Development and Psychopathology (2021), **33**, 1821–1836
doi:10.1017/S0954579421000948

CAMBRIDGE UNIVERSITY PRESS

Special Issue Article

Applying new RDoC dimensions to the development of emotion regulation: Examining the influence of maternal emotion regulation on within-individual change in child emotion regulation

Amy L. Byrd[1], Angela H. Lee[2], Olivia A. Frigoletto[1], Maureen Zalewski[2] and Stephanie D. Stepp[1]

[1]Department of Psychiatry, University of Pittsburgh, Pittsburgh, PA, USA and [2]Department of Psychology, University of Oregon, Eugene, OR, USA

Abstract

While the Research Domain Criteria (RDoC) acknowledges that environmental and developmental influences represent important elements of the RDoC framework, there is little specificity regarding *how* and *when* to systematically examine the impact of these dimensions on domains of function. The primary aims of this paper are to demonstrate the ways in which the RDoC can be expanded to include an explicit emphasis on (a) assessing within-individual change in developmental processes over time and (b) evaluating the extent to which selective and measurable environmental influences drive meaningful change during key developmental periods. We provide data from an ongoing randomized control trial as a proof of concept to highlight how repeated assessments within an experimental intervention design affords the unique opportunity to test the impact of environmental influences on within-individual change. Using preliminary data from 77 mother–child dyads repeatedly assessed across 12 months during the sensitive preschool period, we demonstrate the impact of change in maternal emotion regulation (ER) on within-individual growth in child ER and link that growth to fewer teacher-reported externalizing problems. In line with this Special Issue, findings are discussed within the context of expanding and clarifying the existing RDoC framework to explicitly incorporate environmental and developmental dimensions.

Keywords: dialectical behavior therapy, emotion regulation, externalizing problems, intergenerational transmission, longitudinal, trajectory, preschool

(Received 21 April 2021; revised 1 July 2021; accepted 6 July 2021)

While the Research Domain Criteria (RDoC) now openly acknowledges that the environment and development are "equally important elements of the RDoC framework" (Garvey, Avenevoli, & Anderson, 2016), there is little specificity regarding *how* and *when* to systematically examine the impact of these dimensions on particular domains of function. Although this allows investigators the freedom to define which environmental influences and developmental periods may be most relevant for their research (Cuthbert, 2014), it jeopardizes rigor and reproducibility, and risks recapitulating field-wide norms that are driven by tradition or researcher preference. Moreover, the RDoC does not explicitly delineate development as a dynamic *process,* a central tenet of developmental psychopathology that necessitates repeated assessments over time (Cicchetti & Rogosch, 1999). In line with recent commentaries calling for an expansion of the RDoC framework, we highlight the need to incorporate explicit consideration of *both* environmental and developmental influences on within-individual change. The primary aim of this paper is to demonstrate the ways in which the RDoC can be expanded to reflect the ongoing impact of environmental and developmental dimensions on emotion regulation (ER). Specifically, we propose including an explicit emphasis on (a) examining within-individual change in this developmental process over time and (b) evaluating the extent to which selective and measurable environmental influences drive that change during key developmental periods. We focus specifically on the impact of maternal ER on the development of child ER during the preschool period, a key developmental window known for rapid emotional development (Carlson & Wang, 2007; Denham et al., 2003).

We first provide a brief overview of the RDoC and recent critiques calling for the necessary incorporation of environmental and developmental dimensions. We then summarize literature pointing to the importance of examining ER as a within-individual process that changes over time as a function of environmental and developmental influences. Next, we provide data from our own work as a proof of concept to highlight how repeated assessments within an experimental intervention design affords the unique opportunity to test mechanisms of within-individual change in developmental processes. Specifically, we examine the impact of change in maternal ER on within-individual change in child ER during the preschool period and assess how these within-individual changes are linked

Author for Correspondence: Amy L. Byrd, Department of Psychiatry, University of Pittsburgh School of Medicine, Sterling Plaza, Suite 408, 201 North Craig Street, Pittsburgh, PA 15213; E-mail: amy.byrd@pitt.edu

Cite this article: Byrd AL, Lee AH, Frigoletto OA, Zalewski M, Stepp SD (2021). Applying new RDoC dimensions to the development of emotion regulation: Examining the influence of maternal emotion regulation on within-individual change in child emotion regulation. *Development and Psychopathology* **33**, 1821–1836. https://doi.org/10.1017/S0954579421000948

to internalizing and externalizing problems. Findings are discussed within the context of expanding and clarifying the existing RDoC framework to explicitly incorporate environmental and developmental dimensions. We also consider how this approach can be translated to other key periods of development and extended to other relevant developmental processes.

Widening the RDoC lens to include multiple dimensions

For the last decade, the RDoC has provided an alternative framework for research on mental disorders. The goal of the RDoC is to characterize the pathophysiology of psychopathology, with a specific emphasis on genomics and neuroscience, to identify fundamental circuit-behavior relationships that exist transdiagnostically (Insel et al., 2010). The RDoC aims to create a unified structure to investigate individual differences across multiple domains of functioning and multiple levels of analysis. The overarching goal of this work is to advance our understanding of behavior across the full range of functioning, and ultimately identify and refine targets for intervention (Cuthbert & Insel, 2013). While the RDoC has undoubtedly contributed to advancements in our understanding of psychopathology (Carcone & Ruocco, 2017), recent research has highlighted ways in which its utility and applicability may be enhanced, ultimately increasing traction in pursuit of its intended goals.

Two of the most common critiques have focused on the importance of incorporating dimensions of the environment and development into the RDoC framework. This call for a widening of the RDoC lens stems from decades of research highlighting the ways in which environmental and developmental influences inextricably shape domains of functioning across all levels of analysis (Franklin, Jamieson, Glenn, & Nock, 2015; Garber & Bradshaw, 2020). Accordingly, researchers have proposed variations of a four-dimensional model, including one that retains the original two dimensions and adds two new dimensions that capture critical environmental and developmental influences (Mittal & Wakschlag, 2017; Woody & Gibb, 2015). Along these lines, Garber and Bradshaw (2020) suggest that the inclusion of environmental and developmental dimensions is not only "compatible and complementary" to the current RDoC perspective, but necessary to "inform future research and interventions…with children and adolescents, [and] with adults across the lifespan" (p. 342). These sentiments have been echoed in recent empirical work (e.g., Ip, Jester, Sameroff, & Olson, 2019) and conceptual papers focused on a wide range of psychopathology (e.g., Beauchaine & Hinshaw, 2020; Glenn, Cha, Kleiman, & Nock, 2017), as well as in other special issues of journals including the *Journal of Clinical Child & Adolescent Psychology* (Garber & Bradshaw, 2020) and *Development & Psychopathology* (Beauchaine & Cicchetti, 2016). Taken together, this highlights a growing emphasis on better characterizing change that occurs within-individuals across development and quantifying the extent to which that change is influenced by environmental factors.

Investigating ER as a within-individual process

Emotion regulation (ER) is a dynamic process by which individuals modify the intensity and/or duration of their emotional experience in response to situational circumstances (Cicchetti, Ackerman, & Izard, 1995; Gross, 1998; Thompson, 1994). Effective regulation of emotion aids in organizing adaptive responses to shifting environmental demands (Thompson, 1994) and reflects concomitant changes in cognitive, emotional, and social domains (Fox, 1994; Saarni, Campos, Camras, & Witherington, 2006). Although competing conceptualizations of ER exist, researchers generally agree that it is a multifaceted process that is continually modified across development (Aldao, 2013; Cole, Martin, & Dennis, 2004; Crowell, Vlisides-Henry, & Kaliush, 2020; Morris, Criss, Silk, & Houltberg, 2017; Walden & Smith, 1997).

Regardless of the conceptual model, understanding developmental changes in ER represents a central tenet ubiquitous to all ER theory. However, there is a dearth of research describing how this process develops *within-individuals* over time and, at present, the RDoC offers little guidance on how to achieve this aim. To date, our understanding of the maturation of ER rests almost entirely on evidence obtained from between-person differences utilizing either age-based cohort studies (e.g., comparing delay of gratification in a cohort of 3-year-olds and a cohort of 4-year-olds; Hongwanishkul, Happaney, Lee, & Zelazo, 2005) or prospective longitudinal studies that focus on between-person changes in rank-order stability (for exceptions see Blandon, Calkins, Keane, & O'Brien, 2008; Bocknek, Brophy-Herb, & Banerjee, 2009; Lengua et al., 2015; Moilanen, Shaw, Dishion, Gardner, & Wilson, 2010). While this research has been critical in identifying key development periods of rapid ER growth, continuing to pursue designs that focus on between-person differences is unlikely to lead to any new or substantial discoveries (Cole & Jacobs, 2018). Advances in our methodological and analytic approach are needed to more accurately reflect and capture theoretical conceptualizations of ER as a within-individual process that develops over time (Cicchetti & Rogosch, 1999; Kim-Spoon & Grimm, 2016; Wood, 2011).

Here, we aim to illustrate the potential utility of using repeated assessments to model within-individual change in ER using the RDoC framework. Given that ER is not currently defined by a specific RDoC domain (see Fernandez, Jazaieri, & Gross, 2016; Sun, Vinograd, Miller, & Craske, 2017 for discussions), we build on previous work that utilized the RDoC to assess functioning across related cognitive, emotional, and social domains (Ip et al., 2019). In line with Ip et al. (2019), we focus on within-individual change in four validated constructs across four RDoC domains during the preschool period: *executive control* (cognitive system), *delay of gratification* (positive valence system), *regulation of frustration* (negative valence system), and *emotion knowledge* (social processes system). These constructs are typically conceptualized under the larger umbrella of "self-regulation", each of which are heavily implicated in ER development (Posner & Rothbart, 2000).

Executive control, also termed effortful control, is defined as the ability to regulate attentional and behavioral impulses (Rothbart, Michael, & Kieras, 2006). Executive control can be conceptualized in terms of "hot" and "cool" effortful control, with the latter referring to attentional and inhibitory control in response to neutral, nonrewarding stimuli (e.g., Stroop-like tasks) (Kim, Nordling, Yoon, Boldt, & Kochanska, 2013; Sturge-Apple, Davies, Cicchetti, Hentges, & Coe, 2017). "Hot" executive control, referred to here as *delay of gratification,* denotes inhibition in the face of heightened emotion elicited by a rewarding stimulus (e.g., a toy; Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996). *Regulation of frustration* is another key domain of ER, and it refers to the ability to modify the intensity and/or valence of emotional responses during stressful situations

https://doi.org/10.1017/S0954579421000948 Published online by Cambridge University Press

in order to achieve a desired goal (Cole et al., 2004). Finally, *emotion knowledge* refers to one's understanding of emotion as well as the ability to perceive and understand others' emotional states and reactions (Izard et al., 2011). While many studies have examined these constructs in isolation (e.g., Bendezú et al., 2018; Carlson & Wang, 2007; Moilanen et al., 2010; Supplee, Skuban, Trentacosta, Shaw, & Stoltz, 2011), it has become increasingly clear that the simultaneous consideration of constructs across multiple domains may yield important information about the development of ER (see Campos, Frankel, & Camras, 2004; Ip et al., 2019; Saarni et al., 2006; Zelazo & Cunningham, 2007). Moreover, enhancing our understanding of within-individual change in these domains can sharpen the precision with which we can evaluate the impact of known environmental influences on developmental trajectories of ER.

Environmental influences on ER: The role of maternal ER

Decades of research and theory highlight the influential role of the environment, particularly parental influences, in shaping individual differences in the development of ER (Calkins & Hill, 2007; Hajal & Paley, 2020; Morris et al., 2017). A parent's response to their child's emotion provides immediate feedback about the acceptability of emotions, shaping the way in which emotions are understood, experienced, expressed and regulated in the future (Eisenberg, Cumberland, & Spinrad, 1998; Morris, Silk, Steinberg, Myers, & Robinson, 2007). Mounting research suggests that parents with ER difficulties may find it especially challenging to respond in a supportive manner to their child's expression of emotion (e.g., Buckholdt, Parra, & Jobe-Shields, 2014). For example, parents with ER difficulties may feel overwhelmed by their own internal emotional experience when attempting to navigate challenging emotional interactions with their child, making it more difficult to attend and respond effectively (Rutherford, Wallace, Laurent, & Mayes, 2015). Along these lines, research suggests that parents with ER difficulties are much more likely to ignore, dismiss, magnify, or punish their child's emotional experience, even if unintentionally (Morelen, Shaffer, & Suveg, 2016). This combined with parental modeling of poor ER strategies places children at increased risk for ER difficulties (Li, Li, Wu, & Wang, 2019; Morris et al., 2007, 2017), and in turn, increased risk for internalizing and externalizing psychopathology (Crespo, Trentacosta, Aikins, & Wargo-Aikins, 2017; Ip et al., 2019; Kaufman et al., 2017; Röll, Koglin, & Petermann, 2012).

Taken together, these findings underscore the importance of more precisely characterizing the impact of known environmental influences, like maternal ER, on within-individual change in child ER. While previous work in this area has enhanced our understanding of links between environmental influences and ER development (Bariola, Gullone, & Hughes, 2011), traditional study designs are naturalistic and often focus on between-person differences over time, hindering our ability to precisely pinpoint environmental influences as causal predictors of *within-individual change* in ER (Rutter, Pickles, Murray, & Eaves, 2001). At present, the RDoC provides little guidance regarding *how* to incorporate environmental influences into study designs, impeding collective efforts to capture important explanatory variance in ER as a developmental process. The implementation of prospective, experimental designs would afford opportunities to empirically test environmental influences as causal mechanisms of change in ER and enhance progress toward the identification of potentially malleable intervention targets. For example, employing experimental interventions that target maternal ER would allow us to more precisely quantify the causal impact of this environmental influence on the within-individual change in child ER. Given that intervention studies suggest that parental factors like maternal ER may moderate the effectiveness of traditional parenting interventions (e.g., Shelleby & Shaw, 2014) and that targeting maternal ER can improve child outcomes (Havighurst et al., 2013; Kehoe, Havighurst, & Harley, 2020), there is strong impetus for utilizing experimental manipulation of known environmental influences to examine effects on potential changes in ER over time.

Developmental influences on ER: Preschool as a key period

Prominent theory and empirical research point to key developmental periods across childhood and adolescence during which ER development accelerates (Carlson & Wang, 2007; Denham et al., 2003), highlighting *when* we might aim to examine change in this developmental process. Incorporating more explicit guidance in the RDoC about the timing and tempo with which these processes unfold across time offers a roadmap for optimal intervals of assessment (e.g., frequency and duration of assessment) organized by developmental period. For example, the preschool period is characterized by marked neurobiological changes that underlie notable shifts in cognitive, social, and emotional domains of functioning (Brown & Jernigan, 2012; Garon, Bryson, & Smith, 2008), making it a prime target for frequent assessments of within-individual change in ER. Moreover, the sensitivity of this developmental period makes it particularly vulnerable to environmental influences. Indeed, parental influences on ER development appear to be especially salient during the preschool period (Cole, Lougheed, & Ram, 2018), highlighting the potential significance of clarifying causal mechanisms during this time. Given that prospective work has linked ER problems during the preschool period to the subsequent emergence of internalizing and externalizing problems (e.g., Ip et al., 2019; Röll et al., 2012), focusing our efforts on the development of ER during this developmental period may yield important implications for etiological and intervention models of psychopathology (Beauchaine & Cicchetti, 2019).

Current study

Here, we leverage data from the STEADY Study, an ongoing, multisite, randomized control trial (RCT), which utilizes dialectical behavior therapy (DBT), a robust and effective method for improving ER (Linehan, 1993; Neacsiu, Bohus, & Linehan, 2014). This prospective study design includes repeated assessments of child ER domains over 12 months, allowing for an examination of within-individual change during the preschool period (3–4 years), as well as the opportunity to test (a) how within-individual change is impacted by change in maternal ER and (b) whether within-individual change is related to internalizing and externalizing problems. We focus on a sample of 77 mother–child dyads recruited from a single site between October of 2017 and January of 2020. This includes 39 mothers with ER difficulties (i.e., mothers with borderline personality disorder; BPD) and 38 nondisordered, control mothers (healthy controls; HC). Half of mothers with BPD were randomly assigned to one year of standard DBT skills training, and the other half to "waitlist control" (WLC), which allows us to assess the impact of change in maternal ER on changes in child ER.

https://doi.org/10.1017/S0954579421000948 Published online by Cambridge University Press

We first examine within-individual change in four domains of child ER (i.e., executive control, delay of gratification, regulation of frustration, and emotion knowledge), assessed repeatedly across 12 months (i.e., baseline, 4 months, 8 months, 12 months). To do so, we utilize a free curve slope intercept (FCSI) latent growth curve model, which makes the fewest assumptions about the form or rate of growth (Wood, 2011; Wood & Jackson, 2013). While this approach to modeling within-individual variability is only one of many, the FCSI model allows us to distinguish between the relative amounts of between-person differences (intercept) and within-individual change (slope) for each of the four ER domains. Next, we examined the impact of change in maternal ER on between-person differences (intercept) and within-individual change (slope) for each of the four ER domains. Finally, we assessed whether the effect of change in maternal ER on change in child ER domains impacts teacher-reported internalizing and externalizing problems. We expect that there will be significant between-person differences and within-individual change in each ER domain across the 12-month period. We also hypothesize that improvements in maternal ER will predict within-individual change in each of the child ER domains. Finally, we predict that within-individual change in ER domains will be associated with internalizing and externalizing problems at 12-month follow-up.

Method

Sample

Participants were 77 mothers (M_{age} = 33.17 years, SD = 4.83; 35% racial/ethnic minority) and their children (M_{age} = 42.48 months; SD = 3.78; 56% female; 47% racial/ethnic minority) enrolled in an ongoing RCT. Two groups of mother–child dyads were recruited using a university-based Research Recruitment Program which employed a targeted multimedia and digital messaging program for mothers of children between 36 and 47 months old (i.e., one advertisement targeting BPD and another targeting HC). Mothers with BPD were also recruited from ambulatory psychiatric treatment clinics in the same geographic region.

Inclusion and exclusion criteria

Initial phone screening was conducted to ensure that all mothers were biological mothers with at least 50% physical custody of the target child since birth. During this call, all mothers also completed the 10-item McLean Screening Instrument for Borderline Personality Disorder (MSI-BPD; Zanarini et al., 2003): scores ≥7 were required for the BPD groups and scores <2 were required for the HC group. In addition, mothers in the BPD group were asked about current treatment engagement and any mothers currently participating in DBT services were deemed ineligible.

Eligibility was further determined during an in-person clinical intake, which included semi-structured diagnostic interviews for mothers. Trained research personnel administered the Structured Clinical Interview for the fifth edition of Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (SCID-5; First, Williams, Karg, & Spitzer, 2016) and the Structured Interview for DSM-IV Personality (SIDP-IV; Pfohl, Blum, & Zimmerman, 1995) to determine eligibility. Approximately, 20% of intake interviews were double-coded from digital recordings and showed strong inter-rater reliability (Krippendorff's α = .91). Mothers in the BPD group met at least three diagnostic criteria for BPD, with one of these three symptoms being affective instability or uncontrolled anger (*symptom range* = 3–9; *mean* = 5.13; *SD* = 1.82). HC mothers reported no history of psychiatric illness (e.g., depression, anxiety) currently or since their child's conception, and showed no evidence of clinically significant ER difficulties as determined by scoring 0 on the *affective instability* and *uncontrolled anger* criteria on the SID-P. In addition, any mothers in a current psychotic or manic episode were deemed ineligible.

All mothers and children also completed the Peabody Picture Vocabulary Test Fourth Edition (PPVT-IV; Dunn & Dunn, 2007) and the Expressive Vocabulary Test Second Edition (EVT-2; Williams, 1997) to provide an estimate of IQ. All eligible participants demonstrated standard scores ≥70. All mothers also completed the Ages and Stages Questionnaire (ASQ; Squires, Bricker, & Twombly, 2009), a brief developmental screening instrument designed to detect developmental delays across five domains of development (i.e., communication, gross motor, fine motor, problem-solving, and personal-social skills); only children without developmental delays were eligible.

Procedure

Those who were eligible were enrolled to complete four laboratory assessments (baseline, 4-month, 8-month, and 12-month follow-ups). This assessment schedule paralleled the 12-month DBT treatment schedule (described below). Assessments were conducted by research assistants blinded to mother's group status and included questionnaires to assess maternal ER and behavioral tasks that assessed each of the four child ER domains (described below). Mothers also provided contact information for their child's preschool teacher or daycare provider. Following the baseline and 12-month laboratory assessment, teachers or daycare providers were contacted and asked to complete an online questionnaire assessing internalizing and externalizing problems observed in the preschool/daycare setting. All mother–child dyads completed the in-person baseline assessment, 81.8% completed the 4-month assessment, 71.4% completed the 8-month assessment, and 45.9% completed the 12-month assessment.[1]

Randomization and treatment

Mothers in the BPD group were randomized to receive DBT skills (n = 14) or WLC (n = 25).[2] DBT skills training followed the treatment protocol described by Linehan et al. (2015). This included participation in a weekly standard 2-hour skills group for 12 months, which consisted of teaching skills across four modules: mindfulness, ER, interpersonal effectiveness, and distress tolerance (Linehan, 2014). DBT mothers were assigned a study therapist who met with them at least monthly for 30 minutes and were available to meet weekly if needed. Study therapists were also available for coaching calls. In addition, all study therapists attended weekly consultation team meetings for 1 hour. Study therapists were master and doctoral level clinicians, all of whom had significant training in DBT. The DBT Adherence Scale

[1]The COVID-19 global pandemic impacted our ability to complete in-person follow-up assessments. While questionnaire data were obtained remotely (i.e., DERS), we were unable to complete any in-person child behavioral tasks after March 2020 due to the nation-wide shutdown and research restrictions that limited prolonged in-person contact.

[2]Our randomization schedule predicted equal assignment across treatment condition by December 2020. The current study focuses on participants enrolled prior to the global pandemic (i.e., between October 2017 and January 2020).

https://doi.org/10.1017/S0954579421000948 Published online by Cambridge University Press

(Harned, Korslund, Schmidt, & Gallop, 2021) was used to code randomly selected DBT skills group sessions for adherence and all scored sessions were deemed adherent. Participants randomized to the DBT condition completed, on average, 30 weekly sessions over the course of a year (63% of the 48-week treatment protocol), consistent with treatment compliance in seminal RCTs demonstrating the efficacy of DBT (Linehan et al., 2006; Lynch, Trost, Salsman, & Linehan, 2007). The current study implemented an intent-to-treat design, and all participants were retained in analyses.

Measures

Maternal emotion regulation difficulties

Maternal ER difficulties were measured using the Difficulties with Emotion Regulation Scale (DERS; Gratz & Roemer, 2004). The DERS is a 36-item self-report measure of perceived ER abilities. Mothers indicated how often the items apply to them on a 5-point Likert-type scale ranging from 1 (*almost never*) to 5 (*almost always*). The DERS measures six subscales of ER, including lack of emotional awareness, lack of emotional clarity, impulse-control difficulties, difficulties engaging in goal-directed behaviors, nonacceptance of emotional responses, and limited access to ER strategies. All items were summed to create a total score, with higher scores representing greater ER difficulties.

Child emotion regulation domains

Executive control was measured using the Dimensional Change Card Sort (DCCS; Diamond, Carlson, & Beck, 2005; Frye, Zelazo, & Palfai, 1995; Hongwanishkul et al., 2005). In this task, children were first shown two boxes with target cards attached to the front of the box (i.e., blue card with a black star silhouette, red card with a black truck silhouette) and an open slot on the top of each box. Children were then handed sorting cards (i.e., blue cards with a black truck silhouette, red cards with a black star silhouette), and instructed to sort the cards according to shape (six trials) and then according to color (six trials). Before each shape and color trial, the experimenter stated the sorting rule and presented the child with a card. Once the child demonstrated color and shape knowledge, they advanced to the next level, where the target cards integrated the two sorting properties. Specifically, the target cards had either a red truck or blue star on white backgrounds, and sorting cards were red stars and blue trucks (12 trials). Finally, children were presented with target cards with and without a border. Children were instructed to sort by *color* if the card had a border and by *shape* if the card did not have a border (12 trials). Each trial was scored incorrect (0) or correct (1) and summed to create a total score ranging from 0 to 36, with higher scores representing better executive control.

Delay of gratification was measured using the Gift Delay task (Kochanska et al., 1996). In this task, the child was told that they will receive a present from the experimenter. They were instructed to sit on a chair facing in the opposite direction and specifically told not to peek while the experimenter wrapped their gift. The experimenter then noisily wrapped the present for 60 seconds while the child waited. The current study focused on latency to the child's first peek (i.e., child's head, shoulder, or body turning to peek at the gift) as an indicator of delay ability (range 0–60 seconds), with higher scores indicating better delay of gratification.

Regulation of frustration was measured using two well-validated frustration tasks: Transparent Locked Box (LAB-TAB; Goldsmith & Rothbart, 1996) and Knotted Sack (Chaplin, Klein, Cole, & Turpyn, 2017). These tasks were alternated across the four assessments to mitigate practice effects associated with tasks including an element of deception (Monks, Smith, & Swettenham, 2005). In each task, the child was allowed to pick one of three toys. The experimenter then placed the chosen toy inside the locked box or knotted sack and told the child that once they opened the locked box/knotted sack, they could keep the toy. The experimenter explained that they "had some work to do", turned their chair away from the child, and pretended to do work while the child attempted to open the box or sack. The child was left alone for 2 minutes to open the locked box with the incorrect set of keys or to open the tightly knotted sack. The tasks were coded from digital files using an adapted coding system (Dennis, 2004). The current study included a measure of on-task or problem-solving behavior scored in 4, 30-second epochs. On-task behavior could include any of the following: (a) child using strategies to solve the problem; (b) child working toward opening the box or sack; or (c) child seeking information from the experimenter about how to open the box or sack. Each epoch received a score of 0 *(none or minimal on task behavior)*, 1 *(on task behavior for about half of the epoch),* or 2 *(on task behavior for nearly all or all of the epoch)* and 20% of participants were double-coded to assess reliability (average epoch intraclass correlation [ICC] = .78). Scores for each epoch were then summed to create a total score ranging from 0 to 8, with higher scores indicating more on-task behavior and greater regulation of frustration.

Emotion knowledge was measured using an adapted version of the Affective Perspective Taking task (Denham, 1986; Pears & Moses, 2003; Zalewski, Musser, Binion, Lewis, & O'Brien, 2020). Prior to task initiation, children were shown four emotional faces (happy, sad, mad/angry, scared/afraid) and were instructed to identify all emotions both expressively, then receptively (by pointing). Next, an experimenter taught the child all four basic emotion faces to ensure the child's understanding. The experimenter then presented eight stereotypical situation vignettes using twp puppets: a main character ("Nancy/Johnny") who always matched the sex of the child, and a sibling who was always the opposite sex. The puppets acted out eight scenes portraying various events that might elicit happiness, fear, sadness, or anger (e.g., getting an ice cream cone, being in a dark room). At the end of each vignette, the child was asked to choose a face that described how the puppet was feeling (happy, sad, mad/angry, scared/afraid). The child received two points if they matched the puppet's expressed emotion to the correct face and one point if they chose the wrong face but correctly identified the emotion valence. Scores for each vignette were then summed to create a total score ranging from 0 to 18, with higher scores reflecting more emotion knowledge.

Child internalizing and externalizing problems

To assess internalizing and externalizing problems, preschool teachers or daycare providers completed the Caregiver-Teacher Report Form (C-TRF; Achenbach & Rescorla, 2000) via the Qualtrics survey system (Qualtrics, Provo, UT). The C-TRF contains 100 items assessing internalizing problems and externalizing problems for children who are between 1.5 and 5 years old. All items are rated on a 3-point Likert scale, ranging from 0 (*not true*), to 2 (*very true or often true*), and are then summed to create an internalizing problems and externalizing problems score. Teacher data were available for 83% of the sample ($n = 64$) at

https://doi.org/10.1017/S0954579421000948 Published online by Cambridge University Press

baseline and 60% ($n = 46$) of the sample at the 12-month assessment. At baseline, missing data included seven children who were not yet enrolled in preschool or daycare, two children whose parent did not give consent to contact their teacher, one child whose teacher declined participation, and three children for whom data were determined to be invalid (e.g., teachers completed the questionnaire in less than 5 minutes). At the 12-month assessment, missing data included three children who were still not enrolled in preschool or daycare, 23 children for whom data were missing due to preschool/school closures during the global pandemic, two children who stopped attending preschool or daycare (unrelated to the global pandemic), and three children who were lost to follow-up.

Covariates

Demographic variables. Child age, racial/ethnic minority status (0 = *white*; 1 = *minority status*), and sex (0 = *male*; 1 = *female*) were obtained via maternal report at the first assessment.

Receipt of public assistance. Mothers reported on their annual income and whether or not they received any financial assistance (e.g., WIC, food stamps, welfare, etc.; 0 = *no public assistance*; 1 = *received public assistance*).

Estimated IQ. Verbal IQ was estimated using age-based standard scores on the Peabody Picture Vocabulary Test Fourth Edition (PPVT-IV; Dunn & Dunn, 2007).

Data analytic plan

We conducted preliminary analyses to examine descriptive statistics by maternal group status and bivariate correlations between all study variables using IBM SPSS Statistics (Version 26.0). In addition, we examined the extent to which our RCT produced change in maternal ER difficulties using multigroup latent growth curve analysis (Jung & Wickrama, 2008) in MPlus version 8 (Muthén & Muthén, 2017). Full information maximum likelihood (FIML) was utilized to handle missing data. In this model, negative slopes indicate improvements in ER difficulties while positive slopes indicate worsening ER difficulties. Slopes were compared using Satorra–Bentler scaled chi-square test statistic to compare fit for a model in which slope parameters were specified to vary to a model where slope parameters were constrained to be equal. This comparison was made for all possible group combinations (i.e., DBT vs. HC; WLC vs. HC; DBT vs. WLC).

All primary analyses were conducted in MPlus version 8 (Muthén & Muthén, 2017) using full information maximum likelihood with robust standard errors (MLR) to handle missing data. Model fit was evaluated using standard criteria for chi-square, comparative fit index (CFI; Bentler, 1990), and the root mean square error of approximation (RMSEA, Browne & Cudeck, 1993). To examine within-individual change in child ER domains, we utilized a FCSI latent growth model (Wood, 2011). This model was chosen because it makes the fewest assumptions about the form or rate of growth (Wood, 2011; Wood & Jackson, 2013). In addition, this model sets the intercept and the slope to be orthogonal (the covariance between the intercept and slope variables is set to zero), allowing us to evaluate the relative amounts of between-person (intercept) and within-individual (slope) variability for each of the four ER domains. We report (a) intercept variance as the indicator of between-person differences in ER across 12 months in preschool; (b) squared slope loadings as an indicator of within-individual variability at each assessment; and (c) a comparison of intercept variance to squared slope loadings as an indicator of relative differences in between-person differences versus within-individual change.

Next, we examined how change in maternal ER difficulties impacted differences in the starting point of preschooler ER growth trajectories (intercept: between-person differences) and their pattern of development over 12 months (slope: within-individual change) above and beyond demographic covariates. To do so, we regressed the latent intercept and slope of each child ER domain on the slope of maternal ER difficulties while controlling for demographic covariates. Finally, to evaluate the extent to which each child ER domain was associated with internalizing and externalizing problems at 12-month follow-up, we regressed internalizing and externalizing problems (separately) on the latent intercept and slope of each child ER domains while controlling for internalizing or externalizing problems assessed at baseline, slope of maternal ER difficulties, and demographic covariates. Indirect effects were also assessed using the MODEL INDIRECT command in MPlus.

Results

Descriptive statistics

Table 1 provides descriptive statistics for all study variables by maternal group status and Table 2 shows bivariate correlations from primary study variables across all assessments.

Treatment effects on maternal ER difficulties

Supplementary Figure S1 shows group trajectories from the multigroup LCGM assessing maternal ER difficulties across the study protocol (χ^2 (21) = 24.25, $p = .28$, CFI = .97, TLI = .97 RMSEA = .08). Mothers in the DBT (intercept: b = 110.80, $p < .01$) and WLC (intercept: b = 107.48, $p < .01$) groups demonstrated equivalent levels of ER difficulties at baseline (DBT vs. WLC: $\Delta\chi^2 = 0.23$, $p > .05$), and mothers in both groups demonstrated significantly more ER difficulties at baseline relative to mothers in the HC group (intercept: b = 56.77, $p < .01$; DBT vs. HC: $\Delta\chi^2 = 30.86$, $p < .05$; WLC vs. HC: $\Delta\chi^2 = 47.40$ $p < .05$). In addition, mothers in the DBT (slope: b = −9.22, $p < .01$) and WLC (slope: b = −4.58, $p < .01$) groups demonstrated greater improvements in ER difficulties across 12 months relative to mothers in the HC group, who showed no significant change in ER difficulties (slope: b = −0.12, $p = .82$; DBT vs. HC: $\Delta\chi^2 = 10.28$, $p < .05$; WLC vs. HC: $\Delta\chi^2 = 8.69$, $p < .05$). Mothers in the DBT group showed significantly steeper improvements in ER difficulties when compared to mothers in the WLC group (DBT vs. WLC: $\Delta\chi^2 = 4.07$, $p < .05$).

Between-person differences and within-individual change in child ER domains

Table 3 presents model fit statistics for FCSI latent growth models for child ER by domain, all of which demonstrated good model fit. Unstandardized parameter estimates for the intercept variance and squared slope loadings across assessments are also presented by child ER domain.

https://doi.org/10.1017/S0954579421000948 Published online by Cambridge University Press

Table 1. Descriptive statistics for all study variables by maternal group status

	DBT ($n = 14$)			WLC ($n = 25$)			HC ($n = 38$)		
	N	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
Maternal characteristics									
Age (years)	14	32.72	5.06	25	32.19	5.90	38	33.98	3.87
Minority status	14	0.57	0.51	25	0.48	0.51	38	0.18	0.39
Public assistance	14	0.57	0.51	25	0.56	0.51	38	0.18	0.39
IQ Estimate	14	94.29	16.38	24	98.92	13.57	38	104.37	13.84
Child characteristics									
Age (months)	14	42.21	4.26	25	41.88	4.01	38	42.97	3.47
Minority Status	14	0.64	0.50	25	0.64	0.49	38	0.29	0.46
Sex	14	0.57	0.51	25	0.48	0.51	38	0.61	0.50
IQ Estimate	14	105.36	16.04	24	108.04	20.06	38	113.87	15.93
Maternal ER									
Baseline	14	112.07	22.39	25	108.00	24.00	38	58.05	13.92
4 months	12	99.58	22.74	15	100.40	30.81	36	55.92	12.75
8 months	12	85.00	27.91	12	96.25	19.19	26	56.96	11.97
12 months	12	85.25	17.52	20	95.05	23.34	35	56.11	11.76
Child ER									
Executive Control (*Dimensional Change Card Sort*)									
Baseline	13	15.23	5.13	25	15.56	4.96	38	18.45	4.83
4 months	10	18.30	8.03	12	19.67	7.89	24	24.46	8.49
8 months	8	23.00	9.34	10	23.30	9.37	19	27.63	6.25
12 months	8	27.50	6.26	10	23.60	8.13	16	28.25	6.84
Delay of Gratification (*Gift Delay*)									
Baseline	12	27.75	25.69	23	21.78	22.66	36	41.31	24.10
4 months	12	36.08	25.13	15	30.93	24.28	36	40.06	21.56
8 months	11	38.64	25.30	12	32.33	25.25	27	39.30	23.81
12 months	8	34.00	23.44	10	34.10	27.69	16	43.69	24.44
Regulation of Frustration (*Locked Box/Knotted Sack*)									
Baseline	14	5.14	2.62	24	5.12	2.62	35	4.97	2.56
4 months	11	5.18	2.40	12	3.66	2.53	34	5.20	2.47
8 months	9	5.00	1.80	10	4.70	2.31	24	4.87	2.40
12 months	6	3.33	2.33	8	6.50	2.00	13	4.92	2.72
Emotion Knowledge (*Affective Perspective Taking*)									
Baseline	12	10.33	3.89	25	11.52	3.97	37	13.49	2.64
4 months	11	12.64	2.62	14	13.29	3.36	36	14.53	2.04
8 months	11	13.73	3.47	12	14.17	3.04	24	14.92	2.30
12 months	8	14.88	1.89	10	15.20	1.14	15	15.13	1.30
Teacher-Reported Problems									
Internalizing Problems									
Baseline	10	16.29	8.47	20	12.12	11.74	33	4.03	3.05
12 months	10	12.77	9.04	15	8.54	5.97	20	3.63	3.22

(*Continued*)

https://doi.org/10.1017/S0954579421000948 Published online by Cambridge University Press

Table 1. (*Continued.*)

	DBT (*n* = 14)			WLC (*n* = 25)			HC (*n* = 38)		
	N	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
Externalizing Problems									
Baseline	10	24.29	10.87	20	17.56	11.53	33	7.74	6.42
12 months	10	18.92	11.49	15	16.21	7.76	20	5.97	5.11

Note: DBT = dialectical behavior therapy; WLC = waitlist control; HC = healthy control; ER = emotion regulation.

Executive control

The intercept variance indicates significant between-person differences in levels of executive control across the 12-month preschool period. An examination of squared slope loadings at each assessment shows increases in the relative amount of within-individual variability in executive control (i.e., *0.04* at baseline and *0.37* at 12 months). Comparing the intercept variance and the squared slope loadings at each assessment point reflects a shift from more between-person than within-individual variability to similar levels of between-person and within-individual variability in executive control over 12 months.

Delay of gratification

The intercept variance indicates significant between-person differences in levels of delay of gratification across the 12-month preschool period. An examination of slope loadings at each assessment shows the highest levels of within-individual variability at the first and last assessment (i.e., *3.31* at baseline and *0.90* at 12 months). A comparison of the intercept variance and the squared slope loadings at each assessment point shows more within-individual than between-person variability at the baseline assessment, and more between-person variability in delay of gratification at all subsequent assessments.

Regulation of frustration

The intercept variance indicates significant between-person differences in levels of frustration regulation across the 12-month preschool period. An examination of squared slope loadings at each assessment shows considerable increases in the relative amount of within-individual variability in the regulation of frustration (i.e., *0.19* at baseline to *2.64* at 12 months). Comparing the intercept variance and the squared slope loadings at each assessment point suggests that there was more between-person than within-individual variability in regulation of frustration across 12 months.

Emotion knowledge

The intercept variance indicates significant between-person differences in levels of emotion knowledge across the 12-month preschool period. An examination of squared slope loadings at each assessment suggests considerable decreases in the relative amount of within-individual variability in emotion knowledge (i.e., *8.64* at baseline and *0.30* at 12 months). Comparing the intercept variance and the squared slope loadings at each assessment point reflects a shift from more within-individual than between-person variability in emotion knowledge to more between-person variability at all subsequent assessments.

Effects of maternal ER difficulties on child ER domains

Table 4 presents the associations between change in maternal ER difficulties and change in each child ER domain, controlling for child sex, child age-based estimated IQ, and family receipt of public assistance. All models demonstrated good fit. Standardized parameter estimates and standard errors for associations between change in maternal ER difficulties and between-person differences (intercept) and within-individual change (slope) in child ER domains are also presented.

Executive control

Change in maternal ER difficulties was unrelated to between-person differences in child executive control. There was a significant association between change in maternal ER difficulties and within-individual change in child executive control such that improvements in maternal ER difficulties predicted increases in child executive control.

Delay of gratification

There were no significant associations between change in maternal ER difficulties and between-person differences or within-individual change in child delay of gratification.

Regulation of frustration

There were no significant associations between change in maternal ER difficulties and between-person differences or within-individual change in child regulation of frustration.

Emotion knowledge

Change in maternal ER difficulties was unrelated to between-person differences in child emotion knowledge. There was a significant association between change in maternal ER difficulties and within-individual change in child emotion knowledge whereby improvements in maternal ER difficulties predicted increases in child emotion knowledge.

Effects of child ER domains on internalizing and externalizing problems

Supplementary Table S1 presents the associations between between-person differences and within-individual change in child ER domains and teacher-reported internalizing and externalizing problems, controlling for teacher-reported problems at baseline, child sex, child age-based estimated IQ, and family receipt of public assistance. All models demonstrated acceptable fit. Standardized parameter estimates and standard errors for the effects of between-person differences (intercept) and within-individual change (slope) in each child ER domain on

https://doi.org/10.1017/S0954579421000948 Published online by Cambridge University Press

Table 2. Correlations between main study variables across all timepoints

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Maternal ER																							
1. Baseline																							
2. 4 months	.86**																						
3. 8 months	.79**	.84**																					
4. 12 months	.86**	.79**	.71**																				
Child ER																							
Executive Control *(Dimensional Change Card Sort)*																							
5. Baseline	−.27*	−.32**	−.37**	−.26*																			
6. 4 months	−.34*	−.28	−.35	−.19	.66**																		
7. 8 months	−.28	−.31	−.33*	−.20	.62**	.68**																	
8. 12 months	−.10	−.21	−.20	−.10	.61**	.72**	.89**																
Delay of Gratification *(Gift Delay)*																							
9. Baseline	−.39**	−.32*	−.37*	−.29*	.40**	.72**	.56**	.37*															
10. 4 months	−.21	−.17	−.41**	−.23	.33**	.43**	.50**	.34	.29*														
11. 8 months	−.19	−.27	−.21	−.10	.22	.30	.34*	.19	.26	.54**													
12. 12 months	−.13	−.21	−.15	−.06	.37*	.09	.37	.17	−.02	.19	.28												
Regulation of Frustration *(Locked Box/Knotted Sack)*																							
13. Baseline	−.14	−.19	.04	−.14	.04	.11	.12	.04	.15	.20	−.08	.00											
14. 4 months	−.34**	−.34*	−.36*	−.36**	.22	.23	.33	.39*	.26	.23	.14	.28	−.01										
15. 8 months	.00	−.18	−.06	.20	.22	.20	.12	.36	.21	.37*	.21	.09	.20	.27									
16. 12 months	−.16	−.19	−.22	−.01	.03	.02	−.12	−.18	−.02	.14	.05	.16	.26	.06	.04								
Emotion Knowledge *(Affective Perspective Taking)*																							
17. Baseline	−.33**	−.33*	−.31*	−.28*	.46**	.57**	.38*	.26	.40**	.18	.19	.22	.06	.17	.25	.32							
18. 4 months	−.25	−.19	−.44**	−.06	.33*	.34*	.52**	.39*	.21	.19	.28	.10	−.01	.01	.31	.27	.55**						
19. 8 months	−.20	−.18	−.27	−.08	.19	.10	.14	.17	.23	.30*	.35*	.17	−.01	.05	.25	.37	.43**	.69**					
20. 12 months	.21	.14	.09	.30	.11	.22	.14	.23	−.07	.22	.39*	.24	−.27	−.24	.20	.15	.22	.33	.51**				
Teacher-Reported Problems																							
Internalizing Problems																							
21. Baseline	.46**	.40**	.36*	.53**	−.24	−.14	−.09	−.12	−.24	−.15	−.04	−.16	−.01	−.32*	.01	−.22	−.32*	−.09	−.30	−.10			
22. 12 months	.25	.29	.29	.21	−.06	−.12	−.36	−.18	−.17	−.09	.27	−.05	−.11	−.29	−.19	−.21	−.06	−.01	−.10	.19	.53**		

(*Continued*)

Table 2. (*Continued.*)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Externalizing Problems																							
23. Baseline	.31*	.28*	.25	.39**	−.32*	−.21	−.10	−.01	−.31*	−.20	−.13	−.22	−.06	−.33*	−.08	−.12	−.34**	−.13	−.38*	−.16	.75**	.27	
24. 12 months	.24	.37*	.38*	.18	−.14	−.24	−.35	−.30	−.27	−.39*	−.11	−.12	−.18	−.41*	−.14	.01	−.03	−.12	−.25	.04	.38*	.39*	.65**

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

teacher-reported internalizing and externalizing problems are also presented.

Supplementary Table S1 displays a significant effect of within-individual change in child executive control on teacher-reported externalizing problems. In addition, there was a significant indirect effect whereby improvements in maternal ER difficulties predicted within-individual increases in child executive control and increases in child executive control predicted fewer teacher-reported externalizing problems at 12-month follow-up (Figure 1). There were no other significant effects on teacher-reported internalizing or externalizing symptoms.

Discussion

This study embarks on the ambitious task of applying a multidimensional RDoC framework to the development of ER. While widening the RDoC lens to include an emphasis on environmental and developmental influences, we also sought to sharpen the focus by illustrating *how* and *when* this can be accomplished using RDoC domains in this proof-of-concept design. The current study utilized repeated assessments across 12 months during preschool to demonstrate significant between-person differences *and* within-individual change across several child ER domains. In addition, the current study leveraged an RCT targeting maternal ER difficulties to test the causal impact of this known environmental influence on within-individual change in preschoolers' ER. Preliminary results suggest that treatment-driven improvements in maternal ER difficulties correspond with steeper growth in preschoolers' executive control and emotion knowledge. Moreover, growth in child executive control predicted *fewer* teacher-reported externalizing problems at 12-month follow-up, even after accounting for baseline levels of externalizing problems. Here, we discuss these findings as a proof of concept to highlight how repeated assessments within an experimental intervention design afford the unique opportunity to test environmental mechanisms of change in developmental processes. In line with the goals of this special issue, we emphasize the importance of integrating environmental and developmental dimensions into the existing RDoC framework and offer specific recommendations about how to do so.

Charting within-individual change in developmental processes

The use of longitudinal growth models, here the FCSI model, capitalized on our repeated assessment design and allowed us to parse meaningful between-person differences and within-individual change in four RDoC constructs associated with ER domains: executive control, delay of gratification, regulation of frustration, and emotion knowledge. Importantly, our results showed different patterns of within-individual variability whereby some constructs showed relatively higher levels of within-individual variability at baseline (i.e., 3 years of age; delay of gratification, emotion knowledge) while other constructs showed increases in within-individual variability over time (i.e., 4 years of age; executive control, regulation of frustration). These findings echo previous work demonstrating that functioning within these domains may develop along different timescales (Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003; Lengua et al., 2015) and underscore the importance of charting multiple components of ER simultaneously. In addition, results point to potential "turning points" or accelerated rates of growth that may vary by construct or domain of interest. This is consistent with the broader

https://doi.org/10.1017/S0954579421000948 Published online by Cambridge University Press

Table 3. Fit and model statistics for free curve slope intercept (FCSI) growth models for child emotion regulation by domain

	χ^2	df	*p*	CFI	RMSEA	Intercept variance	Baseline loading^2	4 month loading^2	8 month loading^2	12 month loading^2
1. **Executive Control** (*Dimensional Change Card Sort*)	0.17	2	.92	1.00	<0.001	0.32**	0.04	0.04	0.25	0.37
2. **Delay of Gratification** (*Gift Delay*)	0.54	2	.76	1.00	<0.001	1.46**	3.31	0.04	0.02	0.90
3. **Regulation of Frustration** (*Locked Box/Knotted Sack*)	0.47	2	.79	1.00	<0.001	1.16**	0.19	0.56	0.34	2.64
4. **Emotion Knowledge** (*Affective Perspective Taking*)	0.10	2	.96	1.00	<0.001	2.10**	8.64	1.72	0.31	0.30

Note. Each row represents a separate model. Unstandardized parameter estimates for the intercept variance represent an estimate of relative between-person differences and squared slope loadings represent an estimate of relative within-individual variability at each timepoint across child ER domains.
CFI = comparative fit index; RMSEA = root mean square error of approximation
**$p < .01$ indicates significant between-person variance.

Table 4. Models testing associations between maternal change in emotion regulation and between-person differences and within-individual change in child emotion regulation by domain

						Intercept (between-person)			Slope (within-individual)		
	χ^2	df	*p*	CFI	RMSEA	β	*SE*	*p*	β	*SE*	*p*
1. **Executive Control** (*Dimensional Change Card Sort*)	8.67	10	.56	1.00	<.001	0.10	0.14	.50	**−0.35**	**0.16**	**.03**
2. **Delay of Gratification** (*Gift Delay*)	3.75	11	.87	1.00	<.001	0.27	0.18	.14	−0.23	0.22	.29
3. **Regulation of Frustration** (*Locked Box/Knotted Sack*)	8.27	11	.69	1.00	<.001	−0.38	0.62	.54	0.49	0.42	.25
4. **Emotion Knowledge** (*Affective Perspective Taking*)	3.17	10	.97	1.00	<.001	0.14	0.09	.10	**−0.23**	**0.10**	**.03**

Note. Each row represents a separate model. Coefficients are standardized parameter estimates (β) of the association between maternal change in emotion regulation (ER; slope) and between-person differences (intercept) and within-individual change (slope) in child ER domains. All models control for the child sex, effects of child age-based estimated IQ, and family receipt of public assistance.

developmental psychopathology perspective that emphasizes the potential for nonlinear growth, and discontinuity of change (Cicchetti & Rogosch, 1999; Rutter, 1996; Wood & Jackson, 2013). Taken together, this work highlights the utility of using latent growth modeling to capture meaningful within-individual change that is overlooked when using more traditional between-person models (Cole & Jacobs, 2018; Kim-Spoon & Grimm, 2016; Wood, 2011).

Our emphasis on modeling within-individual change is certainly not new (e.g., Baltes & Nesselroade, 1979), and neither is the call to harmonize developmental theory with methodological and analytic approaches (e.g., Cicchetti & Rogosch, 1999). However, the field has yet to routinely utilize within-individual approaches in practice, despite its consistency with theoretical conceptualizations of development and clear etiological implications. Expanding the RDoC to explicitly define development as a within-individual process would significantly advance research in this area by creating a unified framework and addressing perennial methodological issues that have limited rigor and reproducibility. Specifically, providing a structure that specifies the timing and frequency of assessments needed to capture within-individual change in developmental processes is needed (Fargas-Malet, McSherry, Larkin, & Robinson, 2010; Hopwood, Bleidorn, & Wright, 2021). The utility of this unified structure necessitates validating repeated assessments of developmentally and culturally sensitive domain-specific constructs to ensure our measurements capture the same underlying developmental phenomena over time. Reliable assessments of within-individual change would enhance our etiological understanding and allow for a more accurate characterization of causal effects, enriching our evaluation of known environmental influences on the development of ER.

Testing environmental influences as causal mechanisms of change

By utilizing a prospective, experimental design, the current study was able to empirically test the influence of change in maternal ER difficulties on within-individual change in child ER. To our knowledge, this proof-of-concept study was the first to utilize an RCT designed to link treatment-driven improvements in maternal ER difficulties with within-individual growth in child ER. Specifically, improvements in maternal ER difficulties predicted increasing trajectories of both child executive control and child emotion knowledge across 12 months during the preschool period. These findings are in line with core developmental psychopathology principles which conceptualize context as intricately intertwined with development (Sroufe & Rutter, 1984),

https://doi.org/10.1017/S0954579421000948 Published online by Cambridge University Press

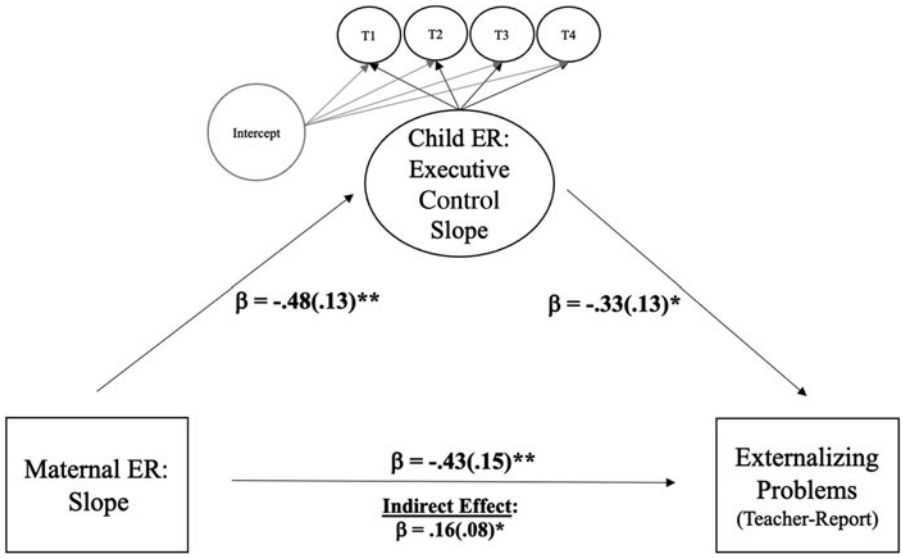

Figure 1. Model testing the indirect association between change in maternal emotion regulation and teacher-reported externalizing problems via within-individual change in child executive control. *Note.* Overall model fit was good (χ^2 (21) = 17.27, p > .05; root mean square error of approximation (RMSEA) = < .001; comparative fit index (CFI) = 1.00). Standardized (β) coefficients are shown for significant paths. Nonsignificant paths (i.e., with the intercept (between-person differences)) are not shown. Model controls for the effects of child sex, child age-based estimated IQ, family receipt of public assistance, and teacher-reported externalizing problems at baseline. *p < .05. **p < .01.

and suggest that fully understanding (and quantifying) developmental change requires systematic manipulation of environmental influences (Garber & Bradshaw, 2020). Further, results demonstrate that maternal-driven growth in child executive control indirectly diminished externalizing problems across the same 12-month period. These findings shift our focus on maternal ER difficulties as a risk factor, to maternal ER difficulties as a malleable target for early intervention that promotes resilience in at-risk children, in line other emerging work in this area (Havighurst et al., 2013; Kehoe et al., 2020).

Of note, the influence of change in maternal ER difficulties on child ER was restricted to the RDoC defined cognitive (executive control) and social (emotion knowledge) systems. This is in line with research documenting the impact of parental influences on children's attention deployment and set shifting (Fay-Stammbach, Hawes, & Meredith, 2014) as well as on children's enhanced knowledge and awareness of emotions (Thompson et al., 2020). However, we failed to detect a link between change maternal ER difficulties and positive (delay of gratification) or negative (frustration tolerance) valence systems. This could be related to the small sample size and reduced power to detect effects. It is also possible that our measurement of these child ER constructs was affected by repeated administration, highlighting the need for future research focused on examining within-individual construct validity over time. In addition, it is helpful to consider these findings within the context of the broader literature on the development of ER in children. Specifically, delay of gratification and regulation of frustration reflect more temperamental (impulsivity, negative reactivity) or phylogenetically older developmental processes (Howse et al., 2003; Lengua et al., 2015; Thomas, Letourneau, Campbell, Tomfohr-Madsen, & Giesbrecht, 2017). While these processes have shown malleability over time (Kiff, Lengua, & Zalewski, 2011; Slagt, Dubas, Deković, & van Aken, 2016), more significant or sustained environmental changes may be required to observe within-individual change. Conversely, there may be cascading effects whereby maternal driven changes in child executive control may exert downstream effects on delay of gratification and regulation of frustration (Zelazo & Carlson, 2012), necessitating continued observations to capture this developmental sequencing. Finally, because our study focused on a global index of maternal ER difficulties and failed to consider mechanisms of change across parallel ER domains, our understanding of exactly how this intervention induced change in maternal ER difficulties is limited and, in turn, limits our understanding of the intergenerational transmission of ER.

Nonetheless, the current study highlights the ability of experimental intervention designs to more precisely quantify the causal impact of environmental influences on developmental processes across time. This work expands on traditional developmental studies that routinely describe and measure environmental factors but are rarely able to manipulate these influences. Importantly, this shift in design and focus directly aligns with the RDoC's overarching goals, and enables us to translate mechanistic findings into specific prevention and intervention targets aimed at reducing risk for psychopathology (Cuthbert, 2014). However, the lack of prescriptive guidance within the RDoC framework prevents collective progress in this area and jeopardizes our ability to capture important explanatory variance in developmental processes of interest. Acknowledging the "environment" as an important dimension is necessary but not sufficient, and guidance for measuring core features of the environment is needed. This includes articulating domains of particular interest (e.g., family factors) and defining relevant constructs (e.g., parental psychopathology, parental influences) as well as including parallel levels of analysis with which these domains can be assessed (e.g., self-report, obervational), all of which would bolster the current RDoC framework. Further, to prevent a recapitalization of the "snap-shot" problem, these environmental influences should be assessed repeatedly, alongside repeated assessments of the developmental domain of interest. These extensions to the RDoC framework would result in greater precision and specificity about the impact of the environment on developmental processes, aiding in the identification of prevention and intervention targets.

Considering developmental influences

The current study focused on the preschool period, a developmental window known for rapid growth in ER development (Carlson & Wang, 2007; Denham et al., 2003). Perhaps unsurprisingly, our frequent, repeated assessments showed meaningful within-individual change across all child ER domains. The

https://doi.org/10.1017/S0954579421000948 Published online by Cambridge University Press

sensitivity of this developmental period was further underscored by heightened vulnerability to environmental influence (Cole et al., 2018), demonstrated here by the impact of maternal ER, *and* the link between changes in child ER and reduced risk for externalizing problems. Examining ER development within this key developmental period undoubtedly contributed to our ability to detect these associations and highlights the importance of explicit inclusion of a developmental dimension into the RDoC framework. While the ideal developmental window may vary – in both timing and tempo – depending on the developmental process of interest, incorporating a developmental dimension into the RDoC that explicitly defines *when* assessment and/or intervention are of utmost relevance would enhance our understanding of behavior and refine treatment targets.

Though we focused here on the preschool period, research clearly demonstrates that ER continues to develop across childhood and adolescence (Garber & Dodge, 1991; Zeman, Cassano, Perry-Parrish, & Stegall, 2006). Moreover, growing research supports the notion that environmental influences (e.g., parenting) continue to exert a critical influence on ER into adolescence (Klimes-Dougan et al., 2007; Laursen & Collins, 2009; Morris et al., 2017). For example, the transition to adolescence is another developmental period hallmarked by substantial neurobiological changes in systems underlying ER (Guyer, Silk, & Nelson, 2016; Steinberg & Morris, 2001), and this developmental period corresponds to the onset of various psychiatric disorders (Spear, 2009). Research suggests that the amplification of emotion during this period may necessitate prolonged emotional scaffolding (Guyer et al., 2016; Morris et al., 2017; Steinberg & Silk, 2002) and emerging work demonstrates that parental influences may exacerbate or mitigate ER difficulties (Byrd, Vine, Frigoletto, Vanwoerden, & Stepp, 2021) and emerging psychopathology (Vanwoerden et al., 2021). This further underscores the importance of incorporating what is known about developmental processes of interest into a well-defined RDoC dimension. Explicitly defining optimal windows of assessment would enable researchers to maximize their ability to detect and understand the impact of environmental influences on within-individual change.

Summary and future directions

In the past decade, the RDoC has increasingly taken hold as an alternative framework for the study of mental disorders (Cuthbert, 2014; Insel et al., 2010). Although environment and development are acknowledged as critical elements of the RDoC framework, the consideration of their influences are largely implicit. Scant guidance on how to incorporate these dimensions has created uncertainty for developmental psychopathologists who want to incorporate these two central tenets – environment and development – within the RDoC framework (Garber & Bradshaw, 2020). Here, in this proof-of-concept study, we demonstrate potential for the RDoC to significantly advance our understanding of environmental and developmental influences on within-individual change in developmental processes. Specifically, through experimental manipulation of the environment (maternal ER) we showed a causal effect on within-individual change in child ER during a key developmental window (preschool), enhancing our etiological understanding of this fundamental developmental process. Further, we found that these within-individual changes reduced externalizing problems during this same developmental window, pointing to maternal ER as an important prevention and intervention target. Thus, while the current study was notably limited by small sample size and the use of single constructs within domains of interest, our approach yielded results consistent with the overarching goals of the RDoC framework: advancing our understanding of behavior and identifying and refining targets for intervention. Here, we illustrate the ways in which environmental and developmental dimensions can be explicitly incorporated into the RDoC framework, paralleling conceptualizations of current dimensions. Future work incorporating these dimensions will hasten our progress toward better characterizing within-individual change in behavior and the extent to which that change is influenced by environmental factors across development.

Supplementary Material. The supplementary material for this article can be found at https://doi.org/10.1017/S0954579421000948.

Acknowledgements. We are grateful to all the families who took part in this study, and to the STEADY Study team, which includes interviewers and their supervisors, study therapists, research assistants, data managers, student workers, and volunteers.

Funding Statement. Funding for this study was supported by grants awarded to Drs. Maureen Zalewski and Stephanie Stepp from the National Institute on Mental Health (R01 MH111758). Additional funding from the National Institute of Health also supported this work (K01 MH119216).

Conflicts of Interest. None.

References

Achenbach, T. M., & Rescorla, L. A. (2000). *Manual for the ASEBA preschool forms & profiles*. Burlington: University of Vermont, Research Center for Children, Youth, & Families.

Aldao, A. (2013). The future of emotion regulation research: Capturing context. *Perspectives on Psychological Science*, *8*, 155–172. doi:10.1177/1745691612459518

Baltes, P. B., & Nesselroade, J. R. (1979). History and rationale of longitudinal research. In J. R. Nesselroade & P. B. Baltes (Eds.), *Longitudinal research in the study of behavior and development* (pp. 1–39). New York, NY: Academic Press.

Bariola, E., Gullone, E., & Hughes, E. K. (2011). Child and adolescent emotion regulation: The role of parental emotion regulation and expression. *Clinical Child and Family Psychology Review*, *14*, 198. doi:10.1007/s10567-011-0092-5

Beauchaine, T. P., & Cicchetti, D. (2016). A new generation of comorbidity research in the era of neuroscience and research domain criteria. *Development and Psychopathology*, *28*, 891–894. doi:10.1017/S0954579416000602

Beauchaine, T. P., & Cicchetti, D. (2019). Emotion dysregulation and emerging psychopathology: A transdiagnostic, transdisciplinary perspective. *Development and Psychopathology*, *31*, 799–804. doi:10.1017/S0954579419000671

Beauchaine, T. P., & Hinshaw, S. P. (2020). RDoC and psychopathology among youth: Misplaced assumptions and an agenda for future research. *Journal of Clinical Child & Adolescent Psychology*, *49*, 322–340. doi:10.1080/15374416.2020.1750022

Bendezú, J. J., Cole, P. M., Tan, P. Z., Armstrong, L. M., Reitz, E. B., & Wolf, R. M. (2018). Child language and parenting antecedents and externalizing outcomes of emotion regulation pathways across early childhood: A person-centered approach. *Development and Psychopathology*, *30*, 1253. doi:10.1017/S0954579417001675

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*, 238–246. doi:10.1037/0033-2909.107.2.238

Blandon, A. Y., Calkins, S. D., Keane, S. P., & O'Brien, M. (2008). Individual differences in trajectories of emotion regulation processes: The effects of maternal depressive symptomatology and children's physiological regulation. *Developmental Psychology*, *44*, 1110. doi:10.1037/0012-1649.44.4.1110

Bocknek, E. L., Brophy-Herb, H. E., & Banerjee, M. (2009). Effects of parental supportiveness on toddlers' emotion regulation over the first three years of life in a low-income African American sample. *Infant Mental Health Journal: Official Publication of The World Association for Infant Mental Health*, *30*, 452–476.

Brown, T. T., & Jernigan, T. L. (2012). Brain development during the preschool years. *Neuropsychology Review*, *22*, 313–333. doi:10.1007/s11065-012-9214-1

Browne, M. W. (1993). Alternative ways of assessing model fit. In K. Bollen & J. Long (Eds.), *Testing structural equation models* (pp. 136–162). Newbury Park, CA: Sage.

Buckholdt, K. E., Parra, G. R., & Jobe-Shields, L. (2014). Intergenerational transmission of emotion dysregulation through parental invalidation of emotions: Implications for adolescent internalizing and externalizing behaviors. *Journal of Child and Family Studies*, *23*, 324–332. doi:10.1007/s10826-013-9768-4

Byrd, A. L., Vine, V., Frigoletto, O. A., Vanwoerden, S., & Stepp, S. D. (2021). A multi-method investigation of parental responses to youth emotion: Prospective effects on emotion dysregulation and reactive aggression in daily life. *Research on Child and Adolescent Psychopathology*, 1–15 (advanced publication online).

Calkins, S. D., & Hill, A. (2007). Caregiver influences on emerging emotion regulation: Biological and environmental transactions in early development. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 229–248). New York, NY: Guilford Press.

Campos, J. J., Frankel, C. B., & Camras, L. (2004). On the nature of emotion regulation. *Child Development*, *75*, 377–394. doi:10.1111/j.1467-8624.2004.00681.x

Carcone, D., & Ruocco, A. C. (2017). Six years of research on the national institute of mental health's research domain criteria (RDoC) initiative: A systematic review. *Frontiers in Cellular Neuroscience*, *11*, 46. doi:10.3389/fncel.2017.00046

Carlson, S. M., & Wang, T. S. (2007). Inhibitory control and emotion regulation in preschool children. *Cognitive Development*, *22*, 489–510. doi:10.1016/j.cogdev.2007.08.002

Chaplin, T. M., Klein, M. R., Cole, P. M., & Turpyn, C. C. (2017). Developmental change in emotion expression in frustrating situations: The roles of context and gender. *Infant and Child Development*, *26*, e2028. doi:10.1002/icd.2028

Cicchetti, D., Ackerman, B. P., & Izard, C. E. (1995). Emotions and emotion regulation in developmental psychopathology. *Development and Psychopathology*, *7*, 1–10. doi:10.1017/S0954579400006301

Cicchetti, D., & Rogosch, F. A. (1999). Psychopathology as risk for adolescent substance use disorders: A developmental psychopathology perspective. *Journal of Clinical Child Psychology*, *28*(3), 355–365.

Cole, P. M., & Jacobs, A. E. (2018). From children's expressive control to emotion regulation: Looking back, looking ahead. *European Journal of Developmental Psychology*, *15*, 658–677. doi:10.1080/17405629.2018.1438888

Cole, P. M., Lougheed, J. P., & Ram, N. (2018). The development of emotion regulation in early childhood: A matter of multiple time scales. In P. M. Cole & T. Hollenstein (Eds.), *Emotion regulation: A matter of time* (pp. 52–69). New York: Routledge.

Cole, P. M., Martin, S. E., & Dennis, T. A. (2004). Emotion regulation as a scientific construct: Methodological challenges and directions for child development research. *Child Development*, *75*, 317–333. doi:10.1111/j.1467-8624.2004.00673.x

Crespo, L. M., Trentacosta, C. J., Aikins, D., & Wargo-Aikins, J. (2017). Maternal emotion regulation and children's behavior problems: The mediating role of child emotion regulation. *Journal of Child and Family Studies*, *26*, 2797–2809. doi:10.1007/s10826-017-0791-8

Crowell, S. E., Vlisides-Henry, R. D., & Kaliush, P. R. (2020). Emotion generation, regulation, and dysregulation as multilevel transdiagnostic constructs. In T. P. Beauchaine & S. E. Crowell (Eds.), *The Oxford handbook of emotion dysregulation* (pp. 85–98). New York, NY: Oxford University Press;.

Cuthbert, B. N. (2014). The RDoC framework: Facilitating transition from ICD/DSM to dimensional approaches that integrate neuroscience and psychopathology. *World Psychiatry*, *13*, 28–35. doi:10.1002/wps.20087

Cuthbert, B. N., & Insel, T. R. (2013). Toward the future of psychiatric diagnosis: The seven pillars of RDoC. *BMC Medicine*, *11*, 126. doi:10.1186/1741-7015-11-126

Denham, S. A. (1986). Social cognition, prosocial behavior, and emotion in preschoolers: Contextual validation. *Child Development*, *57*(1), 194–201. doi:10.2307/1130651

Denham, S. A., Blair, K. A., DeMulder, E., Levitas, J., Sawyer, K., Auerbach-Major, S., & Queenan, P. (2003). Preschool emotional competence: Pathway to social competence? *Child Development*, *74*, 238–256. doi:10.1111/1467-8624.00533

Dennis, T. A. (2004). *Manual for coding child emotion regulation behaviors*. Unpublished research manual. New York, NY: Hunter College, City University of New York.

Diamond, A., Carlson, S. M., & Beck, D. M. (2005). Preschool children's performance in task switching on the dimensional change card sort task: Separating the dimensions aids the ability to switch. *Developmental Neuropsychology*, *28*, 689–729. doi:10.1207/s15326942dn2802_7

Dunn, L. M., & Dunn, D. M. (2007). *PPVT-4: Peabody picture vocabulary test*. Bloomington, MN: Pearson Assessments.

Eisenberg, N., Cumberland, A., & Spinrad, T. L. (1998). Parental socialization of emotion. *Psychological Inquiry*, *9*, 241–273. doi:10.1207/s15327965pli0904_1

Fargas-Malet, M., McSherry, D., Larkin, E., & Robinson, C. (2010). Research with children: Methodological issues and innovative techniques. *Journal of Early Childhood Research*, *8*, 175–192. doi:10.1177/1476718X09345412

Fay-Stammbach, T., Hawes, D. J., & Meredith, P. (2014). Parenting influences on executive function in early childhood: A review. *Child Development Perspectives*, *8*, 258–264. doi:10.1111/cdep.12095

Fernandez, K. C., Jazaieri, H., & Gross, J. J. (2016). Emotion regulation: A transdiagnostic perspective on a new RDoc domain. *Cognitive Therapy and Research*, *40*, 426–440. doi:10.1007/s10608-016-9772-2

First, M. B., Williams, J. B., Karg, R. S., & Spitzer, R. L. (2016). *User's guide for the SCID-5-CV Structured Clinical Interview for DSM-5® disorders: Clinical version*. Washington, DC: American Psychiatric Publishing, Inc.

Fox, N. A. (1994). Dynamic cerebral processes underlying emotion regulation. *Monographs of the Society for Research in Child Development*, *59*, 152–166. doi:10.1111/j.1540-5834.1994.tb01282.x.

Franklin, J. C., Jamieson, J. P., Glenn, C. R., & Nock, M. K. (2015). How developmental psychopathology theory and research can inform the research domain criteria (RDoC) project. *Journal of Clinical Child & Adolescent Psychology*, *44*, 280–290. doi:10.1080/15374416.2013.873981

Frye, D., Zelazo, P. D., & Palfai, T. (1995). Theory of mind and rule-based reasoning. *Cognitive Development*, *10*, 483–527. doi:10.1016/0885-2014(95)90024-1

Garber, J., & Bradshaw, C. P. (2020). Developmental psychopathology and the research domain criteria: Friend or Foe? *Journal of Clinical Child & Adolescent Psychology*, *49*, 341–352. doi:10.1080/15374416.2020.1753205

Garber, J., & Dodge, K. A. (Eds.). (1991). *The development of emotion regulation and dysregulation*. Cambridge: Cambridge University Press.

Garon, N., Bryson, S. E., & Smith, I. M. (2008). Executive function in preschoolers: A review using an integrative framework. *Psychological Bulletin*, *134*, 31. doi:10.1037/0033-2909.134.1.31

Garvey, M., Avenevoli, S., & Anderson, K. (2016). The national institute of mental health research domain criteria and clinical research in child and adolescent psychiatry. *Journal of the American Academy of Child & Adolescent Psychiatry*, *55*, 93–98. doi:10.1016/j.jaac.2015.11.002

Glenn, C. R., Cha, C. B., Kleiman, E. M., & Nock, M. K. (2017). Understanding suicide risk within the Research Domain Criteria (RDoC) framework: Insights, challenges, and future research considerations. *Clinical Psychological Science*, *5*, 568–592. doi:10.1177/2167702616686854

Goldsmith, H. H., & Rothbart, M. K. (1996). *Prelocomotor and Locomotor Laboratory Temperament Assessment Battery, Lab-TAB; version 3.0*. Technical Manual, Department of Psychology, University of Wisconsin, Madison, WI.

Gratz, K. L., & Roemer, L. (2004). 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*, *26*, 41–54. doi:10.1023/B:JOBA.0000007455.08539.94

Gross, J. J. (1998). The emerging field of emotion regulation: An integrative review. *Review of General Psychology*, *2*, 271–299. doi:10.1037/1089-2680.2.3.271

Guyer, A. E., Silk, J. S., & Nelson, E. E. (2016). The neurobiology of the emotional adolescent: From the inside out. *Neuroscience & Biobehavioral Reviews*, *70*, 74–85. doi:10.1016/j.neubiorev.2016.07.037

Hajal, N. J., & Paley, B. (2020). Parental emotion and emotion regulation: A critical target of study for research and intervention to promote child emotion socialization. *Developmental Psychology*, *56*, 403. doi:10.1037/dev0000864

Harned, M. S., Korslund, K. E., Schmidt, S. C., & Gallop, R. J. (2021). The dialectical behavior therapy adherence coding scale (DBT ACS): Psychometric properties. *Psychological Assessment*, *33*(6), 552–561. doi:10.1037/pas0000999.

Havighurst, S. S., Wilson, K. R., Harley, A. E., Kehoe, C., Efron, D., & Prior, M. R. (2013). "Tuning into kids": Reducing young children's behavior problems using an emotion coaching parenting program. *Child Psychiatry & Human Development*, *44*, 247–264. doi:10.1007/s10578-012-0322-1

Hongwanishkul, D., Happaney, K. R., Lee, W. S., & Zelazo, P. D. (2005). Assessment of hot and cool executive function in young children: Age-related changes and individual differences. *Developmental Neuropsychology*, *28*, 617–644. doi:10.1207/s15326942dn2802_4

Hopwood, C., Bleidorn, W., & Wright, A. G. (2021). Connecting theory to methods in longitudinal research, March 28. Retrieved from https://doi.org/10.31234/osf.io/w5huz

Howse, R. B., Calkins, S. D., Anastopoulos, A. D., Keane, S. P., & Shelton, T. L. (2003). Regulatory contributors to children's kindergarten achievement. *Early Education and Development*, *14*, 101–120. doi:10.1207/s15566935eed1401_7

Insel, T. R., Cuthbert, B. N., Garvey, M., Heinssen, R., Pine, D. S., Quinn, K. (2010). Research Domain Criteria (RDoC): Toward a new classification framework for research on mental disorders. *American Journal of Psychiatry*, *167*(7), 748–751.

Ip, K. I., Jester, J. M., Sameroff, A., & Olson, S. L. (2019). Linking Research Domain Criteria (RDoc) constructs to developmental psychopathology: The role of self-regulation and emotion knowledge in the development of internalizing and externalizing growth trajectories from ages 3 to 10. *Development and Psychopathology*, *31*, 1557–1574. doi:10.1017/S0954579418001323

Izard, C. E., Woodburn, E. M., Finlon, K. J., Krauthamer-Ewing, E. S., Grossman, S. R., & Seidenfeld, A. (2011). Emotion knowledge, emotion utilization, and emotion regulation. *Emotion Review*, *3*, 44–52. doi:10.1177/1754073910380972

Jung, T., & Wickrama, K. A. (2008). An introduction to latent class growth analysis and growth mixture modeling. *Social and Personality Psychology Compass*, *2*(1), 302–317.

Kaufman, E. A., Puzia, M. E., Mead, H. K., Crowell, S. E., McEachern, A., & Beauchaine, T. P. (2017). Children's emotion regulation difficulties mediate the association between maternal borderline and antisocial symptoms and youth behavior problems over 1 year. *Journal of Personality Disorders*, *31*, 170–192. doi:10.1521/pedi_2016_30_244

Kehoe, C. E., Havighurst, S. S., & Harley, A. E. (2020). Tuning in to teens: Investigating moderators of program effects and mechanisms of change of an emotion focused group parenting program. *Developmental Psychology*, *56*, 623. doi:10.1037/dev0000875

Kiff, C. J., Lengua, L. J., & Zalewski, M. (2011). Nature and nurturing: Parenting in the context of child temperament. *Clinical Child and Family Psychology Review*, *14*, 251. doi:10.1007/s10567-011-0093-4

Kim, S., Nordling, J. K., Yoon, J. E., Boldt, L. J., & Kochanska, G. (2013). Effortful control in "hot" and "cool" tasks differentially predicts children's behavior problems and academic performance. *Journal of Abnormal Child Psychology*, *41*, 43–56. doi:10.1007/s10802-012-9661-4

Kim-Spoon, J., & Grimm, K. J. (2016). Latent growth curve modeling and developmental psychology. In D. Cicchetti (Ed.), *Developmental psychopathology, Vol. 1, theory, and method* (3rd ed., pp. 986–1041). Hoboken, NJ: Wiley.

Klimes-Dougan, B., Brand, A. E., Zahn-Waxler, C., Usher, B., Hastings, P. D., Kendziora, K., & Garside, R. B. (2007). Parental emotion socialization in adolescence: Differences in sex, age and problem status. *Social Development*, *16*, 326–342. doi:10.1111/j.1467-9507.2007.00387.x

Kochanska, G., Murray, K., Jacques, T. Y., Koenig, A. L., & Vandegeest, K. A. (1996). Inhibitory control in young children and its role in emerging internalization. *Child Development*, *67*, 490–507. doi:10.2307/1131828

Laursen, B., & Collins, W. A. (2009). Parent–child relationships during adolescence. In R. M. Lerner, & L. Steinberg (Eds.), *Handbook of adolescent psychology. Vol. 2: Contextual influences on adolescent development* (3rd ed., pp. 93–42). New York: Wiley.

Lengua, L. J., Moran, L., Zalewski, M., Ruberry, E., Kiff, C., & Thompson, S. (2015). Relations of growth in effortful control to family income, cumulative risk, and adjustment in preschool-age children. *Journal of Abnormal Child Psychology*, *43*, 705–720. doi:10.1007/s10802-014-9941-2

Li, D., Li, D., Wu, N., & Wang, Z. (2019). Intergenerational transmission of emotion regulation through parents' reactions to children's negative emotions: Tests of unique, actor, partner, and mediating effects. *Children and Youth Services Review*, *101*, 113–122. doi:10.1016/j.childyouth.2019.03.038

Linehan, M. (1993). *Cognitive-behavioral treatment of borderline personality disorder*. New York: Guilford Press.

Linehan, M. (2014). *DBT skills training manual*. New York, NY: Guilford Publications.

Linehan, M., Comtois, K. A., Murray, A. M., Brown, M. Z., Gallop, R. J., Heard, H. L., … Lindenboim, N. (2006). Two-year randomized controlled trial and follow-up of dialectical behavior therapy vs therapy by experts for suicidal behaviors and borderline personality disorder. *Archives of General Psychiatry*, *63*, 757–766. doi:10.1001/archpsyc.63.7.757

Linehan, M., Korslund, K. E., Harned, M. S., Gallop, R. J., Lungu, A., Neacsiu, A. D., … Murray-Gregory, A. M. (2015). Dialectical behavior therapy for high suicide risk in individuals with borderline personality disorder: A randomized clinical trial and component analysis. *JAMA Psychiatry*, *72*, 475–482. doi:10.1001/jamapsychiatry.2014.3039

Lynch, T. R., Trost, W. T., Salsman, N., & Linehan, M. (2007). Dialectical behavior therapy for borderline personality disorder. *Annual Review of Clinical Psychology*, *3*, 181–205. doi:10.1146/annurev.clinpsy.2.022305.095229

Mittal, V. A., & Wakschlag, L. S. (2017). Research domain criteria (RDoC) grows up: Strengthening neurodevelopmental investigation within the RDoC framework. *Journal of Affective Disorders*, *216*, 30. doi:10.1016/j.jad.2016.12.011

Moilanen, K. L., Shaw, D. S., Dishion, T. J., Gardner, F., & Wilson, M. (2010). Predictors of longitudinal growth in inhibitory control in early childhood. *Social Development*, *19*, 326–347. doi:10.1111/j.1467-9507.2009.00536.x

Monks, C. P., Smith, P. K., & Swettenham, J. (2005). Psychological correlates of peer victimisation in preschool: Social cognitive skills, executive function and attachment profiles. *Aggressive Behavior: Official Journal of the International Society for Research on Aggression*, *31*, 571–588. doi:10.1002/ab.20099

Morelen, D., Shaffer, A., & Suveg, C. (2016). Maternal emotion regulation: Links to emotion parenting and child emotion regulation. *Journal of Family Issues*, *37*, 1891–1916. doi:10.1177/0192513X14546720

Morris, A. S., Criss, M. M., Silk, J. S., & Houltberg, B. J. (2017). The impact of parenting on emotion regulation during childhood and adolescence. *Child Development Perspectives*, *11*, 233–238. doi:10.1111/cdep.12238

Morris, A. S., Silk, J. S., Steinberg, L., Myers, S. S., & Robinson, L. R. (2007). The role of the family context in the development of emotion regulation. *Social Development*, *16*, 361–388. doi:10.1111/j.1467-9507.2007.00389.x

Muthén, L. K., & Muthén, B. O. (2017). *Mplus user's guide, eighth edition*. Los Angeles, CA: Muthén & Muthén.

Neacsiu, A. D., Bohus, M., & Linehan, M. M. (2014). Dialectical behavior therapy: An intervention for emotion dysregulation. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 491–507). New York: Guilford Press.

Pears, K. C., & Moses, L. J. (2003). Demographics, parenting, and theory of mind in preschool children. *Social Development*, *12*, 1–20. doi:10.1111/1467-9507.00219

Pfohl, B., Blum, N., & Zimmerman, M. (1995). *The structured interview for DSM-IV personality disorders: SIDP-IV*. Iowa City: University of Iowa. Retrieved from http://scholar.google.com/scholar?q=related:82vkkJM2u4kJ:scholar.google.com/&hl=en&num=20&as_sdt=0,5&as_ylo=1995&as_yhi=1995

Posner, M. I., & Rothbart, M. K. (2000). Developing mechanisms of self-regulation. *Development and Psychopathology*, *12*, 427–441. doi:10.1017/S0954579400003096

Röll, J., Koglin, U., & Petermann, F. (2012). Emotion regulation and childhood aggression: Longitudinal associations. *Child Psychiatry & Human Development*, *43*, 909–923. doi:10.1007/s10578-012-0303-4

Rothbart, M. K., Michael, I. P., & Kieras, J. (2006). Temperament, attention, and the development of self-regulation. In K. McCartney & D. Phillips (Eds.), *Blackwell handbook of early childhood development* (pp. 338–357). Malden: Blackwell Publishing.

Rutherford, H. J., Wallace, N. S., Laurent, H. K., & Mayes, L. C. (2015). Emotion regulation in parenthood. *Developmental Review*, *36*, 1–14. doi:10.1016/j.dr.2014.12.008

Rutter, M. (1996). Transitions and turning points in developmental psychopathology: As applied to the age span between childhood and mid-adulthood. *International Journal of Behavioral Development*, *19*, 603–626. doi:10.1177/016502549601900309

Rutter, M., Pickles, A., Murray, R., & Eaves, L. (2001). Testing hypotheses on specific environmental causal effects on behavior. *Psychological Bulletin*, *127*, 291. doi:10.1037/0033-2909.127.3.291

Saarni, C., Campos, J. J., Camras, L. A., & Witherington, D. (2006). Emotional development: Action, communication, and understanding. In *Handbook of child psychology: Vol.3. Social, emotional and personality development* (pp. 226–288). New Jersey: John Wiley & Sons Inc.

Shelleby, E. C., & Shaw, D. S. (2014). Outcomes of parenting interventions for child conduct problems: A review of differential effectiveness. *Child Psychiatry & Human Development*, *45*(5), 628–645.

Slagt, M., Dubas, J. S., Deković, M., & van Aken, M. A. (2016). Differences in sensitivity to parenting depending on child temperament: A meta-analysis. *Psychological Bulletin*, *142*, 1068. doi:10.1037/bul0000061

Spear, L. P. (2009). Heightened stress responsivity and emotional reactivity during pubertal maturation: Implications for psychopathology. *Development and Psychopathology*, *21*, 87–97. doi:10.1017/s0954579409000066

Squires, J., Bricker, D. D., & Twombly, E. (2009). *Ages & stages questionnaires*. Baltimore, MD, USA: Paul H. Brookes.

Sroufe, L. A., & Rutter, M. (1984). The domain of developmental psychopathology. *Child Development*, *55*, 17–29. doi:10.2307/1129832

Steinberg, L., & Morris, A. S. (2001). Adolescent development. *Journal of Cognitive Education and Psychology*, *2*, 55–87. doi:10.1891/194589501787383444

Steinberg, L., & Silk, J. S. (2002). Parenting adolescents. In M. H. Bornstein (Ed.), *Handbook of parenting: Vol. 1: Children and parenting* (pp. 103–133). Mahwah, NJ: Lawrence Erlbaum.

Sturge-Apple, M. L., Davies, P. T., Cicchetti, D., Hentges, R. F., & Coe, J. L. (2017). Family instability and children's effortful control in the context of poverty: Sometimes a bird in the hand is worth two in the bush. *Development and Psychopathology*, *29*, 685–696. doi:10.1017/S0954579416000407

Sun, M., Vinograd, M., Miller, G. A., & Craske, M. G. (2017). Research Domain Criteria (RDoC) and emotion regulation. In C. A. Essau, S. S. LeBlanc, & T. H. Ollendick (Eds.), *Emotion regulation and psychopathology in children and adolescents* (pp. 79–110). Oxford: Oxford University Press.

Supplee, L. H., Skuban, E. M., Trentacosta, C. J., Shaw, D. S., & Stoltz, E. (2011). Preschool boys' development of emotional self-regulation strategies in a sample at risk for behavior problems. *The Journal of Genetic Psychology*, *172*, 95–120. doi:10.1080/00221325.2010.510545

Thomas, J. C., Letourneau, N., Campbell, T. S., Tomfohr-Madsen, L., & Giesbrecht, G. F. (2017). Developmental origins of infant emotion regulation: Mediation by temperamental negativity and moderation by maternal sensitivity. *Developmental Psychology*, *53*, 611. doi:10.1037/dev0000279

Thompson, R. A. (1994). Emotion regulation: A theme in search of definition. *Monographs of the Society for Research in Child Development*, *59*, 25–52. doi:10.1111/j.1540-5834.1994.tb01276.x

Thompson, S. F., Zalewski, M., Kiff, C. J., Moran, L., Cortes, R., & Lengua, L. J. (2020). An empirical test of the model of socialization of emotion: Maternal and child contributors to preschoolers' emotion knowledge and adjustment. *Developmental Psychology*, *56*, 418. doi:10.1037/dev0000860

Vanwoerden, S., Byrd, A. L., Vine, V., Beeney, J. E., Scott, L. N., & Stepp, S. D. (2021). Momentary borderline personality disorder symptoms in youth as a function of parental invalidation and youth-perceived support. *Journal of Child Psychology and Psychiatry*. doi:10.1111/jcpp.13443 (Advanced online publication).

Walden, T. A., & Smith, M. C. (1997). Emotion regulation. *Motivation and Emotion*, *21*, 7–25.

Williams, K. T. (1997). Expressive vocabulary test (2nd ed.) (EVT™ 2). *Journal of American Academy of Child Adolescent Psychiatry*, *42*, 864–872.

Wood, P. K. (2011). Developmental models for children's temperament: Alternatives to chronometric polynomial curves. *Infant and Child Development*, *20*, 194–212. doi:10.1002/icd.692

Wood, P. K., & Jackson, K. M. (2013). Escaping the snare of chronological growth and launching a free curve alternative: General deviance as latent growth model. *Development and Psychopathology*, *25*, 739–754. doi:10.1017/s095457941300014x

Woody, M. L., & Gibb, B. E. (2015). Integrating NIMH research domain criteria (RDoC) into depression research. *Current Opinion in Psychology*, *4*, 6–12. doi:10.1016/j.copsyc.2015.01.004

Zalewski, M., Musser, N., Binion, G., Lewis, J. K., & O'Brien, J. R. (2020). Relations of maternal borderline personality disorder features with preschooler executive functioning and theory of mind. *Journal of Personality Disorders*, *34*, 565–576. doi:10.1521/pedi_2019_33_412

Zanarini, M. C., Vujanovic, A. A., Parachini, E. A., Boulanger, J. L., Frankenburg, F. R., & Hennen, J. (2003). A screening measure for BPD: The McLean screening instrument for borderline personality disorder (MSI-BPD). *Journal of Personality Disorders*, *17*, 568–573. doi:10.1521/pedi.17.6.568.25355

Zelazo, P. D., & Carlson, S. M. (2012). Hot and cool executive function in childhood and adolescence: Development and plasticity. *Child Development Perspectives*, *6*, 354–360. doi:10.1111/j.1750-8606.2012.00241.x

Zelazo, P. D., & Cunningham, W. A. (2007). Executive function: Mechanisms underlying emotion regulation. In J. Gross (Ed.), *Handbook of emotion regulation* (pp. 135–158). New York: Guilford Press.

Zeman, J., Cassano, M., Perry-Parrish, C., & Stegall, S. (2006). Emotion regulation in children and adolescents. *Journal of Developmental & Behavioral Pediatrics*, *27*, 155–168. doi:10.1097/00004703-200604000-00014