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Brief Report

Infant Predictors of Toddler Effortful Control: A Multi-method Developmentally Sensitive Approach

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Effortful control (EC) is a form of self-regulation characterized by inhibition of dominant responses in favour of more adaptive subdominant responses. In the present study, temperamental antecedents in infancy were examined in relationship to toddler EC. Parents reported on infant temperament at 6, 8, 10, and 12 months, using the regulatory capacity/orienting (RCO) factor of the Infant Behavior Questionnaire-Revised. Laboratory indicators of this temperamental construct were also collected at each time point via the Temperament Laboratory Assessment. Relations between changes in temperament across the first year of life and toddler EC (mean age = 22 months) were examined using multilevel modelling. Parent-reported RCO and the component subscale of cuddliness more specifically were the only temperamental variables that prospectively predicted toddler EC. Copyright © 2016 John Wiley & Sons, Ltd.

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From a psychobiological standpoint, temperament is defined as constitutionally based individual differences in reactivity and self-regulation, expressed in the domains of affect, attention, and activity/reactivity (Rothbart & Derryberry, 1981; Strelau, 1983). Self-regulation is of interest in the current study, and particularly the overarching regulation-related dimension of effortful control (EC). As a regulatory ability, EC emerges in toddlerhood and is formally defined as the ability to inhibit dominant responses in favour of subdominant responses (Kochanska, Murray, & Harlan, 2000; Rothbart, Ahadi, & Hershey, 1994). Despite substantial research focused on associations between EC in early childhood and later developmental outcomes (e.g., cognitive and socio-emotional development; see Hughes, Dunn, & White, 1998; Eisenberg et al., 1997; Valiente,

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Lemery-Chalfant, Swanson, & Resier, 2008; Gartstein & Fagot, 2003; Kochanska et al., 2000), there is comparatively less literature examining temperament precursors of EC that emerge early in life.

Temperament Precursors of Effortful Control

Of all the temperament domains, self-regulation undergoes the most significant development in early childhood. By 18 months of age, it becomes possible to reliably measure EC (see Putnam, Gartstein, & Rothbart, 2006), most likely due to the emergence of executive functions and maturation of the frontal lobes (Ruff & Rothbart, 1996). In infancy, the emerging regulatory capacity is based primarily on duration of orienting, a component of the regulatory capacity/orienting (RCO) factor (see Gartstein & Rothbart, 2003). Although the RCO factor represents a unitary construct (Gartstein & Rothbart, 2003), in the current study, we also considered the component subscales, as previous studies indicate these may differ in their respective contributions to a variety of outcomes (e.g., behaviour problems). That is, even subscales that load onto the same factor may nonetheless offer unique predictions with respect to EC (Gartstein, Putnam, & Rothbart, 2012).

Links between RCO in infancy and later EC have been addressed in several studies. Specifically, Putnam, Rothbart, and Gartstein (2008) demonstrated a longitudinal association between RCO in infancy and EC at age 18 months. This relationship between 12-month RCO and 18-month EC was replicated in an investigation using both laboratory and parent-reports of temperament; however, among the laboratory measures, only latency to look away in infancy was associated with toddler EC (Gartstein, Bridgett, Young, Panksepp, & Power, 2013). In addition, a cross-cultural examination of the antecedents of preschool effortful control among American and Russian infants found that RCO in infancy accounted for significant variance in preschool EC across the two cultures (Gartstein, Slobodyskaya, Putnam, & Kinsht, 2009).

To date, only one study has examined developmental trajectories of parent-reported temperament in relation to EC (Bridgett et al., 2011); results indicated that both higher infant RCO intercepts and infant RCO slopes were associated with toddler EC at 18 months. However, it is important to note that Bridgett et al. (2011) relied solely on parent-reports of temperament in infancy. As such, although previous studies have investigated temperament precursors of EC, to our knowledge, no existing study has investigated longitudinal trajectories of both parent-report *and* laboratory indicators of temperament in relation to the development of toddler EC using a multilevel modelling approach.

Approaches to Measuring Temperament

The measurement of temperament in early childhood has been the subject of considerable debate, due in part to evidence for a lack of convergence between parent-report and laboratory indicators (Stifter, Willoughby, Towe-Goodman, & The Family Life Investigators, 2008). Ultimately, there is no ‘gold standard’, and distinct advantages and disadvantages of each approach have been noted. Parent-report questionnaires offer practical advantages and provide ratings of a child’s behaviour across different contexts/situations (Gartstein, Bridgett, & Low, 2012). Although concerns have been raised regarding parents’ abilities to objectively report regarding their children’s temperament, items can be constructed so as to minimize problems associated with the caregivers’

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perspective. For example, Rothbart (1981) made an attempt to develop questionnaires that refrain from 'asking parents either to make global judgments of their child's behavior or to attempt to recollect occasions of child behavior from the distant past' (p. 572). Nonetheless, parent-report indicators may be prone to various biases such as social desirability and parental depression (Majandzic & van den Boom, 2007).

As an alternative approach, laboratory indicators of temperament control for such biases. However, drawbacks of laboratory measures have been identified as well, including a limited number of behavioural observations (Stifter et al., 2008), the impact the experimenter's presence (Majandzic & van den Boom, 2007), and concerns about ecological validity (Rothbart & Goldsmith, 1985). Collectively, these strengths and weaknesses of parent-report and laboratory indicators of temperament underscore the potential utility of using *both* measurement tools in conjunction, and the current study is responsive to recommendations for use of a multi-method approach to measure temperament (Kagan, Snidman, McManis, Woodward, & Hardway, 2002; Stifter et al., 2008).

Current Study

Although a handful of previous studies examined temperamental precursors of EC (Bridgett et al., 2011; Gartstein et al., 2009, 2013; Putnam et al., 2008), use of change models and laboratory measures of temperament as predictors has been limited. Our primary goal was to evaluate longitudinal prediction of EC at 18 months using a combination of laboratory-based indicators and parent-report measures of regulatory capacity/orienting (RCO) collected at 6, 8, and 10 months of age. We hypothesized that multi-method indicators of RCO would be positively associated with EC assessed in toddlerhood, as indexed by higher mean RCO and growth in RCO over the first year of life.

METHOD

Participants

Mothers ($n = 134$) with 4-month-old infants from eastern Washington and northwest Idaho consented to participate. Recruitment was completed via newspaper birth announcements, hospital websites, and the primary prevention program First Steps. Seven mothers overall (all of whom were contacted via published birth announcements) declined to participate. Eligible mothers were fluent in English and had healthy 4-month-olds with no history of birth complications or preterm birth. Mothers were compensated $20 for participation at each assessment period (when infants were approximately 6, 8, 10, 12, and 22 months old). See Table 1 for complete demographic information.

Measures

Infant Behavior Questionnaire-Revised (Gartstein & Rothbart, 2003)

The Infant Behavior Questionnaire-Revised (IBQ-R) is a 191-item parent-report measure of temperament designed for use with infants between ages 3 and 12 months. The IBQ-R yields 14 subscales subsumed by three higher-order factors: surgency/extraversion, negative affectivity, and regulatory capacity/orienting. In the current study, regulatory capacity/orienting (RCO) was of primary interest, as

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Table 1. Descriptive statistics: Primary caregiver/infant demographics ($N = 127$)

Variable	Mean	Range	*SD*	Percent
Maternal age (years)	30.4	20–46	4.9	
Race/ethnicity				
Caucasian				92.2
African American				3.2
Asian				1.9
Hispanic/Latino				1.3
Living arrangement				
Married				92.9
Cohabitating				3.9
Single				1.9
Remarried				1.3
Family income (thousands)	61.1	8.0–130.0	27.0	
Highest education attainment				
Less than high school				1.5
High school diploma				39.2
Some college				26.9
Bachelor's degree				24.6
Graduate degree				7.7
Child sex				
Male				46.6
Female				53.4

well as its component subscales: duration of orienting, soothability, cuddliness/affiliation, and low-intensity pleasure. In general, the IBQ-R demonstrates good psychometric properties (Gartstein & Rothbart, 2003; Gartstein, Knyazev, & Slobodskaya, 2005; Parade & Leerkes, 2008) and predictive validity with respect to early behaviour problems (Gartstein & Bateman, 2008; Gartstein et al., 2010; Gartstein & Marmion, 2008).

Temperament Laboratory Assessment (Gartstein et al., 2013; Gartstein & Marmion, 2008; Gonzalez, Gartstein, Carranza, & Rothbart, 2003)

The Temperament Laboratory Assessment (TLA) is a laboratory-administered procedure adapted from the Laboratory Temperament Assessment Battery (Lab-TAB; Goldsmith & Rothbart, 1999), which is designed to work in parallel with the IBQ-R. In the current study, infants completed the 'arc of toys' procedure measuring attention shifting abilities and manipulation of individual toys. Infants were seated on a couch in the laboratory and presented with several toys arranged around them in an arc; mothers were seated next to the infants but instructed not to intervene (for a complete description of this procedure, see Gartstein, Putnam, & Rothbart, 2012). All episodes were video-recorded and coded by trained research assistants (blind to the purpose of the investigation) who used established criteria to judge manifestations of infant attention/interest, including (i) latency to approach the first toy; (ii) latency to look away from the first toy; (iii) facial interest (averaged across toys); (iv) duration of looking (averaged across toys); (v) duration of manipulation (averaged across toys); (vi) change in toy (overall frequency); and (vii) change in activity (overall frequency). Latency and duration codes reflect the time (in seconds) prior to completing an action, or following a particular action, respectively, whereas the change in toy and activity codes represent frequency counts corresponding to each set of transitions. Lower latencies reflect faster

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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, through either looking or manipulation. Higher frequency counts associated with the change in toy and activity scores represented greater variability in activity with materials, through either 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); and 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 seconds throughout a 3-minute long episode. Inter-rater agreement evaluated for a training dataset ($n = 20$) and a subset of the present sample ($n = 20$) and was deemed adequate: Latency to Approach = 0.95; Latency to Look Away = 0.85; Facial Interest = 0.60; Duration of Looking = 0.71; Manipulation = 0.66; Change Toy = 0.80; Change Activity = 0.85

Early Childhood Behavior Questionnaire (Putnam et al., 2006)

This 201-item parent-report measure assesses temperament from 18 to 36 months. It includes 18 subscales and three higher-order factors: surgency/extraversion, negative affectivity, and effortful control (EC). The EC scale is of interest in the current study and is derived from the subscales of inhibitory control, attention shifting, low-intensity pleasure, cuddliness, and attention focusing scales. The Early Childhood Behavior Questionnaire (ECBQ) has adequate internal consistency for all factors and previously demonstrated construct and predictive validity (Gartstein et al., 2012).

Procedure

Demographics were evaluated via mother-report at the time of recruitment when infants were 4 months old (see Table 1). Longitudinal evaluations of infant temperament occurred at 6, 8, 10, and 12 months, via completion of the IBQ-R and laboratory arc-of-toys episode. All data collection took place ±2 weeks from the infant turning 6, 8, 10, or 12 months of age. When children were at least age 18 months, mothers completed the ECBQ, providing the indicator of toddler EC. The mean toddler age at the time of the ECBQ completion was 22 months.

ANALYTIC PLAN

Construct Building

Descriptive statistics for predictor and outcome variables are provided in Table 2. Cronbach's alphas were computed to determine whether the parent-report and laboratory indicators of RCO formed coherent constructs. Internal consistency of the RCO construct of the IBQ-R was satisfactory (mean $\alpha = 0.93$). Nonetheless, the subscale components of RCO (duration of orienting, soothability, cuddliness, and low-intensity pleasure) were also of interest in the current study, as fine-grained indicators of regulatory capacity. A composite was not developed for the

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Table 2. Descriptive statistics for predictor and outcome variables

Variable	*N*	Mean	Range	*SD*
ECBQ				
Age	84	22.0	18–33	3.1
EC	84	0.0	−8.7 to 7.1	2.9
IBQ-regulatory capacity/orienting				
6 months	112	0.1	−8.6 to 6.9	2.7
8 months	102	0.0	−6.0 to 5.7	2.4
10 months	86	0.0	−5.2 to 8.9	2.5
12 months	101	0.0	−7.8 to 5.2	2.6
TLA: Arc of toys latency to look away				
6 months	80	19.2	2–180	32.1
8 months	108	14.0	1–127	21.3
10 months	103	10.6	1–110	17.3
12 months	106	12.0	1–119	19.2
TLA: Arc of toys latency to approach				
6 months	80	4.0	1–46	7.2
8 months	110	1.7	1–36	1.9
10 months	104	3.2	1–106	11.6
12 months	107	2.4	1–58	6.3
TLA: Arc of toys facial interest				
6 months	80	1.1	0.7–1.7	0.1
8 months	110	1.0	0.6–1.4	0.1
10 months	104	1.1	0.6–3.0	0.3
12 months	107	1.1	0.4–2.0	0.3
TLA: Arc of toys duration of looking				
6 months	80	2.7	1.4–3.0	0.3
8 months	110	2.6	0.9–4.3	0.4
10 months	104	2.6	0.8–3.0	0.4
12 months	106	2.5	0.6–3.0	0.4
TLA: Arc of toys manipulation				
6 months	80	2.4	0.2–3.0	0.6
8 months	110	2.8	1.9–8.3	0.6
10 months	104	2.7	1.2–3.0	0.4
12 months	107	2.7	0.2–3.0	0.4
TLA: Arc of toys change in toy				
6 months	80	3.3	1.0–5.0	1.3
8 months	110	3.2	1.0–5.0	1.0
10 months	104	3.4	1.0–5.0	0.9
12 months	107	3.6	1.0–5.0	1.0
TLA: Arc of toys change in activity				
6 months	80	15.5	3.0–34.0	7.2
8 months	110	17.9	4.0–39.0	7.3
10 months	104	18.4	1.0–38.0	7.9
12 months	107	17.2	3.0–40.0	7.7

Notes. IBQ-R and ECBQ variables were converted to *z*-scores prior to descriptive analyses for construct building.
ECBQ = Early Childhood Behavior Questionnaire (Putnam et al., 2006); IBQ-R = Infant Behavior Questionnaire-Revised (Gartstein & Rothbart, 2003); TLA = Temperament Laboratory Assessment (Gartstein et al., 2013; Gartstein & Marmion, 2008; Gonzalez et al., 2003); EC = effortful control.

'arc of toys' indicators because of inadequate internal consistency at each of the four time points. As a result, these observation-based variables were examined individually in subsequent analyses and included the following: latency to

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approach, latency look away, facial interest, duration of looking, manipulation of toy, change of toy, and change in activity.

Multilevel Modelling

In order to examine the hypothesis that parent-report and laboratory measures of RCO across infancy would predict toddler EC, multilevel models were constructed using Hierarchical Linear Modeling, version 7 (HLM 7.0; Raudenbush, Bryk, Cheong, Congdon, & du Toit, 2011). We chose the multilevel modelling analytical approach for this longitudinal data set due to numerous statistical advantages, including full maximum likelihood estimation of missing data, less restrictive assumptions, and increased power (see, e.g., Speer & Greenbaum, 1995). The HLM models provided for simultaneous estimation of within-participant change in temperament across time (i.e., the four repeated measures) at Level 1, and relations between individual differences in such change and EC at Level 2. All models were computed with time mean-centred. Full maximum likelihood models used in the HLM analyses paralleled the following example:

$$\text{Level 1}: \text{RCO}_{ti} = \pi_{0i} + \pi_{1i}*(\text{TIME}) + e_{ti}$$
$$\text{Level 2}: \pi_{0i} = \beta_{00} + \beta_{01}*(\text{EC}) + u_{0i}$$
$$\pi_{1i} = \beta_{10} + \beta_{11}*(\text{EC}) + u_{1i}$$

Thus, Level 1 specified growth in temperament for each child. In this example, RCO_{ti} represents the repeated observations of RCO for individual infant participants. At Level 2, the β_{01} (intercept) term tests the association between EC and mean levels of RCO when time is mean centred (i.e., at age 9 months), and the β_{11} (slope) term tests the strength of association between EC and growth in RCO across the four assessment waves. In total, 12 models were run to address possible associations between toddler EC and (i) RCO factor; (ii) the subscales of RCO (i.e., duration of orienting, soothability, cuddliness, and low-intensity pleasure); and (iii) the seven ‘arc of toys’ indicators (i.e., latency to approach, latency look away, facial interest, duration of looking, manipulation of toy, change of toy, and change in activity). Finally, given previous research indicating relationships between sex and temperament across the lifespan (e.g., Else-Quest, Hyde, Goldsmith, & Van Hulle, 2006), as well as infant temperament and socioeconomic status (SES; e.g., Jansen et al., 2009), sex and SES were examined as possible covariates. These covariates were retained for six of the variables and paralleled the following model:

$$\text{Level 1}: \text{LkAway}_{ti} = \pi_{0i} + \pi_{1i}*(\text{TIME}) + e_{ti}$$
$$\text{Level 2}: \pi_{0i} = \beta_{00} + \beta_{01}*(\text{SES}) + \beta_{02}*(\text{SEX}) + \beta_{03}*(\text{EC}) + u_{0i}$$
$$\pi_{1i} = \beta_{10} + \beta_{11}*(\text{SES}) + \beta_{12}*(\text{SEX}) + \beta_{13}*(\text{EC}) + u_{1i}$$

RESULTS

Intercepts

Averaged across time, intercepts were significantly greater than zero on all 11 parent-reported RCO subscales and the ‘arc of toys’ laboratory observations, but not the overarching RCO construct (see Table 3). The covariate analyses revealed that intercepts were no longer significant for latency to look away ($\beta_{00} = 6.05$,

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Table 3. Results of multilevel models for regulatory capacity/orienting and first-order traits associated with toddler effortful control

	Intercept			Slope		
Fixed effect	Coefficient (*SE*)	*t*	*p*	Coefficient (*SE*)	*t*	*p*
IBQ-R						
RCO	−0.08* (0.24)	−0.32	0.75	0.02 (0.05)	0.43	0.67
Low-intensity pleasure	4.79[b] (0.08)	62.91	<0.001	−0.05 (0.02)	−2.98	0.004[a]
Soothability	3.63 (0.06)	57.26	<0.001	0.02[b] (0.02)	1.43	0.16
Cuddliness	5.34 (0.09)	58.76	<0.001	−0.09*[,b] (0.02)	−5.32	<0.001
Duration of orienting	3.73 (0.10)	38.71	<0.001	0.02 (0.02)	1.06	0.29
Arc of toys						
Facial interest	1.06 (0.02)	55.15	<0.001	0.01 (0.01)	0.11	0.91
Manipulation of toy	2.69 (0.03)	87.50	<0.001	0.01 (0.01)	1.03	0.31
Latency to look away	12.69 (1.74)	7.31	<0.001[a]	−1.42 (0.75)	−1.88	0.06
Latency to approach	2.25 (0.31)	7.28	<0.001[a]	−0.19 (0.12)	−1.49	0.14
Change in toy	1.60[c] (0.63)	2.55	<0.01	0.32 (0.25)	1.29	0.19
Change in activity	18.28 (0.56)	32.48	<0.001	0.38 (0.20)	1.88	0.06
Duration of looking	2.60 (0.03)	93.12	<0.001	−0.03 (0.01)	−2.88	0.005[a]

Notes. IBQ-R = Infant Behavior Questionnaire-Revised (Gartstein & Rothbart, 2003); RCO = regulatory capacity/orienting; EC = effortful control; SES = socioeconomic status.
*Associated with toddler EC at $p < 0.05$.
[a]No longer significant when controlling for SES and sex.
[b]Significant association with SES.
[c]Significant association with sex and toddler age; as Change in Toy was the only variable associated with toddler age, the covariate model for this variable was as follows:
Level 1: $ChngToy_{ti} = \pi_{0i} + \pi_{1i} * (TIME) + e_{ti}$
Level 2: $\pi_{0i} = \beta_{00} + \beta_{01} * (SES) + \beta_{02} * (SEX) + \beta_{03} * (AGE) + \beta_{04} * (EC) + u_{0i}$
$\pi_{1i} = \beta_{10} + \beta_{11} * (SES) + \beta_{12} * (SEX) + \beta_{13} * (AGE) + \beta_{14} * (EC) + u_{1i}$.

$p = 0.31$) and latency to approach ($\beta_{00} = 1.19$, $p = 0.27$) in the covariate models controlling for SES and sex. Therefore, the covariate-corrected model was used with these two variables.

The covariate-corrected models were retained for two additional laboratory variables (i.e., change in toy and low-intensity pleasure) as a result of significant effects of covariates on the intercepts. Change in toy was associated with infant sex ($\beta_{02} = 0.39$, $p = 0.01$), indicating that girls scored higher than boys on this variable when time was mean centred. Low-intensity pleasure was associated positively with SES ($\beta_{01} = 0.006$, $p = 0.04$). Notably, however, intercepts remained significant for change in toy ($\beta_{00} = 2.93$, $p < 0.001$) and low-intensity pleasure ($\beta_{00} = 4.27$, $p < 0.001$) in the covariate models.

In investigating the association between temperament intercepts and toddler EC, only parent-reported RCO was significant, $\beta_{01} = 0.20$ $p = 0.015$. Thus, higher mean RCO across the longitudinal assessments was associated with higher toddler EC. No other significant associations between intercepts of infant temperament dimensions (either parent-report or laboratory) and toddler EC emerged.

Slopes

Significant slope parameters were observed for three variables: low-intensity pleasure, duration of looking, and cuddliness (see Table 3); however, in the covariate-corrected models, slopes for low-intensity pleasure ($\beta_{10} = -0.05$ $p = 0.33$)

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and duration of looking ($\beta_{10} = -0.01$ $p = 0.72$) were no longer significant. The covariate model was retained for the cuddliness variable, as SES was associated with steeper increases in cuddliness over time ($\beta_{11} = 0.001$ $p = 0.04$). Using the covariate model, the slope parameter for cuddliness remained significant ($\beta_{10} = -0.13$ $p = 0.03$), demonstrating a significant decrease in cuddliness over time. The cuddliness slope was the only construct to demonstrate significant positive association with EC ($\beta_{13} = 0.01$ $p = 0.03$), indicating that infants with a steeper decrease in cuddliness across the first year of life had lower toddler EC. Finally, the slope for soothability was associated positively with SES ($\beta_{11} = 0.001$ $p = 0.02$), indicating that infants with higher familial SES had steeper increases in soothability over time.

DISCUSSION

In the current study, we examined infant antecedents of toddler EC using a longitudinal, multi-method design. Although significant predictive relationships between infant RCO and toddler EC were anticipated, the overarching parent-reported RCO construct and fine-grained measure of infant cuddliness emerged as the only infant temperament characteristic associated with toddler EC. Specifically, the HLM analyses revealed a significant relationship between intercepts for RCO averaged across time and EC in toddlerhood; however, there was no significant relationship between change in RCO during infancy and toddler EC. As a result, although higher levels of parent-reported RCO in infancy were associated with higher toddler EC, *change* in RCO was not related to later levels of EC. Thus, the findings are only partially consistent with previous research (Bridgett et al., 2011; Gartstein et al., 2009; Gartstein et al., 2013).

Differences emerged between the current study and Gartstein et al. (2013) examination of 12-month-old temperament characteristics (via parent-report and laboratory measures) and toddler EC. In particular, Gartstein et al. (2013) found evidence that the TLA construct of Latency to Look Away was predictive of later EC, with shorter looking at 12 months associated with greater EC in toddlerhood. No significant associations between laboratory measures of infant regulation and toddler EC were found in the present study, likely as a result of methodological differences. That is, whereas the Gartstein et al. (2013) study relied on a single set of infancy predictors of EC, measured at 12 months of age, the present study included indicators across multiple bi-monthly assessment points in infancy (6–12 months of age).

The lack of a significant relationship between change in RCO over the first year of life and toddler EC is inconsistent with previous findings by Bridgett et al. (2011). This discrepancy is likely a function of the specific multilevel modelling approach used in this study. In particular, HLM offers distinct advantages, providing the means of examining process-oriented models reflecting development and promising to increase our understanding of how change occurs across time. Importantly, HLM compares the rate of change among individuals, overcoming limitations associated with estimating change by comparing variables at two time points (Wu, 1996). As such, identifying the pattern of change in temperament across infancy in relation to toddler EC, as indexed by the HLM analyses, can be expected to provide a more comprehensive and developmentally sensitive picture of the relationships between these variables, compared to research considering change and/or predictive links across two points in time. Comparable in this regard to other approaches addressing developmental trajectories (e.g., latent growth curve modelling),

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HLM may provide a different pattern of results, as was the case for the present findings concerning RCO, not consistent with those reported by Bridgett et al. (2011).

Of additional interest, results indicated that change in cuddliness over time was associated with toddler EC, whereby infants who demonstrated more rapidly decreasing cuddliness over the first year of life were also rated lower on toddler EC. This pattern of results suggests that more dramatic drops in cuddliness are associated with less advanced EC later in development. Specifically, as cuddliness declines faster over the first year of life, development of independent attention-based regulation (i.e., EC) may be reduced. On the other hand, relying on physical contact to promote regulation could be advantageous with respect to fostering more internally driven regulatory capacity for toddlers. Although these results warrant replication, they offer support for the role of parent–child interactions in the development of EC. In particular, because cuddliness is a caregiver-assisted mode of regulation during infancy, our results likely reflect the influence of the parent–child relationship, which is consistent with previous research indicating that secure attachment promotes the development of EC (see e.g., Drake, Belsky, & Fearon, 2014; Fearon & Belsky, 2004; Gilliom, Shaw, Beck, Schonberg, & Lukon, 2002). The significant association between change in cuddliness and toddler EC is also notable, given that change in the overarching RCO construct did not predict EC development. Collectively, these results underscore the importance of examining fine-grained components of temperament, such as cuddliness, as the subscales do not necessarily function in the same manner as the overarching factor (Gartstein et al., 2013).

Limitations and Future Directions

Our sample was not representative of a diverse range of demographic characteristics, which limits the generalizability of results. Future research should aim to investigate potential antecedents to toddler EC among more demographically diverse samples; increasing the sample size in future studies may also provide the power necessary to further elucidate the associations examined in this study. Additionally, future research should examine predictors of EC not addressed in this study, along with additional time points. Overall, results of the present study, only partially consistent with our hypotheses, underscore the importance of replication and the need for future studies of a similar methodological nature.

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