of measures of ER from multiple levels of analyses. From these findings, we conclude that parental ER should be considered in context: single indicators such as self-report may miss parents who are showing behavioral and physiological signs of dysregulation, or overestimate problems

in individuals who are maintaining regulated and positive behavior. Combining biological indicators of ER with self-reported emotion dysregulation and observed emotional expression allows a window into how multiple levels of self-regulation operate together (or separately). Nevertheless, we note that our two “extreme” profiles of positive and negative ER (i.e., *Well-Regulated* and *Dysregulated*) show general within-cluster concordance in the direction of effects across levels of assessment. Furthermore, we were able to identify maternal ER clusters that seem to confer the greatest risk for negative parenting behaviors.

The current findings bear replication and extension with larger samples and longitudinal studies and thus motivate avenues for further research. This is essential work to advance basic and applied science given potential implications for identification of at-risk mothers and the integration of maternal ER strategies (e.g., mindfulness, coping strategies) into existing and novel parenting interventions (Rutherford et al., 2015; Sanders & Mazzucchelli, 2013). “Two-generation” programs are currently at the leading edge of intervention development, based on arguments and suggestive data that targeting children and parents simultaneously can result in stronger clinical impact (Shonkoff & Fisher, 2013). While parents are often included in child-directed interventions as agents of change, integrated efforts to support parents’ own self-regulation and well-being may serve to reduce many of the barriers that affect families seeking treatment for their children. These ambitious clinical goals can be best served by a fuller understanding of the ways in which self-regulation is related to parenting behavior.

Acknowledgments

Funding Information: William A. and Barbara R. Owens Institute for Behavioral Research at the University of Georgia; National Institute on Drug Abuse, Grant number: P30 DA027827

References

- Abidin RR. The determinants of parenting behavior. *Journal of Clinical Child Psychology*. 1992; 21:407–412.
- Beauchaine TP. Vagal tone, development, and Gray’s motivational theory: Toward an integrated model of autonomic nervous system functioning in psychopathology. *Development and Psychopathology*. 2001; 13:183–214. [PubMed: 11393643]
- Belsky J. Determinants of parenting: A process model. *Child Development*. 1984; 55:83–96. [PubMed: 6705636]
- Berntson GG, Bigger JT, Eckberg DL, Grossman P, Kaufmann PG, Malik M, et al. SPR Committee Report: Heart rate variability: Origins, methods, and interpretive caveats. *Psychophysiology*. 1997; 34:623–648. [PubMed: 9401419]
- Bradley B, DeFife JA, Guarnaccia C, Phifer J, Fani N, Ressler KJ, Westen D. Emotion dysregulation and negative affect: Association with psychiatric symptoms. *Journal of Clinical Psychiatry*. 2011; 72:685–691. [PubMed: 21658350]
- Buckholdt KE, Parra GR, Jobe-Shields L. Intergenerational transmission of emotion dysregulation through parental invalidation of emotions: Implications for adolescent internalizing and externalizing behaviors. *Journal of Child and Family Studies*. 2014; 23:324–332. [PubMed: 24855329]
- Calkins SD, Graziano PA, Berdan LE, Keane SP, Degnan KA. Predicting cardiac vagal regulation in early childhood from maternal–child relationship quality during toddlerhood. *Developmental Psychobiology*. 2008; 50:751–766. [PubMed: 18814182]

- Calkins SD, Dedmon SE. Physiological and behavioral regulation in two-year-old children with aggressive/destructive behavior problems. *Journal of Abnormal Child Psychology*. 2000; 28:103–118. [PubMed: 10834764]
- Calkins SD, Smith CL, Gill KL, Johnson MC. Maternal interactive style across contexts: Relations to emotional, behavioral and physiological regulation during toddlerhood. *Social Development*. 1998; 7:350–369.
- Cheema JR. A review of missing data handling methods in education research. *Review of Educational Research*. 2014; 84:487–508.
- Cicchetti D, Dawson G. Editorial: multiple levels of analysis. *Development and Psychopathology*. 2002; 14:417–420. [PubMed: 12349866]
- Cole PM, Martin SE, Dennis TA. Emotion regulation as a scientific construct: methodological challenges and directions for child development research. *Child Development*. 2004; 75:317–333. [PubMed: 15056186]
- Crandall A, Deater-Deckard K, Riley AW. Maternal emotion and cognitive control capacities and parenting: a conceptual framework. *Developmental Review*. 2015; 36:105–126. [PubMed: 26028796]
- Davis M, Suveg C, Shaffer A. The value of a smile: Child positive affect moderates relations between maternal emotion dysregulation and child adjustment problems. *Journal of Child and Family Studies*. 2015; 24:2441–2452.
- Deater-Deckard K, Li M, Bell MA. Multifaceted emotion regulation, stress and affect in mothers of young children. *Cognition and Emotion*. 2016; 30:444–457. [PubMed: 25759238]
- Dix T. The affective organization of parenting: Adaptive and maladaptive processes. *Psychological Bulletin*. 1991; 110:3–25. [PubMed: 1891517]
- Eisenberg N, Cumberland A, Spinrad TL. Parental socialization of emotion. *Psychological Inquiry*. 1998; 9:241–273. [PubMed: 16865170]
- Formann AK. *The latent class analysis: Introduction to theory and application*. Weinheim: Beltz; 1984.
- Fraley C, Raftery AE. *MCLUST version 3: An R package for normal mixture modeling and model-based clustering*. Seattle: U. of Washington Dept. of Statistics; 2006.
- Graham JW, Olchowski AE, Gilreath TD. How many imputations are really needed? Some practical clarifications of multiple imputation theory. *Prevention Science*. 2007; 8:206–213. [PubMed: 17549635]
- Gottman JM, Katz LF, Hooven C. Parental meta-emotion philosophy and the emotional life of families: Theoretical models and preliminary data. *Journal of Family Psychology*. 1996; 10:243–268.
- Gratz KL, Roemer L. Multidimensional assessment of emotion regulation and dysregulation: Development, factor structure, and initial validation of the difficulties in emotion regulation scale. *Journal of Psychopathology and Behavioral Assessment*. 2004; 26:41–54.
- Gross JJ. Emotion regulation in adulthood: Timing is everything. *Current Directions in Psychological Science*. 2001; 10:214–219.
- Han ZR, Shaffer A. The relation of parental emotion dysregulation to children's psychopathology symptoms: The moderating role of child emotion dysregulation. *Child Psychiatry and Human Development*. 2013; 44:591–601. [PubMed: 23247760]
- Hastings PD, Nuselovici JN, Utendale WT, Coutya J, McShane KE, Sullivan C. Applying the polyvagal theory to children's emotion regulation: Social context, socialization, and adjustment. *Biological Psychology*. 2008; 79:299–306. [PubMed: 18722499]
- Jones JD, Brett BE, Ehrlich KB, Lejuez CW, Cassidy J. Maternal attachment style and responses to adolescents' negative emotions: The mediating role of maternal emotion regulation. *Parenting: Science and Practice*. 2014; 14:235–257.
- Lorber MF. The role of maternal emotion regulation in overreactive and lax discipline. *Journal of Family Psychology*. 2012; 26:642–647. [PubMed: 22888786]
- Keenan K. Emotion dysregulation as a risk factor for child psychopathology. *Clinical Psychology: Science and Practice*. 2000; 7:418–434.
- Kirschbaum C. *Encyclopedia of Psychopharmacology*. Berlin: Springer; 2010. Trier social stress test; 1346–1346.

- Magnusson D. The person approach: Concepts, measurement models, and research strategy. New directions for child and adolescent development. 2003; 2003(101):3–23.
- Mazursky-Horowitz H, Felton JW, MacPherson L, Ehrlich KB, Cassidy J, Lejuez CW, Chronis-Tuscano A. Maternal emotion regulation mediates the association between Adult Attention-Deficit/Hyperactivity Disorder symptoms and parenting. *Journal of Abnormal Child Psychology*. 2015; 43:121–131. [PubMed: 24928735]
- Mills-Koonce WR, Propper C, Garipey JL, Barnett M, Moore GA, Calkins S, Cox MJ. Psychophysiological correlates of parenting behavior in mothers of young children. *Developmental Psychobiology*. 2009; 51:650–661. [PubMed: 19739135]
- Morelen D, Shaffer A, Suveg C. Maternal emotion regulation: Links to emotion parenting and child emotion regulation. *Journal of Family Issues*. 2016; 37:1891–1916.
- Morris AS, Silk JS, Steinberg L, Myers SS, Robinson LR. The role of the family context in the development of emotion regulation. *Social Development*. 2007; 16:361–388. [PubMed: 19756175]
- Mun E, von Eye A, Bates M, Vaschillo E. Finding groups using model-based cluster analysis: Heterogeneous emotional self-regulatory processes and heavy alcohol use risk. *Developmental Psychology*. 2008a; 44:481–495. [PubMed: 18331138]
- Mun E, Windle M, Schainker L. A model-based cluster analysis approach to adolescent problem behaviors and young adult outcomes. *Development and Psychopathology*. 2008b; 20:291–318. [PubMed: 18211739]
- Newcombe NS. Some controls control too much. *Child Development*. 2003; 74:1050–1052. [PubMed: 12938700]
- Obradovi J. How can the study of physiological reactivity contribute to our understanding of adversity and resilience processes in development? *Development and Psychopathology*. 2012; 24:371–387. [PubMed: 22559120]
- Otterpohl N, Schwinger M, Wild E. Are profiles of adaptive and maladaptive anger regulation differently related to adjustment in early adolescence? *Psychology*. 2015; 6:867–879.
- Porges SW, Doussard-Roosevelt JA, Maiti AK. Vagal tone and the physiological regulation of emotion. *Monographs of the Society for Research in Child Development*. 1994; 59:167–186. [PubMed: 7984159]
- Rottenberg J, Clift A, Bolden S, Salomon K. RSA fluctuation in major depressive disorder. *Psychophysiology*. 2007; 44:450–458. [PubMed: 17371497]
- Rutherford HJV, Wallace NS, Laurent HK, Mayes LC. Emotion regulation in parenthood. *Developmental Review*. 2015; 36:1–14. [PubMed: 26085709]
- Sanders MR, Mazzucchelli TG. The promotion of self-regulation through parenting interventions. *Clinical Child and Family Psychology Review*. 2013; 16:1–17. [PubMed: 23397366]
- Shaffer A, Obradovi J. Unique contributions of emotion regulation and executive functions in predicting the quality of parent-child interaction behaviors. *Journal of Family Psychology*. 2017; 31:150–159. [PubMed: 27929314]
- Shonkoff JP, Fisher PA. Rethinking evidence-based practice and two-generation programs to create the future of early childhood policy. *Development and Psychopathology*. 2013; 25:1635–1653. [PubMed: 24342860]
- Sroufe LA, Egeland B, Carlson EA, Collins WA. The development of the person: The Minnesota study of risk and adaptation from birth to adulthood. New York: Guilford Press; 2005.
- Sturge-Apple M, Jones HR, Martin M, Davies PT. Keeping calm and not carrying on: The regulatory roles of parents' HRV and executive functions on discipline during adolescence. Paper presented at SRCD Biennial Meeting; Austin, TX. 2017 Apr.
- Suveg C, Shaffer A, Davis M. Family stress moderates relations between physiological and behavioral synchrony and child self-regulation in mother-preschooler dyads. *Developmental Psychobiology*. 2016; 58:83–97. [PubMed: 26376933]
- Zalewski M, Lengua LJ, Wilson AC, Trancik A, Bazinet A. Emotion regulation profiles, temperament, and adjustment problems in preadolescents. *Child Development*. 2011; 82:951–966. [PubMed: 21413935]
- Zeman J, Klimes-Dougan B, Cassano M, Adrian M. Measurement issues in emotion research with children and adolescents. *Clinical Psychology: Science and Practice*. 2007; 14:377–401.

Figure 1. Patterns of Emotion Regulation Measures by Differences from the Sample Grand Mean

Note. Cluster 1 = *Well-Regulated*; Cluster 2 = *Responsive-Regulated*; Cluster 3 = *Responsive-Expressive*; Cluster 4 = *Dysregulated*. DERS = Difficulties in Emotion Regulation Scale.

Table 1

Means and Standard Deviations of Study Variables within Each Cluster

Measure	Cluster 1	Cluster 2	Cluster 3	Cluster 4
	Well-Regulated	Responsive-Regulated	Responsive-Expressive	Dysregulated
<i>Maternal ER Measures</i>				
DERS Total	65.11 (16.73)	67.71 (19.45)	51.00 (12.06)	77.02 (29.04)
Observed Negative Affect	1.00 (0.00)	2.08 (0.30)	2.96 (1.64)	3.03 (1.44)
Baseline RSA	6.25 (0.71)	6.12 (0.72)	6.85 (1.00)	6.46 (0.86)
RSA Suppression (Speech Task)	-0.47 (0.58)	-0.24 (0.47)	-0.49 (0.56)	-0.31 (0.54)
RSA Suppression (Etch-A-Sketch Task)	-0.07 (0.61)	0.01 (0.15)	0.26 (0.68)	0.27 (0.51)
<i>Observed Parent-Child Measures</i>				
Maternal Structure/Limit Setting ^c	4.25 (1.04)	3.50 (1.62)	3.40 (1.35)	3.18 (1.24)
Dyadic Collaboration ^{a, b, c}	3.92 (1.00)	2.92 (1.51)	2.80 (1.32)	2.76 (1.25)
Maternal Encouragement of Self-Regulation ^c	5.46 (4.16)	2.13 (2.17)	3.20 (2.97)	1.93 (2.95)

Note.

^a significant difference ($p < .05$) between Clusters 1 and 2;^b significant difference ($p < .05$) between Clusters 1 and 3;^c significant difference ($p < .05$) between Clusters 1 and 4. DERS = Difficulties in Emotion Dysregulation Scale; RSA = Respiratory sinus arrhythmia.