The role of sustained attention, maternal sensitivity, and infant temperament in the development of early self-regulation

Matilda A. Frick1*, Tommie Forslund1, Mari Fransson1, Maria Johansson2, Gunilla Bohlin1 and Karin C. Brocki1

1Department of Psychology, Uppsala University, Sweden
2Viksäng Maternal and Paediatric Health Center, Västerås, Sweden

This study investigated infant predictors of early cognitive and emotional self-regulation from an intrinsic and caregiving environmental perspective. Sustained attention, reactive aspects of infant temperament, and maternal sensitivity were assessed at 10 months (n = 124) and early self-regulation (including executive functions, EF, and emotion regulation) was assessed at 18 months. The results indicated that sustained attention predicted early EF, which provide empirical support for the hierarchical framework of EF development, advocating early attention as a foundation for the development of cognitive self-regulation. Maternal sensitivity and surgency predicted emotion regulation, in that infants of sensitive mothers showed more regulatory behaviours and a longer latency to distress, whereas high levels of surgency predicted low emotion regulation, suggesting both the caregiving environment and temperament as important in the development of self-regulation. Interaction effects suggested high sustained attention to be a protective factor for children of insensitive mothers, in relation to emotion regulation. In addition, high levels of maternal sensitivity seemed to foster development of emotion regulation among children with low to medium levels of sustained attention and/or surgency. In all, our findings point to the importance of both intrinsic and extrinsic factors in infant development of self-regulation.

Self-regulation, in the sense of controlling one’s impulses, regulating emotions, and delaying gratification, is essential for an individual to successfully cope with everyday demands in both childhood and adult life (Moffitt et al., 2011). Additionally, early individual differences in children’s ability to self-regulate have been shown to be a positive predictor of a range of clinically and socially relevant behaviours later in life (Mischel et al., 2010; Moffitt et al., 2011), such as social skills (Clark, Prior, & Kinsella, 2002; Eisenberg et al., 1993), peer relationship quality (Calkins, Gill, Johnson, & Smith, 1999), as well as reading ability and academic achievement (Best, Miller, & Naglieri, 2011). It has been shown that the ability for self-regulation begins to develop during the first year of life (e.g., Posner, Rothbart, Sheese, & Voelker, 2012), and is dependent on both intrinsic and environmental factors (e.g., Fox & Calkins, 2003; Friedman et al., 2008; Rhoades, 2011).
Greenberg, Lanza, & Blair, 2011). Yet there is a lack of studies elucidating the development of self-regulation from infancy to early childhood (Hendry, Jones, & Charman, 2016), and most studies have looked at intrinsic and environmental predictors separately in relation to either cognitive or emotional self-regulation. Accordingly, in the present longitudinal study, we aimed to bridge this gap by simultaneously examining developmental intrinsic factors (i.e., sustained attention and infant temperament) and the caregiving environment (i.e., maternal sensitivity) in infancy (10 months) as possible predictors of early cognitive and emotional self-regulation at 18 months. By estimating specific contributions and interaction effects, we aimed to provide new insights into the development of early self-regulation.

Self-regulation
Self-regulation is a complex construct that has been approached in multiple ways coupled with a broad and diverse terminology. However, it is well established that self-regulation refers to processes that support goal-directed behaviours and encompasses both cognitive and affective aspects (Hofmann, Schmeichel, & Baddeley, 2012; Karoly, 1993; Nigg, 2017; Rothbart, Posner, & Kieras, 2006). Examples of distinct although overlapping constructs that are often referred to as self-regulation involve executive functioning (EF; Miyake & Friedman, 2012), effortful control (Rothbart et al., 2006), emotion regulation (Gross, 2011), delay of gratification (Mischel et al., 2010), and yet many more. Recently, successful attempts have been made to present a domain general construct of self-regulation encompassing regulation of actions, emotions, and cognition, differentiating between top-down and bottom-up regulation (Bridgett, Burt, Edwards, & Deater-Deckard, 2015; Nigg, 2017). Cognitive self-regulation, or top-down control, is often referred to as EF, a set of higher-order abilities, such as inhibition, working memory, and shifting, that allow individuals to regulate thoughts and behaviours in order to achieve goals (e.g., Miyake & Friedman, 2012). In addition, effortful control, the temperamental equivalent to EF, shows considerable overlap with both EF (Nigg, 2017) and emotion regulation (Eisenberg & Zhou, 2016; Zhou, Chen, & Main, 2012) and it is important to emphasize that the variation in terminology at least in part comes from differences in research backgrounds (Nigg, 2017). Developmentally, self-regulation is hierarchically organized with lower level components assembling into higher-level components over time (Nigg, 2017). Here, early attentional processes during the first year of life are believed to play a major role in the upstream development of self-regulation (Garon, Bryson, & Smith, 2008; Rothbart et al., 2006), which will be discussed in depth below.

Affective aspects of self-regulation are often referred to as emotion regulation, that is, behaviours, skills, and strategies that aim to regulate experiences and expressions of emotions (Gross, 2011; Rothbart & Posner, 1985; Stifter & Braungart, 1995). Emotion regulation is present during the first year of life in the form of for instance gaze aversion, self-distraction, and proximity seeking to the parent (Mangelsdorf, Shapiro, & Marzolf, 1995; Stifter, Spinnrad, & Braungart-Riek, 1999). Theoretically, emotion regulation stems out of an interaction between emotional reactivity and a control dimension that regulates the reactivity (Calkins & Hill, 2011). As such, emotion regulation can be measured both in terms of regulatory behaviours and in terms of the emotional output. Emotional reactivity and regulation are closely related to the broader construct of temperament as we will discuss below (Rothbart, Ellis, & Posner, 2013).

It has been suggested that EF and emotion regulation develop together during childhood (Bell & Wolfe, 2004; Ursache, Blair, Stifter, & Voegtline, 2013), with attention
and inhibition being important in the development of both (Fox & Calkins, 2003; Garon et al., 2008). Prospective relations between emotion regulation in infancy and EF in early childhood have been found (Ursache et al., 2013) as well as concurrent correlations between executive control and emotion regulation in 4- to 6-year-olds and 7- to 10-year-olds (Carlson & Wang, 2007; Simonds, Kieras, Rueda, & Rothbart, 2007). However, to our knowledge, no one has looked at the correlation between cognitive and emotion regulation as early as at 18 months. Additionally, we aim to further the knowledge on the development of self-regulation by taking a holistic perspective and simultaneously investigate the contribution of early individual differences in sustained attention, temperamental reactivity, and maternal sensitivity at 10 months as predictors of cognitive and emotion regulation at 18 months.

**Attention in relation to early self-regulation**

Several developmental theories point to the significance of early attention as a foundation for the development of self-regulation (Colombo & Cheatham, 2006; Fox & Calkins, 2003; Garon et al., 2008; Posner et al., 2012). As regards EF specifically, Garon and colleges have suggested that the development progresses with a hierarchical organization where more complex functions developmentally build on simpler ones (Garon, Smith, & Bryson, 2014; Garon et al., 2008). According to this model, basic attention, which begins to develop during the first months of life, sets the stage for the onset of simple forms of key EF components at the end of the first year (e.g., holding information in mind and delaying responses; Garon et al., 2014). With maturation, these key basic EF components become closely intertwined and bring about the emergence of complex EF, which continues to develop throughout childhood and adolescence. Garon’s hierarchical perspective that focuses on EF is closely related to the account by Rothbart, Sheese, Rueda, and Posner (2011), in which they hypothesize that children’s increasing ability to regulate behaviour and emotions (i.e., effortful control) stems from separate attention systems that operate at different developmental stages (e.g., Posner et al., 2012). In addition, Colombo and Cheatham (2006) have suggested that the emergence of endogenous and volitional attention towards the end of the first year is a determining factor in the development of self-regulation.

Several studies, primarily within the temperament literature, have empirically investigated the link between early attention processes and self-regulation. For instance, better attentional focus at 6 months was associated with less frustration (Calkins, Dedmon, Gill, Lomax, & Johnson, 2002), and selective and focused attention at 9 months predicted individual differences in self-regulation in terms of effortful control at 2 years (Holmboe, Fearon, Csibra, Tucker, & Johnson, 2008; Kochanska, Murray, & Harlan, 2000). Moreover, it has been shown that sustained attention in infancy predicted cognitive self-regulatory functions in 2- and 3-year-olds (Johansson, Marciszko, Brocki, & Bohlin, 2016; Johansson, Marciszko, Gredebäck, Nyström, & Bohlin, 2015). In the present study, we explore the role of sustained attention as a foundation for early self-regulation, both cognitive and emotional, as the ability to focus is suggested to be the core of any goal-directed behaviour (Garon et al., 2008).

**Temperament in relation to self-regulation**

Temperament has been defined as the child’s reactivity towards the environment and regulation of that reactivity (Rothbart, 2007). Thereby the construct shows considerable
overlap with emotion regulation, but makes a broader claim, including not only emotion but also motor and attentional domains (Rothbart et al., 2013). Rothbart et al. (2013) have described a three-factor model of temperament with two reactive dimensions (negative affectivity and extraversion/surgency) and one regulatory dimension (effortful control). The reactive dimensions are present during the first year of life (Rothbart, 2007) whereas the regulatory dimension shows the most protracted development, presenting stability during the third year of life (Kochanska et al., 2000). Negative affectivity encompasses frustration, fear, discomfort, and sadness and has in infancy repeatedly been related to poorer self-regulation in toddlerhood (Putnam, Rothbart, & Gartstein, 2008; Raikes, Robinson, Bradley, Raikes, & Ayoub, 2007). One exception is that high fear in infancy has been positively related to later inhibition of approach, whereas low fear in combination with surgency was associated with later poor inhibitory control (Rothbart et al., 2013). Extraversion/surgency encompasses positive emotionality, high approach and intensity pleasure, low shyness, impulsivity, and affiliation (Putnam, Helbig, Gartstein, Rothbart, & Leerkes, 2014). The relation between extraversion/surgency and self-regulation is not as clear as for negative affectivity. On the one hand, surgency in infancy has been linked to better self-regulation in toddlerhood (Casalin, Luyten, Vliegen, & Meurs, 2012; Komsi et al., 2006; Putnam et al., 2008), whereas surgency in toddlerhood was linked to poor self-regulation in preschoolers (Putnam et al., 2008). Kochanska, Aksan, Penney, and Doobay (2007) have suggested that positive emotionality is a heterogeneous trait, with strong approach and novelty seeking relating to poor self-regulation, and affiliation and warmth relating to better self-regulation.

Recently, main effects of temperament have been complemented with interaction effects, due to the greater emphasis on the fact that development is a result of the interplay between multiple factors, intrinsic as well as environmental (Baer et al., 2014). The theory of differential susceptibility suggests that children with difficult temperament may be more susceptible to both positive and negative aspects of parenting (Belsky, 2005; Belsky, Bakermans-Kranenburg, & van IJzendoorn, 2007; Kiff, Lengua, & Zalewski, 2011). In line with this proposal, it has been shown that children with difficult temperament are more susceptible to both positive and negative aspects of maternal caregiving in relation to impulsivity (Rochette & Bernier, 2016) and that maternal attention-directing behaviours enhanced EF for inhibited and exuberant children only (Conway & Stifter, 2012). Moreover, the combination of high levels of both negative reactivity and emotion regulation predicted better EF at age four, whereas high levels of reactivity in combination with low levels of regulation predicted worse EF performance (Ursache et al., 2013). In addition, the children in the high reactivity–high regulation group were more likely to have experienced positive parenting behaviour (Ursache et al., 2015). Hence, we aim to explore both main effects of the reactive aspects of temperament (negative affectivity and surgency) and interaction effects with the caregiving environment in relation to early self-regulation.

Parental influences on early self-regulation
Twin studies have shown that there is a substantial genetic contribution in the development of EF (Friedman et al., 2008). Additional studies suggest, however, that the slow maturation of the prefrontal cortex makes development of self-regulation sensitive also to environmental influences (e.g., Noble, Norman, & Farah, 2005). Previous studies have related individual differences in self-regulation to socio-economic status (SES; e.g., Hackman & Farah, 2009), dimensions of parenting such as maternal sensitivity,
scaffolding, and maternal interference (Bernier, Carlson, & Whipple, 2010; Calkins & Johnson, 1998; Hughes & Ensr, 2009), as well as attachment security (Bernier, Carlson, Deschènes, & Matte-Gagné, 2012; von der Lippe, Eilertsen, Hartmann, & Killén, 2010). Rhoades et al. (2011) conclude that much of the family structure, income, and psychosocial risks associated with poor self-regulation seemed to be transmitted through the quality of parenting. Specifically, the caregivers are thought to act as external regulators during infancy, in that they aid the infant in regulating his/her attention and emotions through responding to the infant’s signals (Crockenberg & Leerkes, 2004). In turn, this external regulation supports the child’s emerging capacity to self-regulate (Bernier et al., 2010). One such external regulator is maternal sensitivity, a global measure of the mother’s accessibility, acceptance, cooperation, and sensitivity to the infant’s signals (Pederson et al., 1990). As such, we view maternal sensitivity as a global aspect of the affective quality of the caregiving environment, making it a suitable candidate for predicting self-regulation in the child. We aim to contribute to the scarce knowledge on how the caregiving environment relates to early self-regulation, by examining independent contributions and interaction effects with infant sustained attention and temperamental reactivity.

Aims
In the current study, we wished to enhance the knowledge on early mechanisms behind the development of early self-regulation from a combined infant intrinsic and caregiving environmental perspective. The first aim of the study was to examine sustained attention, infant temperamental reactivity in terms of negative affectivity and surgency, and maternal sensitivity at 10 months as early predictors of cognitive (inhibition and global EF) and emotional self-regulation (latency to distress and emotion regulation) at 18 months. In line with previous theoretical and empirical work, we hypothesized that higher levels of sustained attention and higher levels of maternal sensitivity would predict better self-regulation at 18 months. As for temperament, we made no prediction for surgency, but for negative affectivity, we predicted a negative correlation with self-regulation. The second aim of the study was to investigate independent and interactive effects of the intrinsic and caregiving environmental predictors on self-regulation. We predicted that sustained attention, negative affectivity, and maternal sensitivity all would make independent contributions to early self-regulation. In line with the theory of differential susceptibility (Belsky et al., 2007), we expected an interaction effect between infant temperament and maternal sensitivity, in that infants with high negative affectivity would be more susceptible to both high and low levels of maternal sensitivity. As for interaction effects between maternal sensitivity and surgency, as well as between maternal sensitivity and sustained attention, in relation to self-regulation, we made no a priori hypotheses. A third aim was to investigate the concurrent relation between cognitive and emotion regulation at 18 months. We predicted that they would be positively correlated, as has been found in older children.

Method
Participants
The initial sample consisted of 124 full-term, typically developing, 10-month-old infants (66 boys, 53.2%) and their Swedish speaking mothers. All but one infant lived with both
76.4% of the mothers and 63.4% of the fathers had a college or university degree. 92.5% of the mothers and 89.2% of the fathers were born in Sweden, and 1.7% of mothers and 5.8% of fathers were born outside of Europe. Mean age for mothers was 32.1 years ($SD = 5.0$) and for fathers 34.1 years ($SD = 5.9$). At 18 months, 117 infants remained in the study; one family had moved out of town and six no longer wished to participate. There were no significant differences between completers and non-completers regarding parental education or the predictor variables (independent samples $t$-test; $p$’s .08 to .90).

The infants were recruited via the birth registry of Uppsala, Sweden. Families of newborn infants received a letter from Uppsala Child and BabyLab at the department of psychology, Uppsala University inquiring about interest in participating in studies (30% response rate). Researchers contacted 146 of the interested families by mail and phone. Reasons for declining participation included: Parents did not speak Swedish with the child ($n = 6$), child was born pre-term (fewer than 37 weeks gestational age; $n = 2$), family had moved out of town ($n = 2$), and a reported lack of time ($n = 12$).

**Procedure**

At 10 months (mean age 10.04 months, $SD = 0.24$), infants and mothers visited the laboratory for assessment of sustained attention and maternal sensitivity, and mothers completed questionnaire data of infant temperament. At 18 months (mean age 18.06 months, $SD = 0.26$), the children again visited the laboratory with an accompanying parent for assessment of a range of early self-regulatory measures. Both visits lasted approximately 1 hr. Three trained graduate and undergraduate students and an experienced researcher conducted the testing and coding of data. After each visit, the family received a gift certificate worth approximately $20. The tasks and questionnaires used in this study were part of a larger test battery designed to assess various cognitive and emotional processes in infants. The local ethics committee in Uppsala, Sweden approved the study.

**Measures**

Infant temperament at T1

We used a Swedish translation of the two subscales from the *Infant Behavior Questionnaire – Very Short Form* (IBQ-R VSF; Putnam et al., 2014; translated by Eric Zander) to measure negative affectivity and surgency in the infants at 10 months. These subscales consist of 12 and 13 items, respectively. Mothers rated how often they had observed certain temperamental behaviours in the infant during the last week, on a 7-point scale ranging from never to always (e.g., ‘when tired, how often did your baby show distress?’ and ‘how often during the last week did the baby protest being placed in a confining place?’ for negative affectivity, and ‘how often during the last week did your baby move quickly toward new objects?’ and ‘when tossed around playfully how often did the baby laugh?’ for surgency). The IBQ-VSF has shown satisfactory internal consistency and validity (Putnam et al., 2014). The respective mean of the two scales was used as the independent variables. Cronbach’s alpha was $\alpha = .82$ for negative affectivity and $\alpha = .45$ for surgency. To further explore the low alpha for surgency, we examined ‘scale if item deleted’ and found that removing the two items (in two steps) that had the largest effect on change of alpha turned the alpha to a more adequate level (from $\alpha = .45$ to $\alpha = .69$). The removed items were as follows: ‘how often did your baby notice the sound of an airplane
passing overhead?’ and ‘when placed in an infant seat or car seat, how often did the baby squirm and turn body?’. Removing these items had modest effects on subsequent analyses in that it changed the interaction effect including surgency from marginally significant ($p = .07$) to significant ($p = .04$). All but one mother filled out the form for infant temperament.

**Sustained attention at T1**

We used *Task Orientation (Blocks)* (Goldsmith & Rothbart, 1999) to measure infants’ sustained attention at 10 months by letting them explore toys on their own. Infants sat in a highchair at a table ($60 \times 120$ cm) with the mother approximately 1 m away to the side. The experimenter put three coloured blocks in front of the infant and said ‘here’s for you to play with’. The experimenter instructed the mother to remain neutral, not to comment or play with the infant, and to pick up the blocks if all three fell to the floor. The experimenter then left the room for 3 min. Video cameras recorded the procedure and the amount of time the infant spent looking at and touching the blocks was coded. The measure for looking was used as the measure for sustained attention as many infants explored the blocks by throwing them onto the floor, thus preventing them from touching the blocks but still enabling them to look at the toys on the floor. The 3-min procedure was divided into three 1-min episodes, each divided into six 10-s epochs, and each epoch was coded on a 4-point scale ($0 = \text{does not look at blocks at all}$, $1 = \text{looks for 1–4 s}$, $2 = \text{looks for 5–8 s}$, $3 = \text{looks for 9–10 s}$). A mean value was calculated for each 1-min episode. The mean of all three episodes was used as the measure of sustained attention. Two independent raters coded 18 randomly selected cases (17%). Inter-rater reliability was ICC = .98. Due to a change in procedure (i.e., a switch from large soft blocks that were discovered to be difficult for the infants to grasp, to plastic blocks that were more age-appropriate), 12 infants were excluded on this measure. Additionally, two infants were crying during the procedure and could therefore not complete the task.

**Maternal sensitivity at T1**

We used the *Maternal Sensitivity Scales* (Ainsworth, 1969) to assess maternal sensitivity during a semi-structured 26-min play session divided into six blocks of various lengths based on procedural guidelines provided by Pederson, Moran, and Bento (2013). The blocks contained different elements to ensure a wide spectrum of behaviours relevant for maternal sensitivity. In the first 3-min block, the mother was asked to fill out a form and told that the experimenter would be back shortly with some toys for the infant; thus, the infant was in the room with no toys to play with requiring the mother to divide her attention between the form and the child. In the second 3-min block, the experimenter brought a set of toys and again said she would be back shortly, and then she left the room while the mother kept filling out the form. In the third block, that lasted 7 min, the experimenter brought a new set of toys and the mother was instructed to play with the infant as they usually do at home. The experimenter removed the form from the room. In the fourth block, the experimenter brought a children’s book for the dyad to read for 4 min. In the fifth block, the dyad got a toy that was supposed to be too difficult for the infant to master, to play with for 4 min. In the last block, the dyad played for 5 min without toys. The procedure was video-recorded and coded as a whole on a 9-point scale according to Ainsworth’s global scale of sensitivity vs. insensitivity to the infant’s signals (1969). The scale concerns the mother’s ability to perceive, accurately interpret, and
respond promptly and appropriately to the infant’s signals. Anchor points with descriptions of maternal behaviour are given in the manual: 9 = highly sensitive, 7 = sensitive, 5 = inconsistently sensitive, 3 = insensitive, and 1 = highly insensitive. Two independent raters coded 25 randomly selected cases (20%). Inter-rater reliability was ICC = .74.

Inhibition at T2
We used the Prohibition Task (Friedman, Miyake, Robinson, & Hewitt, 2011) to measure simple inhibition. This measure is considered as cognitive, but also taxes onto more ‘hot’ or affective aspects of regulation because of its conceptual similarities with other delay tasks including a reward (Mischel et al., 2010). The experimenter placed an attractive glitter wand in front of the child, then told the child ‘[child’s name], don’t touch’, and at the same time shook her head and then looked down. The trial continued for a maximum of 30 s starting from the end of the experimenter’s instruction until the child reached for the wand. The measure consisted of number of seconds (0–30) that the child could refrain from reaching for the wand. If the child did not reach for the wand, he/she received a score of 30. One child was excluded from analyses on this measure, due to a procedural error. Two independent raters coded 24 randomly selected cases (20.6%). Inter-rater reliability was ICC = .99.

Global EF at T2
We used the Piagetian A-not-B procedure (Piaget, 1954) to assess global EF, including inhibition of a prepotent response (i.e., inhibiting the response to search for a toy where it was previously hidden), working memory (i.e., holding the hiding location in mind), and shifting (i.e., handling the switch from location A to B; Bell, 2012; Diamond, 2013; Miller & Marcovitch, 2015). The child sat in front but out of reach of an A-not-B apparatus (Johansson, Forssman, & Bohlin, 2014) and the experimenter, in full sight of the child, hid an attractive toy behind one of two cloth covered screens (location A and B). The experimenter then rang a bell to break the infant’s attention from the hiding location, waited 6 s, and then pushed the apparatus so the child could reach it and asked the child to search for the toy by saying ‘where is the toy?’. This was repeated four times at location A, four times at location B, and then again two times back at location A, regardless of where the child searched for the toy (Johansson et al., 2014). As we used a fixed schedule for hiding the toy at A and B rather than it being based on the child’s number of correct searches, we believe our implementation of the A-not-B task captures global EF (i.e., made up by inhibition, working memory, and shifting) better than just shifting. First reach and first look within 10 s for all ten trials were coded independently from each other. That is, the child could reach towards the incorrect location and at the same time look at the correct location and thus would receive 1 point for the correct look and 0 points for the incorrect reach. A reaching response was defined as the first response in which the infant touched one of the screens after the apparatus had been pushed towards the child. Looking was defined as the first look towards one of the screens. Thus, a reach for or a look towards the correct hiding place received a score of 1 each. Incorrect searching or no searching at all received a score of 0. The mean number of correct searches on all trials (0–10; i.e., the sum of reaching and looking divided by two) was used as the measure of global EF. Infants were included in the analyses if they had codable behaviours on at least one trial (however, all trials were administered to all but three infants and results remained the
same with these three infants removed). One infant had no data and was excluded from analyses. Two independent raters coded 20 randomly selected cases (24.4%). Inter-rater reliability was ICC = .98.

**Emotion regulation and reactivity at T2**

We used *Attractive Toy Placed Behind Barrier* (Goldsmith & Rothbart, 1999) to assess both the reactive and the regulatory aspect of emotion regulation. The child was seated in a highchair at the long side of the table, the parent was seated at the left end of the table and the familiar experimenter at the right end, and thus, the child was facing no one. The parent was then told by the experimenter to bring an attractive, plastic, activity multitoy into the child’s view, to demonstrate how it works and then to place it within the child’s reach. The child got to play with the toy for 15 s. The experimenter then raised a 31 × 40 cm Plexiglas barrier approximately 9 cm in front of the child. The parent was asked to gently remove the toy and to place it behind the barrier. The toy was placed behind the barrier for 30 sec and was then returned to the child by the parent. This procedure was repeated for a total of three trials. The three trials were divided into 5-s epochs and coded for reactivity and emotion regulation according to Goldsmith and Rothbart (1999). For our purposes, latency to distress, that is, the sum of the intervals in seconds for all three trials (0–90), from the removal of the toy to the first sign of distress (facial, postural, or vocalic) was used as the dependent measure for the reactive aspect of emotion regulation. Thus, a low score corresponds to a short latency to distress and a high score to a long latency (e.g., a score of 90 means that the infant showed no distress at all). In addition, disengagement of attention (one of the basic strategies for regulating emotions), that is, the mean number of seconds per epoch (0–5) where the child looked away from the stimulus, looked at an object that was unrelated to the episode, or without focusing on any particular object was used as the measure for emotion regulation. Due to a procedural error, data from the first 42 participants had to be excluded on this measure. In addition, emotion regulation could not be calculated for one participant due to camera breakdown.

**Statistical analyses**

Bivariate relations between predictors and outcome variables were studied using Pearson’s correlations for the variables that met criteria for normal distribution and Spearman’s correlations for all other variables. Independent contributions were examined using bootstrapped regression analyses when two or more predictors related significantly or marginally significant ($p$’s < .10) to the same outcome variable. Interaction effects between maternal sensitivity and the variables reflecting intrinsic factors in relation to self-regulation were studied using bootstrapped regression analyses with the *PROCESS* tool made for SPSS by Andrew F. Hayes (www.afhayes.com). In all, 12 moderation analyses were conducted. In the moderation analyses, we added all predictors that had significant or close to significant ($p$’s < .10) correlations with the outcome variable as control variables, to examine whether the interaction contributed with additional variance beyond independent contributions. Bootstrapped regression analyses were used to control for non-normally distributed data. No imputation of missing data was made, due to the relatively low numbers of missing values.

Data were converted to z-scores and screened for outliers ($z > 3$). One outlier was found for sustained attention and two for emotion regulation and both were replaced with
the second most extreme value that was not an outlier (Tabachnick & Fidell, 2001). Scores for skewness and kurtosis were converted to z-scores according to Field (2013) and compared against values expected if skewness and kurtosis were not different from zero. The cut-off used was ±1.96 for z-converted scores ($p < .05$; Field, 2013). This procedure revealed that sustained attention was negatively skewed ($-1.27; z$-score $-5.52$) and had a positive kurtosis (1.73; $z$-score 3.76), maternal sensitivity had a negative kurtosis ($-0.93; z$-score $-2.16$), surgency had a negative skew ($-0.62; z$-score $-2.85$), inhibition had a positive skew (0.99; $z$-score $-4.40$), latency to distress had a negative kurtosis ($-1.48; z$-score 2.69), and emotion regulation was positively skewed (1.88; $z$-score 6.73) and had a positive kurtosis (4.00; $z$-score 7.25). All other variables met criteria for normal distribution, with skewness values ranging from $-0.26$ to 0.19 ($z$-scores $-0.93$ to 0.86) and kurtosis values ranging from $-0.84$ to 0.32 ($z$-scores $-0.88$ to 0.74).

Infant sex and the combined average of the mother’s and father’s level of education did not correlate with any other measure and were left out of the final analyses.

**Results**

**Descriptive statistics and concurrent correlations**

Descriptive statistics are presented in Table 1 and concurrent correlations in Table 2. As for concurrent correlations between predictors, Surgency was positively correlated with negative affectivity and sustained attention, and negatively correlated with maternal sensitivity. As for concurrent correlations between outcome measures, inhibition and emotion regulation were negatively correlated. No other concurrent correlations between variables were significant.

**Longitudinal relations**

The longitudinal correlations are presented in Table 2. Sustained attention at 10 months was positively correlated to inhibition and global EF at 18 months. Further, surgency at 10 months was positively correlated to global EF. Surgency was also marginally significantly correlated to emotion regulation in a negative direction. Maternal sensitivity at 10 months was positively correlated to latency to distress and emotion regulation at 18 months, in that higher maternal sensitivity predicted longer latency to distress and emotion regulation.

**Table 1. Descriptive statistics**

<table>
<thead>
<tr>
<th>Measure</th>
<th>$n$</th>
<th>$M$ (SD)</th>
<th>Range</th>
<th>Possible range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Predictors</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Sustained attention</td>
<td>110</td>
<td>2.55 (0.35)</td>
<td>1.61–3</td>
<td>0–3</td>
</tr>
<tr>
<td>Maternal sensitivity</td>
<td>124</td>
<td>6.02 (1.62)</td>
<td>3–9</td>
<td>1–9</td>
</tr>
<tr>
<td>Negative affectivity</td>
<td>123</td>
<td>3.89 (1.07)</td>
<td>1.6–6.2</td>
<td>1–7</td>
</tr>
<tr>
<td>Surgency</td>
<td>123</td>
<td>5.15 (0.70)</td>
<td>3.3–6.5</td>
<td>1–7</td>
</tr>
<tr>
<td><strong>Outcome variables</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Inhibition</td>
<td>116</td>
<td>10.05 (11.75)</td>
<td>0–30</td>
<td>0–30</td>
</tr>
<tr>
<td>Global EF</td>
<td>116</td>
<td>5.81 (2.10)</td>
<td>0–10</td>
<td>0–10</td>
</tr>
<tr>
<td>Latency to distress</td>
<td>75</td>
<td>35.51 (32.30)</td>
<td>0–90</td>
<td>0–90</td>
</tr>
<tr>
<td>Emotion regulation</td>
<td>74</td>
<td>0.42 (0.48)</td>
<td>0–2.08</td>
<td>0–5</td>
</tr>
</tbody>
</table>
Table 2. Concurrent and predictive correlations between predictors at 10 months and outcome variables at 18 months

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Sustained attention&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Maternal sensitivity&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Negative affectivity</th>
<th>Surgency&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Inhibition&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Global EF</th>
<th>Latency to distress&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Emotion regulation&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustained attention&lt;sup&gt;a&lt;/sup&gt;</td>
<td>–</td>
<td></td>
<td>–</td>
<td>–</td>
<td>.23*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity&lt;sup&gt;a&lt;/sup&gt;</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–.20&lt;sup&gt;*&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative affectivity</td>
<td>–</td>
<td></td>
<td>–</td>
<td>.22&lt;sup&gt;*&lt;/sup&gt;</td>
<td>.02</td>
<td>.06</td>
<td>.05</td>
<td>–.05</td>
</tr>
<tr>
<td>Surgency&lt;sup&gt;a&lt;/sup&gt;</td>
<td>–</td>
<td></td>
<td>–</td>
<td>.15</td>
<td>.25&lt;sup&gt;**&lt;/sup&gt;</td>
<td>.15</td>
<td></td>
<td>–.21&lt;sup&gt;*&lt;/sup&gt;</td>
</tr>
<tr>
<td>Outcome variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhibition&lt;sup&gt;a&lt;/sup&gt;</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td>–</td>
<td>.01</td>
<td></td>
<td>–.30&lt;sup&gt;**&lt;/sup&gt;</td>
</tr>
<tr>
<td>Global EF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.04</td>
<td></td>
<td>–.16</td>
</tr>
<tr>
<td>Latency to distress&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>–</td>
<td>–</td>
<td>.21&lt;sup&gt;*&lt;/sup&gt;</td>
</tr>
<tr>
<td>Emotion regulation&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>–</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. <sup>a</sup>Spearman’s rho, all other analyses conducted with Pearson’s correlations.
<sup>*</sup>p < .10; <sup>*p</sup> < .05; <sup>**p</sup> < .01.
higher levels of emotion regulation during the attractive toy placed behind barrier task. In addition, maternal sensitivity was also negatively correlated to inhibition.

As for independent contributions, the regression analysis with inhibition as outcome variable was significant, \( p = .01, R^2 = 0.09 \), and showed that sustained attention contributed independently to inhibition (\( \beta = .25, p < .01 \)) whereas maternal sensitivity did not (\( \beta = -.12, p = .23 \)). The regression analysis with global EF as outcome variable was also significant, \( p = .04, R^2 = 0.06 \), but with no significant contributions of either sustained attention (\( \beta = .16, p = .13 \)) or surgency (\( \beta = .16, p = .12 \)). Further, the third regression analysis with emotion regulation as outcome variable was significant, \( p < .01, R^2 = 0.17 \), and both surgency (\( \beta = -.31, p = .03 \)) and maternal sensitivity (\( \beta = .20, p = .03 \)) made independent contributions.

**Interaction effects**

Two significant interaction effects between maternal sensitivity and the intrinsic factors were found (see Table 3). First, there was an interaction effect showing that children with low to medium levels of sustained attention had a longer latency to distress if they had more sensitive mothers and a shorter latency to distress if they had less sensitive mothers (see Figure 1). The Johnson–Neyman method showed that the interaction between maternal sensitivity and sustained attention was significant when sustained attention was between \(-1.39\) and \(0.08\) (mean-centred values), which included 52% of the cases. Among children with high levels of sustained attention, there was no significant relationship between maternal sensitivity and latency to distress.

The second interaction effect showed that children with low to medium levels of surgency had higher levels of emotion regulation if they had more sensitive mothers and low levels of emotion regulation if they had insensitive mothers (see Figure 2). The Johnson–Neyman method showed that the interaction between maternal sensitivity and surgency was significant when surgency was between \(-2.56\) and \(0.13\) (mean-centred values), which included 48% of the cases. Among children with high surgency, there was no relationship between maternal sensitivity and emotion regulation, and as can be seen in Figure 2, this group had the lowest level of emotion regulation.

**Table 3.** Significant interaction effects between intrinsic factors and maternal sensitivity at 10 months in relation to self-regulation at 18 months

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Outcome variable</th>
<th>( \beta )</th>
<th>( t )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Latency to distress</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustained attention</td>
<td></td>
<td>(.02)</td>
<td>(0.21)</td>
<td>(.82)</td>
</tr>
<tr>
<td>Maternal sensitivity</td>
<td></td>
<td>(.28)</td>
<td>(2.47)</td>
<td>(.02)</td>
</tr>
<tr>
<td>Sustained attention ( \times ) sensitivity</td>
<td></td>
<td>(-.24)</td>
<td>(-2.25)</td>
<td>(.03)</td>
</tr>
<tr>
<td><strong>Emotion regulation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgency</td>
<td></td>
<td>(-.24)</td>
<td>(-2.01)</td>
<td>(.05)</td>
</tr>
<tr>
<td>Maternal sensitivity</td>
<td></td>
<td>(.24)</td>
<td>(2.26)</td>
<td>(.03)</td>
</tr>
<tr>
<td>Surgency ( \times ) sensitivity</td>
<td></td>
<td>(-.22)</td>
<td>(-2.09)</td>
<td>(.04)</td>
</tr>
</tbody>
</table>

*Note.* Only significant interaction effects are reported due to lack of space. Twelve moderation analyses were performed; two were significant.
The current longitudinal study investigated infant predictors of cognitive and emotional self-regulation in toddlerhood from a combined developmental intrinsic and caregiving environmental perspective. Sustained attention appeared as particularly important for latency to distress and emotion regulation.

**Figure 1.** Simple slopes of the regression of maternal sensitivity at 10 months on latency to distress (z-scores) 18 months at three levels of sustained attention at 10 months. Lines represent low (1 SD below the mean), mean, and high (1 SD above the mean) levels of sustained attention. At low and mean levels of sustained attention, there was a significant relationship between maternal sensitivity and latency to distress ($p < .01$ and $p = .02$, respectively).

**Figure 2.** Simple slopes of the regression of maternal sensitivity at 10 months on emotion regulation (z-scores) 18 months at three levels of surgency at 10 months. Lines represent low (1 SD below the mean), mean, and high (1 SD above the mean) levels of surgency. At low and mean levels of surgency, there was a significant relationship between maternal sensitivity and emotion regulation ($p < .01$ and $p = .03$, respectively).

[Correction added on 23 October, 2017, after first online publication: Figure 2 was updated.]

**Discussion**

The current longitudinal study investigated infant predictors of cognitive and emotional self-regulation in toddlerhood from a combined developmental intrinsic and caregiving environmental perspective. Sustained attention appeared as particularly important for...
early cognitive self-regulation and maternal sensitivity for early emotion regulation in a positive direction. Moreover, surgency made an independent contribution to emotion regulation in that high levels of surgency were associated with lower levels of emotion regulation and vice versa. In addition, we found significant interaction effects suggesting that high maternal sensitivity was associated with higher emotion regulation among children with lower levels of sustained attention and/or surgency. Overall, the results were largely in line with our predictions suggesting both independent and interactive effects of intrinsic and caregiving environmental factors in the development of self-regulation as will be discussed in detail below.

Sustained attention predicts early cognitive self-regulation
Sustained attention in infancy, considered in the literature as one of the basic elements of self-regulation in general (Ruff & Rothbart, 2001), and of EF specifically (Garon et al., 2008), predicted better performance of both inhibition and global EF at 18 months. In line with our predictions, this finding provides empirical support to the hierarchical framework of EF development (Garon et al., 2008; Nigg, 2017; Posner et al., 2012). In addition, sustained attention made a significant independent contribution to inhibition beyond maternal sensitivity in infancy. Attention skills are thought to be closely intertwined with EF, in that the ability to focus attention is a prerequisite for the understanding of tasks, following rules (e.g., inhibit prepotent but inappropriate responses), and to control what information to process (Colombo & Cheatham, 2006; Garon et al., 2008). Our results demonstrate that intrinsic factors in infancy, in terms of individual differences in sustained attention, have a special role in relation to early development of cognitive self-regulation.

Our results are in line with previous results showing that sustained attention in free play with a parent at 12 months was predictive of A-not-B performance and effortful control at 24 months, as well as working memory at 36 months (Johansson et al., 2015, 2016). Thus, we extend these findings by showing that sustained attention in another context (solitary exploration of toys) also predicts cognitive self-regulation and that it can be captured even at the early age of 18 months. In addition, we show that sustained attention predicts both pure cognitive, or ‘cold’, aspects EF as measured with the A-not-B task, and the more ‘hot’ aspects of EF as captured with the prohibition task. Thus, our results contribute to the growing empirical evidence to the theories of attention as the foundation for self-regulation. In addition, the interaction analyses indicated that high sustained attention may be interpreted as a protective factor in relation to emotion regulation in children of insensitive mothers. Contrary to previous findings (e.g., Calkins et al., 2002, in 6-month-olds), there was no main effect of sustained attention on emotion regulation. Perhaps as children grow older and attention becomes more intertwined with other factors, effects are more likely to be shown in interactions rather than in direct effects.

Maternal sensitivity predicts emotion regulation
Maternal sensitivity predicted both aspects of emotion regulation in our frustration task at 18 months, in that children of more sensitive mothers had a longer latency to distress and showed more regulatory behaviours than children of insensitive mothers. This suggests a significant and specific role of maternal sensitivity in the affective aspects of self-regulation. In addition, interaction effects showed that the relation between maternal
sensitivity and latency to distress was significant only when the child’s level of sustained attention was low to medium. Specifically, high levels of maternal sensitivity seemed to extend the latency to distress among these children, from being the shortest to becoming at least as long as for children with high sustained attention. Interpreted within Belsky’s framework of differential susceptibility (Belsky et al., 2007), the results suggest low sustained attention as the susceptibility factor and maternal sensitivity as the environmental factor that moderates level of latency to distress. Of note, the interaction effect between maternal sensitivity and sustained attention in relation to regulatory behaviours in the emotion regulation task was in the same direction but did not reach significance ($p = .11$). Finally, the second interaction effect showed that the relation between maternal sensitivity and emotion regulation was significant only when the child’s level of surgency was low to medium, which will be further discussed under temperamental effects on self-regulation.

In sum, maternal sensitivity is a global measure of the mother’s accessibility, acceptance, cooperation, and sensitivity to the infant’s signals (Pederson et al., 1990). As such, maternal sensitivity can be viewed as a gentle external regulator of the infant’s emotions, which in time becomes internal within the child, presented in this study as better emotion regulation and a longer latency to distress at 18 months. Our results suggest that this effect is present in children with lower levels of sustained attention and/or surgency.

The parent’s presence during the frustration task could potentially have influenced our measures of emotion regulation. However, the regulation that is being assessed is child-initiated. The history of the parent as regulator might of course influence the child (which is indeed one of the hypotheses of our study), but in our emotion regulation task the parent is instructed to remain neutral and is as such doing nothing to regulate the child. Even if the presence of the parent is affecting the child’s regulation, it is still to be considered ‘intrinsic’ self-regulation. It would of course be interesting to assess this type of regulation also in the absence of the parent. However, as the parent is present also in the cognitive tasks as he/she is instructing the infant in the prohibition task, we believe that the presence of the parent is balanced across our tasks.

Contrary to our predictions and in contrast to previous findings, there was no significant relationship between maternal sensitivity and global EF and we found a negative correlation between maternal sensitivity and inhibition. However, maternal sensitivity made no independent contribution to inhibition when entered into the regression together with sustained attention, again suggesting a clearer role for intrinsic rather than extrinsic factors for the development of inhibition in this age range. Nevertheless, the relationship between maternal sensitivity and cognitive self-regulation should be further investigated, preferably using several measures of each cognitive component. Most previous studies have assessed EF at a slightly older age than we have (mean age 26 months; Bernier et al., 2012, 2010; Hughes & Ensor, 2005; Rochette & Bernier, 2016), and 18 months might be too early to capture stable effects of maternal sensitivity on cognitive self-regulation due to developmental aspects of EF that will be discussed below. In addition, whereas maternal sensitivity is considered a global measure of the quality of the mother–child interaction, maternal behaviours such as scaffolding and autonomy support are more task-specific and focused on problem-solving. Such parenting behaviours might have a stronger influence on cognitive aspects of self-regulation (Bernier et al., 2012; Hammond, Müller, M, Bibok, & Lieberman-Finestone, 2012), while the more global maternal sensitivity might be a stronger predictor of emotion regulation.
Temperamental effects on self-regulation

Surgency, as measured with the IBQ-R VSF (Putnam et al., 2014), capturing an active, happy infant interested in and attentive to the outer world, was positively associated with global EF at 18 months. However, surgency made no independent contribution to global EF, suggesting that it was something overlapping between surgency and sustained attention, perhaps the attentiveness in the surgent activity, that explained the predictive relation to cognitive self-regulation.

Further, surgency made an independent contribution to emotion regulation, in that high levels of surgency predicted low levels of emotion regulation. Moreover, we found an interaction effect showing that among children with low to medium levels of surgency, there was a positive association between maternal sensitivity and emotion regulation that was not found among children with high levels of surgency. This suggests children with lower levels of surgency to be more susceptible of sensitive parenting in relation to emotion regulation, whereas sensitive parenting did not matter for children high in surgency in relation to emotion regulation. That is, infants with high levels of surgency showed low levels of emotion regulation independently of levels of maternal sensitivity. Perhaps infants at the high end of surgency do not have the same susceptibility to environmental factors as infants low in surgency, and therefore are not as receptive of sensitive parenting. Thus, high surgency could be considered a risk factor for later poor emotion regulation, regardless of levels of maternal sensitivity. Altogether, these results are in line with the proposal that surgency is a risk factor for later problems with hyperactivity/impulsivity (Nigg, 2006) and that poor emotion regulation is a common associated feature thereof (Martel, 2009). However, the interaction between maternal sensitivity and surgency was specific to regulatory behaviours and not to latency to distress in the emotion regulation task. It seems as if high surgency was consistently associated with poor emotion regulation but with greater variability in distress scores. Thus, the group of highly surgent infants seems to be homogeneous as regards regulation but heterogeneous as regards negative reactivity during the task. That is, some surgent children might not have perceived the task as frustrating and therefore did not employ regulation, while others might have found it very frustrating but could not exhibit regulatory behaviours.

Concurrent correlations in toddlerhood

The third aim of the study was to investigate concurrent relations between cognitive self-regulation and emotion regulation. Contrary to our predictions, the self-regulatory tasks at 18 months showed little consistency across tasks with only one significant correlation, a negative correlation between inhibition and emotion regulation. The lack of consistency between the two EF measures (inhibition and global EF) is consistent with several previous studies of early EF (e.g., Miller & Marcovitch, 2015; Wiebe, Lukowski, & Bauer, 2010). There are a few potential explanations for this lack of consistency. It has been suggested that the second year of life is a time of rapid and distinct development of EF, with lacking coherence and stability across tasks (Miller & Marcovitch, 2015). This could reflect an initial absence of an underlying commonality of EF (Miller & Marcovitch, 2015) seen in older children and adults (Miyake & Friedman, 2012; Wiebe et al., 2011). Theoretically, this goes well with Garon’s proposal that the different aspects of EF show differently protracted developmental trajectories (Garon et al., 2008), and may as such not be correlated at every time point. In line with both of these proposals (Garon et al., 2008; Miller & Marcovitch, 2015), the different aspects of EF might initially be distinct and
with time become coordinated and integrated into more complex EF. Indeed, it is also possible that the different aspects of EF are difficult to assess in a valid and reliable way at this early age and may as such contain noise (Miller & Marcovitch, 2015). The lack of a significant correlation between global EF and emotion regulation might be due to the same reasons (i.e., differently protracted trajectories that are later integrated). The negative correlation between inhibition and emotion regulation may at first seem counter-intuitive. Yet, one possible explanation could be that children with high levels of inhibition are less emotionally reactive and thus in less need of using regulatory behaviours. However, we found no significant correlation between inhibition and latency to distress. Perhaps a reactive measure more focused on degree of distress rather than latency to distress could answer this question.

To sum up, even though there are theoretical reasons to believe that cognitive and emotion regulation develop in parallel (e.g., Bell & Wolfe, 2004) and that prospective as well as concurrent correlations have been found in older children, to our knowledge no study has previously examined the concurrent relation empirically at this early age. One way to further examine the relationship between cognitive and emotion regulation would be to assess the two constructs repeatedly over time, to see how and when they are correlated and how they affect each other.

Strengths, limitations, and future directions
The current study aimed to longitudinally and simultaneously examine effects of infant intrinsic factors and the caregiving environment in relation to both cognitive and emotional self-regulation, and presents some novel findings. Our sample showed high levels of SES and the results might not generalize to more socially diverse samples. Despite this social skewness, we have shown that intrinsic and environmental predictors relate differently to cognitive and emotion regulation. Here we want to make a note on the distinction between the labels intrinsic and environmental. We are well aware that intrinsic by no means fully corresponds to inherited or genetic and that environmental does not fully correspond to contextual. The two may, even at this early age, be intertwined and a result of gene × environment interactions. As such, genetically informed work is of importance for future study in this area, in that genetic risk can be expressed through higher exposure and greater sensitivity to environmental stressors (Bridgett et al., 2015; Lau & Eley, 2008).

Conclusions
The results from this longitudinal study first and foremost emphasize distinct early predictors of cognitive and emotional self-regulation. Specifically, sustained attention played an independent role in the development of cognitive self-regulation providing empirical support for the hierarchical framework of EF development. In addition, maternal sensitivity had an independent effect on emotion regulation in a positive direction whereas surgency made an independent contribution to emotion regulation in a negative direction. Interaction effects propose high sustained attention as a protective factor for children of mothers who were low in sensitivity, whereas children with low levels of sustained attention and/or surgency appeared to be particularly susceptible to sensitive parenting in relation to aspects of emotion regulation. In addition, at this early age cognitive and emotion regulation do not seem to develop in parallel. These results give us valuable information into the mechanisms behind the unfolding of self-regulation,
suggesting differential pathways into the development of cognitive and emotional aspects of self-regulation. From a clinical perspective, our findings point to the relevance of targeted interventions such as cognitive training and parent training programmes in response to deficits in specific aspects of self-regulation, which should be further investigated.

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References


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