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MOTHERS' EFFORTS TO EXTRINSICALLY REGULATE TODDLERS DURING A FRUSTRATING WAIT: IMMEDIATE AND LONGITUDINAL ASSOCIATIONS WITH TODDLERS' SELF-REGULATION

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Abstract

Multiple theoretical perspectives define self-regulation as a dynamic process characterized by deploying executive processes (EP) to limit, modulate, or change initial, automatic, or habitual prepotent responses (PR). As such, it is most strongly inferred when change in PR is shown to occur as a function of EP (Cole & Ram, 2015). Prevailing theory posits that self-regulation develops in early childhood as a result of parents' sensitive efforts to support children's emerging self-regulation (Kopp, 1982). Yet, few studies have explicitly tested parenting effects using dynamic (i.e., time-series) measures of children's EP and PR and parenting behaviors as they unfold during situations designed to tax children's regulatory skills.

This dissertation addresses this gap in the early childhood literature by modeling associations between children's EP and PR behaviors during a waiting task. We tested whether the association between 24 month-old children's EP and PR was strengthened by mothers' efforts to extrinsically support children's EP during the task. An expected inverse relation emerged between children's EP and PR (Cole, Bendezú, Ram, & Chow, unpublished manuscript). However, contrary to expectations, children's EP and the strength of the association between children's EP and PR decreased in the context of mothers' efforts to support children's regulation; furthermore, within-task estimates of mothers' influence on children's self-regulation did not predict children's self-regulation at 36 months of age. Associations between children's PR and EP at 24 months were not moderated by children's gender, temperament, maternal education, or family income. Results are discussed in terms of implications and directions for future research.

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Introduction

Self-regulation has emerged as a central concept in the psychological sciences; accumulating evidence has linked it to many indicators of mental and physical health and economic productivity across the lifespan (Duckworth & Seligman, 2005; Hofmann, Luhmann, Fisher, Vohs, & Baumeister, 2014; Moffitt, Arseneault, Belsky, & Dickson, 2011; Tangey, Baumeister, & Boone, 2004; Wagner & Heatherton, 2015). The literature has been wide-ranging and multidisciplinary, resulting in models of self-regulation informed by the developmental, clinical, cognitive, social, and biological psychology literatures (Carver & Scheier, 2000; Heatherton, 2011; Hofmann, Schmeichel, & Baddeley, 2012; McClelland, Geldhof, Cameron, & Wanless, 2015; Mischel, Cantor, & Feldman, 1996; Vohs & Baumeister, 2011). Some have called for integrating this work (National Institutes of Health, 2010) into an overarching theoretical model, with the aim of advancing understanding of self-regulation across the lifespan. The present study drew from a larger project sharing this aim (Cole & Ram, 2015).

The models of self-regulation cited above drew from many disciplines but shared an underlying emphasis on conceptualizing it as a dynamic process, unfolding over time and involving the ability to influence, i.e., inhibit, change, delay, modulate some prepotent response (PR) by deploying, i.e., engaging, activating, initiating an executive process (EP; Cole & Ram, 2015). PR encompasses automatic, habitual, and biologically primed behaviors, emotions, and thoughts triggered by specific environmental cues (e.g., fleeing when danger is detected, fighting when faced with an obstacle). EP is the use of higher-order frontal lobe functions, including memory, planning, reasoning, and directing attention, to tamp down, modulate, or limit the execution of a PR given situational factors rendering PR unsafe or unacceptable. Lifespan examples include young children learning to share instead of hitting, teenagers reminding themselves of career goals when they're tempted to skip homework, or adults taking a deep breath and smiling at a frustrating boss to remain professionalism. Each of these examples includes changing an initial PR (hitting, avoiding difficult/boring tasks, or fighting with someone) using an executive process (behavioral inhibition, memory and planning, monitoring one's physiological state and controlling one's emotion expression) to meet situational demands.

Given the definitional emphasis on self-regulation as *change,* more work has focused on modeling the dynamic properties of self-regulation, i.e. changes in the level and rate of change in indices of EP and PR across time; evidence that EP changes PR, and vice versa, strengthens the inference that regulation occurred (Cole, Bendezú, Ram, & Chow, unpublished manuscript; Cole, Martin, & Dennis, 2004; Thompson, 1994). Evaluation of nuanced changes in behavior can be investigated by taking advantage of time-series data generated in observational research designs. Specifically, observations of children in laboratory tasks designed to elicit emotional reactions (e.g., anger, fear) are usually coded by classifying putative regulatory behaviors in brief intervals. These time-series provide information on the dynamic flow of prepotent responses evoked by the task and behavioral indices of executive processes. In the present study, we used this theoretically- driven conceptualization of self-regulation to mathematically model associations between behavioral indices of children's PR and EP across time, generating within- and between-child estimates of regulatory performance.

Moreover, we drew from a theoretical framework on the development of self-regulation (Kopp, 1982; 1989) asserting that parental influences in early childhood contribute to the quality of children's self-regulation as they enter preschool age. The dissertation tested whether mothers' support of children's EP in the service of limiting PR predicted child self-regulation at 36 months of age. We focused on early toddlerhood, when children demonstrate inchoate signs of self-regulation and variability in their regulatory capacities (Kopp, 1982, 1989).

Developmental models of self-regulation in early childhood assumed parents support children's emerging self-regulation by extrinsically regulating children when they cannot regulate themselves (Calkins, 1994; Kopp, 1982; Thompson, 1998). Examples include cuddling distressed infants, reminding impatient toddlers to wait, and telling preschoolers not to grab others' toys. Broadly, these and other parenting strategies used have been categorized as directing, defined as giving commands, i.e., "do this," "don't do that", and structuring, i.e., encouraging children to use their own skills to self-regulate. The frequency of parenting strategies used and general parenting sensitivity, i.e., responding creatively in meeting children's needs, have each been associated with children's self-regulatory abilities (Braungart-Rieker, Garwood, Powers, & Notario, 1998; Halligan, Cooper, Fearon, Wheeler, Crosby, & Murray, 2013).

Few studies have assessed both the frequency and sensitivity of parents' efforts to extrinsically regulate children during situations specifically designed to tax children's self-regulation. Parenting strategies and/or sensitivity and children's regulation often have been assessed in different situations, or within the same situation but with different measures (e.g., a rating scale for parenting and observational coding for children), or with measures too general to detail more than correlations. These approaches cannot demonstrate how dyads navigate challenging situations as such situations unfold.

This limitation is of theoretical concern, given the need to test the assumption that parenting is a mechanism of self-regulatory development, and also is of practical interest. Many clinical interventions aim to promote children's regulatory abilities via parenting (e.g., Webster-Stratton, Reed, & Hammond, 2004). Studies tracking both parenting and child regulation simultaneously during challenging situations have allowed for measurement of parents' and children's influences on each other and added to our knowledge of the optimal timing of parents' efforts to extrinsically influence children's regulation (Chow, Haltigan, & Messinger, 2010; Cole & Ram, 2015; Dumas, Serketich, & LaFreniere, 1995; Hollenstein & Lewis, 2006; Lunkenheimer, Olson, Hollenstein, Sameroff, & Winter, 2011; Moore, Hill-Soderlund, Propper, Calkins, Mills-Koonce, & Cox, 2009; Roben et al., 2015). This dissertation aimed to contribute another such study by synthesizing parent and child behavioral observations during a frustration challenge, and modeling associations between parents' efforts to extrinsically regulate children and changes in children's self-regulation.

In addition to parenting, other factors likely contribute to regulatory development, including intrinsic child factors, such as gender and temperament (Crouter & Booth, 2003; Fox & Calkins, 2003). These factors likely influence the extent to which parental efforts successfully change the association between child PR and EP, either in the moment or cumulatively across early childhood. For example, children with more difficult temperaments, characterized by high negative affectivity and low effortful control, may be more overwhelmed by challenges and less responsive to parental efforts than children with the inverse profile (Calkins & Johnson, 1998; Kim & Kochanska, 2012; Spinrad, Stifter, Donelan-McCall, & Turner, 2004). Additionally, broader factors like maternal education and family resources may influence the frequency and sensitivity of parental efforts to extrinsically regulate children (Morris, Silk, Steinberg, Myers, & Robinson, 2007). In sum, intrinsic child and family factors may amplify or dampen overall parenting effects on child self-regulation. Consequently, we aimed to parse the independent effects of parenting by quantifying parents' influence on children's regulation after accounting for intrinsic child and family factors.

Finally, researchers have proposed that parents' frequent and sensitive efforts to extrinsically regulate young children are associated with children's fully achieving self-regulation, i.e., using EP to modulate PR without needing parental support (Calkins, 1994; Kopp, 1982; Thompson, 1998). However, longitudinal studies of associations between parenting and children's self-regulatory dynamics in early childhood have been few in quantity, utilized a diverse range of methodological approaches, and have mixed findings (Grolnick, Bridges, & Connell, 1996; Halligan et al., 2013; Spinrad et al., 2004). We extended these findings by testing whether dyad-specific differences in parenting effects predicted children's independent regulation at preschool age.

Precursors to Self-Regulation

By 4 years of age, most children display the hallmarks of self-regulation; they can wait, delay gratification, inhibit behavior, reflect on consequences of their actions, remember what expectations given different situations, and initiate EP without caregiver support (Brownell & Kopp, 2007). Self-regulatory performance is essential to school readiness; at school, children must wait, share, follow directions, and tolerate adult direction (Eisenberg, Valiente, & Eggum, 2011; Ursache, Blair, & Raver, 2012). Preschoolers' self-regulation has been associated with behavioral adjustment, positive peer interactions, and academic performance (Blandon, Calkins, Grimm, Keane, & O'Brien, 2010; Degnan, Calkins, Keane, & Hill-Soderlund, 2008; Keenan, 2000; Lindsey, Cremeens, Colwell, & Caldera, 2008). To achieve self-regulation, children proceed through five developmental stages. These stages, i.e., *neurophysiological modulation* (0 to 2 months), *sensorimotor modulation* (3 to 12 months), *control* (12 to 18 months), *self-control* (18 to 24 months), and *self-regulation* (26 to 48 months), are marked by qualitative changes in limiting, changing, and modulating PR (Kopp, 1982). Each stage has been linked to particular aspects of neurological, sensorimotor, cognitive, and self-identity development (Posner & Rothbart, 2000). The present study focused on the transition from the self-control to self-regulation stages.

We briefly review the first three stages to provide context for discussion of the target stages. In the *neurophysiological modulation* stage, infants use reflexive and instinctual behaviors, e.g., non-nutritive sucking, to limit overstimulation. In the *sensorimotor modulation* stage, infants' vision becomes clearer and they learn to reach and grasp. They consequently begin to perceive, manipulate, and connect their actions to objects and people (Kopp, 1982). As they enter the second year of life, children reach the *control* stage and begin to show approximations of self-regulatory behaviors (Kopp, 1982). Children have developed attachments and as such are motivated to comply with caregivers (Kochanska, Coy, & Murray, 2001). They use emerging higher-order executive functions (Posner & Rothbart, 2000) to do so, but require explicit signals to engage in control behaviors, because they cannot adapt their behavior across different situations. Children are just starting to walk at this stage, and consequently have a strong impulse to explore their environment, even if it is unsafe to do so.

Between 18 and 24 months old, children enter the *self-control* stage (Kopp, 1982; Vaughn, Kopp, & Krakow, 1984), the focus of the present study. In this stage, children are able to see others' perspectives (Carlson, Mandell, & Luke, 2004) and use language to enhance representational thinking. They have a sense of self and display self-conscious emotions like shame and pride (Kochanska, Gross, Lin, & Nichols, 2003). They also demonstrate improved memory and attentional control (Ruff & Rothbart, 1996). Consequently, they demonstrate signs of self-regulation; they remember rules and limits, assess their own actions relative to caregivers' expectations, and retain knowledge of social norms. However, they have not yet *fully* achieved self-regulation because, as a group, their abilities to *consistently* modulate PR, *flexibly* adapt to new situations, *adjust* when a regulatory strategy is ineffective, and *maintain* EP during delays are limited (Vaughn, Kopp, Krakow, Johnson, & Swartz, 1986). Children in this stage particularly struggle to maintain control when their goals and desires are blocked, i.e., not gratified immediately (Sullivan & Lewis, 2012). This happens often. Toddlers have greater mobility, a burgeoning sense of themselves as agentic, and a consequent strong desire for autonomous exploration and activity ("Let me do it!"). However, they are not yet skilled at evaluating the safety or social appropriateness of a PR (Brownell & Kopp, 2007). They will run after a ball bouncing into the street, demand candy before dinner, and refuse to wait their turn.

As a result, parents begin to set and enforce limits around safe and socially acceptable behaviors in toddlerhood (Thompson, 1998), but parents' limit-setting blocks the immediate gratification of children's goals and desires ("Want it NOW!"). Per the functional emotions perspective (Barrett & Campos, 1987), doing so is likely to evoke anger, an emotion that readies the body's prepotent responses to overcome obstacles. Young children's low-intensity anger has been associated with more attempts to surmount challenges (Dennis, Cole, Wiggins, Cohen, & Zalewski, 2009). High-intensity anger expressions peak in toddlerhood, particularly in the context of temper tantrums (Potegal & Davidson, 2003; Potegal, Kosorok, & Davidson, 2003).

A major developmental goal of this stage is to learn to regulate the prepotent responses to blocked goals, i.e., anger and immediately indulging one's wants; children must learn to express anger appropriately, modulate anger to take socially appropriate and safe actions to overcome obstacles, and tolerate adult limits (Cole, Hall, & Hajal, 2013; Cole, Teti, & Zahn-Waxler, 2003; Kopp, 1989). Given the importance of regulating anger during delays, we assessed toddlers' self-control during a laboratory task in which mothers asked them to wait to open a desirable gift. This task created a situational demand for children to wait patiently until a goal (opening the gift) was no longer blocked (because permission to open the gift was granted). In prior work this task has elicited children's anger and challenged their regulatory abilities (Block & Block, 1980; Vaughn et al., 1986; Cole et al., 2011).

The meaning of emotion regulation, like that of self-regulation, has evolved over time with multidisciplinary and multi-method approaches to its study (Campos, Frankel, & Camras, 2004; Cole et al., 2004; Goldsmith, Pollak, & Davidson, 2008; Gross, 1998, 2013; Thompson, 1994). Like self-regulation, emotion regulation is conceptualized as a dynamic process unfolding over time; unlike self-regulation, emotion regulation *specifically* focuses on deploying EP to modify, change, or adjust the intensive and temporal features of emotional PR (Cole et al., 2004; Thompson, 1994). Per Kopp (1989), self-regulation involves caregivers' teaching children social conventions; as such, emotion regulation and self-regulation are distinct in infancy, as infants are expected to display intense emotions. However, the concepts merge in the toddler period, when emotion expressions are more volitional, upheavals are more intense and unmanageable, and caregivers aim to teach emotion display rules (Thompson, 1998). As in the study of self-regulation, there have been consistent calls to assess emotion dynamics, that is, change in emotional expressions and other indices of emotional experience across time, during emotionally evocative situations, rather than collecting more static measures of emotional experience (i.e., questionnaires) that may be biased or limited in providing novel information (Cole et al., 2004; Thompson, 1994).

Strategies children use to attempt to regulate anger during delays include self-soothing, distracting themselves from desired objects, and bidding to adults for support or information (Buss & Kiel, 2004; Cole et al., 2011; Kochanska et al., 2001; Mangelsdorf, Shapiro, & Marzolf, 1995). Studies using contingency analyses have established group-level associations between these regulatory strategies and subsequent decreases in anger expressions, strengthening the inference that strategy use reflects deployment of EP to self-regulate (Buss & Goldsmith, 1998; Crockenberg & Leerkes, 2004; Diener & Mangelsdorf, 1999; Ekas, Braungart-Rieker, Lickenbrock, Zentall, & Maxwell, 2011; Grolnick et al., 1996). However, few studies have explored individual differences in these associations; doing so with older children in our sample yielded new insights into concurrent associations between regulatory processes, temperament, and externalizing problems (Cole et al., unpublished manuscript). We extended this work by modeling within- and between-child associations between younger children's regulatory strategies (EP) and anger and desire for the gift (PR) during the wait.

Given prior contingency analyses, we expected an overall inverse association between children's EP and PR, indicating that increasing anger and focus on the gift triggered deployment of regulatory strategies, which subsequently decreased anger and focus on the gift. However, we also expected significant variability between- and within-children, because we know that children in this stage demonstrate signs of self-regulation, but are not yet mature and consistent regulators. We expected that even those children with relatively strong regulatory abilities, demonstrated by regulatory successes, may falter (i.e., deviate from inter-average) when they reach the limits of their regulatory abilities (Braungart-Rieker, Garwood, Powers, & Wang, 2001; Kopp, 1989), experiencing regulatory failures (Cole et al., 2013; Kopp, 1989).

One type of failure is *regulatory ineffectiveness;* PR overwhelms EP. Toddlers have more difficulty initiating distractions than older children, and bid to adults in an angrier tone, indicating that intense anger may override successful use of regulatory strategies (Cole et al., 2011; Kochanska et al., 2001; Mangelsdorf et al., 1995). Once toddlers initiate a regulatory strategy, they may also experience *regulatory interference,* when strategy use fails to curb anger or desire for the gift (Cole et al., unpublished manuscript). In the present study, we modeled how children's PR and EP were associated in short intervals (15 second epochs) within the challenging wait, such that we captured regulatory successes (epochs in which EP and PR were strongly associated) and failures (epochs in which EP and PR were weakly associated) for each child. We then tested whether parental efforts to extrinsically regulate children strengthened these moment-to-moment associations between children's EP and PR.

Parents as Extrinsic Regulators of Young Children

The idea that parents externally regulate children has been infused throughout conceptualizations of self-regulation in early childhood; e.g., Kopp (1989) wrote, "infants and young children must have external support for regulating their emotions" (pp. 345). Definitions of regulation have included "extrinsic or intrinsic" regulatory influences (Cole et al., 2004; Fox & Calkins, 2003; Gross, 1998, 2013; Thompson, 1994); extrinsic influences are thought to operate across the lifespan (e.g., adult romantic partners influence each other) but may be especially important in early childhood because intrinsic EP has not fully developed (Calkins, 1994).

Children are most dependent on adults for extrinsic regulation in infancy, when caregivers have been shown to engage in close face-to-face interactions that help modulate children's emotional states and physiological arousal (Feldman, 2007; Tronick, Cohn, & Shea, 1986). As children learn to walk and talk in toddlerhood, they are driven to explore, try new things, and test limits and boundaries, but need their parents to teach them how to do so safely and appropriately. Children's newfound desire for autonomy changes parents' daily experiences as well; instead of participating in the frequent, intimate, and more parent-driven face-to-face interactions of infancy, parents must adjust to allowing children some leeway to explore or manage situations independently, monitoring children's attempts to do so, and judging when and how to intervene if children become unsafe, inappropriate, or overwhelmed (Brownell & Kopp, 2007; Thompson & Goodvin, 2007).

The wait task presents such a situation to parents. Rather than being encouraged to interact with their children for the entire task (as in reading or free play tasks), the wait task required mothers to remain with children, but to complete “work” (questionnaires) and otherwise do whatever they would normally do when children need to wait for something they want. Mothers could therefore allow children to wait independently, monitor how they were doing, and choose to intervene if they wished. Preliminary contingency analyses indicated that mothers shifted their attention away from work and toward children in response to both increases and decreases in children’s PR (LeDonne & Cole, 2012), establishing that all mothers attended to children during the wait, and encouraging further exploration of how mothers’ interactions related to changes in children’s PR. We did not examine associations between children’s use of regulatory strategies (EP) and changes in mothers’ attention. In addition to intervening when children become overwhelmed, i.e., when PR is increasing, mothers may also attempt to support children in sustaining regulatory efforts. To our knowledge, this will be the first study to examine dynamic associations between mothers’ parenting behaviors and toddlers’ PR *and* EP during a challenging task.

In moments when children become unsafe, inappropriate, or overwhelmed while waiting, parents may not only need to turn their attention toward children, but also instruct, set limits, or encourage alternative strategies; in other words, they direct and structure children in an effort to encourage their regulatory development (Grolnick, Kurowski, McMenamy, Rivkin, & Bridges, 1998; Morris, Silk, Morris, Steinberg, Aucoin,

& Keyes, 2011; Putnam, Spritz, & Stifter, 2002). *Structuring* entails parental attempts to harness and support children's emerging regulatory skills using emotional tone (e.g., changing tone of voice to attract attention), physical movement (e.g., pointing to something), or language (e.g., encouraging distraction or reasoning). It involves encouraging children to *do for themselves* rather than *doing for* them. For example, if children must wait, parents might prompt them to create a game to distract themselves, rather than choosing a game and directing them in to play it. Our definition of structuring extended the construct of scaffolding (Vygotsky, 1978) defined as parents' supporting the *successful* execution of advanced tasks children could not manage alone. We defined structuring as any parental attempt to encourage children's use of regulatory skills, regardless of whether children were immediately successful. Casting a wider net allowed us to statistically model how often structuring was associated with changes in children's PR and EP (coded by separate teams) rather than requiring our coders to judge parenting and whether subsequent child changes occurred. It has often been assumed that parents' efforts influence how children's PR and EP unfold during a challenging situation, but, as noted, few studies have tested these associations.

Parents' attempts to structure children may be unsuccessful if they are not sensitive, i.e., appropriate to children's immediate concerns and developmental level. Given this, we coupled our rating of whether or not structuring occurred with a rating of its sensitivity. Sensitivity has been broadly associated with positive outcomes for young children, including improved regulation when frustrated (e.g., Braungart-Reiker et al., 1998; Halligan et al., 2013) and inhibition and attention control during standardized cognitive assessments (Cevas, Deater-Deckard, Kim-Spoon, Watson, Morasch, & Bell, 2014). In the wait, children whose mothers engaged in sensitive structuring were better regulated, regardless of the specific strategy used (Spinrad et al., 2004). Indeed, parenting strategies deployed in a non-sensitive manner may not optimally encourage child self-regulation; mothers who suggested a distraction *and* helped children begin the distraction if needed had better-regulated children than mothers who suggested a distraction but did not help children begin if needed (LeCuyer and Houck, 2006). Both mothers structured, but the former were more sensitive and thus may have had a greater impact than the latter. Other studies (e.g., Spinrad et al., 2004), but not many, included both frequency and sensitivity of structuring; we did so in the present study because both frequency and sensitivity have been shown to independently predict children's regulatory development.

Structuring was distinguished from directing, defined as giving a command or prohibition without targeting regulatory abilities, or changing the physical environment to limit frustration (e.g. moving gifts out of children's view). Directing is external regulation, in that it changes children's emotions or behaviors, but, because parents "do for" children, directing may be less helpful in promoting emerging *independent* regulation (Calkins & Johnson, 1998; LeCuyer & Houck, 2006). Directing is not necessarily problematic; parents likely use a mixture of structuring and directing in everyday life depending on situational demands. In the present study, we included directing but weighed it less than structuring in our overall scoring of maternal behaviors.

The evidence that structuring, scaffolding, and other related parenting behaviors (e.g., "positive controls"; Karreman, van Tuijl, van Aken, & Dekovic, 2006) promote improved child self-regulation has been mixed. Meta-analytic studies (Karreman et al., 2006) found small effects of parenting on children's self-regulation, though the wide age range (2-5 years) analyzed may wash out stronger effects at critical junctures in regulatory development, e.g., as children shift from the self-control to self-regulation stages in their third year (Kopp, 1989). Studies reporting within-task associations between children's self-regulation and parenting found more frequent parental support to be associated with frequency of child regulatory strategies (Calkins & Johnson, 1998) and compliance (Blandon & Volling, 2008) when in parents' presence and longer delay of gratification when parents were absent (Denham, 1993). Others found, after controlling for age differences, that children whose mothers made more frequent regulatory attempts during a wait had children who were *less* able to regulate independently (Grolnick et al., 1998). Given that most find associations between parenting behavior and children's regulatory attempts, we hypothesized that the association between children's EP and PR would be stronger in moments when mothers sensitively structured children's efforts to wait compared to when they did not.

Longitudinal studies pertain to the present study's final goal, i.e., predicting children's self-regulation based on parenting effects at earlier ages. In a small sample (*N* = 43) of mother-toddler dyads, Spinrad and colleagues (2004) found that whether or not mothers intervened in an effort to regulate toddlers' emotions during laboratory challenges was associated with toddlers showing fewer negative expressions in a disappointment task at 5 years of age. Mothers who did not attempt to regulate toddlers' emotions ultimately had preschoolers who struggled more to handle the disappointment. However, findings were constrained by the small sample size, which did not permit analysis of dyadic differences in parenting or children's regulation, and by the analysis of overall frequency scores, which did not permit examination of whether mothers were responding to changes in child PR, EP, or both.

Studies of samples of low-income children and families found that maternal positive control when children were age 3.5 was correlated with more frequent use of regulatory strategies in challenging tasks at age 6 (Gilliom, Shaw, Beck, Schonberg, & Lukon, 2002), that maternal sensitivity at an 18 month free play was associated with longer latencies to anger and more frequent use of regulatory strategies in frustration challenges at age 5 (Halligan et al., 2013), and that supportive parenting was associated with the average level and rate of change in children's emotion regulation across preschool (Bockneck, Brophy-Herb, & Banerjee, 2009). Other findings linked supportive parenting in toddlerhood to social competence but not to longer delays of gratification by preschool age (LeCuyer & Houck, 2006). Findings were likely mixed due to diverse approaches to conceptualizing and measuring parenting (i.e., examining only strategies, only sensitivity, or both) and children's outcomes. Several studies measured parenting and children's regulation in separate tasks (e.g., Bockneck et al., 2009; Dagne & Snyder, 2009; Halligan et al., 2013), rather than assessing parents' *in vivo* attempts to help children navigate frustration challenges (Grolnick et al., 1998; Spinrad et al., 2004). To address these concerns, we created a composite measure of parenting that incorporates both whether structuring occurred and its sensitivity, and measured parenting and children's regulation simultaneously during the wait.

Another measurement issue was when outcome measures of children's self-regulation were derived from observations of children completing intellectual functioning tests (e.g., Bayley Scales of Infant Development). While these tests include an emotion regulation rating scale, they were not designed to tax emotion regulation, and may have introduced confounds. For example, total testing time and items administered vary according to intellectual functioning (e.g., having very fast or slow processing speed) such that children may have been exposed to the test for different amounts of time and difficulty levels. To avoid these issues, we used a laboratory assessment explicitly designed to tax young children's anger regulation and administered for the same amount of time (8 minutes). It used standard instructions for all dyads at both our initial assessment (24 months child age) and outcome stages (36 months child age; Block & Block, 1980; Vaughn et al., 1986). We expected that children whose self-regulation was influenced by parents' regulatory efforts during the 24 month wait would independently initiate more regulatory strategies at 36 months than children whose parents' efforts were weakly associated with 24-month self-regulation.

Alternative Explanations

Though parents may drive socialization of children's emotion regulation, the exchange is not unidirectional. The transactional model proposed child outcomes to be products of continuous, reciprocal, and bidirectional transactions between children, caregivers, and the environment over time (Sameroff, 2009). Children's characteristics shape caregivers' responses to them and overall developmental trajectories. Failing to account for these child factors may contribute to the misinterpretation of parents' effects on children's development (Bell, 1979; Crouter & Booth, 2003).

The transactional model describes ontogenetic development, but can also be applied to microsocial exchanges that develop into reinforced patterns of interpersonal behavior over time (Dix, 1991; Reis, Collins, & Berscheid, 2000; Sameroff, 2009) to influence children's regulatory development (Eisenberg, Cumberland, & Spinrad, 1998; Morris et al., 2007; Thompson, 1994). One important influence on microsocial interactions may be how the intensity of children's responses to challenges influences parenting behaviors. For example, in an arm restraint task, parents used more extrinsic regulatory strategies when their toddlers displayed longer and more intense distress during the restraint than others (a between-dyad effect; Mirabile, Scaramella, Sohr-Preston, & Robison, 2009). Less is known about the extent to which parents increase their attempts to extrinsically regulate toddlers when toddlers' PR rises above their typical level, regardless of whether they are more or less reactive than other toddlers (a within-dyad effect). Children who are able to manage the task well overall compared to other children may still falter and become frustrated; in those moments, parents may chose to intervene or not. Our multilevel modeling approach teases apart these between- and within-dyad effects and clarifies the implications of in-the-moment parenting responses for toddlers' long-term regulatory development.

The extent to which children are extrinsically regulated may also be influenced by children's overall tendencies toward reactivity or inhibition across a variety of situations, i.e., their temperament (Calkins & Johnson, 1998; Rothbart & Bates, 2006). The dimensions of Negative Affectivity (NA) and Effortful Control (EC) have been associated with toddlers' anger expressions and regulatory efforts when frustrated (Tan, Armstrong, & Cole, 2013) and have been theorized to be one intrinsic factor contributing to self-regulatory development (Fox & Calkins, 2003). However, few studies have examined associations between temperament, children's regulation, and parenting behavior during challenging delays with toddlers.

In interpreting their finding that more maternal regulatory attempts were associated with poorer child regulation, Grolnick and colleagues (1998) posited that mothers decide whether to attempt to regulate children's waiting behavior based on prior experiences with how children generally handled waiting. That is, mothers with more generally reactive children may make more regulatory attempts, while mothers with more controlled children may adopt a "wait-and-see" approach. To explore whether mothers' perceptions of children's general tendencies toward reactivity or inhibition influence parenting behavior during the wait, we included maternal ratings of child NA and EC at 18 months as covariates. Thus we assessed the predictive utility of examining within-task associations between parenting and children's self-regulation by testing whether they predict children's longitudinal regulatory development over and above maternal perceptions of children's general reactivity or inhibition.

We also considered gender effects because of prior documentation of small but statistically significant differences in PR and EP. Boys overall displayed more anger expressions and used fewer regulatory strategies in frustrating tasks than girls, though differences were most pronounced in at-risk samples (Chaplin & Aldao, 2013; Chaplin, Cole, & Zahn-Waxler, 2005; Cole, Zahn-Waxler, & Smith, 1994; Silk, Shaw, Skuban, Oland, & Kovacs, 2006). Furthermore, children's gender predicted parenting behavior, though findings were mixed. Some studies reported that parents discouraged girls' expressions of anger and frustration more than boys' (Chaplin et al., 2005), particularly in low-income samples (Chaplin, Casey, Sinha, & Mayes, 2010). However, gender differences in the association between parenting and children's regulation have not emerged in other low-income samples (Bockneck et al., 2009).

Finally, longitudinal samples have skewed toward either middle- to high-income families (LeCuyer & Houck, 2006; Spinrad et al., 2004) or very low-income urban families with children identified as at risk for behavior problems (Bockneck et al., 2009; Gilliom et al., 2002; Halligan et al., 2013). The present study added to the diversity of families represented in the literature by drawing from a sample of typically-developing children growing up in economically strained (above the national poverty line but below median income) rural families. In general, higher income and maternal education have predicted more sensitive parenting and better child self-regulation, but associations have been strongest in very low-SES samples (Garner & Spears, 2000; LeCuyer-Maus & Houck, 2002; Mirabile et al., 2009; Tamis-LeMonda, Briggs, McClowry, & Snow, 2009), and less consistent in high-SES samples (e.g., Ekas et al., 2011; Hoffman, Crnic, & Baker, 2006). In our economically strained (but not very poor) and rural sample, lower income-to-needs ratio (INR, a measure of family resources given national standards) but not maternal education, predicted longer child anger bouts in the wait (Tan et al., 2013). In another strained sample, both low INR and maternal education were associated with more negative parent-child interactions (Lindsey et al., 2008). To account for possible differences in associations due to socioeconomic factors, we included INR and maternal education as covariates in our models.

In sum, the mixed findings require further investigation of whether and how parents' efforts to extrinsically support children's regulation actually do change, modulate, or influence behavioral indices of children's PR and EP. Taking a dynamic approach, i.e., evaluating of the level and rate of change in children's PR and EP behaviors in concert with maternal efforts to help children regulate in an emotion-eliciting situation, was necessary to determine the strength of parenting effects in micro-social transactions and their import for children's outcomes. Evidence that parents' extrinsic regulatory efforts change children's EP and PR as a challenging situation unfolds strengthens the inference that parents influence children's regulation from moment-to-moment, supporting the assertion that microsocial patterns accumulate over time to help children learn to self-regulate (Chow et al., 2010; Cole et al., 2004; Thompson, 1994).

The present study mathematically modeled changes in children's PR and EP as a function of mothers' efforts to support EP and reduce PR across a task designed to elicit children's frustration (a PR) and regulatory strategies (EP) while asking mothers to remain with their children but do whatever they would normally do when children have to wait. This generated precise estimates of the extent to which parents externally regulated children's anger and desire for an attractive gift during a challenging wait, while controlling for alternative explanations. We expected that children's EP and association between children's EP and PR would increase in the presence of mothers' attempts to extrinsically regulate children's emotions and behaviors via directing and sensitive structuring.

Methodological Considerations

Despite evidence that parents serve as extrinsic regulators of children's emotion expressions and behaviors, there are methodological limitations to extant research. Certain measurement approaches have limited ability to advance our understanding of regulatory processes. Evaluating the appropriateness of emotional expressions and strategies requires situating them in context (Campos et al., 2004). Yet, rating scales required parents to give general answers about overall tendencies, summarizing across a number of different emotional situations (e.g., Eisenberg et al., 1998). This may increase reporter biases (Schwarz, 2007). Rating scales also do not distinguish among different aspects of emotion regulation, such as frequency, intensity, duration, and forestalling of emotional responses, though these temporal variables differentially predict children's outcomes (Cole et al., 2011; Hernández et al., 2015; Thompson, 1994). Similarly, global ratings of children's regulatory abilities or parents' sensitivity (e.g., Ensor, Roman, Hart, & Hughes, 2012; Martin, Clements, & Crnic, 2002; Newland & Crnic, 2011) do not yield temporal information, such as how the association between PR and EP varies within and between children and how parents respond to variations.

Given that self-regulation has been conceptualized as a dynamic process involving change in both PR and EP (Cole et al., unpublished manuscript; Cole et al., 2004; Thompson, 1994), many have noted the potential of moving beyond static "flat" measures to examine regulatory dynamics (e.g., Buss & Goldsmith, 1998; Crockenberg & Leerkes, 2004; Gilliom et al., 2002). Doing so tests whether putative regulatory strategies are followed by subsequent changes in emotion, allowing for stronger inference of regulation. Examining correlations between frequency scores can mask these associations. For example, prior work (LeDonne, 2012) did not find a significant association between frequency of children's and mothers' anger expressions in the wait. We might have concluded that maternal anger expressions did not influence children's anger expressions in the task, a surprising result given prior work on dyadic mutuality

(Deater-Deckard & Petrill, 2004). However, when we examined temporal contingencies, we found that changes in toddlers' anger expressions were more likely after maternal anger expressions than other maternal expressions or behaviors, implying the more nuanced interpretation that though the overall frequencies were not correlated, when mothers did express anger it still influenced children's subsequent expressions.

Contingency analyses (Bakeman & Gottman, 1997) move beyond questionnaire measures, but have also been limited by assessing only group-level likelihoods of decreases in emotion expressions following strategy use. Multiple contingency tests increase the likelihood of statistical errors and fail to account for interdependence. Calculating variables describing temporal qualities of emotion expressions and behaviors (e.g., latency, duration, or frequency scores) and generating their associations (e.g., Cole et al., 2011; Lindsey et al., 2008; Nelson, O'Brien, Grimm, & Leerkes, 2013) has been limited by concerns that the interpretation of one descriptive variable can change when considered in light of the others. For example, two children may have the same anger latency but differ in duration; a child who is quick to anger but recovers quickly would have the same latency as a child who quickly angers but stays angry for the remainder of the task. A clinician or parent might not be concerned for the former child, but may be for the latter. Indeed, it is important to consider multiple temporal measures when predicting child regulatory outcomes (Hernández et al., 2015).

In the present study, we built on prior work by utilizing multilevel modeling to estimate within- and between-dyad differences in associations between PR and EP, generating precise estimates of the associations between children's PR, EP, and parents' extrinsic efforts for each dyad (Bryk & Raudenbush, 1992). This allows us to model children's regulatory processes and parents' attempts to influence those processes across the frustrating wait. Application of such models has been fruitful in modeling dynamic processes in other disciplines (as discussed in Ram & Pedersen, 2008) and, in child psychology, has been used to examine emotion regulation processes in older children (Morris et al., 2011), finding mothers' strategies to be followed by decreases in children's anger and sadness (Morris et al., 2011). It is consistent with other emerging work modeling self- and co-regulation dynamically (Boker & Laurenceau, 2006; Chow, Ram, Boker, Fujita, & Clore, 2005; Dagne & Snyder, 2009, 2011; Helm, Sbarra, & Ferrer, 2012; Ram & Pederson, 2008).

The Present Study

In the present study, we used a multilevel modeling approach to model the dynamics of children's self-regulation, i.e., the association between children's PR (anger expressions, focus on the gift) and EP (distraction, bids for adult support or information), during a challenging wait at 24 months child age. At this age, children demonstrate inchoate signs of self-regulation, yet still have difficulty tolerating blocked goals (i.e., not being able to open the attractive gift) and delays (i.e., waiting). Consequently, it is an opportune age to measure variability in self-regulation, quantified as the association of children's EP and PR, within and between children. Given prior literature, we expected a group-level inverse association between children's PR and EP. However, we also expected children to experience regulatory failures (deviations from their within-task average EP and PR association) given that at this age, they have not achieved regulation without parental support.

Parents have been thought to serve as extrinsic regulators of children's emotion and behaviors during early childhood (Fox & Calkins, 1994). In our study, 24 month-old children were required to wait while mothers worked. This situation taxes children's regulatory abilities. If children's tolerance for the wait wanes, either because they are overwhelmed by frustration or desire for the gift (i.e., PR increases), or they cannot sustain a regulatory strategy, (i.e., EP decreases), parents intervene to encourage children's self-regulation using directing or structuring behaviors. We expected that sensitive efforts to do so would strengthen the within-epoch and within-dyad associations between children's EP and PR, after accounting for intrinsic child factors (gender, temperament) and family factors (maternal education and family income relative to needs). We further predicted that dyads with stronger parenting effects at 24 months would have children better able to manage another wait at 36 months.

Method

We used data from the Development of Toddlers Study (D.O.T.S.), a longitudinal investigation of emotion regulation development in early childhood (Cole, Nelson, Crnic, & Blair, 2000). Participating families completed four in-home visits when children were 18, 30, 36, and 42 months of age and five laboratory visits when children were 18, 24, 36, and 48 months and 5 years of age. For the present study, we used data collected during the 24- and 36-month laboratory visits.

Recruitment and Enrollment

Eligibility criteria. Recruited families had an 18 month-old (+/- 2 weeks) child at the first home visit that had lived with caregivers since at least 3 months of age and did not have any disabilities that interfered with participation (e.g., hearing problems, autism). Eligible families had an annual household income above the poverty line (as defined by the United States government; United States Census Bureau, 2001-2003), and at or below the national median income for the family's size. Researchers selected families in this income range because they were underrepresented in the literature and had vulnerabilities and strengths relevant to children's emotional development.

Recruitment procedures. To recruit eligible families, the Penn State Population Research Institute identified census tracts within a half-hour drive of the University and had a high proportion of households with (a) young children and (b) income within the target range. Undergraduate research assistants (RAs) then searched local newspapers for birth announcements while graduate students and investigators contacted community leaders (clergy, daycare providers, preschool administrators, pediatricians, and local officials) to familiarize them with the study. Letters were sent to families who lived in or close to the identified communities who, per published birth announcements, had one child in the family reaching 18 months of age during the study's recruitment period; these letters were followed up by a phone call from the project coordinator. Additional recruitment efforts were (1) distributing flyers at local events, including health and Head Start fairs and town festivals, and (2) accepting word of mouth referrals from participating families. Interested families completed a phone screening with the project coordinator to confirm meeting eligibility requirements, including collecting information about family income. If the family was eligible to participate, the project coordinator collected more demographic information. These recruitment strategies led to enrolling 128 families in the D.O.T.S.

Participants

The sample used in this dissertation study was 114 mother-child dyads drawn from the original 128 D.O.T.S. participating families. The 14 excluded dyads did not complete the 24 month laboratory visit (*n* = 6), completed part of the visit but not the wait task (*n* = 1), or completed less than half of the task (*n* = 7) due to opening the gift too early (*n* = 3) or children becoming too distressed (*n* = 4).

Mothers identified 106 of the 114 participating children (61 boys) as White and 8 children as biracial. The visits from which data for the dissertation were drawn took place within two weeks of children's second (M_{age} = 24.41 months, *SD* = 1.31) and third birthdays (M_{age} = 35.83 months, *SD* = 1.02). Of the 114 participating mothers, 42 (37%) had not attended college and 72 (63%) had completed at least some college courses. Mothers were unemployed (*n* = 33, 29%), part-time (*n* = 37, 32%), or full-time workers (*n* = 44, 39%). Mean family income was $40,090 (*SD* = $14,510).

Procedures

The D.O.T.S. research team conducted 2.5 hour-long laboratory visits at the Child Study Center at The Pennsylvania State University. Mothers remained with children for the entire visit to avoid separation anxiety interfering with tasks designed to induce frustration or disappointment. Trained RAs alternated administration of challenging (e.g., wait task, clean up) and non-challenging (e.g., free play, reading) tasks to limit emotional carry-over. After the visit researchers compensated mothers for their time and children received a project t-shirt, participation certificate, and small toys.

The present study focused on the wait, introduced by Block and Block (1980) and Vaughn and colleagues (1986). It was designed to tax young children's self-regulation by frustrating the goal of opening a gift. We required young children to wait to open the gift for 8 minutes while mothers completed questionnaires (see Carmichael-Olsen, Greenberg, & Slough, 1985; Cole et al., 2003, 2011, 2013; Martin et al., 2002). Prior studies used the wait to document cross-sectional associations between mothers' and children's emotions (Martin et al., 2002) and longitudinal effects of dyadic emotion regulation in preschool on externalizing behaviors (Cole et al., 2003). In D.O.T.S., we showed developmental changes in children's anger expressions (Cole et al., 2011) and associations between children's expressions and regulatory strategies and mothers' self-reported emotions across early childhood (Cole et al., 2013).

During both the 24- and 36-month visits, RAs cleared the room of other play objects, reminded mothers to review the written task instructions, which had been explained earlier, and then handed mothers a clipboard with instructions and questionnaires while saying, "Here is the work I told you about." The questionnaires asked mothers to (1) describe how children usually managed waiting, (2) rate own and children's emotions during the wait task, and (3) rate how children usually felt while waiting. Questions were designed to engage mothers and permit commentary on whether observed behaviors were typical.

Next, RAs placed a shiny, wrapped gift on a child-size table, saying "Here is a surprise for you" and gave children a boring toy. At 24 months the toy was one cloth cymbal; at 36 months it was a car with broken wheels. RAs said, "Here is something for you to play with. I'll be back in a few minutes." As RAs left, mothers said, "[The gift] is a surprise is for you, but you have to wait to open it until I finish my work." Instructions specified that mothers "do whatever you normally do when your child has to wait for you." After 8 minutes, RAs returned and signaled to mothers to allow opening the gift.

Observational Coding

We video recorded the wait. Three independent trained teams reviewed the videos and coded (1) children's emotion expressions, (2) children's behavior, or (3) mothers' behaviors. The files from each team were time-synced to allow time-series analyses. Team members were undergraduate coders earning credit for laboratory work, supervised by graduate or investigator master coders. We did not inform coders of study hypotheses or of other teams' coding. New coders practiced until reaching 80% inter-rater agreement with the master coder. Each team met weekly to review difficult coding decisions and the 15% of cases randomly selected for reliability checks.

Children's emotion expressions. Coders used facial, vocal, gestural, and postural indicators of anger, sadness, anxiety, and joy (Cole et al., 2003; see Appendix B) to rate emotion expressions in each second of the 480 second wait. Coders rated intensity on a 1 (*low)* to 3 (*high)* scale. If there was no evidence of any emotion, coders coded the second as neutral. Though prior work has combined sad, anxious, and angry codes into an overall negativity score (e.g., Lorber & Slep, 2005), the present study used only anger codes (Cohen's $\kappa = .86$) because the wait was specifically designed to elicit anger by blocking opening the gift. Sadness and anxiety expressions may function differently (Barrett & Campos, 1987) and occurred infrequently (<6% seconds).

Children's behaviors and regulatory strategies. We used a standard system for coding children's regulatory strategies and desire for the gift during challenging tasks (Cole et al., 2011; Mangelsdorf et al., 1995; Roben, Cole, & Armstrong, 2013; see Appendix C). *Focusing on the gift* was defined as looking at, touching, attempting to reach for, or asking to open the gift. *Self-soothing* included behaviors like thumbsucking or putting head on the table. *Bidding to adults for support* was defined as commenting to mothers about task demands (e.g., saying “this is a long wait”). We cross-referenced the behavioral and emotion expression coding to further describe bids as angry or calm. *Information seeking* was defined as requesting to know more about the wait (e.g., saying “how much more work do you have?”). *Distraction* involved focusing attention away from task demands; distractions could be *focused* (e.g., moving furniture, saying ABC’s) or *unfocused* (e.g., wandering around the room).

Coders noted the onset and offset of each behavior for each second of the 480-second wait. They further coded each behavior as mother- or child-initiated. We defined *child-initiated* strategies as occurring when children either independently started or sustained a behavior for at least 15 seconds after a maternal suggestion. Coders also rated behaviors as non-disruptive or disruptive; *disruptive behaviors* were those adults would typically attempt to stop (e.g., hitting, playing with outlets), or those children continued after a maternal prohibition. Reliability for the coding system was acceptable (average Cohen’s κ = .82, range .73 to .91).

Mothers’ regulatory efforts. Structuring takes time to execute; we coded it in 32 15-second epochs spanning the 480-second task. We defined it as mothers’ attempts to encourage children to use their own executive skills to self-regulate (Lindeke, 2011; Reitz, 2009; see Appendix D). We considered structuring more elaborate than directing, i.e., giving simple commands (“do this”) and prohibitions (“don’t do that”) without targeting skills. We only coded directing if structuring did not occur.

Coders noted the predominant maternal behavior per epoch (structuring, only directing, or neither; Cohen’s κ = .94). Coders rated structuring quality on a scale from

1 (minimal) to 4 (high; intra-class correlation = .91) based on sensitivity. Low-quality structuring was brief, unelaborated, or asynchronous with children's needs; high-quality structuring was creative and attuned to children's behavior and developmental level.

Coders also noted skills mothers targeted, i.e., capacities mothers encouraged children to use to self-regulate. We defined targeting *attention focusing* as encouraging sustained or increased attention on an activity. Targeting a*ttention redirection* entailed directing children's attention to back to a desired activity. (Both attention redirection and focusing happened rarely in the wait task; they may be more suited to the context of other laboratory assessments like the reading task.) Targeting *inhibitory control* involved encouraging children to stop and think about the waiting rules before acting (e.g., "Remember, you have to wait until I finish my work"). Note that inhibitory control was similar to directing, but instead of giving only a command (e.g., "don't touch that") mothers had to encourage use of children's own self-control (e.g., "you know the rule"). Targeting *distraction* required attempts to switch children's attention away from one object to another object (e.g., focusing attention away from the gift and toward the boring toy). Targeting *planning* entailed reminding children of steps toward goals or of future possibilities (e.g., "if you wait patiently, you'll be able to open the prize"). Finally, targeting *language* involved encouraging children to verbally label, describe, or elaborate on their experience (e.g., "how are you feeling?").

Measures

The behavioral coding generated descriptively rich but dichotomous variables; these were difficult to interpret independently at the dyadic level. Multilevel modeling approaches benefit from variable measures summarizing conceptually important processes at each level of analysis (i.e., within-time, within-dyads, and between-dyads). Consequently, we aggregated child behavior within each second and maternal behavior within each epoch to capture the extent of PR and EP occurring within each timeframe.

Children's PR. We considered PR at 24 months to be indicated by behaviors signaling frustration and desire for the gift. It was quantified as the summed codes for children's anger intensity, angry bidding, focus on the gift, and disruptive behaviors. This yielded a score for each second with a possible range from 1 to 7; higher scores represented more PR (Cole et al., unpublished manuscript).

Children's EP. Children's EP at 24 months consisted of child-initiated, non-disruptive regulatory strategies. Children rarely engaged in more than one strategy in one second. Consequently, we assigned scores to each strategy based on developmental maturity (Calkins & Johnson, 1998; Grolnick et al., 1996) and sophistication of executive functioning required to initiate and sustain it (Rothbart & Bates, 2006). Children received a score of 1 for self-soothing, considered less mature than other strategies, a score of 2 for calm bids, 3 for information seeking, 4 for unfocused distraction, and 5 for focused distraction. In the rare instances when children used more than one strategy per second, we summed the ranked scores. This yielded a within-second score ranging from 1 to 7 with higher scores reflecting more advanced EP (Cole et al., unpublished manuscript).

Mothers' regulatory efforts as extrinsic EP. We derived a composite score to quantify the extent and sensitivity of mothers' efforts to regulate children's waiting. In each epoch, mothers received 1 point for directing and attention focusing or redirection. Mothers received 2 points for only inhibitory control, considered more advanced than directing because it included a command *and* targeted executive skills. Children's ability to use skills related to language, planning, or distraction develop later in toddlerhood and in the preschool years (Kopp, 1982; Rothbart & Bates, 2006) and therefore mothers earned 3 points for targeting at least 1 of these skills, 4 points for targeting 2 out of 3 skills, and 5 points for targeting all 3 skills.

Highly sensitive efforts to target children's self-regulation may have a greater influence than non-sensitive or developmentally inappropriate structuring. Consequently, we multiplied the score mothers received for skills targeted by the structuring sensitivity rating to generate the final score. It had a possible range from 0 to 20. Low scores indicated mothers' targeting less advanced skills with less sensitive structuring; high scores indicated targeting advanced skills with greater sensitivity.

Outcome Variables. We generated a 36-month Child EP score using the same scoring system and based on the same emotion and behavior coding used for the wait task at 24 months child age. As at 24 months, the 36-month EP score was based on child-initiated regulatory strategies, and so assessed how independently children waited. We examined whether the within-dyad association between extrinsic EP and children's self-regulation at 24 months predicted 36-month child EP bout frequency (M = 21.32, SD = 6.16), latency (in seconds; M = 6.69, SD = 6.44), duration (in seconds; M = 12.91, SD = 5.79), and average score (M = 4.09, SD = 0.48).

Covariates. To rule out alternate explanations for significant associations between children's PR, children's EP, and extrinsic EP, we controlled for a number of within- and between-dyad factors. As described above, we included the NA and EC scales from the Toddler Behavior Assessment Questionnaire Revised (TBAQ-R;

Goldsmith, 1996), completed by mothers at child age 18 months, as between-dyad covariates. Mothers rated 105 items about children's actions in the past two weeks on a scale from one (extremely untrue) to seven (extremely true). We derived a Negative Affectivity scale based on the mean of scaled anger, sadness, social fearfulness, and soothability (reverse-scored) scores (α = .81, *M* = 3.45, *SD* = 0.54), and an Effortful Control scale based on the scaled attention focusing and shifting and inhibitory control scores (α = .82, *M* = 6.85, *SD* = 0.56; Tan et al., 2013).

We also included children's gender (boys = 1, girls = 2), mothers' education (no college = 1, some college =2), and families' income-to-needs ratio (INR) as between-dyad covariates. INR measures a family's ability to meet basic needs based on income relative to national standards (United States Census Bureau, 2001-2003). An INR of <1 indicates poverty while >3 indicates average income. Average INR (*M* = 2.31, *SD* = 0.91) for the 114 included families indicated economic strain.

Data Analyses

We screened all data files for errors and correct time-syncing, then used SAS 9.4 (SAS Institute Inc., 2012) to merge all variables a long time-series dataset. The final sample was children's PR, children's EP, and extrinsic EP scores for 54,720 seconds of data, nested within 3,648 epochs, nested within 114 dyads. Mean number and length of children's PR, children's EP, and extrinsic EP bouts are in Table 1. Given the nested data, we used a three-level model to test within-epoch (Level 1), within-dyad (Level 2), and between-dyad (Level 3) associations between children's EP and PR, as well as how those associations were moderated by extrinsic EP. At the dyad level (Level 3) we controlled for children's gender, children's temperament, maternal education, and family income-to-needs ratio. Models were estimated using SAS 9.4 PROC MIXED.

Data preparation. When conducting multilevel modeling with repeated measures, patterns of covariation between dependent and predictor variables can differ across levels of analysis. If not corrected, this creates difficulties in interpretation of the intercepts and parameters because they represent weighted averages of associations across levels (i.e., a mix of within-dyad and between-dyad associations; see Bolger & Laurenceau, 2013). To correct for this problem and generate level-specific estimates, we centered variables at the epoch-, dyad-, and sample-level means. For example, children's PR at Level 1 was first centered within each epoch for each child to obtain a *secChildPR* (time-centering) score capturing second-to-second fluctuations in PR independent of epoch-to-epoch changes. Similarly, at Level 2 we subtracted the mean child PR in the epoch from the children's mean PR score across the task to generate variable *epochChildPR* (person-centering); at Level 3, we subtracted children's mean task PR from the grand mean PR to generate *avChildPR* (grand-mean centering). Thus fixed-effects estimates were parameterized such that intercepts represented the level of child EP when child PR was at the level mean and the parameter estimates represented change in child EP for each unit deviation from the mean. We followed the same protocol for centering extrinsic EP and control variables at Levels 2 and 3.

Model specification. A 3-level model tested within-epoch (Level 1), within-dyad (Level 2), and between-dyad (Level 3) associations between children's EP and PR as moderated by extrinsic EP. The model was specified as:

Level 1: $\quad secChildEP_{djt} = \beta_{0dj} + \beta_{1dj}(secChildPR_{djt}) + e_{djt}$

Level 2: $\beta_{0dj} = \gamma_{00d} + \gamma_{01d}(\text{epochExtEP}_{dj}) + \gamma_{02d}(\text{epochChildPR}_{dj}) + u_{0dj}$

$\beta_{1dj} = \gamma_{10d} + \gamma_{11d}(\text{epochExtEP}_{dj}) + \gamma_{12d}(\text{epochChildPR}_{dj}) + u_{1dj}$

Level 3: $\gamma_{00d} = \pi_{000} + \pi_{001}(\text{avExtEP}_{d}) + \pi_{002}(\text{avChildPR}_{d}) + v_{00d}$

$\gamma_{01d} = \pi_{010} + \pi_{011}(\text{avExtEP}_{d}) + \pi_{012}(\text{avChildPR}_{d}) + v_{01d}$

$\gamma_{02d} = \pi_{020} + \pi_{021}(\text{avExtEP}_{d}) + \pi_{022}(\text{avChildPR}_{d}) + v_{02d}$

$\gamma_{10d} = \pi_{100} + \pi_{101}(\text{avExtEP}_{d}) + \pi_{102}(\text{avChildPR}_{d}) + v_{10d}$

$\gamma_{11d} = \pi_{110} + \pi_{111}(\text{avExtEP}_{d}) + \pi_{112}(\text{avChildPR}_{d}) + v_{11d}$

$\gamma_{12d} = \pi_{120} + \pi_{121}(\text{avExtEP}_{d}) + \pi_{122}(\text{avChildPR}_{d}) + v_{12d}$

where secChildEP_{djt} was the child EP score in second *t* of epoch *j* for dyad *d,* β_{0dj} was the epoch-specific intercept, β_{1dj} was the epoch-specific association between child EP and PR, and e_{djt} was a second-by-second residual time-series.

We modeled the epoch-specific intercepts and associations at Level 2, where γ_{00d} and γ_{10d} represented the expected level of child EP and the expected association between child EP and PR, respectively, for a prototypical epoch. Conceptually, parameter γ_{10d} represents the construct of self-regulation, i.e., the extent to which EP and PR were coupled as they changed from second to second within typical epochs. We expected an inverse relationship between children's EP and PR, such γ_{10d} would have a negative value, reflecting that as EP increases, PR decreases, and vice versa. This pattern indicates regulatory effectiveness, i.e., that children are successfully using regulatory strategies to limit their anger and desire for the gift.

Also at Level 2, parameters γ_{01d}, γ_{11d}, γ_{02d}, and γ_{12d} indicated the extent that the epoch deviations from dyads' average extrinsic EP and child PR moderated the Level 1 intercepts of and associations between child EP and PR, with u_{0dj} and u_{1dj} as unaccounted-for differences. Parameter γ_{11d} captures the effectiveness of mothers' extrinsic regulation efforts by quantifying the extent to which mothers' efforts to direct or structure children change the momentary Level 1 child EP and PR association. In other words, parameter γ_{11d} estimates the extent to which child self-regulation is strengthened (EP and PR become more negatively associated) or weakened (EP and PR become less negatively associated) when mothers sensitively encourage children's use of regulatory skills. We predicted that extrinsic EP would significantly moderate the association between children's EP and PR, such that in epochs with higher extrinsic EP scores there would be a stronger association between children's EP and PR than in epochs with lower extrinsic EP scores. In other words, parameter $\gamma_{11d,}$ representing the average dyad in the average epoch, would have a negative value, meaning that when extrinsic EP scores in an epoch are higher than the dyadic average, the association between secChildPR and secChildEP moves further away from zero (becomes more inversely correlated). Finally, in terms of longitudinal predictions, we expected that dyads with stronger extrinsic EP moderation (more negative scores for $\gamma_{11d,}$ calculated as $\pi_{110} + v_{11d}$) would have children with higher EP scores at 36 months of age. In other words, the more extrinsic EP influenced children's regulation at 24 months, the better able the children would be to self-regulate by 36 months of age.

At Level 3, within-epoch associations between child EP and child PR at Level 1, as well as the extent of moderation by within-dyad extrinsic EP and child PR at Level 2, were each modeled as a function of dyads' deviations from the grand mean in average extrinsic EP and average child PR. Residual between-dyad differences were captured by v_{00i}, v_{01i}, v_{02i}, v_{10i}, v_{11i}, and v_{12i}. We included between-dyad covariates at Level 3.

Modeling procedures. We first examined descriptive statistics and bivariate correlations. Then, we ran unconditional means models, i.e., models without predictors, to generate covariance estimates for calculating within-epoch, within- dyad, and between-dyad intraclass correlations (ICCs). ICCs estimate the proportion of variability at each level of analysis, i.e., how similar units were within a group (Bell, Ene, Smiley, & Schoeneberger, 2013; Hox, 2010). It is important to evaluate ICCs before testing multilevel models because variability in the dependent variable needs to be distributed across levels of analysis for a multilevel approach to be warranted.

We used the Satterthwaite method for determining degrees of freedom given its ability to test the significance of interaction effects for variables across levels (Bell et al., 2013; Kenny, Kashy, & Cook, 2006). We estimated models using the Restricted Maximum Likelihood (REML) approach, which is the default in SAS 9.4 and is recommended for multilevel modeling (Bartlett, 1937; Hox, 2010; Raudenbush & Bryk, 2002; Snijders & Bosker, 2012). To assess model fit, we compared the -2 Log Likelihood, Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) across models (Raudenbush & Bryk, 2002; Snijders & Bosker, 2012). Finally, we generated pseudo-R^2 measures using McFadden's R^2 formula, which compares the log likelihoods from the intercept (unconditional means) model and model with predictors to estimate the additional variance explained by including predictor variables.

Testing within-epoch and within-dyad effects. We proceeded with model-building by first adding our Level 1 predictor, secChildPR, to the unconditional means model. We included it as a fixed effect at Level 1, and as a random effect at Levels 2 and 3, to assess whether the within-epoch association between secChildEP and secChildPR varied within- and between-dyads. We next added Level 2 predictors, epochExtEP and epochChildPR, to test their main effects on secChildEP as well as the extent to which they moderated the relationship between secChildEP and secChildPR, i.e., adding interactions for secChildPR*epochExtEP and secChildPR*epochChildPR. We entered each of these as fixed effects at Level 2 and random effects at Level 3. We then trimmed non-significant effects; given the large number of fixed and random effects tested in a 3-level model, we used $p < .01$ as our significance criteria. This model-building process generated estimates of associations between child EP, child PR, and extrinsic EP across levels of analysis needed to test study hypotheses and yielded the model from which we derived Bayesian estimates for longitudinal analyses.

Testing between-dyad effects. Once we determined a parsimonious model for the Level 1 and 2 effects, we tested main and moderation effects of deviations from the overall sample mean for extrinsic EP, i.e., avExtEP, and child PR, i.e., avChildPR, as fixed effects at Level 3. We added each main effect, two-way, and three-way interaction individually to the model and trimmed those that did not achieve significance. To evaluate alternative explanations for significant effects, we entered our control variables as Level 3 parameters. Including every possible interaction between the control variables (child gender, Negative Affectivity, Effortful Control, maternal education, and family INR) and major variables of interest at each level of analysis would have yielded a very large number of possible combinations of main effects and two- and three-way interactions, such that running all possible iterations would inflate the likelihood of Type I error. As such, we tested only those interactions considered most relevant based on prior literature and/or examination of the bivariate correlations (described below).

Testing longitudinal predictions. Using a model without Level 3 predictors included (Model 5 in Table 2) we extracted Bayes estimates of the dyad-level γ_{11d} coefficients (calculated as $\pi_{110} + v_{11d}$) to measure the extent to which extrinsic EP moderated the association between children's EP and PR for each dyad. We then regressed those scores onto indices of children's 36-month EP, including EP latency, duration, number of bouts, and average score. The formula was as follows:

$$36childEP_i = \beta_{0i} + \beta_{1i}(ExtEPMod) + e_i$$

where 36 month child EP for child *i* was a function of the intercept, β_{0i}, and β_{1i}, representing the association between 24 month extrinsic EP moderation of child self-regulation and the 36 month child EP, and $e_{i,}$ representing residual error.

Results

Descriptive Statistics

Overall means. Table 1 presents the frequency, latency, duration, and average scores of child PR, child EP, and extrinsic EP composites, as well as for each coded variable comprising the composite scores. Our time-series approach and aggregation of coded data yielded variable scores necessary for multilevel modeling. Total *N*s indicated that nearly all children (*N* = 112 out of 114) exhibited behavioral indices of PR and/or EP while waiting. Child PR was characterized by brief but frequent bouts of anger expressions and focus on the desirable gift. Latency scores revealed children tended to start showing frustration within the first minute of the 8-minute wait. Overall anger intensity was moderate. As described, child PR summed behaviors signaling frustration or desire (angry bids, focus on gift, and disruptive behaviors) and anger intensity; mean within-second PR indicated that children tended to be coded with either two behaviors without anger or one behavior with low intensity anger.

Child EP was characterized by brief unfocused distractions and calm bids, with a moderate number of sustained focused distractions (considered the most mature strategy) and fewer bouts of self-soothing and information seeking (less mature strategies). Latency scores revealed that children tended to engage in unfocused distractions in the first minute of the 8-minute task, with longer latencies to other EP behaviors. EP behaviors tended to be brief; average bout duration was less than 20 seconds. The mean composite EP score indicated that children tended to be ranked as using somewhat mature strategies (calm bids and unfocused distractions).

Nearly all mothers (N = 112) used structuring, while about half (N = 58) also had epochs in which they did not structure but used directing. On average mothers had few but long bouts of structuring. Most mothers started structuring within the first minute of the task (when many stated the task instructions and then further elaborated for children), then had more structuring or directing bouts interspersed throughout the task. More mothers targeted children's skills in using inhibitory control, distraction, and planning than language or attention focusing, and, as noted, only two mothers targeted attention redirection (which may be more suited to other laboratory tasks). Mothers quickly encouraged children to distract themselves, then tended to target children's other skills (language, planning) later in the task. Overall structuring quality was considered to be moderate, reflecting the high standard for a score of 5 (extremely creative and highly sensitive structuring). The mean extrinsic EP score revealed that mothers targeted a variety of children's skills with moderate sensitivity.

Bivariate correlations. We present three types of bivariate correlations to provide descriptive information and screen for potential interactions between major variables and covariates. We do not present inferential statistics given that multilevel models generated more precise estimates of associations between our variables of interest than the correlations. The within-epoch correlation (Level 1) reflected the association between epoch-level deviations in child EP and PR (i.e., secChildPR). Child EP scores above the epoch mean were moderately associated with child PR scores lower than the epoch mean, and vice versa (r = -.35).

The second correlation was within dyad (Level 2), reflecting associations between deviations in child PR (i.e., epochChildPR), extrinsic EP (i.e., epochExtEP), and child EP from dyadic means. At Level 2, child EP had a strong inverse association with child PR (r = -.55) and a moderate inverse association with extrinsic EP (r = -.33). Epochs with child EP above dyad means had lower child PR and extrinsic EP. Also at Level 2, extrinsic EP had a small association with child PR (r = .14), i.e., extrinsic EP tended to increase in epochs with high child PR.

The final between-dyad correlations (Level 3) reflected associations between grand mean deviations in child PR (i.e., avChildPR), extrinsic EP (i.e., avExtEP), child EP, and covariates, i.e., children's gender and Negative Affectivity (NA) and Effortful Control (EC) at 18 months, mothers' education, and family INR. (Point-biserial correlations are presented for child gender and mothers' education). As at Levels 1 and 2, at Level 3, child EP had a strong inverse association with child PR (r = -.76), and a moderate inverse association with extrinsic EP (r = -.33), indicating that dyads with higher child EP than the sample mean tended to have lower child PR and extrinsic EP. Level 3 extrinsic EP and child PR scores were unrelated (*r* = .02).

In regards to covariates, temperament variables had weak associations with child EP and PR (*r*s between -.03 and .07) and small-to-moderate associations with extrinsic EP (r_{EC} = .22, r_{NA} = -.16). Children's gender had weak associations with child EP (*r* = -.08) and extrinsic EP (*r* = .06) and a small association with child PR (*r* = .16; girls > boys). Maternal education had small associations with child EP (*r* = .14), child PR (*r* = -.14), and extrinsic EP (*r* = .11). Family INR had small-to-moderate associations with child EP (*r* = .31), child PR (*r* = -.35), and extrinsic EP (*r* = .12). When including these variables as Level 3 covariates in our models, we tested only those with correlations above .10 to limit testing excessive interactions and inflating the Type I error rate.

In sum, bivariate correlations between variables at each level indicated that EP and PR were inversely related across levels of analysis. Extrinsic EP was inversely related to child EP within and between dyads, but had weak associations to child PR. Finally, modest associations emerged between variables of interest and covariates, with the strongest associations for family INR. Overall, level-specific bivariate correlations indicated cross-level variability in associations, warranting more precise estimation of these associations using a multilevel modeling approach.

Intraclass correlations (ICCs). Unconditional means models yielded covariance estimates used to calculate ICCs for child EP and PR at each level of analysis. (Though child EP was our dependent variable, we checked PR's ICCs to ensure there was enough variance present to run the models). Within-epoch ICC measured similarity between seconds in the same epoch, within-dyad ICC measured similarity of epochs in the same dyad, and between-dyad ICC measured similarities across dyads. ICCs were calculated using these formulas (Bell et al., 2013):

$ICC_{WD} = \sigma^2_{WD} / (\sigma^2_{WD} + \sigma^2_{BD} + \sigma^2_e)$

$ICC_{BD} = \sigma^2_{BD} / (\sigma^2_{WD} + \sigma^2_{BD} + \sigma^2_e)$

$ICC_{WE} = 1.0 - ICC_{BD} - ICC_{WD}$

Where σ^2_{WD} denotes within-epoch variance, σ^2_{BD} denotes between-dyad variance, and σ^2_e denotes residual error variance, and with the remaining unexplained variance existing within epochs. For child EP, within-epoch, within-dyad, and between-dyad ICCs equaled .33, .51, and .16, respectively, indicating that 33% percent of the variance in child EP was within-epochs, 51% was within-dyads, and 16% was between-dyads. For child PR, within-epoch, within-dyad, and between-dyad ICCs equaled .32, .26, and .40, respectively, indicating that 32% percent of the variance in child PR was within-epochs, 26% was within-dyads, and 40% was between-dyads. Thus, meaningful proportions of variance in both child EP and PR were distributed across each of the three levels, further supporting our modeling approach (Hox, 2010).

Within-Epoch and Within-Dyad Effects

Table 2 presents the unstandardized estimates from the 3-level models predicting child EP with Level 1 and 2 predictors. Model 1 includes fixed and random effects for secChildPR. We hypothesized child PR and EP to be inversely related, given that 24 month-olds display inchoate self-regulation (Kopp, 1989). As expected, the Level 1 fixed effect for secChildPR was negative, indicating the expected association between child EP and PR. The fixed effects estimate for secChildPR, $\pi_{100,}$ indicates that in a prototypical epoch there was a 1.07 unit decrease in child PR for every one unit increase in child EP. Model 1 also revealed significant random effects for secChildPR at Levels 2 and 3, suggesting heterogeneity in levels and rates of change in child PR within and across dyads. The significant covariance parameters at Level 2 and 3 indicate that child EP and PR continued to be inversely related within dyads, such that increases in EP were associated with children's PR dropping below their within-child average level, and between dyads, such that dyads with higher child EP relative to the group mean had lower-than-average child PR. In sum, our initial modeling efforts supported our first hypothesis, that child EP and PR would be inversely related.

In Models 2 through 5, we added our Level 2 predictors, i.e., epochExtEP, epochChildPR, and secChildPR*epochExtEP and secChildPR*epochChildPR.
The Level 2 random effects for epochExtEP were nonsignificant (estimates < .00, $p >$ .01). Given that all mothers began by giving children standardized instructions about waiting, they had limited variability in their extrinsic EP scores in the first epoch. We therefore removed this effect from Models 4 and 5.

Model 5 tests within-epoch and within-dyad associations between child PR, child EP, and epochExtEP. Pseudo R^2 for this model equaled 0.11, indicating that including the predictors explained 11% more of the variance in child EP than the intercept model. The significant inverse association between within-epoch child PR and EP held, as did the inverse covariance between them at Levels 2 and 3. Additionally, all Level 2 fixed effects were significant. Level 2 epochExtEP refers to the within-dyad association between extrinsic EP and child EP when all other predictors equal zero. We thought this relation would be positive; unexpectedly, we found a significant inverse association ($\pi_{010} = -0.09$, $p < .01$) such that in epochs when children had higher EP, mothers had lower EP scores than typical for them overall, and in epochs when children had lower EP mothers had higher extrinsic EP than typical for them overall.

The significant inverse association of epochChildPR (π_{020} = -1.13, $p < .01$) indicates that in epochs when children had higher EP, they tended to have lower epoch PR than was typical for them overall. The random effects of epochChildPR at Level 3 were also significant, indicating between-person variation in the association between epoch-level child PR and EP. This lends further support to our first hypothesis, i.e., that child EP and PR would be inversely related.

Finally, we tested for moderation between our Level 2 predictors and the within-epoch child EP and PR association. Recall that we were particularly interested in the secChildPR*epochExtEP interaction, as it indicates the extent to which change in extrinsic EP weakens or strengthens the association between child EP and PR within a prototypical epoch, i.e., how much maternal efforts to extrinsically regulate children were associated with child self-regulation in a typical epoch for a typical dyad during the wait. Contrary to expectations, the interaction effect was positive and significant (π_{110} = 0.06, $p < .01$). Recall that the overall association between child EP and PR was negative in value, indicating successful regulation. If extrinsic EP strengthened the correlation between EP and PR, the correlation would become *more negative* in value, signaling that children were better regulated in the context of extrinsic EP. However, when extrinsic EP scores were higher, the within-epoch association between child EP and PR tended to become *more positive* in value, i.e., moved closer to zero, signaling a weaker association between child EP and PR in the presence of extrinsic EP. Epoch-level child PR also moderated within-epoch child EP and PR, π_{110} = 0.40, $p < .01$, indicating epoch-level PR increases were associated with a weaker association between epoch-level PR and EP.

Between-Dyad Effects

We next tested Level 3 fixed effects for dyad deviations from sample-level mean extrinsic EP, i.e., avExtEP, and child PR, i.e., avChildPR. We added each main and interaction effect, including two- and three-way interactions between Level 3, Level 2, and Level 1 predictors to Model 5 one at a time, then trimmed non-significant effects. Significant estimates emerged for average extrinsic EP and child PR to child EP; these estimates are presented as Model 6 in Table 2. Both were inversely related to child EP, indicating that dyads with lower average extrinsic EP and child PR than the sample mean tended to have higher child EP. The pseudo R^2 value for this model also equaled 0.11, the same as Model 5, indicating that adding between-person predictors did not explain more variance in child EP than the Level 1 and 2 predictors alone.

Recall that bivariate correlations indicated possible covariate effects. No relations between temperament and extrinsic EP were significant, nor were relations between child gender and PR (*ps* > .05). Maternal education and family INR did not significantly relate to child EP, child PR, or extrinsic EP (*ps* > .05).

Longitudinal Predictions

We extracted the γ_{11} parameter from Model 5 using SAS ODS output, then calculated the moderation parameter for each dyad, yielding scores from -0.38 (indicating that extrinsic EP strengthened the relation between child EP and PR for that dyad) to 0.25 (indicating that extrinsic EP weakened the relation for that dyad) with a mean effect of -.002 (*SD* = 0.10). We regressed these scores onto each child's individual bouts, latency, mean duration, and average EP score at 36 month wait. Unexpectedly, our 24 month estimate did not predict 36 month child EP, *ps* > .05.

Discussion

Self-regulation has import across the lifespan (Duckworth & Seligman, 2005; Hofmann et al., 2014; Moffitt et al., 2011; Tangey et al., 2004; Wagner & Heatherton, 2015). The present study drew from a larger project focused on testing an overarching definition of self-regulation to better understand its role in development (Cole & Ram, 2015). Drawing from multidisciplinary approaches to self-regulation, it was conceptualized as a dynamic process involving the ability to influence, i.e., inhibit, change, delay, modulate prepotent responses (PR) by deploying, i.e., engaging, activating, initiating executive processes (EP; Cole & Ram, 2015). We combined multiple streams of observational coding to capture child behaviors conveying PR (i.e., frustration, including anger expressions, angry bids, focus on the gift, and disruptive behaviors) and EP (i.e., self-soothing, calm bids for information or support, and unfocused and focused distractions), as well as maternal behaviors (i.e., structuring or directing) representing efforts to externally influence children's regulation with varying degrees of sensitivity. Then multilevel models estimated the within-epoch association between child EP and PR, i.e., self-regulation, and the extent to which it was moderated by extrinsic EP, i.e., mothers' efforts to support children's regulation. To rule out alternative explanations for within-epoch and within-dyad associations, we controlled for between-dyad differences in average level of extrinsic EP and child PR, and tested for moderation effects of child gender, temperament, maternal education, and family resources. Finally, within-dyad Bayes estimates predicted whether mothers' influence on children's self-regulation at 24 months predicted children's EP at 36 months.

Our study focused on within-person processes in 24 month old toddlers, theorized to be in the self-control stage of regulatory development, such that they can engage EP strategies to limit PR, but inconsistently and for limited periods (Kopp, 1982; Cole et al., 2011). Findings bolstered the theoretical description of child regulatory abilities at this stage. The intra-class correlations for EP and PR revealed that roughly half the variance in both was situated within rather than between children. Even children who handled the task well relative to others fluctuated around mean EP and PR scores. Summary scores averaging children's performance across time without accounting for these fluctuations may miss important nuances in how children actually navigate challenges. For example, children with little variability in EP and PR behaviors may be viewed as more calm, while children with wider fluctuations may be seen as more liable and thus raise concerns, even with similar summary scores as the former children.

Within-child variability also suggests that toddlers may experience ego depletion as the waiting task unfolds. Ego depletion models conceptualize self-regulation as a metaphorical "mental muscle" that can weaken if taxed for too long (Vohs & Baumeister, 2011). The construct has been developed in the adult literature but is less often applied in early childhood. Yet, it is reasonable to think that some children may start off managing the wait task relatively well, but become depleted as it progresses and fail to maintain EP. Work with 36 month olds shows that distraction seems to help forestall, but not eliminate, children's frustration in the wait (Cole et al., 2011). Our data plots reveal that some children are stable in their EP and PR at the start of the wait, but show greater fluctuations it progresses. Future work may further examine the raw data to identify and test the significance of points when children's regulatory capacity is depleted, i.e., when variability in PR and EP drops, and explore whether depletion points predict children's later self-regulation.

We quantified self-regulation using a parameter in our multilevel model, $\gamma_{10d,}$ representing the association between children's EP and PR. Our hypothesis that child EP and PR were inversely related was confirmed; there was a significant association between child EP and PR across all levels of analysis. This fit with our conceptualization of self-regulation as a dynamic process characterized by the ebb and flow of PR and EP in relation to each other across time (Cole & Ram, 2014; Cole et al., unpublished manuscript). It extends prior temporal contingency analyses finding associations between children's use of distraction and subsequent reductions in anger expression intensity and focus on task demands (e.g., Buss & Goldsmith, 1998). Contingency analyses offer insight into second-to-second changes in expressions and behaviors; to the present study builds on the prior contingency studies by situating micro-second changes within larger intervals in the challenging wait. In doing so, we found that associations between PR and EP behaviors held at varying timescales (i.e., seconds versus epochs) and measured the variability in associations across levels.

Accumulated evidence from contingency analyses shows that use of putative regulatory strategies subsequently changes children's PR (e.g., Buss & Goldsmith, 1998). One way to build on this work is to expand our focus to examine not only occasions when regulatory strategies are followed by decreases in PR, but also to examine regulatory failures, e.g., what happens when children's EP fails to reduce PR, or when PR overwhelms children's attempts at EP. Results indicated that while the inverse EP and PR association held across levels, the strength of the association varied within epochs, within children, and between children. All children experienced regulatory failures, but we have limited knowledge of how those failures may influence regulatory development. Such failures may present children with opportunities for learning what regulatory strategies do or do not work under different contexts; applying such information marks the achievement of the self-regulation stage (Kopp, 1982). On the other hand, chronic regulatory failures may create cycles increasingly unmodulated distress, becoming problematic over time (Cole et al., 2013; Thompson, 1994). Therefore, further work examining individual differences in regulatory successes *and* failures, and implications for regulatory development, is needed. Moreover, evidence indicates the value of studying change in these dynamic processes developmentally.

This dissertation drew from the work of Cole and colleagues (unpublished manuscript) by using summary indices of EP and PR within each second or epoch, and conducting analyses on these rather than separate analyses for each behavior (see Morris et al., 2011). Creating EP and PR indices increases within-time variability, which decreases the number of models to run and the potential for spurious findings. Conceptually, there is value in creating a holistic "snapshot" of unfolding and related behavior within and across seconds, a strategy adding to the literature investigating each emotion and each strategic effort separately. In creating these variables, we judged how to categorize and assign points to different behaviors (e.g., distraction, bidding, focusing on the gift) as EP and PR with careful consideration to the developmental literature (Diener & Mangelsdorf, 1999; Grolnick et al., 1996, 1998; Mangelsdorf et al., 1995; Rothbart, Ziaie, & O'Boyle, 1992). However, these decisions warrant further examination in future research.

For example, we included calm bids in our EP score, reasoning calm bidding to be a "mature" EP strategy because older children bid calmly more than younger children (Cole et al., 2011). Yet, one could argue that calm bidding entails requesting help and expressing impatience (e.g., asking "are you done yet?"). Therefore, perhaps calm bids should be categorized as low-level PR rather than EP. On the other hand, we often witnessed toddlers bidding without waiting for a response and without getting a response from mothers, who ignored them and continued to work. Rather than using their bids to mothers to demand and obtain help managing the wait, toddlers seemed to enjoy talking aloud (talking "at" mothers rather than "with" them) to remind themselves of the rules of the task and keep themselves occupied (e.g., "Mom, are you done yet? No, you're not done. When you're done I can open the prize right? But I have to wait!"). Future work may consider modifying the coding schema to distinguish this "chatter," which may be better conceptualized as self-talk in the presence of mother rather than direct bids intended to solicit help or advice.

The waiting task creates a realistic situation for taxing toddlers' regulatory skills in that they must wait (Vaughn et al., 1986) while regulating frustration caused by their blocked goal of wanting to open an attractive gift. As with prior work (Cole et al., 2003, 2011), observational coding indicated that children desired the attractive gift (e.g., by pointing to it, reaching for it, or asking mothers for it), and disliked waiting (i.e., by calmly or angrily asking mothers when work would be complete and the wait over). Indeed, four children reached a level of distress that caused the research team to conclude the child would not recover without intervention and therefore RAs ended the wait. We excluded these children from analyses because they completed less than half of the task, so, due to the nature of the multilevel modeling, their data contribution was unlikely to add to the findings. However, excluding them limits the range of possible reactions to the task that could be observed, and raises concerns that we missed those children who represent the extreme end of the spectrum of reactivity to the task demands. Future data collection may consider ways to encourage these children to complete the entire task, or enough of the task to contribute statistically meaningful data, so that the entire distribution of potential responses is captured. However, this concern must be balanced with ethical obligations not to cause undue distress to our young participants.

Mothers were present during the wait, but were working on completing questionnaires. This creates a realistic situation for mothers, who must assess how children handle the wait and decide from moment-to-moment whether and how to intervene if children struggle to do so. Though other studies have examined relations between parental sensitivity and parenting strategies, ours is one of few to examine parents' behaviors and indices of toddlers' self-regulation as they navigate a challenging task *together*, rather than in separate tasks or different measures (e.g., a questionnaire for parents and a frustration task with an RA for children). Yet, parents' responses to children's emotional distress (i.e., anger) in such situations are theorized to play a key role in shaping children's regulatory behavior over time (Calkins, 1994; Kopp, 1982; Thompson, 1998). Simultaneously tracking parents and children permitted assessment of co-regulatory influences, i.e., the extent to which parents' efforts influenced children from moment to moment (Chow et al., 2010; Dumas et al., 1995; Lunkenheimer et al., 2011; Moore et al., 2009; Roben et al., 2015). We operationalized co-regulation with parameter $\gamma_{11d,}$ quantifying the extent to which mothers' efforts to direct or structure children were associated with second-to-second changes in the association between children's EP and PR within each epoch of the wait.

Given prior work finding significant group-level associations between the frequency of mothers' structuring and children's self-regulation (Grolnick et al., 1998; Spinrad et al., 2004), we hypothesized that mothers' sensitive efforts to extrinsically regulate children's regulation would be associated with stronger coupling between children's EP and PR. This hypothesis was not confirmed; in fact, the opposite effect emerged. Increases in mothers' regulatory efforts were associated with weaker (i.e., closer to zero) within-epoch associations between child EP and PR for a typical dyad. Mother's extrinsic EP was also associated with lower child EP scores within epochs. While this was unexpected, it is important to consider that the second-to-second temporal sequencing of mother and child behaviors within the 15-second epochs is unclear. Rather than detecting *subsequent* changes in child self-regulation after mothers' regulatory efforts, i.e., children's EP rising after mothers extrinsically regulate, as prior studies aimed to do, what we may be detecting here is a pattern wherein children's ability to maintain EP wanes, PR begins to rise, and mothers then intervene to help children regulate. In other words, we may be detecting what child behaviors elicit maternal efforts to extrinsically regulate children's behavior.

Prior work provides evidence that mothers tended to allow children to wait on their own, but monitor the situation and turn their attention toward toddlers in response to changes in toddler PR behaviors (LeDonne & Cole, 2012). This is a viable parenting strategy given toddlers' burgeoning autonomy and parents' desire to encourage more independent regulation (Brownell & Kopp, 2007). Indeed, when considering mothers' choices to intervene or not when their toddler seems to be becoming dysregulated or overwhelmed, it is important to consider that our laboratory assessment only provides one "snapshot" of the child's behavior and regulation. Mothers, meanwhile, are making decisions not only based on how their child is doing in the moment, but on their knowledge of their child's previous reactions to efforts to intervene. Mothers may be aware that intervening may escalate their child's distress, and find it a better option to let the child express distress and comfort or talk with the child later. A limitation of the present study was that it assessed mothers' behavior in the moment, but was unable to unpack motivations behind mothers' choices to intervene or hold back. Future research could add a "debriefing" session after the wait, where mothers are asked to review the videotape and describe why they acted as they did at key points. Post-interaction video review has been used in prior studies (e.g., Lorber & Slep, 2005) to allow mothers to rate their emotions during interactions with their children.

The present study adds to prior work by assessing mothers' reactions not only to PR but to EP as well. Results suggest that mothers may intervene, i.e., use extrinsic EP, in moments when children cannot sustain a regulatory strategy, such that EP begins to decrease below the mean epoch or dyad level, or when children cannot effectively use EP to limit PR and thus have a weak EP/PR association. An alternative interpretation is that maternal efforts led to momentary increases in children's anger, decreasing EP and triggering increases in PR. However, only modest support for this interpretation was found. Bivariate correlations between extrinsic EP and child PR were modest, and interactions between overall average extrinsic EP and epoch-level child PR were non-significant. Prior work found that children tended to respond to mothers' attention to them positively (LeDonne & Cole, 2012). One avenue for extending this work could be to identify dyads for which children are dysregulated by maternal efforts to regulate their waiting; these could be dyads at risk for developing patterns of coercive cycling associated with behavioral disorders (Patterson, Dishion, & Bank, 1984). However, given that our sample was not comprised of at-risk children, and overall behavior problems are relatively low (Cole et al., 2011), this is an unlikely interpretation.

Another consideration is that we may have been overly optimistic in our assumption that mothers' efforts to extrinsically regulate children would lead to shifts in children's self-regulation within a 15-second epoch. This may be too short of a time for toddlers to process maternal input. A next step may be to develop models to examine associations between mothers' extrinsic EP and toddler self-regulation in subsequent epochs. Alternatively, it also may have been unrealistic to assume that maternal structuring, even at its most sensitive, would have an immediate effect on toddlers' self-regulation. In some cases it may. In other cases, adaptations of structuring attempts over the course of a task may have an effect eventually. Finally, in yet other cases, it may the accumulation of sensitive and creative structuring of child self-regulation that has a longer term effect on child behavior. Theory suggests that it is the cumulative effect of consistent and repeated sensitive parental efforts over multiple interactions that eventually leads to children's internalization of parental regulatory influences and promotes independent self-regulation (Calkins, 1994; Kopp, 1982). So, though we did not find that mothers' efforts immediately strengthened children's self-regulatory abilities, the fact that mothers made these efforts to support child regulatory skills may still be valuable for children's developmental outcomes. An interesting next step will be to explore whether maternal structuring is more or less effective, i.e., is associated with stronger or weaker child regulation, at different points in the task.

Maternal efforts to influence children's self regulation unfold across several seconds and need to be viewed in total before coding decisions can be reliably made. To allow for time to make these nuanced decisions, and improve coding agreement, our original coding team divided the 8-minute wait into 32 epochs, each 15 seconds long, and then noted whether or not structuring occurred in the epoch or not. In retrospect, dividing the task up in this way created somewhat arbitrary cut-points for capturing structuring behaviors. Sometimes mothers started structuring in one epoch and it led into another; in this case, mothers received credit for both epochs. Future coders may consider using an event-based coding structure instead. Doing so may allow for a more fine-grained matching of structuring behaviors to children's EP and PR behaviors than we were able to achieve in the present study.

However, using an event-based system introduces new concerns. For example, mothers do not always have distinct starts and stops in their directing or structuring. Coders will need to select a time window (e.g., 5 seconds) or set another criteria (e.g., whether mother turns away from her child and toward her work) to decide when structuring or directing starts and stops. More research on the implications of such decision rules regarding start and stop times for results is needed to guide the development and refinement of observational coding protocols. In addition to creating within-second composite scores for child EP and PR, we also created an epoch-level structuring score to characterize the presence and quality of maternal efforts to extrinsically influence children's regulatory processes, either through directing (telling children what to do or not do) or structuring (encouraging children to use their own skills in the service of self-regulation). Mothers were further assigned points for targeting more mature child skills (i.e., planning) with higher quality structuring that was creative and sensitive to the child's needs and developmental level. As with the child PR and EP scores, using a structuring composite increased variability and utility in complex models and provided a holistic cross-person, rather than cross-variable, depiction of mothers' efforts within a given epoch. With both structuring frequency and quality comprised in one variable, it is difficult to parse whether one, the other, or both are significantly influencing children's regulation. A next step will be to develop an analytic plan for modifying the models to accommodate these variables separately and test whether effects on child EP and PR are distinct.

Furthermore, we assigned equal distances between structuring scores – e.g., directing earned one point, inhibition two points, etc. – but future work may consider whether this truly reflects the potential impact of directing versus structuring on child regulation. Perhaps more sophisticated structuring should have greater distance, because they may be optimal for promoting children's self-regulation. At this juncture, much of the parenting literature has characterized parenting dichotomously; as warm or harsh, sensitive or insensitive, etc., but few studies have directly compared the effects of different *specific* parenting strategies (e.g., targeting child inhibition versus planning skills) on subsequent changes in child PR and EP. More contingency- and time-series studies are needed to fully inform the development of super-ordinate parenting variables based on observational coding data.

The present study used broad strokes to assess momentary parenting effects, exploring whether mothers' structuring attempts modified associations between child EP and PR within the epoch, regardless of whether or not children successfully utilized the skills encouraged. As such, a change in the association between children's EP and PR coupled with structuring could be explained by children (1) actually engaging in the specific strategy mothers encouraged, (2) engaging in some other strategy, or (3) being soothed by mothers' attention rather than engaging in any strategy. Adding a measure of children's success at implementing mothers' suggested regulatory strategies, e.g., exploring whether children actually distracted themselves if mothers encouraged them to do so, may strengthen the inference that mothers' efforts extrinsically regulate children during the wait and increase the predictive value of the resulting parameters.

In addition to parenting, child-specific (Crouter & Booth, 2003; Fox & Calkins, 2003) and socioeconomic factors may contribute to children's regulatory development. In the present study, we found significant bivariate correlations between these covariates and child EP, PR, and extrinsic EP, but effects were not significant when included in the multilevel models. Overall, this pattern supports a robust association between child EP and PR across levels of analysis. Proportionally greater variance in child EP was distributed within-dyads than between-dyads, and when the multilevel models accounted for the distribution of variance at different levels, it likely diminished the variance available to explore between-dyad effects.

Results revealed bivariate relations between child temperament and extrinsic EP, such that mothers rating children as higher in Negative Affectivity had higher extrinsic EP scores. However, child temperament variables did not moderate associations between children's EP and PR within the wait. Prior work in our sample found mixed evidence for associations between temperament and behavioral indices of child EP and PR (Tan et al., 2013). One possibility is that temperament questionnaires capture how mothers feel their children tend to react to emotionally evocative or otherwise taxing situations, which may influence how mothers try to help children in a particular situation, but does not necessarily relate to what children actually do when challenged in this *specific* situation (a wait; Grolnick et al., 1998). Reactive children may have been less so in the laboratory because they knew they were being observed, or wanted to earn a prize, or had their mother's undivided attention during the laboratory visit. Additionally, due to our study design, temperament was assessed at 18 months but not at 24 months; it is possible that a concurrent measure of temperament may have been a stronger covariate in the multilevel model. Given that NA tends to decrease and EC to increase between 18 to 24 months (Calkins & Johnson, 1998; Posner & Rothbart, 2000), it is possible that some of our toddlers with higher NA at 18 months would have had lower scores if assessed concurrently with the waiting task.

Recent meta-analyses (Chaplin & Aldao, 2013) showed evidence of small but significant gender differences in child EP and PR behaviors. They suggest that gender differences may develop and be context-specific. For instance, young boys and girls may not alter emotional behavior to conform to gender expectations with their mothers (Cole et al., 2011) but may do so when interacting with a friendly but unfamiliar RA

(Cole, 1986). The present study used gender-neutral codes for child behaviors; for example, distraction was coded whether children were engaging in a physical activity (e.g., throwing the boring toy and chasing it down, pushing the child-size chairs across the room) or a more sedate one (e.g., pretending the toy was a baby doll, nursing the broken horse). While there may well be gender differences in the types of activities that children engaged in to distract themselves, they received equal credit for the distraction.

In addition to child temperament and gender, systemic factors like maternal education and family resources have been theorized to influence the frequency and sensitivity of parental efforts to extrinsically regulate children (Morris et al., 2007). We add another sample to the mixed findings relating child self-regulation and parenting to SES by drawing from a sample of economically strained, but not very poor, rural families, underrepresented in the extant literature. Results indicate correlations of family income-to-needs ratio to maternal extrinsic EP, but nonsignificant moderation of child EP and PR, or associations with extrinsic EP, in multilevel analyses. Studies of very low-income samples (Bockneck et al., 2009; Gilliom et al., 2002; Halligan et al., 2013) tend to find stronger SES effects than in the present study, while such effects are dampened in convenience and high-income samples (LeCuyer & Houck, 2006; Spinrad et al., 2004). Findings fit with work showing that economic strain may not adversely influence children’s developing self-regulation if day-to-day parenting is sensitive and structures regulatory skills (Raver, 2004).

One potential covariate to consider for inclusion in future studies is a parent’s own self-regulation, either in terms of trait self-control or in specific parenting situations. Parenting is an emotionally laden experience (Dix, 1991; Dix, Gershoff, Meunier, &

Miller, 2004); children's misbehavior, anger, and/or efforts to manage the wait may elicit emotional responses from parents that contribute to their moment-to-moment decisions about whether to interact with children or not, how much they encourage children to harness regulatory skills, and the sensitivity with which they do so. Understanding the relations between parents' own self-regulation, their efforts to extrinsically support child self-regulation, and children's regulatory development is an exciting direction for future research (Cole & Ram, 2015; Cole & Teti, 2011).

Finally, researchers have proposed that parents' frequent and sensitive efforts to extrinsically regulate young children are associated with children's fully achieving self-regulation, i.e., using EP to modulate PR without parental support (Calkins, 1994; Kopp, 1982; Thompson, 1998). However, longitudinal studies of associations between parenting and children's self-regulatory dynamics in early childhood have been few in quantity, utilized a diverse range of methodological approaches, and have mixed findings (Grolnick, Bridges, & Connell, 1996; Halligan et al., 2013; Spinrad et al., 2004). We extended this literature by testing whether -differences in parameter $\gamma_{11d,}$ which quantified the extent of dyadic co-regulation, predicted children's independent regulation when they reached preschool age. This longitudinal prediction did not come to fruition; there were no significant associations between 24 month maternal extrinsic EP and children's independent initiation of regulatory strategies during the waiting task at 36 months. The assumption that parents' scaffolding of children's regulatory efforts contributes to children's eventual internalization of socialization goals and ability to regulate independently is a key component of a number of prominent theories of regulatory development in early childhood (Kopp, 1989; Thompson, 1998). Yet, few studies have explicitly tested longitudinal effects of parenting on toddlers' moving from the self-control to self-regulation stages. Extant studies used tasks not explicitly designed to frustrate young children and elicit anger (e.g., the Bayley Scales of Infant Development), general questionnaire measures, or did not assess emotion dynamics. An exception is work by Spinrad and colleagues (2004) that included frequencies of mothers' attempts to regulate children's emotions summed across different tasks.

Given these methodological differences, it is difficult to assess why longitudinal hypotheses were not supported. One possibility is that we need to expand our work to assess associations between parenting and child self-regulation not only within each epoch, but across epochs as well, following the approach of Morris et al. (2011), in which mothers' efforts within one epoch were used to predict changes in child EP and PR behaviors in the subsequent epoch. This may yield greater predictive validity. Similarly, we also may need to examine patterns of coregulation at multiple age points to capture how consistently and sensitively parents structure and scaffold children's regulatory skills across multiple timescales (moment-to-moment, but also across ages and types of tasks). Such work offers the potential for novel insights into the within-time and within-dyad level processes underlying the development of self-regulation.

The present study combines multiple streams of observational data to model extrinsic and intrinsic regulatory processes across the wait. Though beyond the scope of this project, another promising direction would be to incorporate other measures of prepotent responding and executive processing, such as psychophysiological measures of arousal (skin conductance, cortisol), and regulation (e.g., vagal tone). Doing so is likely to strengthen the field's inference that regulatory processes are occurring, and contribute further to our understanding of regulatory dynamics as they unfold over time. Additionally, though we focused on mothers, fathers, other adult caregivers (e.g., grandparents) and siblings all may also support children's regulatory development in varied ways. As we continue to study children's self-regulation, another important direction is to consider development in the context of family life and day-to-day regulatory challenges families must navigate together.

In sum, this dissertation contributed to the extant literature by modeling associations between children's PR and EP and maternal efforts to support children's regulatory abilities. We precisely estimated the influence of maternal behavior on child self-regulation within a challenging task and across time. Results showed significant within-child variability in EP and PR across the wait, which has the potential to reveal nuanced patterns of self-regulation as it unfolds over time. Furthermore, we found a consistent inverse relation between child EP and PR across levels of analysis, though the strength of the relation varied within epochs, children, and between children. It may be fruitful to explore instances of regulatory failures in addition to regulatory successes. Parenting effects opposed expectations and failed to predict longitudinal outcomes. Potential explanations for this include the nature of the behavioral coding, which was epoch- rather than event-based, and the exclusion of a measure of child success in implementing parents' suggested regulatory strategies. Future research will continue to test theories of parents' influence on the emergence of children's self-regulation by investigating change in regulatory processes at the within-time, within-dyad, and between-dyad levels across early childhood.

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Appendix A
Tables

Table 1

Sample-Level Descriptive Statistics for Coded Variables from 24-month Wait Task

	N (Dyads > 1 bout)	# Bouts		Latency (in seconds)		Duration (in seconds)		Score	
		M	(SD)	M	(SD)	M	(SD)	M	(SD)
Child PR Composite	114	21.28	(10.05)	4.23	(6.49)	18.76	(29.41)	2.03	(1.16)
Anger expressions	112	17.68	(11.61)	27.27	(42.58)	13.04	(29.61)	1.58	(0.72)
Focusing on the gift	110	11.75	(6.57)	12.87	(37.46)	6.79	(5.16)	--	
Angry bids	104	8.53	(7.06)	80.71	(103.11)	3.31	(2.39)	--	
Disruptive behaviors	108	8.44	(6.35)	56.20	(37.46)	7.66	(6.68)	--	
Child EP Composite	114	17.20	(6.36)	20.30	(30.11)	16.34	(19.93)	3.90	(1.25)
Self-soothing	78	2.77	(3.41)	156.08	(120.37)	10.19	(37.03)	--	
Calm bids	108	7.39	(5.55)	74.44	(106.31)	2.79	(1.81)	--	
Information seeking	12	0.19	(0.65)	203.25	(74.93)	0.19	(0.59)	--	
Unfocused distraction	112	12.68	(5.20)	28.47	(40.63)	10.25	(6.74)	--	
Focused distraction	109	5.56	(3.23)	92.74	(93.29)	16.96	(16.09)	--	

(continued)

	N (Dyads > 1 bout)	# Bouts		Latency (in seconds)		Duration (in seconds)		Score
		M	(SD)	M	(SD)	M	(SD)	M (SD)
Extrinsic EP[b]	112	5.32	(2.18)	1.67	(4.67)	36.54	(25.57)	6.85 (4.22)
Directing	58	1.02	(1.26)	94.98	(131.70)	9.60	(11.20)	--
Structuring	112	4.96	(2.29)	1.64	(4.64)	33.11	(20.76)	--
Quality	112	---	---	---	---	---	---	2.24 (0.53)
Attention focusing	61	1.22	(1.74)	85.67	(129.26)	9.58	(9.82)	--
Attention redirecting	2	0.03	(0.29)	0.15	(1.50)	0.26	(1.98)	--
Inhibitory control	109	3.53	(1.99)	96.88	(107.90)	21.49	(10.64)	--
Distraction	103	2.90	(2.10)	23.27	(71.15)	19.26	(11.23)	--
Planning	100	3.35	(2.30)	65.61	(109.42)	18.31	(9.78)	--
Language	85	2.27	(2.29)	133.64	(143.10)	14.20	(11.57)	--

Note. Not all dyads had bouts of every behavior, so N denotes the number of dyads with >1 bout. Latency and duration are in seconds. “Score” gives within-second child EP, PR, and extrinsic EP scores and within-second anger intensity.
[b] Extrinsic EP, directing, and structuring were coded in 15-second epochs but are given in seconds here for ease of comparison to child coding.

Table 2

Estimates from Three-Level Models Predicting Child EP with Level 1 and 2 Predictors (N = 114)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Fixed Effects						
Level 1						
Intercept, π_{000}	1.83* (0.08)	1.83* (0.08)	1.83* (0.08)	1.83* (0.08)	1.83* (0.08)	1.83* (0.08)
secChildPR, π_{100}	-1.07* (0.06)	-1.04* (0.06)	-0.97* (0.06)	-1.01* (0.06)	-1.07* (0.06)	-1.07* (0.06)
Level 2						
epochExtEP, π_{010}		-0.11* (0.01)	-0.09* (0.01)	-0.09* (0.01)	-0.09* (0.01)	-0.09* (0.01)
epochChildPR, π_{020}			-1.10* (0.07)	-1.09* (0.07)	-1.13* (0.06)	-1.13* (0.06)
secPR*epochExtEP, π_{110}				0.07* (0.01)	0.06* (0.01)	0.06* (0.01)
secPR*epochChildPR, π_{120}					0.40* (0.03)	0.40* (0.03)
Level 3						
avExtEP, π_{001}						-0.11* (0.02)
avChildPR, π_{002}						-0.65* (0.06)
Random Effects						
Level 2						
Intercept, $\sigma^2_{\mu 0}$	2.35* (0.06)	2.09* (0.05)	1.30* (0.03)	1.30* (0.03)	1.30* (0.03)	1.28* (0.03)
secChildPR, $\sigma^2_{\mu 1}$	1.25* (0.04)	1.24* (0.04)	1.22* (0.04)	1.14* (0.04)	1.03* (0.04)	1.03* (0.04)
Covariance, $\sigma_{\mu 0 \mu 1}$	-0.76* (0.04)	-0.59* (0.04)	-0.20* (0.03)	-0.21* (0.03)	-0.26* (0.03)	-0.26* (0.03)
Level 3						
Intercept, σ^2_{v00}	0.71* (0.12)	0.73* (0.11)	0.75* (0.11)	0.75* (0.11)	0.75* (0.11)	0.27* (0.05)
secChildPR, σ^2_{v10}	0.35* (0.06)	0.33* (0.05)	0.29* (0.05)	0.31* (0.05)	0.33* (0.05)	0.34* (0.05)
Covariance, $\sigma_{v00\ v10}$	-0.38* (0.07)	-0.37* (0.07)	-0.34* (0.06)	-0.35* (0.06)	-0.38* (0.06)	-0.20* (0.05)
Intercept, σ^2_{v02}			-0.42* (0.07)	-0.42* (0.07)	-0.41* (0.07)	-0.18* (0.05)
epochChildPR, σ^2_{v12}			0.38* (0.08)	0.38* (0.08)	0.36* (0.07)	0.21* (0.05)
Covariance, $\sigma_{v02\ v12}$			0.20* (0.05)	0.21* (0.05)	0.20* (0.05)	0.39* (0.08)
Residual, σ^2_e	0.95* (0.01)	0.95* (0.01)	0.94* (0.01)	0.94* (0.01)	0.95* (0.01)	0.95* (0.01)

(continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Model Fit						
-2LL	167199.1	166462.5	165194.4	165066.1	164855.3	164813.1
AIC	167213.1	166476.5	165214.4	165086.1	164875.3	164833.1
BIC	167232.2	166495.6	165241.6	165113.3	164902.5	164860.3

Note. EP = executive processes, PR = prepotent responses, ExtEP = Extrinsic executive processes, i.e., parenting variable. Values derived from SAS 9.4 PROC MIXED. Entries show parameter estimates with standard errors in parentheses. Estimation method = REML; Satterthwaite degrees of freedom.

* $p < .01$.

Appendix B

D.O.T.S. Emotion Coding System

By Pamela M. Cole, Crystal N. Wiggins, Anna M. Radzioch, & Amanda M. Pearl

This coding manual has been edited for brevity and formatting. The dissertation used only anger and neutral codes.

Introduction

Judgments are made repeatedly on a second-by-second basis. The system distinguishes the emotion's valence (positive or negative) from regulatory attempts. It classifies the emotion the individual appears to be communicating according to 4 categories. The coder judges which basic emotions the individual appears to be communicating and then rates the intensity of each, ranging from not at all to strong.

The purpose of this coding system is to classify the emotion displays of individuals during lab-based procedures. Emotions are classified using 1-second intervals. During each interval, the coder scans the entire second and determines which of 4 basic emotions were present or absent. The system is limited to 4 basic emotion families: happiness, anger, anxiety, and sadness. There are separate cues provided for each emotion codes. They are based on consensus across different research projects attempting to provide methods for reliably classifying discrete emotions (Ekman, Izard, Scherer). These discrete emotion families are based on research that indicates certain facial, vocalic, and to a lesser degree, gestural and postural, cues are consistently associated with emotion families. Facial cues are based on muscle movements that change the face's appearance. Vocal cues are based on the prosodic quality of utterances (i.e., the tone of voice) and NOT on the content of the individual's utterance.

Emotion Codes

Happy (HAP). Joyful, excited, enthused, delighted, gleeful, pleasantly surprised. Vocal cues include light and lilting voice with pitch becoming higher and/or louder than previous vocalizations. Lilting is speaking rhythmically with fluctuating pitch, i.e., a swing or cadence in the voice. Code includes laughing, giggling, and humming in a singsong. Facial cues include smiling, slightly or broadly, in which corners of mouth turn up, cheek area rounds up as muscle is contracted; smile may or may not be accompanied by crinkling around eyes, which often appears as brightness in eyes; forehead is smooth, brows may rise as in happy surprise. Postural and gestural cues include a little tension in the body (i.e., body is not slumped) with shoulders and chest appearing relaxed. Individual may jump up, raise arms in glee, and/or clap hands with delight.

Sad (SAD). Disappointed, regretful, specific kind of unhappy, hopeless, dejected. Voice lowered from previous volume without intention to whisper or drops off at end of utterance. If individual is whining, these sad vocal cues must still be present for some part of the whining to give any sadness. Facial cues include lip corners pulling down, bottom lip appearing loose as in a pout (*note: pouts may also contain cues of anger*), drooped eyes, and brows forming an oblique shape (^). Postural and gestural cues include head dropping down and to the side, shoulders and/or body slumping or going slack, eye rubbing in effort to catch or hide tears.

Angry (ANG). Frustrated, hostile, annoyed, irritated, mad, impatient. Vocal cues are voice becoming harsh, conveying protest, irritation, impatience, frustration, and/or hostility. Vocal pitch is louder and deeper and utterances have a plosive quality (as in the sound [p] in *pit*). If child whining HAS protest quality, code ANG. For mothers, ANG can be coded if the voice has a deeper, lower pitch, mild sternness, or a warning tone. Words may be emphatic and deliberately spaced but they must also use a warning or disapproving tone. Facial cues can include furrowed brow, but there must be additional cues to code as anger, narrowed eyes as in a "hard stare", clenched or set jaw clenched, squared off mouth if open, and/or lips pressed or tightened if mouth closed. Postural and gestural cues include arms akimbo and/or finger wagging or jabbing. Aggressive behaviors are **NOT** code-able without additional anger cues.

Anxious/Worried (ANX). Nervous, tense, jittery, wary. Vocal cues include strained voice that conveys stress and may sound shaky or tight. Tension in the vocal chords makes them constrict in a way that disrupts smoothness of speech. Voice may sound fearful. If whining has NO protesting quality, code as ANX or SAD. Facial cues include furrowed or deepened brow, raised eyelids, wide eyes, retracted lips (i.e., think of saying "eek" if you see a snake or insect), lip-biting, and/or darting glances. Postural and gestural cues include hand or foot moving in repeated, jittery, fidgeting fashion, upper body (neck, head, and shoulders) appearing stiff, shoulders raised tensely. If individual has a nervous habit of shaking hand or foot and continues this throughout the procedure, it is NOT coded as ANX because we code only changes in behavior.

Neutral. No signs of vocal, facial, or postural cues of any of the above 4 emotions. Voice sounds "matter of fact".

Not able to be coded. Use this code either when an emotion is present that is not included in our coding system (e.g., surprise, disgust) or you are unable to rate emotions because you cannot see nor hear the individual.

Emotion Intensity

Intensity is coded on a 0 – 3 scale. Score is determined by the number and quality of emotion cues present in an episode. Code of 0 denotes *no sign* of any cue for this emotion. Code of 1 denotes s*light intensity* ranges from slightest perception of emotion cue to extended but mild level of intensity. Cues may be very brief, fleeting, or slight. If extended in duration, the cues must be faint or minimal. There may be only one cue present but if more than one present, must be slight, faint, and minimal. Code of 2 denotes c*lear but moderate intensity* ranging from a brief but clear expression to an enduring but moderate level of intensity (in other words, expression could definitely be fuller but is not). More than one cue is likely to be present. Code of 3 denotes s*trong intensity* ranges from brief but full expression to full and more enduring expression of emotion. Typically there are multiple cues; body/gestures are likely but not necessary. Cues should be clear and unambiguous.

Appendix C

D.O.T.S. Child Strategy Use Coding System

By Patricia Z. Tan and Pamela M. Cole

This manual has been edited for brevity and formatting. Only codes relevant to the task used in this dissertation were included. To apply these codes to other LABTAB tasks, please contact Pamela M. Cole and request the entire manual.

Goals of Coding System

The first goal is to note the **onset and offset** of regulatory strategies (double-coding is possible, particularly with self-soothing). The second goal is to specify children's use of ODD (support-seeking) and Fd (focus on demand). The third goal is to observe maternal prohibitions. The fourth goal is to note duration of child touching the prize.

Descriptions of Behavioral Codes

Bids to Mother or RA. Verbal or non-verbal bids for adult support or attention include ODD, ODDi, ODO, and ODDpa. ODD is coded in the wait task when a child bids to mother about delay, e.g., wanting to open the prize or wanting mother to finish her "work". Examples include saying "I want the prize". If child is asking to be closer to mother (e.g., "can I sit next to you?), the behavior is most likely ODD. ODO is questions, statements, or requests that are not relevant to the challenge of the task. ODDi is defined as asking mother for more information regarding the wait. For example: "how much longer?"; "how many more questions?"; "Why do I have wait?"; "Are you almost done?"; "Are you done?" ODDpa is coded when the child makes statements reflecting positive anticipation of the wait task prize. For example: "I bet it's candy!"

Other examples of ODD include the child repeatedly asking mother to watch while they are engaged in an activity, otherwise repeatedly asking for mother's attention, asking to be (physically) closer to mother, asking mother for her pen and papers, talking to Mom/RA about challenging aspects of waiting (e.g., how boring or broken the toy is, how much they would like to open the prize, needing Mom to open the prize). Statements like "Can I open it?"; "I want to open it now!"; "This can't fly!"

Further examples of ODDi (information-seeking) include statements like "Are you done yet?"; "Are you almost done?"; "How many more questions?"; "Where is [RA]?"; "When is [RA] coming back?"; "Why [do I have to wait]?"; "How much longer do I have to wait?" Other examples falling under the category of seeking information about what is allowed during the task include "Can I sit next to you?"; "Can I play with the car?" "Can I touch it [questionnaires]?" Asking "Are you done yet?" is coded as ODDi unless the question is repeatedly asked to mother within the minute and it seems like the child is whiny. In this case, the first two bids will be coded as ODDi but all following bids (using similar wording) will be coded as ODD. If child asks Mom why she is doing work/completing questionnaires, then the question would be coded as ODDi.

ODO includes chatting with mother about non-challenging aspects of the wait task or completely unrelated events. Examples include statements such as "I love snack!"; "Can I pretend?"; "I'm taking the horse to the hospital"; "Look Mom, the car is flying!"; "Can I go to the bathroom?"; "My leg hurts." If the child is talking to mother about a way to "fix" the toy (i.e., pretending to fix the horse's leg, pretending to bring the horse to the hospital) it is considered ODO (and not ODD). If, however, child is complaining to Mom about the brokenness (or boringness) of the toy, it would be coded as ODD.

If child is asking mother for attention or approval (in the vein of “look what I did/am doing!”), there are 2 options. The first is to code behavior ODD if child has been constantly asking for Mom’s attention or if child is asking for support related to waiting. The second is to code behavior as ODO if child has asked 1-2 times for Mom to check out a game that he or she has devised for him/herself.

In the wait task, code a “b” next to a D1 or D2 code when the child distracting him or herself with the boring toy (i.e., broken car; broken horse). Similarly, code a “b” next to an ODD code when child is talking to Mom about the brokenness of the toy.

Self-soothing. Rhythmic, soothing movements or putting head on table.

Distractions. Distractions are coded as D1 or D2. D1 is defined as a brief distraction in which eye gaze *typically* does not stay in 1 direction for > than 4 seconds. The child does not seem to initiate the distracting behavior or settle on 1 particular activity/behavior. D2 is defined as focused distraction. Use child’s eye gaze to help determination of D1 vs. D2 and whether or not to double code ODD with D1 or D2. If child is intently gazing down at an object and manipulating object, action is most likely JUST a D2. In contrast, if child is looking around the room, without any pauses in a single direction, most likely code as a D1. However, if child is focused on the object for more than 4 seconds, then the D1 will be bumped up to a D2. If child is engaged in one object and glances away for 1-2 seconds before reengaging in the same activity, code the entire sequence as D1. If child is engaged in one object or activity, glances away, and then starts another activity, then code sequence as D2 to D1 then back to D2.

Focus on demand. Focus on demand is coded as either Fd(D), FdO, or FdPlay. Fd(D) is focus on challenge of task, i.e., opening the surprise or mother’s attention in the wait task. In the wait task this includes touching or trying to open the prize and fingering the paper wrapping or string ribbon on the prize. FdO is focus on secondary challenge of wait task, i.e., focusing on mother or questionnaires that mother is completing, looking at mother. FdPlay is playing with the prohibited surprises during the wait task, e.g., making the prize ride on the car, swinging the prize around.

Important Notes Regarding Behavioral Codes

Distinguishing between codes. ODD trumps FD if they occur simultaneously (e.g., children ask mothers for prize while reaching for or touching the prize). ODD can also trump FdO if children ask for questionnaires/pen in the wait task. When children first approach mothers, code an ODD. However, if children continue to stand around mothers, watching mothers fill out questionnaires, then code as a FdO.

Staring at mothers' questionnaires and/or pens will be coded as FdO. Asking mothers for pen/papers would be coded as ODD. However, if children ask mothers why they are doing work/completing questionnaires, then code as ODDi. Finally, if children grab at pen, it would then be disruptive Fd. If children ask for the pen/questionnaire while grabbing for it, then code as disruptive ODD.

Singing is coded as D1 if children sing while walking around the room but can be D2 if they seem intent on the song and stare at one particular object while singing. If children sing about the wait, then code as FdD.

Entering more than one code for the same event. More than one code can be entered for the same event. If children looking at mothers and manipulate an object, code an ODD and D1 unless children intently stare at the object, bringing it close to eyes. However, if children are simply touching it while looking at mother, then action is an ODD. Code ODD and D1 even if children do not look at but are clearly talking TO mothers while manipulating an object.

Other Codes

Disruptive behaviors. Behaviors adults would stop if supervising children. Code any behavior as disruptive if parents or RAs explicitly prohibit the behavior and children continue it.

Adult- versus child-initiated behavior. For each code, indicate whether the behavior was adult- or child-initiated. After the initial adult prompt, **code the first 15 seconds** or until you see a clear break in the behavior of behavior as adult-initiated. Then code as child-initiated.

Maternal prohibitions. Code on- and off-set in the wait task. If, after mothers give prohibitions, children are still touching the prize, code a disruptive FD. This includes the start of the task. If children touch the prize after mothers finish the prohibition at the start of the task, also code as disruptive FD. Remember that to be coded as disruptive behavior must occur within 45 seconds of the prohibition. For example, if mothers say "don't touch the socket" and children continue code as disruptive D2 in the next 45 seconds. If mothers do not re-state the prohibition after 45 seconds, any continued socket-touching is coded as self-initiated.

Touch. Code when children touch the prize in the wait task.

Comment Section

If task is abnormal or ends early, note what happened and why under the Comment section. Write in the content of children's bids (i.e., "What are you doing?"; "I want the prize now!"). Please ALWAYS do this when you code ODDi and ODO.

Appendix D

D.O.T.S. Structuring Coding System

By Pamela M. Cole and Elizabeth B. Reitz

This coding manual was edited for brevity and formatting. Only codes used in the dissertation were included here; for the full manual, see Pamela M. Cole.

Goals of the Coding System

One aim of the D.O.T.S. project is to examine whether emerging language and executive functions skills contribute to effectiveness, appropriateness, and awareness of emotion regulation in early childhood. We assume that they do, that the integration of different domains of skills depends upon environmental input, and that parents are a central source of that input. This manual describes a coding system developed to assess parental contributions.

We use the term “structuring” to describe parents’ efforts to harness children’s emerging skills in the service of self-regulation. That is, structuring should capture attempts to provide children with a platform for regulating behavior independently. Instead of simply fixing situations or telling children what to do, structuring involves efforts to get children to do something themselves. Parents “structure” use of attention, language, inhibitory control, and planning to self-regulate. We assume this not only helps children acquire skill at self-regulation but also creates an environmental context supporting the growth of neural networks between areas of the brain that communicate to support complex self-regulation.

Parental structuring invokes children’s use of the following **skills**: *attention* to focus on key aspects of a task and to shift attention away from distractions; *planning* to anticipate action and consequences of action; *language* to understand how to behave; *response inhibition* to delay action. The system also includes assessment of the quality of parental structuring attempts (degree of developmental sensitivity on a 0-4 scale).

Because structuring is a complex action (it may involve a sequence of behaviors invoking several child skills), judgments require more than a few seconds of observation. Our system evaluates parental structuring every 15s. We ascertain if structuring occurred and, if so, its dimensions. This allows enough time to interpret parental behavior and enough observations to capture variability across parents.

The goal of this coding system is to analyze components of structuring. The concepts of structuring and scaffolding are common in the literature, but are generally judged globally. In addition, Vygotsky's concept of scaffolding requires that (a) parents have accurate knowledge of children's abilities and (b) children successfully execute behavior. Our definition of *structuring* has neither requirement. Parents may unwittingly engage in effective structuring and children may learn from the parent's attempts even if they cannot execute the action. The coding system, however, does track whether or not children successfully execute parents' suggestions.

Structuring differs from directing, which is when mothers provide direction without building off existing skills or helping accomplish the task themselves. Mothers provide some input (i.e., through a command) but do not encourage use of executive functions.

Structuring Coding Steps

1. At the start time, coders should calculate 15s intervals and mark the start and stop times for each segment on the coding sheet before beginning to code.
2. Coders watch 15s of interaction.

3. Coders decide whether mothers structured. If no, indicate ‘nothing’ (1) or ‘directing’ (2) on the coding sheet. Directing indicates that mothers told children what to do or what not to do but did not structure language or executive function to self-regulate. If nothing or directing describes the episode, coders mark a 0 in the quality of structuring category. Then, coders watch the next 15s epoch.
4. If structuring was attempted, coders continue to evaluate the episode by:
    a. Determining what child skills were targeted, and,
    b. Rating the quality of structuring on a 0-4 scale.
5. There are times, especially in the wait task, when the epoch unnaturally divides mothers’ structuring attempts. As a result, it is difficult to code the behavior in the second epoch because much of the structuring was not within those 15 seconds, but is continuing with similar quality as in the previous epoch. When this happens, coders should mark a ‘C’ on side of the coding sheet to indicate a *continuation,* code as many behaviors as were present, and give the quality from the last epoch. However, this decision is only made when the structuring event is clearly unnaturally divided by the 15 second epoch.

Child Skills

More than one skill can be structured in an epoch. Coders must determine which skills are targeted. Child skills are the capacities *within children* that mothers either attempt to build on or strengthen. Coders ask: Are mothers drawing on children’s capacities for attentional, behavioral planning, language, or inhibitory control? These skills are further distinguished in 6 categories: attention focusing, attention redirecting, distracting, planning, inhibitory control, and language.

Attention Focusing. Young children have some limited capacity to focus and sustain attention on a task or activity. For this code mothers must harness children's capacity to sustain or increase focus. Children are *already attending* to the task. Code, for instance, if children are playing with the wait task toy and mothers by make the toy more interesting by making up a game to play with the toy. In the reading task, children might be listening to the story; mothers may point at the pictures, using vocal tone or inflection to make the story more exciting or interesting. Mothers could also comment on children's independent play, such as "you really like that little table" or "you're doing a good job" to reinforce or further focus attention on the activity. Remember it is NOT necessary for children to comply.

Attention Redirecting. Young children are easily distracted. They have some ability to redirect their attention. For this code, mothers must harness children's attention back to a task. That is, to harness capacity to redirect attention, children must be *currently off task.* For instance, children grow disinterested in a story and try to get off mothers' lap. Mothers structures redirecting when they try to regain interest by increasing positive vocal tone or saying, "Look what the frog is doing now!" Children must have either looked away or physically moved away from the task for redirection to be coded, i.e., have clearly demonstrated loss of attention.

Commonly, mothers will redirect and then after a time of children paying attention they will continue to focus children's attention. Attention focusing and redirection can be double coded if children lose attention, mothers say something, children return to the task, and mothers says something else. For instance, children look away, mothers say, "look at the frog," children look back, and then mothers say, "He and the boy went to a restaurant." Mothers redirect and then continues to focus children afterward.

Mothers can only be coded for redirection if they notice children's loss of attention. When mothers are not attuned enough to notice and continue to participate in focusing behaviors, only code attention focusing with quality of 1 and child success a 2 since children are sometimes paying attention and sometimes not.

Distracting. Parents capitalize on children's distractibility when it is best to switch attention *away* from something. Parents shake rattles or keys to distract upset infants; young children may need distracting from a desirable object or from feeling unhappy. Mothers target children's ability to shift attention by promoting focus to something else. For example, children may lose attention in a game and mothers draw their attention to a different object (e.g., the wall poster) or activity (e.g., playing with the broken car in the 36 month wait task). Mothers may encourage distraction so that they do not focus on wait task gift by suggesting something else to do.

Remember that mothers can structure all child skills without words, i.e., by placing the distracting toy in front of children during the wait and not verbally introducing it. In this case, mothers would be coded as distracting.

Planning. Young children sometimes only think about what's immediately before them. Parents can call upon a developing ability to think about the steps to a goal or what will happen next or in the future (consequences of misbehavior, good things that come if one waits). Mother can harness this emerging ability by fostering thinking ahead or using information about the future to regulate. This may come in the form of operational steps within a task or talk of what to expect in the immediate or distant future. For instance, if children are building something, mothers may demonstrate steps involved by saying, “First you can do this. Then try that.” Mothers may show or tell children that the largest blocks should go on the bottom and then the smaller blocks on top.

Alternatively, children may tire of reading one book and indicate that another is on the table. Mothers target planning by saying they will finish one book and then read the other. Mothers may also allude to future events in the storybook so as to maintain children’s attention. For instance, before turning pages, mothers may say, “I wonder what will happen next?!” Mothers also remind children when work is done they will do something fun. In the wait the mother may say, “You have to wait until I am done with my work, but then you can open the prize.”

Pay close attention to what mothers say. Mothers use words connoting temporal sequences, i.e., until, when, then, first, next, after, soon, in a minute. Mothers use sequential steps or future-oriented thinking to help children regulate current behavior. Structuring planning often involves if-then statements. All of these examples structure developing planning skills. When mothers do not clearly describe what will happen (e.g., “that’s for later” or “not yet”), do not code planning.

Language. Children have rapid advances in vocabulary and grammar during the ages studied. Their burgeoning language can be harnessed to help them understand experience and guide behavior. Mothers can harness children’s language by describing children’s intentions (“Looks like you want to open the present!”) or by embellishing verbally on activities (“Oh, you are pointing to the frog.”). This <u>only happens when children behave</u> and mothers provide words for children’s actions. Another example might be children trying to climb on mothers' lap and mothers saying, "You want to get on mommy's lap." Mothers say the words children cannot yet say.

Mothers also use questions to encourage children to think about activities or behavior or intentionally and slowly labeling objects ("This is a f-r-o-g."). When mothers describe objects or activity, they harness children's verbal encoding of information. For this code, distinguish general talk from attempts to get *children to use language* to process information. For example, if mothers are reading, they may harness language by asking children to label pictures (i.e., "What is this?"), or pointing to pictures and saying slowly and articulately, "This is an f-r-o-g." This is <u>different</u> from reading the story because mothers are going beyond the immediate content of the book.

Mothers may state a rhetorical question, i.e., not really asking the question but instead giving a command in question form to persuade children to do something. An example is: "You have to sit, ok?" Mothers are directing and should not be coded as structuring language, because mothers are not trying to target language skills. They are adding a question to soften the directing. Coders should err on the side of coding mothers for encouraging children's language, while accounting for the nature of the question and children's language abilities in the quality score.

Included in this code is recasting of children's language. *Recasting* is defined by parents' building upon children's vocabulary and grammar by repeating what children say or adding to what they say. For example, children may make an unclear utterance and mothers articulate it. Mothers may also recast by extending what children say. For example, if children say "prize, prize" and mothers may say, "You are waiting for the prize." Recasting also includes modifying grammar; in response to "I hurted my finger" and mothers say “you hurt your finger.” If mothers repeat what children have already said without adding further meaning, it is **not** recasting.

Finally, mothers often target children’s language in conjunction with physical movement. Mothers may point to objects while labeling them or acting out a word in a story. While reading, mothers will say, “the bucket is on the frog’s head,” and then point to children’s heads and say, “on his head.” This example is subtle but illustrates how mothers can utilize the current environment to demonstrate the meaning of a sentence or word. Mothers may say “The frog is running” while simulating running movements.

Inhibitory Control. The last skill involves children’s emerging ability to stop and think to refrain from acting. Inhibitory control refers to the capacity to stop a PR and act differently. PRs are very basic and automatic. The most common example is in the Stroop test in which the names of colors are written in different colors that do not correspond to the color font. One must inhibit the natural tendency to say the name of the color in which the word is written in order to perform correctly by reading the word. Mothers can harness this developing skill. In our system, this occurs when mothers encourage *children to inhibit* PR. For example, mothers may remind children of rules (“remember, you have to wait until I’m done”). Mothers help children use self-control (“Remember the rule? Don’t open the prize until I am finished my work”) and do not simply do for them (“Don’t touch the prize”). In the latter case, mothers are <u>directing</u> children. Mothers may anticipate children’s actions and promote inhibitory control before the action, e.g., by reminding of a rule for waiting. Mothers frequently combine inhibitory control with distraction. For example, a mother may say, “Remember to wait. Why don’t you look at the posters until I am done?” In this case, she both reminds the child of rule *and* provides an alternative response, so both inhibitory control and distraction are coded.

Distinguishing between codes

Subtle differences between codes must be considered to ensure accurate and reliable coding. For example, mothers' physically stopping children is coded as directing, not structuring, because mothers stopped children rather than encouraging stopping oneself. Mothers' distracting children is considered structuring of attention, not response inhibition (e.g., saying, "You have to wait. Why don't you play with that toy?"). Mothers' saying "no, no, no, let that alone and sit down," is directing, not structuring.

Structuring quality

If structuring occurred, rate the quality of the attempt. Structuring quality is rated on a 5 point scale based on the dimension of sensitivity and creativity. A sensitive interaction is well-time and paced to children's moods and developmental level. Parents neither over- nor under-stimulate, knowing when to increase or reduce the amount of stimulation children are experiencing. For example, parents discontinue activities beyond children's capacities or introduce new activities when children appear bored. Sensitive parents provide developmentally appropriate stimulation that facilitates exploration and actions children can achieve. Parents may encourage the development of new skills, but do not have expectations beyond children's age. Sensitive parents provide children with contingent vocal stimulation and acknowledge children's interest, efforts, affect, and accomplishments. During a particularly sensitive interaction, one has the sense that mothers are paying close attention to children's cues to create synchronous and fluid interactions.

The creativity with which mothers employ structuring is also an element of structuring quality. Although the developmental sensitivity with which mothers interact with children is paramount, some are able to be especially dynamic and original in their approach. Mothers demonstrating exceptional creativity should be considered for the highest quality rating. Creativity can be observed, for example, in mothers who generate novel functions for toys in direct response to children's contributing to the interaction. If children say "vroom," creative mothers could incorporate the vocalization into subsequent pretend play. Any instance of *insensitivity,* such as being harsh or scaring children to get attention, results in the quality rating dropping to a 1 or 2.

Structuring quality is rated as 0 if it did not occur. A score of 1 indicates minimal quality such that mothers attempted to harness one or more child skills but was minimally or marginally sensitive, i.e., brief, unelaborated, incomplete, or out of synch. Children may have needed more structure. Mothers might try to engage children's attention by saying "Look!" but do nothing else to enlist attention. Mothers might persist at one strategy when a variety of strategies in a sequence may be more helpful. Mothers exhibiting minimal quality structure with little attention paid to children's cues or needs. Though mothers are structuring, it is done independently in a non-dyadic manner. Coders may rate quality as 1 when the interaction is "barely" structuring.

Contingent, but not sensitive, structuring is rated with a score of 2. Mothers are participating in more elaborated or enthusiastic structuring than at rating of 1, but coders do not sense that mothers are structuring well. Mothers use a greater number of strategies, or more creative and diversified strategies, than at a rating of 1; however, the interaction is not well-timed, fluid, or creative. As opposed to mothers rated as 1, mothers rated 2 behave contingently with children, e.g., by structuring in response to children's bids or monitoring children's reactions. Though contingent, mothers are not sensitive; they may acknowledge bids but respond inappropriately or in a way that is too advanced for children's age, i.e., with developmental insensitivity. For example, mothers speak too quickly or too much for young children to understand or make use of their speech. Mothers may move the interaction along too fast, e.g., by turning book pages while children are still looking at the pictures. A hallmark of developmental sensitivity is the pace at which mothers present new information or stimulation. Developmentally insensitive mothers appear rushed. They are encouraging children's executive functions, but in a suboptimal way. Mothers whose structuring is not sensitive cannot receive a score above a 2 for the epoch.

Structuring of moderate quality is scored as 3, meaning that mothers make clear and elaborated attempts to harness one or more child skills. Mothers seem generally aware of children's needs in the interaction and developmental level, reflecting sensitivity. At the same time, mothers' behaviors do not have the spectacular quality is reflected by a score of 4, e.g., sensitivity may not be consistent throughout the entire interaction. Coders should consider a rating of 3 for mothers who recast something children say, unless it is coupled with less sensitive structuring behaviors. Recasting is an advanced teaching strategy often associated with higher-quality structuring.

Finally, structuring quality is rated a 4 to denote high quality when mothers exhibit creativity and/or skill in structuring attempts. It gives the impression of being well timed and synchronized with children's contributions to the interaction (e.g., motivation, emotional intensity or apparent ability). Mothers may make one attempt and then adapt to meet children's needs. Mothers may also be consistently sensitive. Scores of 3 or 4 indicate sensitive structuring. Elaborate structuring receives a score of 4.

Coders should remember that structuring is primarily a parental code. The quality with which mothers execute it should be determined as independent of children's behaviors as possible. However, there are times when children's cues or reactions to mothers must be considered. Generally speaking, when coders observe developmentally inappropriate or insensitive maternal behaviors given children's cues, it is appropriate for coders to take children's cues into account. However, if mothers' structuring attempts are unsuccessful despite being developmentally appropriate and sensitive, children's reactions should be ignored as much as possible. We want to capture the attempts that may seem unsuccessful at the time, but may actually contribute to positive child development over time.

Additional Rules and Examples

Instrumental assistance entails physically modifying a negative situation or promoting or prolonging an enjoyable one. It addresses children's needs in the moment but does not engage children's skills. It is also not teaching children to solve problems but is rather solving a problem for them. Parents might guide children's movements; code instrumental assistance only if parents are actually doing the movement. If parents' physical efforts are guiding or facilitating, consider coding structuring.

Mothers often give "if… then" directions to their children. This is considered both using language and targeting planning skills.

When considering whether a maternal behavior is structuring or not, it may be helpful for coders to think about which executive function is being encouraged. For example, mothers may use a series of instructions to explain how to build a car out of blocks. In doing so, they may tap on the table to direct children's attention to the blocks and say, "Wait to touch the blocks until Mommy shows you how to build the car. Then you can do it." In this example, mothers are focusing children's attention by tapping on the table, inhibiting children from touching the blocks before the explanation is finished, and providing children with information to plan the behavioral sequence effectively.

ABBREVIATED VITA

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EDUCATION

2015	Ph.D.	Child Clinical Psychology, Penn State
2013	M.S.	Child Clinical Psychology, Penn State
2008	B.A.	*Summa cum laude*, Psychology, Stonehill College

AWARDS

2009	Penn State Psi Chi Students' Outstanding Teaching Assistant
2008-2015	Travel funding for professional conferences

RESEARCH*

2011-2014	Penn State	Early Growth and Development Study, Neiderhiser
2008-2014	Penn State	Development of Toddlers Study, Cole
2008-2013	Penn State	Bliss and Blues of Parenting Study, Cole
2008-2010	UCLA	Collaborative Family Study, Baker
2007-2008	Stonehill	Facial Recognition Study, Poirier

CLINICAL TRAINING

2014-2015	SUNY Upstate	APA-Accredited, full time clinical internship
2008-2013	Penn State	Graduate Clinician, PSU Psychological Clinic Assessment, therapy, & consultation experience

TEACHING EXPERIENCE

2014	World Campus	Well-Being & Positive Psychology
2013	University Park	Infant Development
2013	World Campus	Elementary Statistics
2008-2013	University Park	Teaching assistant for senior seminars and courses in children's mental health services, child-clinical psychology, and introductory psychology

SERVICE ACTIVITIES

Student Representative	Department Clinical Training Committee APA Reaccreditation Practicum Training Committee
Program Liaison	Council of University Directors of Clinical Psychology
Ad Hoc Reviewer	APS Student Competitions, Psi Chi Research Fair, Various professional publications jointly with advisers

MEMBERSHIPS

American Psychological Association
Society for Research in Child Development
Association for Psychological Science
Behavior Genetics Association

**List of publications and presentations available upon request*