Origins of Effortful Control: Infant and Parent Contributions

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Abstract

Effortful control (EC) refers to the ability to inhibit a dominant response to perform a subdominant one and has been shown as protective against a myriad of difficulties. Research examining precursors of EC has been limited to date, and in this study, infancy contributors to toddler EC were examined. Specifically, parent/family background variables (e.g., education, income), maternal temperament, perceived stress, and internalizing symptoms were addressed, along with infant temperament: positive affectivity/surgency (PAS), negative emotionality (NE), and regulatory capacity/orienting (RCO); and laboratory observation-based indicators of attention. Infant attention indexed by the latency to look away after initially orienting to the presented stimuli emerged as an important predictor of later EC, after accounting for other child and parent/family attributes, with shorter latencies predicting higher levels of EC. Mothers' extraversion and parenting stress were the only parent/family attributes to significantly contribute to the prediction of toddler EC, with the former promoting and the latter undermining the development of EC. Infant temperament factors were also examined as a moderator of parent/family influences, with results indicating a significant interaction between mothers' EC and infant RCO, so that children with greater RCO and mothers high in EC exhibited the highest EC scores in toddlerhood.

Interest in the study of temperament in early childhood has been steadily increasing as such individual differences have been linked to later personality and social development, as well as adjustment and psychopathology (Kagan, 1998; Rothbart & Bates, 2006). On the basis of the psychobiological theoretical approach to temperament (Rothbart & Derryberry, 1981), which has become prominent in temperament investigations, temperament is conceptualized as constitutionally based individual differences in reactivity and self-regulation, influenced

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by heredity, maturation, and experience. "Constitutionally" refers to the relatively enduring biological make-up of the individual, with reactivity encompassing arousability of affect, motor activity, and attentional responses (e.g., orienting), assessed by threshold, latency, intensity, time to peak intensity, and recovery time of reactions to stimuli. Self-regulation encompasses processes such as inhibitory control and self-soothing, serving to modulate reactivity (Rothbart & Bates, 2006).

A number of characteristics related to self-regulation (e.g., voluntary attention, inhibitory control) are associated with the development of the executive attention system, which begins to emerge and mature at the end of the first year of life (Rothbart, Ahadi, & Hershey, 1994). These regulation-related attributes have been shown to form an over-arching temperament factor referred to as effortful control (EC), with the theoretical basis provided by Rothbart's psychobiological structural model of temperament, and empirical support emerging in multiple factor analytic studies, including data from different cultural groups (Ahadi, Rothbart, & Ye, 1993; Kusanagi, 1993; Rothbart, Ahadi, Hershey, & Fisher, 2001). EC is generally conceptualized as including temperament attributes such as focusing and shifting attention, inhibiting a response as a situation necessitates it, and responding to low-intensity stimulation and reward (Rothbart, Ellis, Rueda, & Posner, 2003). More formally, EC refers to the ability to inhibit a dominant response to perform a subdominant response (Kochanska, Murray, & Harlan, 2000; Rothbart et al., 1994).

Studies addressing manifestations of EC in early childhood have largely focused on the contributions of EC to adjustment, behavior problems, emotional difficulties, and social competence. For example, lower levels of EC have been demonstrated to predict difficulties with emotion regulation, lower social competence, and externalizing and internalizing type problems (Eisenberg et al., 2000; Hughes, White, Sharpen, & Dunn, 2000; Gartstein & Fagot, 2003; Hughes, Dunn, & White, 1998; Silk, Steinberg, & Morris, 2003). These consequences of EC-related deficits make it imperative to closely study the development of EC, focusing on its precursors, such as child temperament and attention, as well as parent/ family characteristics. To date, there has been relatively little systematic study of early antecedents of this regulatory domain of temperament, examining child and parent/family contributions to EC development simultaneously, with a few notable exceptions. Kochanska et al. (2000), for example, examined the contribution of child-focused attention and mothers' responsiveness, demonstrating unique positive and significant effects for these predictors of EC at 22 months. Bridgett et al. (2011) reported that higher maternal EC and higher intercept/slope of infant regulatory capacity/orienting (measured throughout the first year of life), along with greater maternal time spent in interactive care-giving with infants, contributed to higher toddler EC at 18 months. In a study with somewhat older children, Cipriano and Stifter (2010) showed that maternal interactive behaviors, including commands and prohibitive statements with a positive emotional tone, led to higher levels of EC at 4 years of age for exuberant children. Overall, results of these studies support the importance of considering both child and maternal characteristics in understanding the development of EC.

Early attentional attributes (e.g., duration of orienting, habituation) have important implications for the development of EC, and subsequently for social competence and

adjustment (Ruff & Rothbart, 1996). Duration of looking is thought to reflect the amount of information processed by an individual (Cohen, 1972) and can be observed as early as the third month of life. Subsequently, sustained visual attention to stationary objects or visual displays begins to slowly but steadily decline (Lewis, Goldberg, & Campbell, 1969), presumably because of greater flexibility in the infants' orienting reactions (Posner & Rothbart, 1991). It is not surprising that the development of attention is closely linked with the emergence of self-regulation, given that to attend to the environment effectively, infants must be able to regulate the balance between the needs of their internal systems (i.e., arousal) and the demands of external stimulation (Bornstein & Seuss, 2000). Even very young infants exhibit strategies that serve to control arousal and attention, such as self-stimulation and gaze aversion (Thompson, 1998), maximizing opportunities for an alert state, and facilitating parent–child interaction (Barnard, Bee, & Hammond, 1984; Sumner & Spietz, 1995). These self-regulatory abilities are further enhanced after the first year of life with the emergence of executive attention skills (Rothbart et al., 1994; Ruff & Rothbart, 1996), largely as a result of the maturation in the executive attention network (Rothbart & Rueda, 2005). Thus, infant regulation and related attentional skills manifested by the end of the first year of life set the stage for the development of EC, reliably identifiable in the toddler period (Kochanska et al., 2000; Putnam, Gartstein, & Rothbart, 2006). It is also likely that flexibility of orienting reactions, resulting in faster disengagement from stimuli and more rapid attention shifting, becomes more important toward the end of the first year of life because of the increasing behavioral repertoire supported by this domain of attention (e.g., exploration efforts newly afforded by locomotion). That is, the importance of attentional flexibility may be enhanced during this transitional period of increasing independent activity, with the supporting attentional skills in turn facilitated by the "coming online" of the executive attention system. Attention shifting may be a unique aspect of attention in that it is related to disengagement inherent in habituation, observed early in the first year of life, as well as a component of the EC constellation, emerging as a function of the frontal region maturation occurring during the toddler period (Posner & Rothbart, 2007; Ruff & Rothbart, 1996). Later in life, factor analytic models of executive function, a construct also implicated in self-regulation and the maturation of the prefrontal cortex (Blair & Ursache, 2011; Gyurak et al., 2009), have consistently included attention shifting as a core executive function component (e.g., Latzman & Markon, 2010; Miyake et al., 2000). Thus, indicators of attention shifting/flexibility obtained at the end of the first year of life may be particularly important in understanding the emergence and development of EC and related constructs.

Other early emerging temperament attributes are also likely to contribute to the development of effortful regulation in early childhood. For example, Komsi et al. (2006, 2008) found a positive association between mothers' ratings of their infants' positive affectivity (e.g., activity level, smiling/laughter, soothability, and duration of orienting) and later EC. Gartstein, Slobodskaya, Putnam, & Kinsht (2009) also reported positive associations between early positive emotions and later EC, measured via parent-report, whereas Kochanska, Aksan, Penney, and Doobay (2007) noted associations between children's early positive emotions in the context of mother–child interactions and later EC measured through laboratory procedures. Several studies have also noted negative associations between

negative affectivity and EC. Putnam, Rothbart, and Gartstein (2008), for example, found longitudinal links between low infant negativity and high childhood EC. Similarly, Stifter and Spinrad (2002) noted that excessive crying, a behavioral indicator of negative emotion, appeared to compromise early emotion regulation, and Bridgett et al. (2009) found that high infant negative affect adversely impacted early attention/regulation. These findings suggest a complex interplay between emotion and emerging attentional processes enabling self-regulation, making it important to consider child emotionality in studies examining the emergence of EC, which has not been consistent in the existing literature.

Mechanisms of self-regulation available to infants prior to the emergence of EC are limited (e.g., gaze aversion, physical self-soothing), which helps explain why infants rely heavily on caregivers for assistance in the regulation of emotion and behavior, and why caregivers' own characteristics and contextual factors related to parental functioning are also likely to play a role in shaping the development of EC. Few studies have examined connections between parental temperament and children's EC, with only one study noting connections between maternal and toddler EC (Bridgett et al., 2011), although prior research has shown links between other domains of caregiver individual differences and childhood temperament characteristics, as well as child adjustment/psychopathology. For example, higher levels of parental extraversion, measured when children were 6 months of age, predicted an increase in child EC, so that children of more extraverted mothers demonstrated greater gains in this domain of attention-based regulatory functioning at 5 years of age (Komsi et al., 2008). On the other hand, maternal negative emotionality was linked with insecure child attachment, poor rule internalization, and problem behaviors (Kochanska, Clark, & Goldman, 1997), suggesting that higher maternal negative emotionality may place children at greater risk for poor self-regulation. Similarly, mothers' and fathers' neuroticism were related to more severe forms of child attention deficit and antisocial behavior, whereas mothers' conscientiousness and fathers' agreeableness were linked with fewer problems for offspring (Nigg & Hinshaw, 1998). Mothers' emotional stability and conscientiousness were negatively related to child externalizing problems, whereas autonomy demonstrated a positive relationship with these child behavior problems/symptoms (Prinzie, 2005).

Overall, a number of important links between maternal temperament/personality dimensions and child outcomes have been reported in the literature, although to date, parental EC has largely been overlooked in this context, despite potentially important connections between parent and child EC, operating through genetic and environmental pathways. That is, children's EC appears to be in part determined by hereditary factors (Lemery-Chalfant, Doelger, & Goldsmith, 2008), with parents who have higher levels of EC likely to pass this predisposition on to their offspring. Caregivers' EC is also likely to shape the nature of parent–child interactions and other aspects of parenting/caregiving (Bridgett et al., 2011; Cumberland-Li, Eisenberg, Champion, Gershoff, & Fabes, 2003; Eisenberg, Cumberland, & Spinrad, 1998) important in the development of EC in early childhood, with higher levels of parental EC leading to enhanced functioning in these related domains.

Parenting/family stress, as well as caregivers' anxiety and/or depression, collectively referred to as internalizing problems, are also likely to contribute to the development of child EC, disrupting of the progression toward children's greater self-regulation capabilities.

Mother-report of prenatal family stress, for example, was associated with observational assessments of poor EC in the preschool period (Henrichs et al., 2011). Maternal depression has been linked with a variety of problematic outcomes with respect to social-emotional development (Cummings & Davies, 1994), particularly in early childhood (Hammen & Rudolph, 1996). More recently, Pesonen, Raäikkönen, Heinonen, Järvenpaää, and Strandberg (2006) demonstrated that preschool children exhibited lower levels of EC when their parents self-reported greater depression vulnerability (e.g., self-criticism, dependence). Mothers' prenatal state and trait anxiety were also related to difficult temperament at the end of the first year of life, with difficult temperament including intense reactivity coupled with under-regulation (Van den Bergh, 1990), whereas pregnancy-related fears were linked with poorer attention regulation (Buitelaar, Huizink, Mulder, de Medina, & Visser, 2003). Mothers' internalizing symptoms and perceived stress are likely to disrupt parenting/parent–child interaction strategies, expected to contribute to the development of child EC. That is, mothers experiencing greater levels of internalizing symptoms and stress are likely to be less responsive, less positive in their interactions with their young children, and could also spend less time in caregiving activities because of distress/impairment related to symptoms and/or stress. The links between stress and internalizing symptoms have been well documented (e.g., Melchior et al., 2007; de Rooij, Schene, Phillips, & Roseboom, 2010), suggesting these should be examined together, and mothers of young children have long been described as experiencing considerable stress because of the significant caregiving demands (Patterson, 1982). However, the contributions of perceived parenting stress and maternal symptoms of depression/anxiety have not been previously examined with respect to early emerging child EC and will be addressed in the context of this study.

Contextual/demographic influences have been consistently linked with important child outcomes, with low income and parental education emerging as key contributors to poorer child functioning (e.g., Mistry, Biesanz, Taylor, Burchinal, & Cox, 2004; Ritsher, Warner, Johnson, & Dohrenwend, 2001). More specific to EC, cumulative risk (e.g., ethnic or racial minority, poverty, household density, single-parent status, adolescent parent status, number of household moves in child's lifetime, negative life events, parental depression, history of mental health or legal problems, prenatal substance exposure, and poor postnatal functioning) was negatively related to growth/development in this regulatory domain of temperament for school-age children (Bridgett & Mayes, 2011; Lengua, Honorado, & Bush, 2007). Similarly, Li-Grining (2007) showed that children exposed to more socio-demographic risk factors performed more poorly on executive attention/EC measures. Gender differences in child EC have also been reported, with a recent meta-analysis indicating that girls tend to demonstrate higher levels of this type of attention-based regulation (Else-Quest, Shibley-Hyde, Goldsmith, & Van Hulle, 2006). Thus, in this study, demographic factors were included in the models to determine the predictive role of family/ parenting variables, potentially shaping the development of EC.

Research with samples of primarily older children has addressed child, parent, and family variables in examining predictors of EC; however, few studies to date have considered the interactions between child and parent variables as potential contributors to children's EC. Rothbart and Bates (2006) outlined the theoretical importance of interactions between child temperament and parent-related factors, recommending a moderator framework for

understanding cumulative effects of child temperament characteristics, such as negative affectivity and regulatory capacity, and parents' own characteristics (e.g., temperament). In the case of the temperament-by-parent characteristic interaction, child temperament attributes have been widely conceptualized as moderating the impact of parent factors, therefore, child negative emotionality and self-regulation would, for example, be expected to moderate the impact of maternal temperament on child EC. Thus, infants with lower levels of regulatory capacity and/or higher levels of negative affectivity are likely to experience more adverse effects of maternal attributes, such as internalizing symptoms and/or stress, as well negative emotionality. It is also possible that children with lower regulatory capacity and/or more intense negative emotionality have difficulty organizing their emotional and behavioral responses in the context of interactions with a dysphoric/overwhelmed mother, leading to lower levels of EC. This effect may be a function of a compromised "goodness of fit", wherein mothers experiencing more internalizing symptoms and/or stress are particularly challenged to respond with appropriate demands/expectations to their youngsters with higher negative emotionality and/or less well-developed regulatory skills. It has also been demonstrated that infants higher in negative emotionality (e.g., irritability) may be more susceptible to environmental inputs, including parenting/parent–child interaction factors (Klein Velderman, Bakermans-Kranenburg, Juffer, & van IJzendoorn, 2006; van den Boom, 1995), and may also be more sensitive to the impact of parental internalizing symptoms, reactivity to stress, and/or negative affectivity. Notable examples of child temperament moderator effects (e.g., Cipriano & Stifter, 2010; Lengua, Wolchik, Sandler, & West, 2000; Morris et al., 2002) have been reported for older children, yet child temperament-by-parent attribute interactions occurring during infancy may be even more important for the subsequent development of EC, given the rapid development of attentional networks during this period.

CURRENT STUDY

This study was conceived to address some of the remaining gaps in the existing literature addressing the development of EC. In particular, research examining joint contributions of child, parent, and family factors, including their interactive effects, has not been widespread. Thus, the primary goal of this study is to simultaneously examine child and parent/family contributors to toddler EC, including interaction effects that reflect the moderation afforded by infant temperament factors. Specifically, family income, socio-economic status (SES), mothers' education, temperament, stress, and internalizing symptoms were examined via mother-report, along with infant positive affectivity, negative emotionality, and regulatory capacity, and evaluated as predictors of toddler EC. Laboratory-based observations of infant attention were also conducted, with the derived indices included as potential predictors of later EC. Infant age at the time of the final evaluation addressing EC and gender was included in the analyses to control for the potential effects of these variables (e.g., Else-Quest et al., 2006).

Consistent with prior work in samples of older children, we anticipated significant independent contributions of parent/family and infant predictors to toddler EC. Specifically, it was hypothesized that greater socio-demographic risk (i.e., lower levels of income, SES, and mothers' education) would be linked with lower toddler EC. We also expected parent

temperament factors to be linked with the development of child EC, with parent extraversion and EC promoting the development of child EC and parent negative affectivity detracting from this developmental progress. In addition, parental internalizing symptoms and perceived stress were hypothesized to lead to lower levels of child EC. With respect to infant temperament attributes, higher positive affectivity and regulatory capacity were expected to lead to higher levels of toddler EC, whereas higher negative emotionality was hypothesized to result in lower levels of EC for children. We also anticipated significant contributions of laboratory-based indicators of attention. In particular, we anticipated that more effcient attending/processing (e.g., evidenced by faster shifts of attention) would be linked with greater gains in EC by the toddler period.

Finally, given evidence of the importance of child temperament-by-parent characteristics interactions noted in prior work (e.g., Lengua et al., 2000; Morris et al., 2002; Rothbart & Bates, 2006), these effects were examined in this study. Specifically, we anticipated significant interaction effects between infant temperament factors (i.e., positive affectivity, regulatory capacity, and negative emotionality) and parent characteristics, including maternal temperament, internalizing symptoms, and perceived parenting stress. It was hypothesized that infant negative emotionality would enhance the disruptive impact of maternal risk factors (e.g., internalizing symptoms), whereas regulatory capacity would play a protective function, buffering against parent-related risk and enhancing the impact of caregiver protective factors (e.g., maternal EC and extraversion), with respect to toddler EC.

METHODS

Participants

Mothers of 4-month-old infants (*N* = 147) from Eastern Washington and Northwestern Idaho were recruited through birth announcements released by hospitals and published in a local newspaper, as well as through the primary prevention program First Steps. First Steps provided information about this research, along with developmental information aimed at preventing child maltreatment, to all parents of infants delivered in two local hospitals. Potential participants, identified through First Steps, who indicated an interest in a study addressing temperament development, were contacted by project staff. None of the potential participants recruited through the help of the First Steps program declined participation, whereas seven families contacted based on published birth announcements decided not to take part in this research. English-speaking primary caregivers, largely representative of the community in terms of their economic, educational, and ethnic backgrounds, took part in this study, with an approximately equal numbers of male and female infants (see Table 1). Only families with healthy full-term 4-month-old infants were eligible to participate; families with infants who were premature, experienced significant medical difficulties or birth complications, or were identified as being developmentally delayed or disabled were not eligible to participate. Caregivers were compensated with $20 for participation in each assessment (i.e., at 4, 12, and 18 months of age).

Measures

Baseline (4 months of age): Parent/family predictors—A Demographics Questionnaire was included in this study to evaluate the parent/family background characteristics. Parents were asked to respond to questions concerning age, education, income, ethnicity, and marital status. We also obtained enough information about occupational status to assign the Revised Duncan Socio-economic Index (TSEI2; Stevens & Featherman, 1981), a widely utilized indicator of occupation prestige.

The Adult Temperament Questionnaire (ATQ; Evans & Rothbart, 2012; Rothbart, Ahadi, & Evans, 2000) is a 177-item self-report instrument that contains 13 scales, loading onto four broad factors: Negative Affect (Fear-11 items; Discomfort-13 items; Frustration-13 items; Sadness-14 items), Extraversion/Surgency (Sociability-14 items; Positive Affect-11 items; High-Intensity Pleasure-13 items), EC (Inhibitory Control-11 items; Attentional Control-12 items; Activation Control-12 items), and Orienting Sensitivity (Neutral Perceptual Sensitivity, Affective Perceptual Sensitivity, Associative Sensitivity). Respondents are asked to use a 1–7 Likert scale, which reflects how representative each item/statement is of the participants' tendencies. For this study, the over-arching factors of Negative Affect, Extraversion/Surgency, and EC were utilized. Satisfactory psychometric properties, including adequate internal consistency ($a > .80$ on 13 of the 18 scales), and significant associations between dimensions of the ATQ and the "Big 5" personality factors, have been reported (Evans & Rothbart, 2012; Rothbart et al., 2000). Specifically, the ATQ over-arching factors of EC, Negative Affect, and Extraversion were reported to have satisfactory internal consistency ($a's$ range .75–.81; mean = .78), and each was significantly correlated with the corresponding Big 5 factors (e.g., EC with conscientiousness, Negative Affect with Neuroticism; Rothbart et al., 2000). In the present sample, Cronbach's alphas for subscales comprising the parent EC indicator (i.e., Activation Control, Attentional Control, and Inhibitory Control) were satisfactory, ranging from .62 to .72 (mean $a = .66$). For extra-version, alphas ranged from .60 to .74 (mean ɑ = .69) for subscales of Sociability, High-Intensity Pleasure, and Positive Affect. Finally, negative affect was made up of Fear, Sadness, Frustration, and Discomfort, with Cronbach's alphas ranging from .60 to .75 (mean ɑ = .66).

Beck Depression and Anxiety Inventories (BDI-II/BAI; Beck, Epstein, Brown, & Steer, 1988; Beck, Steer, & Brown, 1996a; Beck, Steer, Ball, & Ranieri, 1996b) were utilized to measure maternal symptoms of depression and anxiety, referred to as maternal internalizing symptoms. Each is a 21-item self-report instrument, with items rated on a 0–3 Likert scale, reflecting the severity of symptoms. The BDI-II has been widely utilized in research and clinical settings as an indicator of depressive symptoms and their severity, whereas the BAI was introduced as a counterpart aimed at identifying symptoms of anxiety, also consistently demonstrating satisfactory reliability and validity (Beck et al., 1996a, 1996b). Specifically, satisfactory internal consistency (BDI-II: ɑ = .91; BAI: ɑ =92), test–retest reliability (1 week, BDI-II: $r = .93$; BAI: $r = .75$), and convergent validity were demonstrated for these self-report measures of depressive and anxiety symptoms. In this study, similar internal consistency estimates were obtained (BDI-II: ɑ = .90; BAI: ɑ = .80).

Parent Stress Inventory (PSI; Abidin, 1995) was administered to obtain information regarding the amount of stress inherent in parent–child/family relationships. Fine-grained indicators, including bond with the child (seven items), parental perception of competence (13 items), and the restriction imposed on the parent by the caregiving responsibilities (seven items), were summed to form an overall stress composite utilized in this study. Individual items are rated on a 1–5 Likert scale, reflecting parental agreement with the different statements. Reliability and validity of the PSI have been previously demonstrated (Abidin, 1995), perhaps most importantly with families of preschool-age children (Sheeber & Johnson, 1992, 1994). Satisfactory internal consistency for the composite score has been reported for this instrument ($\alpha = .90$; Abidin, 1995) and was also observed for the present sample ($\alpha = .86$). Validity of the PSI has been supported by a number of investigations ranging in topics from the family impact of children's developmental delays and medical conditions, to infant attachment security, and the development/maintenance of behavior problems (Beck, Young, & Tarnowski, 1990; Cameron & Orr, 1989; Jarvis & Creasey, 1991).

Time 2 (12 months of age): Infant temperament/attention predictors—The Infant Behavior Questionnaire-Revised (IBQ-R; Gartstein & Rothbart, 2003) represents a rationally derived, fine-grained, parent-report assessment tool, designed for children between 3 and 12 months of age. This 191-item instrument yields 14 scales that have been demonstrated to form three over-arching factors: Positive Affectivity/Surgency (Activity Level, Smiling and Laughter, Vocal Reactivity, Approach, High-Intensity Pleasure, and Perceptual Sensitivity), Negative Emotionality (Fear, Distress to Limitations, Sadness, and negatively loading Falling Reactivity), and Regulatory Capacity/Orienting (Duration of Orienting, Soothability, Cuddliness/Affliation, and Low-Intensity Pleasure). Individual items are rated on a 1–7 Likert scale reflecting the frequency of occurrence of the different manifestations of temperament in the past week (2 weeks for less frequent events, such as encounters with unfamiliar settings/adults). Reliability of the IBQ-R has been supported for mothers and fathers, as well as samples from different cultures, with Cronbach's alpha's ranging from .77 to .96 (Gartstein & Rothbart, 2003; Gartstein, Knyazev, & Slobodskaya, 2005; Parade & Leerkes, 2008). Evidence demonstrating the predictive and construct validity of this instrument is also available, including prediction of toddler symptoms of depression and anxiety and significant correlations with laboratory-based observation indicators (Gartstein & Bateman, 2008; Gartstein & Marmion, 2008; Gartstein et al., 2010). The IBQ-R factors, Negative Emotionality, Positive Affectivity/Surgency, Regulatory Capacity/Orienting, were utilized as infant temperament predictors in this study. Internal consistency of the 14 IBQ-R subscales comprising these three temperament factors was evaluated for the present sample, with the Cronbach's Alphas ranging from .65 to .96 (mean $\alpha = .82$).

The Temperament Laboratory Assessment (TLA; Gartstein & Marmion, 2008; Gonzalez, Gartstein, Carranza, & Rothbart, 2003). This laboratory protocol represents an adaptation of the widely used Lab-TAB episodes (Goldsmith & Rothbart, 1996), designed to elicit reactive and regulatory aspects of temperament consistent with the IBQ-R (i.e., that parallel this parent-report instrument). The Arc of Toys episode utilized for the purposes of this

study represents a modification of the Basket of Toys procedure, wherein an infant is presented with toys that have been placed around him/her in the shape of an arc. This placement of toys was considered advantageous because it provided an opportunity to include ratings of shifting of attention, as well as activity, from one toy to the next. That is, the distribution of toys across the arc, rather than their placement in a single location (i.e., the basket), permits observers to reliably determine the focus of the infant's attention, and its shifting from one object to another. Specifically, the following toys, duck, rattle, small soft pig, a soft ball, and nesting cups, were arranged from the baby's left to right, always in this order.

During the task, infants were comfortably seated on a couch in the laboratory, with the toys arranged in a circular pattern around them. This location/position was selected to provide support for the infants (i.e., they could sit with their backs against the couch for support), as needed, during manipulation of toys. The toys were arranged close enough to the infant to enable reaching with ease. The mother was seated next to the infant in a chair throughout the episode, but was instructed not to intervene. This episode provides a number of indices of attention/interest, including: (1) latency to approach the first toy, (2) latency to look away from the first toy, (3) facial interest (averaged across toys), (4) duration of looking (averaged across toys), (5) duration of manipulation (averaged across toys), (6) change in toy (overall frequency), and (7) change in activity (overall frequency). Latency and duration codes reflect the time (in sec) prior to completing an action, or following a particular action, respectively, whereas the change in toy and activity codes represents frequency counts corresponding to each set of transitions. Lower latencies reflect faster reactions on the part of the infant (i.e., approaching the first toy or looking away), whereas longer duration intervals reflect more prolonged engagement with materials, either through looking or manipulation. Higher frequency counts associated with the change in toy and activity scores represented greater variability in activity with materials, either through switching materials, or engaging in a different manner with the same toy. The facial interest code required observers to make judgments concerning the degree of interest displayed on the infants' faces. Specifically, the following rating scale was used: 0 = no facial region shows codable interest, infant is not looking at the toys; 1 = identifiable, but low-intensity interest (child is attending to the toys); 2 = a definite facial indication of interest occurs, or coder otherwise has an impression of a strong facial interest (e.g., fixation on an object; child's mouth may fall open and/or eyebrows raise straight up and together). Thus, higher scores were indicative of greater levels of observable interest. These facial interest ratings were assigned every 5 sec throughout a 3-min-long episode.

Coders assigning these ratings took part in comprehensive training, aimed at achieving adequate inter-rater agreement, operationalized as Pearson product moment (PPM) correlation coefficients of at least .60 for each pairwise association reflecting agreement between raters. Ratings utilized in this manuscript were assigned by the first (MAG) and third (BNY) authors, along with two intensively trained undergraduate research assistants. Specifically, all coders provided ratings for training cases (N = 20) to obtain adequate agreement (coefficients of at least .60). Inter-rater agreement was subsequently examined for a subset of the present sample (N = 20). The training cases were selected from a previously

collected data set (see Gartstein & Marmion, 2008 for description), comprised of participants recruited in the same manner as those involved in this study, meeting the same selection criteria (e.g., 12-month-old infants, etc.). Inter-rater agreement indices were computed for the available sample ($N = 40$): Latency to Approach = .95; Latency to Look Away = .85; Facial Interest = .60; Duration of Looking = .71; Manipulation = .66; Change Toy = .80; Change Activity = .85.

Toddler effortful control follow-up (18 months of age)—Early Childhood Behavior Questionnaire (ECBQ; Putnam et al., 2006) was designed for children between 18 and 36 months of age, developed in a manner similar to the IBQ-R (Gartstein & Rothbart, 2003). This parent-report instrument consists of 201 items, distributed over 18 scales and three factors: Negative Emotionality (Discomfort, Fear, Sadness, Frustration, Motor Activation, Perceptual Sensitivity, Shyness, and Soothability, loading negatively), Surgency/ Extraversion (Impulsivity, Activity Level, High-intensity Pleasure, Sociability, and Positive Anticipation), and EC (Inhibitory Control, Attention Shifting, Low-intensity Pleasure, Cuddliness, and Attention Focusing), which was utilized as the dependent variable in this study. Items are rated on a 1–7 Likert scale reflecting the frequency of occurrence of the different manifestations of temperament in the past 2 weeks. Available evidence supports internal consistency of the ECBQ scales and factors with overall Cronbach's alphas ranging from .57 to .90, with only one coefficient for Impulsivity falling below .60, the value considered the threshold for adequate internal consistency (DeVellis, 1991). Longitudinal stability correlations were generally large over 6- and 12-month spans and moderate to large from 18 to 36 months, with considerable inter-rater agreement for primary and secondary caregivers (Putnam et al., 2006). Evidence of construct and predictive validity has also been demonstrated, with ECBQ factor and scale scores predicting indicators obtained from the Children's Behavior Questionnaire (Rothbart et al., 2001), another established childhood temperament measure, as well as the scores from the Child Behavior Checklist (Achenbach & Rescorla, 2000), a widely used screening tool for early behavior problems/symptoms of psychopathology (Gartstein, Putnam, & Rothbart, in press; Putnam et al., 2008). Internal consistency of the sub-scales comprising EC, examined as the dependent variable in this study, was determined for the present sample, with Cronbach's alphas for Inhibitory Control, Attention Shifting, Low-intensity Pleasure, Cuddliness, and Attention Focusing ranging from .64 to .87 (mean $a = .76$).

Procedure

Parent temperament, stress, internalizing symptoms, and demographic factors were assessed via mother-report when the infants were 4 months of age, with the child temperament evaluation taking place at 12 months. At that time, parents were asked to complete the IBQ-R and have their children to take part in the TLA procedure, during which the observation-based indices of attention used in this study were obtained. Subsequently, when the children were at least 18 months of age, parents completed the ECBQ, providing the indicator of EC utilized in this study. Questionnaires included in this investigation were mailed to the parents and completed at home, at their convenience. All infants were 4 and 12 months of age (±2 weeks) at the time of the baseline and the 12 month follow-up assessments, respectively; however, greater variability in age occurred in the context of the final follow-

up evaluation (see Table 1). This variability was a function of the rolling recruitment strategy utilized in this study, wherein not all participants were recruited simultaneously. As a result, by the time all participating children were at least 18 months of age, necessary to obtain a reliable index of EC, some participating children had reached 33 months of age. To account for the age span of the children at the final follow-up, toddler age was controlled in the first step of the multiple regression analyses.

Missing data

At the 12-month assessment, missing data were 31.29% ($n = 101$) and at the 18-month assessment, missing data were 40.14% ($n = 88$). To determine whether data were missing completely at random (MCAR), Little's MCAR test, based on a chi-square distribution, was used; a nonsignificant test supports the assumption that data are MCAR (Little, 1988). In this study, Little's MCAR test was not significant, $\chi^2 (482) = 509.69$, $p = .19$, which suggests that the MCAR assumption is tenable based on the patterns of missing data. In addition to using Little's MCAR test, potential differences between responders and nonresponders at 12- and 18-month evaluations for all of the variables included in further analyses were examined via independent t-tests, with none emerging as significant. The latter findings also support the absence of systematic reasons for missing data. In light of these results, and consistent with recent recommendations for handling missing data (Acock, 2005; Enders, 2001; Widaman, 2006), missing values were imputed using the expectation-maximization (EM) algorithm, deriving maximum likelihood estimates for missing values based on existing data (Enders, 2001). This procedure enabled us to perform analyses with the full data set ($N = 147$), wherein missing values were imputed using EM.

RESULTS

Prior to conducting the primary analyses, all variables were examined for normality. On the basis of recommendations by Tabachnick and Fidell (2007), variables that were significantly skewed were transformed using either the logarithm or the square-root transformations, the selection of which depended upon how severely the data were skewed. Next, Pearson product moment (PPM) correlation coefficients between all of the continuous independent variables (family SES, income, maternal education, internalizing symptoms, stress, and temperament, child age, infant temperament and the observation-based indices of attention) and the dependent variable (toddler EC) were examined (Table 2). A point biserial correlation was computed to evaluate associations with child gender, a single discrete variable included in these analyses.

A number of significant relationships were observed for the variables of primary interest in this study, although indices of association for child EC and family/demographic factors were nonsignificant. Infant temperament factors, including infant regulatory capacity/orienting and negative emotionality, were significantly associated with toddler EC, with the former leading to higher scores and the latter being associated with lower levels of later EC. Infants' shorter latency to look away from the stimuli presented in the laboratory was associated with higher toddler EC, with this indicator being the only laboratory-based measure significantly associated with later EC. Maternal temperament factors were all

significantly associated with child EC, with mothers' EC positively associated with toddler EC, along with extraversion, and negative emotionality demonstrating a significant negative association. Mothers' internalizing symptoms and perceived parenting stress were significantly negatively correlated with toddler EC. Not surprisingly, children's age during the toddler follow-up evaluation was significantly associated with EC, with older children obtaining higher scores.

A hierarchical multiple regression procedure was conducted next (final regression equation indices, with all of the predictors included in the model, presented in Table 3). The order of entry into the regression equation was determined by the role of an individual variable in the model (i.e., more or less exogenous to the dependent variable—child EC), the nature of the predictor (main effect vs. interaction effect), as well as the timing of the evaluation producing each index. Child age and gender were entered first as a block, followed by family/background variables (SES, income, and education). Of these, only child age made a significant contribution to predicting toddler EC (Table 3). Maternal temperament factors were entered next, of which only extraversion was associated with a significant effect in the final equation, with higher levels of this maternal attribute translating into greater toddler EC. Maternal internalizing symptoms and perceived parenting stress were included in the following block, with the stress indicator emerging a significant predictor, functioning as a risk factor with respect to child EC (i.e., leading to lower levels of the dependent variable).

Child temperament predictors (positive affectivity, negative emotionality, and regulatory capacity) were entered next as a block, followed by the laboratory observation-based index of attention (latency to look away), which accounted for a significant amount of variance in child EC in the final equation. The selection of this Latency to Look Away score as the primary laboratory observation indicator of attention for the hierarchical multiple regression procedure was made in part on the basis of the correlation coefficients between all of the laboratory-based indices and toddler EC (Table 2). That is, latency to look away proved to be the single reliable laboratory observation-based predictor of later EC, in addition to being identified as a theoretically meaningful precursor of EC in our literature review. The latency to look away from the first stimulus presented in the context of the laboratory observational procedure predicted later EC, with shorter latency to first attention shift being linked with higher levels of EC. Infant regulatory capacity also made a significant contribution to toddler EC, with higher levels of regulation measured at 12 months of age leading to more advanced EC later.

A number of interaction effects involving infant temperament factors (i.e., positive affectivity, regulatory capacity, and negative emotionality) and parent characteristics, including maternal temperament (negative emotionality, extraversion, EC), internalizing symptoms, and perceived parenting stress, were examined. One significant interaction effect, involving mothers' EC and infant regulatory capacity/orienting, emerged in the context of the hierarchical multiple regression analyses (Table 3). This significant interaction, reflecting moderation afforded by infant RCO, was followed up with a schematic representation depicting this effect, following recommendations of Aiken and West (1991). Infant regulatory capacity as a moderator of mother EC is represented in Figure 1, wherein children whose mothers report high levels of their own EC and infant

regulatory capacity can be seen as exhibiting the highest levels of EC. On the basis of recommendations for examining simple slopes in interactions (see Preacher, Curran, & Bauer, 2006), follow-up simple slope analyses, calculated using Preacher's interaction slopes calculator (see Preacher et al., 2006), indicated that the slope associated with the effect of maternal EC was statistically significant only for the condition of higher levels of the moderator (i.e., infant RCO values at least 1 SD above the mean; simple slope = 1.03, $t =$ 2.03, p .05). The slope associated with maternal EC did not reach statistical significance under other investigated conditions: the mean level of RCO (simple slope = .90, $t = 1.86$, p > .05) and low levels of RCO (1 SD < mean; simple slope = .77, $t = 1.66$, $p > .05$).

DISCUSSION

Infancy contributors to toddler EC, including child and parent characteristics, were examined in this study. Parent/family background variables (e.g., education, income), mothers' temperament, internalizing symptoms and perceived stress, along with child age, gender, infant temperament (i.e., Positive Affectivity/Surgency, Negative Emotionality, and Regulatory Capacity/Orienting), and laboratory observation-based indicators of attention, were evaluated as predictors of toddler EC. Analyses indicated that infant attention observed in the laboratory, specifically, latency to look away after the initial orienting reaction in response to the presented stimuli, was an important predictor of later EC. This index of attention emerged as a significant predictor after accounting for other child attributes, with shorter latencies to first attention shift predicting higher levels of toddler EC. Additional significant predictors included mothers' extraversion, with higher levels being reflected in higher toddler EC, and perceived parenting stress, which emerged as a risk factor, leading to lower levels of child EC. An interaction between infancy Regulatory Capacity/Orienting and mothers' EC also emerged as significant, reflecting the hypothesized moderation effect associated with infant temperament.

The latency to look away from the first presented stimulus—an index of attention obtained during a structured laboratory observation—was related to toddler EC subsequently reported by mothers. This index of attention is conceptually similar to latencies obtained in the context of the habituation paradigm, with shorter latencies predicting higher levels of toddler EC in this study, after accounting for other infant temperament attributes, maternal temperament, stress, internalizing symptoms, and family demographic characteristics. Shorter latencies to first attention shift likely represent a marker for processing speed, and/or other memory related process, with more efficient processing of the stimuli in infancy leading to superior EC later. The latter interpretation is consistent with results reported by Rose, Feldman, and Jankowski (2003), wherein attention shifting and processing speed were related to visual recognition memory. Specifically, infants who demonstrated shorter looks/ more shifts in attention and faster processing speed outperformed others in terms of recognition memory. Results of the present investigation demonstrating the protective role of shorter latencies to look away can also be thought of as consistent with those of habituation studies, although the latter have not addressed antecedents of EC per se. Nonetheless, previously demonstrated relationships between faster habituation and more advanced cognitive functioning are relevant, in so far as faster habituation and shorter duration of looks (i.e., faster shifts of attention) are likely products of the same underlying

attentional processes. A recent meta-analysis indicated an association between faster habituation and higher IQ scores (Kavsek, 2004), summarizing across multiple relevant studies. In addition, look duration, inversely related to faster habituation, was shown to correlate negatively with the Bayley Scales of Infant Development Mental Development Index, and novelty preference (related to habituation, in so far as faster habituation could be interpreted as a tendency to shift attention toward novel stimuli more readily) was positively related to Mac-Arthur Language Production scores (Colombo, Shaddy, Richman, Maikranz, & Blaga, 2004). In his 2001 review of attention development in infancy, Colombo discussed potential mechanisms responsible for the link between shorter look duration and more adaptive outcomes, noting that patterns of prolonged looking duration were related to less extensive visual scanning, with infants who looked for longer durations relying on local elements/features in visual stimuli for recognition (Colombo, Mitchell, Coldren, & Freeseman, 1991; Freeseman, Colombo, & Coldren, 1993; Frick & Colombo, 1996), a less-effective approach to processing information.

The significant contribution of infant regulatory capacity to toddler EC, and to some extent that of the latency to look away, can be interpreted as an indication of stability of attention-based self-regulation skills that first begin to emerge in infancy, and by the second year of life encompass multiple aspects of voluntary attention attributed to EC. Although the regulatory capacity infancy factor is functionally similar to the toddler EC measure, reflecting individual differences in the regulatory domain of temperament, considerable differences between the two constructs exist as a function of developmental differences between the first and the second years of life. Specifically, the infancy regulatory capacity factor contains the Soothability scale, not included in the ECBQ EC factor, which in turn incorporates Inhibitory Control and Attention Shifting, which are not a part of the IBQ-R regulation factor. Thus, the relationship between infant regulatory capacity and toddler EC may be more accurately construed as a demonstration of precursors of EC, observed in the first year of life. This interpretation is consistent with the existing literature; namely, previous studies noting the relative stability of attentional processes in early childhood (Gartstein & Bateman, 2008; Kannass, Oakes, & Shaddy, 2006; Kochanska et al., 2000).

Our findings demonstrating the contribution of infant regulation to toddler EC provided further support for the longitudinal relationships between temperament attributes measured in infancy (3–12 months of age) and later in childhood (e.g., Bridgett et al., 2011; Putnam et al., 2006). However, perhaps more importantly, our results provided support for the hypothesized moderator effect involving infant temperament, with respect to infant regulatory capacity. That is, infants whose mothers self-reported greater EC were described as demonstrating higher levels of EC in toddlerhood, if they also exhibited higher levels of regulation in infancy. It may be that the mechanism through which maternal self-regulation influences the development of child EC is genetic in nature, at least in part, and that toddlers whose mothers report higher levels of EC for themselves and for their children as infants, in for the form of RCO, have greater genetic predisposition toward more advanced EC, which they transmit to their offspring. Several studies have examined the heritability of EC via genetically informed designs, finding substantial genetic contributions (e.g., Lemery-Chalfant et al., 2008; Mullineaux, Deater-Deckard, Petrill, Thompson, & DeThorne, 2009). Nonetheless, meaningful environmental effects are also likely to exist. For example,

Eisenberg et al. (1998) proposed a heuristic model, which has received some support (e.g., Bridgett et al., 2011; Cumberland-Li et al., 2003; Deater-Deckard, Sewell, Petrill, & Thompson, 2010; Valiente, Lemery-Chalfant, & Reiser, 2007), wherein parent characteristics, such as EC and other relevant emotion-regulation attributes, contribute to parenting practices that modulate child arousal. This model suggests that adequate caregiver EC exerts a direct influence on parenting practices that support optimal development of children's emotion-related regulation, including EC (see Bridgett et al., 2011 for an empirical example). This pathway could be more available to children who demonstrate higher levels of regulatory capacity/orienting in infancy, wherein children with greater regulatory capacity are able to utilize their parents' interventions more effectively. Some evidence has pointed to the possibility that certain temperament profiles/constellations may be associated with differential susceptibility to environmental influences; however, this research has focused on the contribution of negative emotionality/irritability, demonstrating, for example, that more reactive infants may benefit more readily from the effects of increased maternal sensitivity (Blair, 2002; Klein Velderman et al., 2006). Results of the present investigation suggest that future research should examine infant regulatory capacity/ orienting as an additional domain which may be a marker of openness to certain parenting strategies, which in turn may lead to more optimal EC.

Mothers' extraversion also emerged as a significant predictor, with higher levels leading to more advanced child EC at 18 months of age. This finding is consistent with our hypothesis, as well as results reported by Komsi et al. (2008), wherein higher levels of parental extraversion predicted an increase in child EC, with children of more extraverted mothers demonstrating greater gains in this domain of attention-based regulatory functioning in the preschool period. This link suggests a protective function of maternal extra-version with respect to the development of child self-regulation, and future research should examine the mechanism of this link more closely. It may be that, similar to the pathway of parental EC influence, maternal extraversion supports positive parent–child interaction dynamics, which in turn lead to advances in child EC. Maternal-perceived parenting stress, on the other hand, was linked with risk relative to the emerging EC in the second year of life, with higher levels of stress being associated with lower child EC. This pattern of results is consistent with our hypothesis and prior research, wherein maternal stress has been linked with lower levels of child attention/regulation (e.g., Henrichs et al., 2011). It is possible that maternal stress serves as a risk factor, predicting lower child EC, by disrupting parenting/parent–child interactions necessary to support the development of this regulatory domain of functioning. The children's sensitivity to such disruptions in parenting may be particularly pronounced as EC first "comes online" in the second year of life, and this possibility should be more closely examined in future studies.

Although many of the hypotheses in the current investigation were supported, several of the independent variables hypothesized to predict child EC were not associated with statistically significant effects, whereas others saw their contributions reduced to nonsignificant levels with other predictors in the regression equation. Interestingly, infant negative emotionality produced a significant simple correlation with toddler EC, but did not account for a significant amount of unique variance when entered into the regression equation together with the other infant temperament factors (i.e., regulatory capacity and positive affectivity)

and the laboratory-based index of attention. The latter result suggests that the variance accounted for by negative emotionality was overlapping with that explained by the other predictors and is important in terms of making connections with the existing literature. That is, addressing infant negative emotionality as an independent variable in the absence of other temperament/attention-related factors may result in identifying its significant contrition to later EC (e.g., Stifter & Spinrad, 2002), and the exclusion of these additional factors represents a potential explanation for the discrepancy between the results of this study, and those indicating a significant link between negative emotionality and EC. Demographic variables addressed in this study generally failed to contribute to the prediction of toddler EC (e.g., with the exception of the marginal effect of family income). This overall pattern of nonsignificant findings associated with background factors is likely a function of the community sample utilized in the present investigation, which does not reflect the full range of economic disadvantage reported in other studies (e.g., Lengua et al., 2007). Although the present sample can be described as representative of the community from which it was recruited, this community does not itself present with an opportunity to explore the full extent of socio-economic risk factors. Studies that are not constrained by examining a small portion of the socioeconomic distribution, but rather have access to samples wherein the full continuum is represented, may be better suited to identify the effects of socio-demographic variables on the development of EC in childhood, as well as other attributes. On the one hand, the nature of the present sample could be considered a limitation; however, our examination of contributors to early EC within a sample characterized as relatively "low risk", at least in terms of the socio-economic factors, provides important information about these developmental processes under such conditions. Examinations of this type provide the needed context for interpreting effects obtained from samples that reflect greater socio-economic disadvantage. It is also plausible that the overall lack of significant contributions for the background variables was observed because the positive effects related to higher income/SES (i.e., the greater accumulation of enriching experiences) have not had sufficient time to accrue, given how early in life we examined precursors of child EC.

It should also be noted that child gender did not contribute to the prediction of child EC in the context of this study, despite prior reports of gender differences for this domain of temperament (Else-Quest et al., 2006). Such gender differences may not be salient in early childhood when EC first "comes online", becoming more prominent with age. Even if not significantly different in terms of mean levels, attention-based regulation efforts may serve different functions for boys and girls, and the exploration of such differences should continue in future research. For example, gender differences related to attention-based regulation were observed by Crockenberg, Leerkes, and Barrig Jo (2008), wherein girls, but not boys, exhibited lower levels of aggression as toddlers if they had looked away from a frustrating event in the laboratory at 6 months of age. Thus, disengagement of attention was differentially related to later aggression for girls and boys, serving a protective function for the former, but not the latter group. In addition, maternal internalizing problems and negative emotionality did not account for significant amounts of variance in the context of our hierarchical multiple regression analyses, despite demonstrating significant simple correlations with toddler EC. That is, these predictors did not account for unique variance in child EC, once other independent variables were also being considered. Simple correlations

associated with these predictors were consistent with our hypotheses, however, with higher levels of maternal negative affectivity and anxiety/depression being linked with lower child EC.

Limitations and future directions

Results of this study provided support for a number of our hypotheses, demonstrating the importance of certain caregiver and child attributes, as well as an interaction effect involving these, in predicting emerging child EC. Several limitations should be noted, however, and considered in drawing conclusions on the basis of these findings. First, as already noted, the sample utilized in this study does not reflect the broad range of demographic characteristics important to consider in generalizing to more disadvantaged groups. Thus, future studies should examine how the independent variables included in this study combine in their influence on child EC in samples more diverse in terms of ethnicity and other demographic characteristics. Second, despite our use of a laboratory indicator of infant attention, the reliance on maternal report was still considerable, and other sources of information should be examined for additional variables in future work. Parent–child interaction factors have been mentioned in the context of several mechanisms linking parent characteristics and the development of child EC in this study (e.g., Bridgett et al., 2011; Cumberland-Li et al., 2003; Deater-Deckard et al., 2010; Valiente et al., 2007), and thus an examination of such factors should be undertaken in the future. The latter would also be essential in elucidating bidirectional influences that involve child temperament and parental attributes/behaviors. Father's attributes, father-report of child and family variables, were not considered in this study and would be of interest in future research addressing the development of EC. Finally, the design of this study did not provide an opportunity to identify a genetic pathway of influence for the contribution of maternal attributes to child EC, which should be addressed in future research, preferably simultaneously considering parenting/parent–child interaction factors, to simultaneously examine potential genetic and environmental effects.

In addition to the limitations described above, it should be noted that recent studies have indicated that change in early temperament attributes may be more important to consider than more static indicators in predicting later outcomes related to social-emotional functioning in childhood (e.g., Bridgett & Mayes, 2011; Bridgett et al., 2009; Gartstein et al., 2010). Furthermore, there is now evidence that change in mother-reported regulatory capacity/orienting makes an important contribution to toddler EC (e.g., Bridgett et al., 2011), yet no studies have examined repeated laboratory observations of attention-based variables, including this study, wherein the latency to look away was examined only at one point in time. In the future, child attention and temperament indices obtained from the laboratory setting at different assessment points throughout infancy should be considered to evaluate the impact of growth, or change parameters, associated with these variables on early EC. On a related note, it would be of interest to developmental science to ascertain how early in infancy predictors of EC can be reliably observed.

Results of the present investigation have potentially important implications for research and practice, as far as such efforts address the development of self-regulation. Existing studies have provided evidence for the contributions of childhood EC to numerous outcomes. For

example, high levels of EC have been linked to increased social competence (Eisenberg et al., 2004; Fabes et al., 1999), fewer behavioral difficulties (Bridgett & Mayes, 2011; Eisenberg et al., 2009; Gartstein & Fagot, 2003; Olson, Sameroff, Kerr, Lopez, & Wellman, 2005), and greater academic competence (Valiente, Lemery-Chalfant, Swanson, & Reiser, 2008). Results of the present investigation suggest that emerging EC itself has important infancy precursors, including child and parent temperament attributes. In particular, earlier aspects of regulatory capacity and attention represent important antecedents of EC. Further identification of parenting factors that facilitate the development of EC, including those enhancing the growth of its precursors, is likely to provide fruitful avenues for early intervention efforts aimed at children at risk for poor emotional and behavioral control.

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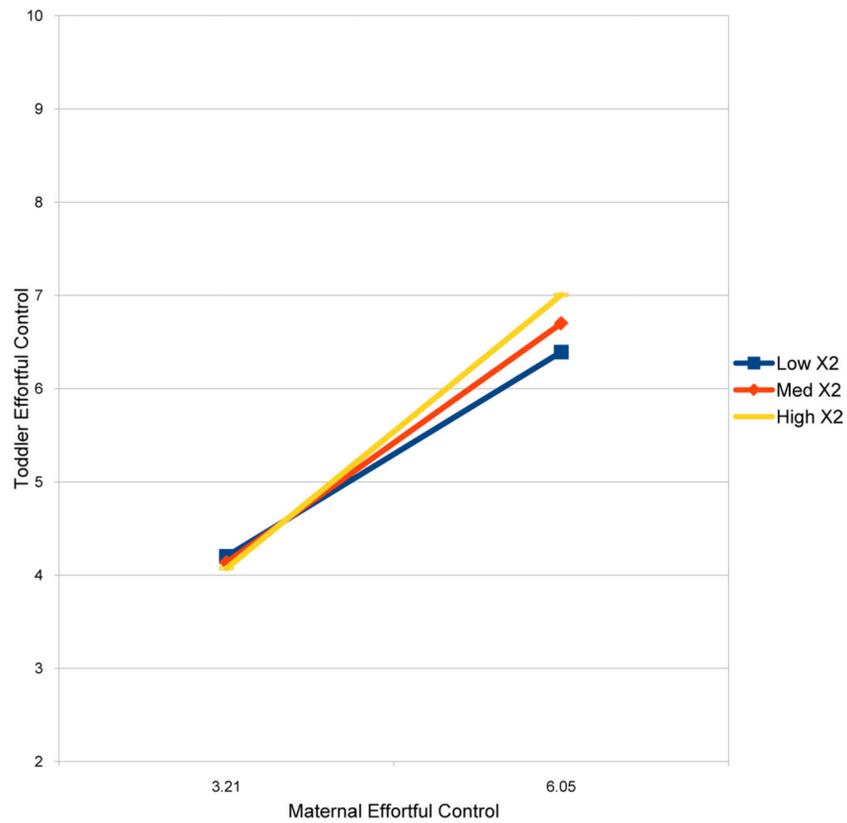
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Low X2: Infant Regulatory Capacity/Orienting 1 SD < Mean

Med X2: Infant Regulatory Capacity/Orienting 1 SD = Mean

High X2: Infant Regulatory Capacity/Orienting 1 SD > Mean

Figure 1.
Infant orienting/regulatory capacity- maternal effortful control interaction. Low X2, Infant Regulatory Capacity/Orienting 1 SD < Mean; Med X2, Infant Regulatory Capacity/ Orienting 1 SD = Mean; High X2, Infant Regulatory Capacity/Orienting 1 SD > Mean.

TABLE 1

Descriptive Statistics: Primary Caregiver/Infant Demographics; Independent and Dependent Variables (N = 147)

Variable	Mean	Range	Standard deviation	Percentage
Maternal age (years)	28.67	20 to 42	5.27	
Ethnicity				
Caucasian				91.9
African American				3.7
Asian				2.9
Hispanic/ Latino				1.5
Living arrangement				
Married				93.1
Divorced/ Separated				1.6
Single				3.8
Remarried				1.5
Highest education attainment	15.87 Years	10–20 Years	2.29 Years	
Less than high school				2.8
High school diploma				6.4
Some college				26.2
Bachelors degree				39.7
Graduate degree				24.8
Family income				
$0–$7,000				5.2
$7,001–$10,000				3.0
$10,001–$13,000				5.2
$13,001–$16,000				4.5
$16,001–$20,000				9.0
$20,001–$30,000				10.4
$30,001–$50,000				29.9
$50,001–$75,000				17.2
Over – $75,000				15.7
Family socio-economic status[a]	5.79	3.87 to 9.50	1.91	
Maternal ATQ effortful control[b]	−.11	−5.11 to 3.79	2.25	
Maternal ATQ negative emotion[b]	−.05	−7.76 to 7.31	2.88	
Maternal ATQ extraversion[b]	.00	−6.21 to 4.88	2.02	
Maternal internalizing symptoms[b]	.00	−2.20 to 1.81	0.90	
Maternal PSI total[a]	4.30	3.29 to 5.74	0.40	
Child's gender				
Males				50.8
Females				49.2

Variable	Mean	Range	Standard deviation	Percentage
Child's age (months) – toddler follow-up	22.58	19–33	3.38	
IBQ-R positive affectivity/surgency	−.76	−9.90 to 8.43	3.69	
IBQ-R negative emotionality	.03	−4.78 to 8.23	2.67	
IBQ-R regulatory capacity/orienting	−.14	−6.69 to 4.57	2.50	
TLAArc of toys latency to look away[c]	.76	0.00 to 1.90	0.36	
TLA/latency to approach[c]	.36	0.00 to 1.77	0.23	
TLA/intensity of facial interest[a]	1.27	1.00 to 1.52	0.05	
TLA/duration of looking[d]	1.37	1.00 to 1.53	0.09	
TLA/duration of manipulation[d]	1.49	1.00 to 1.58	0.09	
TLA/number of toy changes	3.66	1.00 to 5.00	0.84	
TLA/number of activity changes[a]	4.26	1.73 to 6.32	0.72	
ECBQ effortful control[b]	0.00	−8.69 to 7.13	2.90	

Note. TLA = temperament laboratory assessment.

[a] Scores subjected to a square-root transformation.

[b] Composite scores based on *z*-scored component scales.

[c] Socres subjected to a logarithmic transformation.

[d] Scores subjected to a reflective transformation.

TABLE 2

Correlations between Family/Parent/Background Variables, Infant Temperament, Attention in the Laboratory and Effortful Control (*N* = 147)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Toddler effortful control	1																				
2. Family socio-economic status	.13	1																			
3. Family income	−.12	.33**	1																		
4. Mothers' education	−.09	.33**	.18*	1																	
5. Child age	.24**	.06	.01	−.07	1																
6. Child gender	.06	−.01	−.01	.03	.02	1															
7. Mothers' effortful control	.25**	.29**	.22**	.23**	.09	−.01	1														
8. Mothers' negative emotionality	−.34**	−.12	−.13	−.03	−.09	.04	−.41**	1													
9. Mothers' extraversion	.36**	−.06	−.04	−.12	−.01	−.10	.13	−.36**	1												
10. Mothers' internalizing	−.22**	−.10	−.22**	−.07	−.28**	−.01	−.27**	.39**	−.19*	1											
11. Mother's stress	−.32**	−.30**	−.25*	−.17*	−.14	−.03	−.40**	.38**	−.13	.52**	1										
12. Infant negative emotionality	−.30**	−.21*	.02	−.09	−.17*	.04	−.30**	.43**	−.05	.32**	.25**	1									
13. Infant regulatory capacity	.39**	.19*	.06	−.25**	.14	.03	.22**	−.22**	.17*	.05	−.11	−.24**	1								
14. Infant positive affect	.12	.16	−.12	−.23**	.15	−.20**	.17*	.05	.23**	.16*	−.03	.06	.44**	1							
15. Latency to look away	−.30**	.03	.29**	.11	−.15	.18*	−.05	−.03	−.07	−.09	−.13	−.03	−.03	−.10	1						
16. Latency to approach	−.06	−.09	.12	−.06	−.25**	.25**	−.09	.10	−.13	.12	−.02	−.02	.01	−.17*	.14	1					
17. Intensity of facial interest	.04	−.07	.05	−.01	−.20*	−.23**	−.12	−.06	.09	−.16	−.07	−.09	.01	−.11	.18*	.04	1				
18. Duration of looking	−.10	−.03	−.09	−.13	−.19*	−.18*	−.18*	−.01	−.01	−.09	.09	−.01	−.09	.06	.08	−.13	.53**	1			
19. Duration of manipulation	−.13	−.15	−.13	−.13	−.05	.05	−.27**	.08	−.24**	.04	.04	.21*	−.07	.03	.04	−.06	.39**	.58**	1		
20. Number of toy changes	.08	−.13	−.24**	−.19*	.08	.22**	−.05	.30**	−.01	.10	.11	.10	−.03	.10	−.17*	−.04	−.13	−.02	.05	1	
21. Number of activity changes	.01	−.13	−.04	−.07	−.05	.05	−.22**	.14	.01	−.07	.09	.04	−.20**	−.28**	−.13	−.05	.07	.14	.10	.43**	1

Note.

*
p < .05 level

** $p < .01$ level (two-tailed).

TABLE 3

Hierarchical Multiple Regression: Predicting Toddler Effortful Control ($N = 147$)

Variable	R	R²	R² change	F change	Beta
Model 1	.25	.06	.06	4.68[*]	
Child age (months)[a]					.14[*]
Child gender					.09
Model 2	.33	.11	.05	2.57[†]	
Family socio-economic status					.05
Family income					−13[†]
Mothers' education/Total years					−.02
Model 3	.55	.30	.19	12.68[**]	
Mothers' effortful control					.06
Mothers' negative emotionality					−.05
Mothers' extraversion					.25[*]
Model 4	.58	.33	.03	3.07[*]	
Mothers' internalizing symptoms					−.01
Mothers' stress composite					−.22[**]
Model 5	.64	.41	.08	5.65[**]	
Infant positive affectivity/Surgency (PAS)					−.15[†]
Infant regulatory capacity/Orienting (RCO)					.32[**]
Infant negative emotionality (NE)					−.09
Model 6	.68	.47	.06	14.29[**]	
Latency to look away					−.30[**]
Model 7	.71	.50	.03	2.92[*]	
Mothers' effortful control*Infant NE					−.05
Mothers' effortful control*Infant PAS					−.13[†]
Mothers' effortful control*Infant RCO					.20[*]

Note.

[*] $p < .05$ level

[**] $p < .01$ level

[†] $p < .10$.

[a] Child's age at the time of the final follow-up addressing toddler effortful control.