Home is where the heart is:

A study on the links between physiological emotion regulation, maternal emotion socialization and aggression

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ABSTRACT

Home is where the heart is: A study on the links between physiological emotion regulation, maternal emotion socialization and aggression.

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Deficits in emotion regulation (ER) have been suggested as an underlying cause of persistent aggression problems in children. This study examined whether maternal emotion socialization (ES) strategies had differential impacts on aggression depending on children's physiological capacity for ER. A total of 61 children between the ages of 4 to 7 years and their mothers were included in this work. Children's regulatory physiology, as measured by respiratory sinus arrhythmia (RSA), was assessed while they engaged in relaxing activities, an anger induction task, and a delay of gratification task. Measures of maternal ES were gathered with questionnaires and observations of mother-child interactions during a clean-up task. Children's and mothers' reports of aggression were gathered with a newly designed Me Not Me task and the Child Behavior Checklist, respectively. The main goal of this study was to explore whether physiological regulation moderated links between ES and aggression; it was expected that there would be stronger links between ES and aggression for children with poorer physiological regulation. Findings supported previous works suggesting that adaptive physiological regulation is supported by RSA withdrawal in mild challenge situations. Children were more aggressive when they displayed low RSA withdrawal in affectively and behaviourally challenging situations. There was some indication that this was especially true for children who also experienced unsupportive ES from their mothers, suggesting that extrinsic influences may have more of an impact when internal regulatory resources are

weaker. Supportive responses to children's emotions may therefore be crucial for those who have poorer physiological regulation.

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Introduction

Aggressive behaviour is of great concern to the members of society. This behaviour emerges early on and if not resolved, puts individuals at risk for a variety of psychosocial problems later on in life (Tremblay et al., 2004). Many researchers have begun to study the development of aggressive behaviour in hopes of translating such information into prevention and treatment programs for aggressive youths. This work has identified emotion regulation (ER) as being an important factor in understanding aggression and the development of ER skills are thought to support decreases in this destructive behaviour (Keenan, 2000; Keenan & Shaw, 2003). The development of ER is affected by many intrinsic and extrinsic factors present in children's lives (Calkins & Hill, 2007; Fox & Calkins, 2003). It is believed that both the maturation of children's physiological capacity to emotionally regulate and parents emotion socialization practices are important to the development of ER. Understanding the links between physiological regulation and emotion socialization may therefore be crucial to our understanding of aggression as well as further advances in prevention and treatment efforts.

Childhood Aggression

Aggression is a human behaviour that is often harmful, destructive and very costly to society and its members. Childhood aggression is of particular concern to many; in the past 40 years, rates of this behaviour have been steadily rising in several countries (Dodge, Coie & Lynam, 2007). Children who are aggressive are likely to become chronically aggressive and develop a variety of psychosocial problems throughout childhood, into adolescence and then adulthood (Tremblay et al., 2004). Such problems

include substance abuse, school failure, unemployment, violent crimes and medical conditions resulting from hazardous life styles (Tremblay et al., 2004; Tremblay, 2002).

The spontaneous onset of aggression in school-aged children has been shown to be highly unlikely and the precursors to aggressive behaviour are present long before school entry (Tremblay et al., 2004). By 17 months of age, the majority of children are physically aggressive towards their siblings, peers and adults (Tremblay et al., 2004). When physical aggression peaks between the ages of 2 to 3 years, few if any sex differences are observed in the rate and form of this behaviour among youngsters (Dodge et al., 2007). It is thereafter that sex differences in aggressive behaviour become pronounced. Physical aggression is more common and stable in boys, whereas forms of social and relational aggression are more typical of girls (Dodge et al., 2007). Other changes in the structure and utility of aggressive acts occur as well. For example, many different types of aggression, including indirect, direct, as well as more covert forms such as lying or cheating, begin to emerge. Aggressive acts then become more hostile and person directed in contrast to the more non-social forms of aggression that existed earlier on (Dodge et al., 2007). It seems that, for some, aggression may begin to serve as a coping response for dealing with the anger and frustration one feels when goals are blocked or when one is faced with challenging life situations. Indeed, when one is faced with such challenges, anger (affective arousal) promotes the physiological and the behavioural response patterns that support "assertive efforts to ensure one's goals are attained" (Hastings, Zahn-Waxler, & Usher, 2007, p.77). With growth, most children begin to adopt more appropriate means of expressing their desires, i.e. with the use of language. However, aggressive behaviour does not decrease for a minority of children,

and it is they who are at risk for developing a host of problems, in addition to harming others and themselves (Tremblay et al., 2004).

Many different factors have been proposed to account for this decline in aggressive behaviour during the early childhood years. The development of effortful control, delay of gratification, and an increase in contact and feedback from peers have all been suggested as helping to decrease levels of aggression (Dodge et al., 2007). However, researchers have begun to highlight the important role that emotion regulation (ER) plays in the more reactive forms of this destructive behaviour (Dodge et al., 2007). Developments in ER skills are thought to be largely responsible for this drop in aggression and deficits in ER may account for the persistence of this destructive behaviour (Keenan, 2000; Keenan & Shaw, 2003). Moreover, research in the field of developmental psychopathology supports the link between behavioural and emotional problems and the regulation of negative emotions (Cicchetti, Ackerman & Izard, 1995; Eisenberg et al., 2001; Eisenberg et al., 1997; Frick & Morris, 2004; Silk, Steinber & Morris, 2003).

The Development of Emotion Regulation

Since the late 20th century ER has emerged as a topic of great interest in the psychological literature. Many definitions of this construct have since been proposed, yet most individuals in the field agree upon one put forth by Thompson in 1994 (Gross & Thompson, 2007; Calkins & Hill, 2007; Thompson & Meyer, 2007). ER is said to consist of the extrinsic (i.e. behaviour of others) and intrinsic (i.e. neurophysiology, cognitive evaluations and subjective experiences) processes that are responsible for monitoring, evaluating and modifying both positive and negative emotional reactions (Thompson,

1994; Thompson & Meyer, 2007; Calkins & Hill, 2007; Zeman, Cassano, Perry-Parrish, & Stegall, 2006). These processes may be conscious or unconscious, automatic or effortful and act to diminish, heighten or maintain one's emotional arousal so that successful interpersonal interactions are possible (Calkins & Hill, 2007; Thompson & Meyer, 2007; Calkins, 1994). ER is, therefore, an active process working to change the dynamics of an emotion and not the emotion itself (Thompson & Meyer, 2007).

There are various stages in the normative development of ER. In infancy, our first responses to external stimuli are believed to be characterized by our physiological or temperamental reactivity (Fox & Calkins, 2003). Newborns will differ in their threshold level to respond as well as the intensity with which they respond to stimuli designed to elicit negative affect (Calkins, Fox & Marshall, 1996). Infants are born with a minimal capacity to regulate these responses; however, some reflexive behaviours, such as head turning or sucking, are often used by newborns to alter their distress (Kopp, 1989). With development, the infant's visual and motor systems improve and they slowly gain control over their arms and hand movements and begin to be able to voluntarily turn their heads. Infants are then able to turn away from distressing stimuli and to distract themselves by turning away and focusing on an interesting object or toy (Kopp, 1989). While these unplanned and unmonitored strategies are quite useful for regulating low levels of arousal, they prove less efficacious when the infant is faced with a high state of emotional arousal (Kopp, 1989). In times such as these, infants require the external assistance of a caregiver to sooth their distress and regulate their intense emotions.

During infancy, parents provide comfort and regulate distress that may be caused by hunger, fatigue, or discomfort etc. (Thompson & Meyer, 2007). Caregivers attempt to

sooth their infants' distress by attending to basic needs, such as feeding or changing a dirty diaper. With age, neurophysiological advances in the infant provide the basis for more complex regulatory processes to emerge. These changes allow infants' arousal responses to become more graded (e.g. different levels/stages in the progression of arousal) as well as more emotionally complex. Decreases in emotional lability also begin to occur, which aid caregivers' efforts in the management of emotional arousal (Thompson, 1994). Shortly thereafter, parents switch from using tactual and kinaesthetic soothing methods, to using more vocal techniques to help regulate their child's emotions (Kopp, 1989).

As children move into toddlerhood and become better able to communicate verbally, caregivers begin to teach their children how to manage distress and impulses, and delay gratification through interactions and communication (Calkins, 1994). The ability to use language allows children the opportunity to regulate by talking through emotionally challenging situations or expressing distress to their caregiver (Zeman et al., 2006). Increases in memory, attention, and cognitive ability also allow more complex forms of ER to emerge in the second and third years of life. Toddlers begin to understand that not only can they feel distress, but that they can feel better or worse depending on what they do for themselves (Kopp, 1989). They also become aware of the causes of emotional distress and how they can use ER strategies to change or remove causes of this distress to protect themselves. For example, the use of transitional objects emerges in toddlerhood. Children seek out and repeatedly use a select object for comfort in times of distress. Children begin to understand that the object can be used to handle their distress and they

do this in a purposeful manner. Children also begin to explicitly seek out and solicit their caregiver's help when they find themselves in frustrating situations (Kopp, 1989).

As children move into the preschool and early elementary years they are able to choose from an increasing number of behavioural strategies to manage their emotions with respect to the demands of social situations (Zeman et al., 2006). They begin to have a deeper understanding of display rules, which are culturally defined rules that guide emotional behaviour so that it is consistent with the demands of the social context (Zeman et al., 2006). This form of ER sometimes requires the intentional separation of one's emotional experience from how that experience is expressed, e.g. altering one's facial expression to only look mildly angry when furious or putting on a happy face when one is sad (Zeman et al., 2006). Preschool children begin to understand this emotional split and begin to use it much more as they move into middle childhood (Zeman et al., 2006).

Parents continue to support children's emotional development into the middle childhood years. However, with time they tend to adopt different strategies for helping their sons and daughters emotionally regulate. In these years, boys and girls begin to adopt and become proficient in different ER strategies (Zeman et al., 2006). Boys seem to be better at neutralizing their emotional reactions, while girls tend to substitute one emotional display for another (Zeman et al., 2006). Children also begin to understand that others may have different emotional reactions than they do to a given situation, and that others can also choose to modify their expression of emotion (Zeman et al., 2006).

Understanding the development of ER over the course of childhood requires a proper examination of the intrinsic and extrinsic factors that contribute to ER (Calkins & Hill,

2007; Fox & Calkins, 2003). Intrinsic factors are considered to be those that are innate to the child. These include the child's temperament or disposition, cognitive skills, as well as the underlying physiological and neural systems that support and are engaged in the regulation of arousal (Calkins & Hill, 2007; Fox & Calkins, 2003). Extrinsic factors are external to the child and include the ways in which parents, siblings, peers and other caregivers socialize emotional responses (Calkins & Hill, 2007; Fox & Calkins, 2003). It has been suggested that the maturation of intrinsic processes lays the foundation for the increasingly complex regulatory skills seen in childhood (Calkins, Graziano & Keane, 2007). However, it is important to recognize that biological processes are also subject to the influence of extrinsic factors (Rutter, Moffitt, & Caspi, 2006; Caspi et al., 2003; Calkins & Fox, 2002). Thus, the development of ER is a relational process and the regulatory strategies one acquires result from interactions between all of the above factors (Thompson & Meyer, 2007; Thompson, 1994).

Physiological Regulation

As mentioned, many endogenous processes are considered important to the development of ER in children. Porges' Polyvagal theory (Porges, 1995, 2001, 2007) describes the maturation of the parasympathetic system as being important in the regulation of emotion. This theory provides a framework for conceptualizing the physiological basis of ER through the dynamic physiological control of cardiac activity, which facilitates attentional and emotional processes, as well as social interaction (Porges, 2001). It suggests that individual differences in the functioning of the vagal system may account for differences in the expression and regulation of emotion, which

are thought to be critical components to adaptive social interaction and adjustment (Porges, Doussard-Roosevelt, & Maita, 1994; Porges, 2007).

The Polyvagal theory delineates three phylogenetic stages in the development of the autonomic nervous system (Porges, 2007). Each of these phylogenetically ordered stages is associated with a different subsystem of the autonomic nervous system and adaptive behaviours (Porges, 2007). The oldest system, the immobilization system, is a function of the unmyelinated vagus originating from the dorsal motor nucleus (Porges et al., 1994). This vegetative vagus innervates portions of the stomach and heart, and is primarily involved with digestion and respiration (Porges et al., 1994). In conditions of danger, the vegetative vagus acts to suppress metabolic demands and is responsible for immobilization behaviours such as death feigning (Beauchaine, Gatzke-Kopp, & Mead, 2007). The second system, the mobilization system, depends upon the functioning of the sympathetic nervous system and engages fight or flight behaviours when the organism is threatened (Porges, 2007). The final and newest system supports social communicative behaviours and is dependent upon the functioning of the myelinated vagus nerve originating in the brainstem's nucleus ambiguus. The nucleus ambiguous vagus or the smart vagus connects to areas in the body such as the larynx, pharynx, bronchi, esophagus and sinoarterial node, the heart's pacemaker (Porges et al., 1994). It is the activity from the smart vagus, also known as cardiac vagal tone, that is said to be important to regulatory processes by mediating cardiac activity in response to environmental demands (Beauchaine, 2001). The smart vagus supports calm behavioural states by inhibiting the sympathetic nervous system's influence on the heart (Porges, 2007). These three systems are seen as "dynamic, providing adaptive responses to safe,

dangerous, or life-threatening events and contexts" (Porges, 2007, p. 120). To do this, they are organized in a phylogenetically determined hierarchy, such that the newest system responds to environmental challenge first. Only when this fails do the more primitive systems engage (Porges, 2007).

Appropriate vagal response to environmental challenge will largely depend on two factors: the demands of a given context and whether or not it is *perceived* as safe. When the environment is perceived as safe, the smart vagus acts as a "brake" to inhibit sympathetic arousal of the heart, allowing for a calm and homeostatic state benefiting social interaction (Porges, 2007). Slightly lessening the "brake" – called vagal withdrawal - allows the body to meet the metabolic demands necessary for engaging coping skills needed to deal with demanding, yet non-threatening stimuli (Calkins et al., 2007). In affect arousing (e.g. anger) or threatening conditions, greater vagal withdrawal would allow for sympathetically mediated acceleration of the heart, which supports fight/flight behaviours and lets the body to respond to the perceived demands of the situation (Beauchaine, 2001). In essence, the vagal brake is removed or reduced so the body can meet the metabolic demands of mobilization, and maintained or increased to support social interaction (Porges, 2007). Therefore vagal activity "is related to behavioural and psychological processes along a continuum, from prosocial-affiliative interactions to fight/flight behaviours" (Porges, 2007, p.122). However, whether or not vagal withdrawal is actually adaptive depends not only on the demands of a given context, but whether it truly contains a threat (Porges, 2007). Given the function of the smart vagus, deficiencies in its functioning are thought to be linked to psychopathology (Beauchaine et al., 2007).

Cardiac vagal tone is most commonly indexed by respiratory sinus arrhythmia (RSA) (Porges et al., 1994). RSA is a measure of the parasympathetic influence on heart rate variability attributable to the vagus nerve; higher RSA levels indicate greater parasympathetic activity (Porges, 2007). In infancy, RSA is thought to reflect a child's capacity to successfully engage with the environment, such that infants with high baseline levels of RSA are more responsive to environmental stimuli than are low baseline RSA infants (Beauchaine, 2001). Some studies have also linked high baseline RSA in infancy to good developmental outcomes later on in life (Doussard-Roosevelt et al., 1997; Richards & Cameron, 1989). Baseline levels of RSA increase over the toddler and preschool years, however individual differences in RSA during this time remain relatively similar (Blandon, Calkins, Keane & O'Brian, 2008; Fox & Field, 1989; Porges, Doussard-Roosevelt, Portales & Suess, 1994). From toddlerhood and into adolescence RSA seems to continue to mark the ability to appropriately engage with the environment as well as the ability to emotionally regulate (Beauchaine, 2001). While findings on sex differences in RSA are mixed and deserve further attention, girls, who are often seen as being more emotionally and socially competent than boys, have been found to have higher resting levels of RSA (Fabes, Eisenberg, Karbon, Troyer & Switzer, 1994; Suess, Porges & Plude, 1994).

Both resting-state or baseline RSA and dynamic changes in RSA in response to stimuli are related to the experience of emotion. Researchers have typically used baseline RSA to assess individual differences in typical levels of arousal and reactivity as well as the ability to maintain homeostasis (Beauchaine, 2001; Porges, 1995). Low baseline RSA has been linked to a variety of adjustment problems, including anger and aggression (e.g.

Calkins & Dedmon, 2000; Beauchaine et al., 2007). Dynamic changes in RSA in response to environmental demands are used to assess individual differences in ER (Beauchaine, 2001). Evidence seems to indicate that moderate decreases in RSA (vagal withdrawal, or suppression) are favourable when engaging with stressful environmental situations; however, excessive decreases in RSA are associated with emotional lability or emotional states, such as anger (Beauchaine, 2001). For example, Beauchaine and colleagues (2007) found that adolescents and school-age children with Disruptive Behaviour Disorders displayed significantly lower baseline RSA than controls and also showed decreasing levels of RSA withdrawal during an activity designed to induce arousal.

While many works support such relations between baseline and dynamic changes in RSA and maladaptive behaviour, there are also many others that have failed to reproduce them (e.g. Burgess, Marshall, Rubin & Fox, 2003; Gerlach, Wilhelm & Roth, 2003). Such conflicting results might suggest that results with RSA are not necessarily reliable (Hastings & De, 2008). However, a variety of alternate hypotheses have been proposed based on these mixed findings. Some suggest that there is a critical time or sensitive period in the years preceding middle childhood where relations between RSA and aggressive behaviour begin to emerge (Beauchaine et al., 2007). Others have proposed that perhaps low baseline RSA marks a trait-like vulnerable physiology towards developing problems depending on environmental experience (Beauchaine, 2001). With regards to dynamic changes in vagal tone, it has been hypothesized that there is an optimal range of vagal withdrawal and that vagal withdrawal may be more costly for those with baseline deficiencies (Porges, 2007; Beauchaine, 2001; Beauchaine et al.,

2007). It is also likely that environmental influences impact the development of dynamic vagal regulation (Hastings & De, 2008). Thus, it may be that environmental influences on the development of ER may be especially important in early childhood for youngsters with a vulnerable physiology.

The Importance of Emotion Socialization

Although underlying physiological factors play a critical role in the emergence of ER skills, these physiological factors are influenced by and interact with extrinsic factors as well (Calkins, 1994). A child's emotional development and ER skills are shaped by their experiences with parents, other caregivers and peers (Thompson & Meyer, 2007; Calkins & Hill, 2007; Denham, Bassett & Wyatt, 2007). Furthermore, many works emphasize the special importance of maternal influences in the socialization of emotion as these parent-child interactions begin shortly after birth and are the most prominent throughout early development (Thompson & Meyer, 2007). Emotion socialization occurs in everyday interactions and involves helping the child to experience all possible emotions, to understand their own emotions and those of others, and to regulate their emotions (Hastings & De, 2008). Such processes may be unconscious or conscious to the parent and may help or hinder emotional development in the child.

Several factors are thought to influence the way parents socialize emotion. Some studies have indicated that the way parents socialize emotion might be different for boys and girls (Brody & Hall, 1993). It is well known that society has assigned rules for how each gender is expected to experience emotion. For example, anger is an emotion that is typically seen as a masculine emotion and not one that is always acceptable in girls. Girls are said to experience a wider variety of emotions and more intensely than boys do, with

the exception of certain emotions such as anger and pride (Brody & Hall, 1993). These differences and rules might influence how parents socialize emotions in boys versus girls. Indeed, parents tend to discuss emotions more often with daughters than with sons and are likely to discourage the expression of anger and aggression in their daughters (Zahn-Waxler, 2000). A child's age is another factor that seems to change the way parents socialize emotions. As children age, parents tend to discourage emotional outbursts and are more likely to ignore such emotional displays (Dix, 1991; O'Neal & Magai, 2005). Recent findings have also suggested that the benefits of certain emotion socialization strategies differ with children's age. Hastings and De (2008) found that older children were less socially competent when their mothers ignored their negative emotions; however, this relationship was not significant for younger children. Together, these findings suggest that gender and age are both important to our understanding of emotion socialization.

It is also likely that the ways in which parents socialize children's emotions is highly influenced by their beliefs about their own and their child's emotions (Eisenberg, Spinrad & Cumberland, 1998). Parents are thought to hold beliefs about what emotions "should be felt and expressed, how they should be felt and experienced and what should be done in emotional situations" (Gottman, Kats & Hooven, 1997; Denham et al., 2007, p. 618). Such beliefs are projected to children by how parents deal with their own emotions and how they respond to children's emotions (Denham et al., 2007).

Hence, emotion socialization can occur though many avenues. For example, emotion socialization can occur via modeling, which includes the child's observations of particular emotions or the emotional context a child is exposed to (Denham et al., 2007).

Emotions can also be socialized through more direct means, by parents teaching about the emotional world or by their "contingent reactions" to children's emotional displays (Denham et al., 2007, p. 618). Both indirect and direct methods of emotion socialization provide children with information about the nature of emotions such as happiness, sadness or anger. They also teach children about how emotions should be expressed and when (Denham et al., 2007). Children are likely to eventually encode and integrate these ideas about which emotions can be felt, how they should be felt and what should be done in emotional experiences (Denham et al., 2007). Together, these ideas form an emotional repertoire, complete with prescribed patterns of responding, that children can use in response to the emotional challenges they will inevitably encounter in the larger social world.

Parents, can therefore, be seen as coaches of their children's emotions (Saarni, 1999). Supportive or 'emotion-coaching' parents send the message to their children that their emotions are worthy of discussion and exploration. Emotion-coaches tend to validate children's emotions and help their child label their emotions (Gottman, Kats, & Hooven, 1996). More supportive or positive profiles of parental emotion socialization such as this have been associated with favourable adjustment and emotional outcomes in children. It has been found that mothers' openness and encouragement of emotional expression is related to children's social functioning (Eisenberg, Fabes & Murphy, 1996). In addition, Gottman et al. (1996) found that parental encouragement of emotional conversation was related to better ER skills in children, which is believed to impact behavioural functioning. However, supportive reactions to negative emotions are those that are thought to be especially important to the development of ER. Emotion-coaching parents

are more likely to have such reactions as they not only acknowledge such emotions, but they also problem solve with their child by discussing goals and strategies for dealing with situations that lead to the experience of negative emotions (Gottman et al., 1997). Parents who openly acknowledge and discuss negative emotions such as anger may be teaching children how to express and modulate their emotional arousal (Eisenberg et al., 1996). It is argued that children who learn how to express this kind of emotion in a regulated manner are more likely to behave in socially acceptable ways (Eisenberg et al., 1996). Conversely, negative parent reactions, such as those that would heighten or extend emotional arousal, to children's display of negative emotions would be expected to undermine the learning of ER skills (Hoffman, 1983).

Parents who hold an 'emotion-dismissing' philosophy tend to see negative emotions as undesirable and that their experience should be avoided. They also tend to view anger and sadness as being potentially harmful to children (Gottman at al., 1996). As such, emotion-dismissing parents often adopt unsupportive/ negative emotion socialization strategies, for example by ignoring or denying negative emotions (Gottman at al., 1996). These parents do not view negative emotions as beneficial or as opportunities for teaching and thus, tend not to problem solve with children about how to deal with negative emotions (Gottman at al., 1996). Such negative parent emotion socialization processes have, in fact, been related both to children's problems with aggression and ER. For example, Eisenberg and her colleagues (1999) conducted a longitudinal study to examine relations between parental reactions to children's negative emotions and children's appropriate/problem behaviour. The authors found that parents' punitive and distress reactions to children's negative emotions at 6-8 years of age predicted problem

behaviours at 10-12 years of age. Results from another study conducted by Eisenberg and her associates (2001), showed that negative maternal emotion socialization was negatively related to reports of grade-school children's ER. Furthermore, results indicated that relations between mothers' negative emotion socialization and children's problem behaviour was mediated through children's ER (Eisenberg et al., 2001). Such results outline the possible damaging effects of more negative emotion socialization strategies on children's emotional and behavioural development.

A Biopsychosocial Model of Emotion Regulation and Adjustment

Considering the factors involved in the development of ER presented above, it is reasonable to postulate that parental responses to children's emotions might have differential impacts on children's behavioural adjustment depending on children's physiological capacity for ER. Individual differences in biological or neurological mechanisms might predispose children to display varying degrees of emotional reactivity and regulatory ability (Calkins, 1994). Behavioural and emotional displays of a child's dispositional capacity for ER would emerge early and a parent would respond to these displays with caregiving and emotion-training behaviours, which might be influenced by such factors as the child's age, gender and temperament, as well as the parent's beliefs about emotion and its expression (Calkins, 1994; Calkins & Hill, 2007). Some parents may not appropriately adapt their responses to their child's emotional displays while others might react with more suitable and supportive responses (Calkins, 1994). These patterns of responding are likely to either support or undermine the development of the physiological substrates of ER and emotional in general (Zeman et al., 2006; Calkins, 1994). Thus, identifying how important childhood emotion socialization experiences

interact with the physiological substrates of ER may prove to be a crucial step in understanding how parents facilitate the development of ER and may have direct implications for diminishing children's aggressive behaviour over time.

There is a small literature that speaks directly to how variations in regulatory physiology, emotion socialization, and aggression are related. Gottman and colleagues (1996) published a study with results central to understanding these links. They sought to understand how parents' beliefs about emotion and physiological measures of ER might be related to a variety of child outcomes (e.g. academic achievement, peer relations, child health). Fifty-six families participated in laboratory and home visits when children were 4- to 5-years old and again three years later. Teacher ratings of child outcomes were also collected at the second assessment period.

Gottman and colleagues (1996) found evidence to suggest parent's beliefs about emotion were indeed related to both negative and supportive emotion socialization behaviours and to children's basal regulatory physiology. In addition, children's vagal withdrawal during an affect-eliciting video clip (a scene from the *Wizard of Oz*, where Dorothy is kidnapped by flying monsters) at age 5 predicted parent reports of children's ER at age 8. The more RSA withdrawal children showed at age 5 the less parents reported having to regulate children's negative affect and inappropriate behaviour at age 8. The reported ER ratings were also related to child outcomes, e.g. peer relations. Lastly, children who received supportive emotion socialization at age 5 were described as socially competent by their teachers at age 8. Based on the pathway from parental beliefs about emotion to children's basal physiology, the authors suggested that caregivers' coaching of children's emotions might have a soothing effect on children and possibly

change key aspects in their physiological regulation. In essence, children's ability to regulate was thought to be the result of both the child's physiology and external environment.

More recently, Hastings and De (2008) explored parental socialization of negative emotions and basal parasympathetic cardiac functioning in terms of preschool children's social competence and behaviour problems. They found that parents' emotion socialization strategies were more strongly associated with the behaviour of preschool children who had low baseline RSA than for those with high baseline RSA. In addition, none of the results between emotion socialization and social competence were strong for children with high baseline RSA. These results suggest that those with low baseline RSA might be more sensitive to the effects of emotion socialization than those with high baseline RSA.

Taken together, these studies provide preliminary support for a biopsychosocial model of emotion regulation and adjustment. Poor emotional reactivity, indexed by low baseline RSA, and negative emotion socialization are associated with externalizing problems. Additionally, dynamic vagal regulation seems to be affected by emotion socialization and is important to childhood adjustment. Of note, most of the existing studies in this line of research focus on more general outcomes such as externalizing behaviours at large or academic achievement. There are currently no studies examining how baseline and dynamic physiological regulation and emotion socialization are specifically related to aggression.

Goals of the Current Study

The current work aims to address this gap by examining the links between maternal emotion socialization practices, children's physiological emotion regulation, and children's aggressive behaviour. Sixty-one children aged 4 to 7 years were included in the current cross-sectional study. Children's regulatory physiology was assessed while children engaged in relaxing activities, an anger induction task and a delay of gratification task. Measures of maternal emotion socialization were gathered with questionnaires and observations of mother-child interactions during a clean-up task. Children's and mothers' reports of aggression were gathered with a newly designed Me Not Me task and the Child Behavior Checklist, respectively. Four main hypotheses were tested. Firstly, it was expected that children with poorer physiological regulation would be more aggressive. Secondly, it was expected that children who experience more negative maternal responses to their emotions, or poorer emotion socialization, would be more aggressive. Thirdly, vagal regulation was expected to moderate links between emotion socialization and aggression; stronger links between emotion socialization and aggression were expected for children with poorer vagal regulation. Fourthly, vagal regulation was examined as a possible mediator of association between emotion socialization and aggression problems. These hypotheses were examined with observed and mother reported measures of emotion socialization, and measures of baseline and dynamic vagal stimulation in response to emotionally and behaviourally demanding contexts. Findings were expected to be stronger for vagal suppression than baseline vagal tone. There were no specific hypotheses for observed or questionnaire based measures as being the superior index of emotion socialization. There were also no specific hypotheses for mother or child reports as being the superior index of aggression. Finally, age and sex

were examined as potential moderators of the links between vagal regulation, emotion socialization and aggression.

Methods

Participants

Recruitment Strategy. Participants included in this study were drawn from a larger sample of 180 families participating in an ongoing longitudinal study. Children and their mothers were initially recruited through letters sent out to daycare centers and elementary schools, advertisements placed in magazines, and posters placed in community centers and libraries in the Greater Montreal area. An abridged version of the Child Behavior Checklist (CBCL; Achenbach, 1999; see Appendix A), was used to over-select for children with high and low levels of aggression. Inclusion criteria included having a child four or six years of age who was enrolled in kindergarten or grade one, being a legal parent or guardian and having full or shared custody of the child, the mother being willing to participate, and being able to speak English or French. Exclusionary criteria included the child having serious physical (e.g. in a wheel chair, Cerebral Palsy, etc.), cognitive (e.g. mental retardation, language impairment, fetal alcohol syndrome, etc.) or psychiatric (i.e. autism-spectrum, pervasive development disorders, etc.) conditions.

Current Sample. While all children were four or six years of age when recruited, some had turned five or seven by the time they came to the lab. A total of 61 children (33 male, 28 females) between the ages of 4.14 to 7.17 years ($M = 5.77$, $SD = 1.10$) were included in the current sample. Only children for whom sufficient physiological data was available were included in the present study. Thirty-three children spoke English as their

first language, seven children spoke French as their first language, and four children spoke a language other than English or French as their first. Information on the first language of the remaining children was not available. The majority of children had no medical or psychological problems; however, four children had respiratory problems. Mother's age ranged from 22.42 to 46.42 years (M = 38.07, SD= 4.34). Thirty-eight mothers spoke English as their first language, eight spoke French as their first language, and 15 spoke another language as their first language but were fluent in either English or French. Ten mothers had a graduate degree, 20 had an undergraduate degree, 12 had some university education, seven completed a C.E.G.E.P. degree (a two-year pre-university program in Québec), and 12 completed high school. There were 48 Caucasian, two Hispanic, two African American, three Asian, and two Middle Eastern/ North African mothers. The remaining two mothers were of mixed ethnic background or chose not to report it. The families were primarily middle to upper-middle socioeconomic class. Annual household income before taxes ranged from under $10,000 to over $200,000 Canadian (*Mode* = $80,000 – $90,000).

Measures

Socio-demographics. The Preliminary Information Form (see Appendix A) was used during the initial telephone screening to gather demographic information about children and their families. This questionnaire asked mothers to provide a variety of information on their family composition (e.g. marital status, how many children live in the home, ethnic status). In addition, mothers were asked to report on their level of education, occupation and annual income.

Emotion Socialization Measures. Mothers' emotion socialization techniques were assessed through questionnaire and observation. Mothers completed The Parenting Practices Questionnaire (PPQ; Robinson, Mandleco, Olsen, & Hart, 1995), an instrument designed to assess authoritarian, authoritative and permissive parenting practices. A subset of questions on the PPQ was used to assess mothers' positive and negative responses to children's emotions. There were six items on the PPQ that addressed positive emotion socialization practices (e.g. I show sympathy when my child is hurt or frustrated, I give comfort and understanding when my child is upset). Nine items from the PPQ were used to create the negative emotion socialization scale (e.g. I explode in anger towards my child, I scold and criticize to make my child improve). Both scales had acceptable reliability with an alpha of 0.62 and 0.82 for the positive and negative emotion socialization scales respectively. A copy of the PPQ can be found in Appendix A.

Observations of mothers' emotions during parent-child clean up sessions were also used to assess mothers' emotion socialization techniques. The "Mothers' Behaviour during Clean-up" coding scheme was developed for the purpose of coding the five minute long mother-child clean-up task in the current study (see Appendix B). Time-sampling was used to rate five aspects of mothers' behaviours (supportive/structure, controlling, permissive, negative, and warm behaviours) every 60-seconds on 5-point Likert-style scales (ranging from 1: absent, to 5: strong/frequent). Two maternal behaviours were used in this investigation. Negative behaviours were coded when mothers were observed frowning, criticising, threatening, expressing disapproval, using an aggravated tone, and/ or physical force with their child. Warm behaviours included

mothers smiling, encouraging, using warmth, showing affection, and/ or praising their child.

Two individuals coded the videos. Each person coded half of the videos on their own and both coded approximately 20% of the videos to evaluate inter-rater reliability. Reliabilities were $\alpha = 0.93$ for Negative, and $\alpha = 0.97$ for Warmth. The ratings of Warmth and Negativity were used, respectively, as indices of mothers' expression of positive and negative affect during the clean up task.

Child Outcome Measures. Mothers and the children each reported on levels of aggression. Depending on their child's age, mothers completed either the CBCL for 1 ½ - 5 years, or the CBCL for 6 - 18 years (Achenbach & Rescorla, 2000; Achenbach, 1999). The CBCL has been widely used by researchers studying childhood adjustment and has sufficient reliability and validity. Children's aggression was measured using the raw scores for the Aggressive Behavior subscale.

Children provided self-reports of aggression using a newly developed interview procedure called the Me Not Me Game (MnM; as described below; see Appendix C). There were seven items in this activity that reported specifically on aggressive behaviour. The seven aggression items on this measure had acceptable reliability (Cronbach's alpha = 0.65) and modest convergent validity with the aggression subscale of the CBCL, $r = 0.22, p < 0.10$.

Equipment. The Mini-Logger 2000 (Mini Mitter, Inc.), a lightweight ambulatory monitor, was used to collect children's cardiac activity. This data was later examined using Mxedit software (Delta Biometrics, Inc).

Procedures

Overview. This study was part of a larger project run by Dr. Paul Hastings. Only procedures and measures related to the current study are described here. Assessments were conducted in the laboratory when children were between 4 and 7 years old, while their mothers accompanied them. Many of the laboratory tasks were done while the child wore the physiological equipment (Mini-Logger 2000 ^{tm}), including the Mood Induction Stimulus and Delay of Gratification tasks. Assessment sessions were filmed and typically lasted between 150 and 180 min. Questionnaire packets were also mailed to mothers before the laboratory visit, for them to complete at home and bring to the assessment session.

Questionnaire Packet. Mothers were mailed a packet of questionnaires to complete before coming to the lab visit with their child. Among other questionnaires, mothers completed the full CBCL (Achenbach, 1999) and the PPQ (Robinson et al., 1995).

Laboratory Assessment. Families that met the selection criteria were contacted to schedule an assessment. Two research assistants (RA), one male and one female, greeted each mother-child pair and escorted them to a large playroom that held a variety of age-appropriate toys (e.g. toy car, crayons and paper). The male RA explained the procedure of the visit to mothers and obtained their consent, while the female RA began to interact with the children. The female RA then briefly explained the planned activities to the children (e.g. "You are going to watch some videos, play some games and do some puzzles") and obtained their assent.

Mothers and their children began the visit with a free-play period and then completed a puzzle task. Children and their mothers were then asked to participate in a clean-up task

by the male RA. Mothers were instructed to have their child put all the toys in the room into a large box that the male RA had brought in.

Following the clean-up task, children were shown the Mini-Logger 2000 ^{tm} and verbal assent to put it on was obtained. Mothers sat quietly behind their children while baseline data were recorded. Children listened to peaceful music, watched a gentle video and sat quietly with their eyes closed for this baseline period. These tasks were used to obtain baseline data for the Delay of Gratification task (see below). The Mood Induction Stimulus for Children (MISC; Cole, Jordan & Zahn-Waxler, 1990) was then shown to the children while their mothers were in another room. Additional baseline data were recorded during the video introduction to the MISC (described below); these baseline data were used for the Anger Induction task.

The MISC (Cole et al., 1990) was designed to present mood-inducing stimuli to children in a way that controlled for its affective content and the duration of exposure (Cole et al., 1996). The MISC was presented in a video format, using different versions for males and females. The 1 min introduction portion of the MISC told children that they were going to see pictures and hear stories about a child who lived in outer space named "Zudok, who does things and feels things just like you do." This portion of the MISC was engaging but affectively neutral in tone. The video then included 5 emotion inducing segments. Each segment began with a 15s introduction to the story, a 30s description of specific events in the story (including verbal, facial and musical affect cues), and a 15s epoch depicting a resolution to the event. All segments were designed to induce different emotions; however, only data from the segment to induce anger was used in the current study.

A delay of gratification task was then presented. Children were seated at a table and offered a plate of cookies by the female RA. After the plate of cookies was placed on the table, the RA then said she had forgotten something in another room and had to get it before snack time could begin. The children were asked not to eat the cookies until the RA returned and were then left alone for one minute. Mothers were then brought back into the room for break. Mothers and their children then worked separately for the remainder of the visit.

The last task in the laboratory visit was the Me Not Me Game. In the Me Not Me Game, children were presented with several pairs of cards, each pair depicting an emotion, behaviour or thought pattern. One card endorsed the statement (e.g. "I am...", "I like...) and one card rejected the statement (e.g. "I am not...", "I do not like..."). Children were asked to select the one card from each pair that described them. The Mini-Logger 2000 ^{tm} belt was then removed and children were given a small gift in thanks for their participation. Mothers were given remuneration ($75CDN) after having returned their completed questionnaire packet.

Processing Cardiac Data

Each child's baseline and task vagal tone (RSA) were recorded using the Mini-Logger 2000 ^{tm} (Mini-Mitter, Inc). Two sets of baseline data were collected. The first set was collected while each child sat quietly, listened to peaceful music, and watched a gentle video, in order to keep children stationary and raise as little affect as possible. A second set of baseline data was recorded during the introduction segment of the MISC. Task RSA was examined in two challenge tasks: the delay of gratification and the anger induction task. Data on continuous inter-beat intervals (IBI) were attained through a

recording band that was connected to each child's chest using two adhesive electrodes during these tasks. IBIs were recorded between successive R-waves, to the nearest millisecond and then transmitted to the Mini-Logger 2000 ^{tm}, which the child wore in a fanny-pack around his or her waist. The Mini-Logger 2000 ^{tm} could store up to two hours of recorded data, which was then transferred and stored in a computer for later editing of artifacts.

The IBI files were examined using Mxedit software (Delta Biometrics, Inc). Each data file was visually scanned for artifacts and outlier points that result from movement or recording errors. These outlier points were then edited by summing or dividing them so that they would be consistent with the adjacent data. Reliable and usable data from the baseline procedures, the anger induction segment of the MISC (AI) and delay of gratification task (DG) were available for all 61 children included in the current study. These IBI data files were then analysed using Porges (1985) method of calculating RSA. This method uses a 21-point polynomial algorithm that isolates heart rate variability at the amplitude and period of oscillations associated with breathing, in units of ln(msec^2). A band-pass filter was then applied to quantify RSA corresponding to the developmentally-normative spontaneous respiration found in young children, 0.24 to 1.04 Hz. RSA was computed for each sequential 20-second interval in each IBI file. The mean of the values for the first three baseline procedures (music, video and quiet baseline) was used to calculate the first RSA baseline (B1 RSA) in the analyses, mean $r = 0.87$. A second RSA baseline (B2 RSA) was calculated from RSA values during the introduction of the MISC. For the 61 children, B1 RSA M= 6.99 ln(msec^2), SD = 1.05 , and B2 RSA M= 6.98 ln(msec^2), SD = 1.14. Task RSA values for the anger induction and delay of

gratification tasks were also computed, DG RSA M= 6.83 ln(msec^2), SD = 1.25, and AI RSA M= 6.72 ln(msec^2), SD = 1.50.

These RSA values were then used to calculate children's RSA change from B1 to DG and B2 to AI using residualized change scores (e.g. Nazzaro et al., 2005; Hastings et al., 2008). It is appropriate to use residualized change scores when calculating change if there is a "significant and positive relationship between episode measures" (Calkins & Keane, 2004, p.107). B1 RSA and DG RSA were significantly positively correlated, r = 0.75, as were B2 RSA and all segments of AI RSA, mean r = 0.75; therefore, standardized residuals were used as the indices of vagal withdrawal. B1 RSA was used as the baseline for DG RSA because both procedures involved the child sitting without distraction. Changes in RSA from B1 to DG could therefore be inferred to reflect the involvement of parasympathetic regulation for complying with the instruction to not eat the cookies while waiting. B2 RSA was used as the baseline for AI RSA because both components of the MISC involved watching a video stimulus while listening to narration, but B2 was affectively neutral whereas AI portrayed angry affect. Changes in RSA from B2 to AI could therefore be inferred to reflect the involvement of parasympathetic regulation in responses to anger.

Results

Descriptive Statistics

Prior to analysis, baseline measures of RSA, RSA during AI and DG, aggression and maternal ES were examined for missing values and normality. There were two cases with missing values on the questionnaire measure of ES, four cases missing child self-reported aggression, and one case missing the quiet baseline measure of RSA. Group

mean substitution was used to estimate missing values on each measure (Tabachnick & Fidell, 2007). It was necessary to apply a square root transformation to the measure of maternal negativity during clean-up to correct for positive skew. No outliers were detected in the data set. Descriptive statistics for the measures used in the current study can be found in Table 1. Raw CBCL and MnM scores were used in the analyses. Raw CBCL scores were used instead of T-scores to avoid the floor effect of T = 50 for low aggression scores, but raw scores $M = 10.28$ ($SD = 8.65$) is equivalent to T-score $M =$ 58.46 ($SD = 9.56$).

Standardized Residuals for RSA withdrawal

Standardized residuals were used to compute the change scores for RSA withdrawal in the AI and DG tasks, accounting for baseline RSA. In these analyses, either RSA during AI or DG was entered as the dependent variable and baseline measures of RSA were controlled for in step 1. B2 RSA was used to obtain RSA withdrawal during the AI stimulus and B1 RSA was used to obtain measures of RSA withdrawal during the DG activity. B1 RSA accounted for a significant portion of the variance in RSA during the DG task, ß = 0.75, $p < 0.05$. B2 RSA accounted for a significant proportion of the variance in children's levels of RSA during the presentation of the AI stimulus, ß = 0.74, $p < 0.05$.

Preliminary Analyses

Zero order Pearson correlations were used to examine whether measures could be combined to produce overall measures of positive and negative ES, baseline RSA, RSA suppression, and aggression (see Table 2). Measures of maternal ES from observations during clean-up and the PPQ were not significantly correlated. Similarly, measures of

Table 1

Descriptives

	Variables	Minimum	Maximum	Mean	Standard Deviation
Aggression	Mother Reported	0.00	30.00	10.28	8.65
	Child Reported	0.00	6.00	1.75	1.63
Emotion	Reported Positive	2.80	5.00	4.24	0.43
Socialization	Reported Negative	1.22	3.44	1.98	0.50
	Observed Positive	1.00	3.00	1.88	0.59
	Observed Negative	1.00	1.66	1.12	0.19
Physiological	Music Baseline	4.58	9.61	7.04	1.03
Emotion	Video Baseline	4.53	9.47	7.01	1.07
Regulation	Quite Baseline	4.21	9.85	6.95	1.17
	Mean Baseline	4.63	9.59	6.99	1.05
	B1 RSA				
	MISC Intro Baseline	2.33	10.19	6.50	1.61
	B2 RSA				
	RSA during AI	3.26	9.56	6.72	1.50
	RSA during DG	4.35	9.94	6.83	1.25

Table 2

Correlations among measures of RSA, Emotion Socialization, and Aggression

Variables		1	2	3	4	5	6	7	8	9	10
Aggression	1. Mother Reports	--	.22+	-.07	.43***	-.15	.10	-.08	.02	.09	-.25*
	2. Child Reports		--	-.14	.12	-.03	.13	-.07	-.01	.02	-.09
Emotion	3. Reported Positive			--	-.29*	-.12	-.06	.03	-.10	.04	.04
Socialization	4. Reported Negative				--	-.12	.11	.07	.17	.06	-.03
	5. Observed Positive					--	-.35*	-.15	-.10	.19	-.06
	6. Observed Negative						--	.10	.09	.01	-.19
RSA	7. B1 RSA							--	.78***	.01	.00
	8. B2 RSA								--	-.02	.07
	9. AI ΔRSA									--	.02
	10. DG ΔRSA										--

NOTE: + < .10, * < .05, ** < .01, *** < .001.

vagal suppression during the DG task and the AI were not significantly related. The correlation between the measures of aggression on the CBCL and the MnM only approached significance; thus, these measures were not combined.

Zero order correlations and independent samples t-tests were used to assess if there were age or sex differences in any of the measures of RSA, aggression, and maternal ES. Age was negatively correlated with mother reports, $r = -0.37$, $p < 0.05$, and child self-reports, $r = -0.37$, $p < 0.05$, of aggression. Younger children were significantly more aggressive than older children on both measures. Mothers were observed to use significantly more negative ES techniques with boys ($M = 0.26$, $SD = 1.10$) than girls ($M = -0.32$, $SD = 0.78$) during the clean-up task, $t\ (59) = 2.35$, $p < 0.05$. Based on these preliminary analyses, age and sex were controlled in further analyses.

Is aggression more strongly related to dynamic vagal regulation than baseline measures of vagal tone?

Links between baseline RSA and aggression. Partial correlations were used to test links between B1 RSA or B2 RSA and aggression. Children's B1 RSA was not related to either mother, $pr = -0.05$, *ns*, or child, $pr = -0.05$, *ns*, reports of aggression. Again, children's B2 RSA was not related to either mother, $pr = -0.06$, *ns*, or child, $pr = 0.02$, *ns*, reports of aggression.

Links between RSA withdrawal and aggression. Partial correlations were used to test links between RSA withdrawal during the AI stimulus and the DG task with aggression. Children's RSA withdrawal during the AI stimulus was not related to mother reports of aggression, $pr = 0.00$, *ns*, but was weakly associated with children's self-reported aggression, $pr = 0.23$, $p < 0.10$. Children who showed less RSA withdrawal

during the anger induction reported themselves as more aggressive than children with more RSA withdrawal. Children's RSA withdrawal during the DG task was weakly related to mother reported aggression, $pr = -0.22$, $p < 0.10$, but was not related to children's self-reports of aggression, $pr = -0.04$, *ns*. Children who showed more RSA withdrawal during the delay of gratification were described by mothers as more aggressive than children with less withdrawal.

Physiological emotion regulation and ES

Links between baseline RSA and ES. Partial correlations were used to test links between B1 RSA or B2 RSA and maternal ES. B1 RSA was not related to mother reported positive, $pr = 0.3$, *ns,* or negative, $pr = 0.05$, *ns*, ES strategies. Nor was B1 RSA related to observed negative, $pr = 0.07$, *ns*, or positive, $pr = -0.13$, *ns,* ES strategies used during clean-up. Similarly, B2 RSA was not related to mother reported positive, $pr = -.12$, *ns*, or negative, $pr = 0.11$, *ns*, ES strategies. Neither was B2 RSA was related to observed negative, $pr = 0.05$, *ns*, or positive, $pr = -0.11$, *ns* ES strategies used during clean-up.

Links between RSA withdrawal and ES. Partial correlations were used to test links between RSA withdrawal during the presentation of the AI stimulus and DG task, and maternal ES. Mother-reported positive ES strategies were weakly related to children's RSA withdrawal during AI, $pr = 0.23$, $p < 0.10$. Children who showed less RSA withdrawal during the anger induction had mothers who reported using more positive ES strategies. Mother-reported negative ES strategies were not related to children's RSA withdrawal during the AI stimulus, $pr = 0.15$, *ns*. Neither observed positive, $pr = 0.03$, *ns*, or negative, $pr = -0.06$, *ns*, ES strategies were related to children's RSA withdrawal

during the AI stimulus. Neither mother-reported nor observed ES strategies were related to children's RSA withdrawal during the DG task, all $|pr| \leq .16$.

Is poorer maternal ES related to children's aggression?

Partial correlations were used to test whether maternal ES and children's aggressive behaviour were related. Mothers who reported more negative ES strategies also described their children as more aggressive on the CBCL, $pr = 0.50$, $p < 0.05$. There were no other significant associations between the measures of ES and the measures of aggression, all $|pr| \leq .21$.

Testing the contribution of physiological emotion regulation and maternal ES to aggression

Overview. Hierarchical linear regressions were used to look at the effects of physiological emotion regulation, mother's ES, and children's age and sex on aggression. Because of the many variables and limited sample size, interactions with parenting, age, and sex were each run in separate regressions in order to maximize power. For each regression, the control variables of age and sex were entered in Step 1. In Step 2, RSA and mother's ES strategies were entered. The interaction terms of parenting, age, or sex with RSA were entered in Step 3. Standardized variables were used in the analyses. Significant interactions with parenting were examined by regressing the parenting variable onto aggression scores at high and low values of RSA, in order to clarify how children's physiological capacity to regulate emotions moderated the link between maternal ES and aggression. Significant interactions with age were examined in younger (4 yr) and older (6 yr) children separately, in order to clarify how age moderated the link between children's physiological capacity to regulate and/or parenting and aggression.

Significant interactions with sex were examined in boys and girls separately, in order to clarify how sex moderated the link between children's physiological capacity to regulate and/or parenting and aggression.

Baseline RSA, RSA withdrawal to DG, and RSA withdrawal to AI were examined in separate regression analyses. Separate regression analyses were run for mother reported ES and observed ES. The dependent variables of mother-reported aggression and child self-reported aggression, of course, were also predicted in separate regression analyses. Therefore, a total of 36 regression analyses were examined. Only regression analyses that revealed significant or borderline ($.05 < p < .10$) effects of RSA and/or ES are presented in the text. Tables reporting the regression analyses without significant effects of RSA or ES are included in Appendix D.

Does baseline RSA moderate relations between poor maternal ES and aggression?

Two regression analyses were conducted to predict mother-reported and child-reported aggression from children's B1 RSA and mother reports of ES. Many of the existing studies examining baseline RSA collect physiological information while children are engaged in one kind of calming activity (e.g. watching a calming video or reading a story book); however, such measures may not represent a true baseline given that they are collected while children's attention is on a single type of external stimulus (Calkins et al., 2007). Baseline analyses in the current study used B1 RSA, a measure averaged from children's RSA during three different calm activities, in order to include the most general or "truest" available baseline measure possible. In these analyses, children's age and sex were entered at the first step, children's baseline RSA as well as mothers' positive and negative ES strategies were entered in the second step, and interactions between RSA and

reported ES were entered in the third step. Mother-reported aggression was significantly associated with mothers' reports of negative ES strategies (see Table 3). Mothers who reported using more negative ES strategies also described their children as being more aggressive. Conversely, children's self-reports of aggression were not significantly associated with baseline RSA or mother-reported ES (see Appendix D).

The next set of regression analyses looked at children's B1 RSA and observed measures of mothers' ES in predicting mother and child reported aggression. Children's age and sex were entered as covariates in the first step, baseline RSA as well as observed ES strategies were entered in the second step, and the interactions between RSA and ES were entered in the final step. Children's baseline RSA and mother's observed ES strategies did not account for a significant portion of the variance in mother reported aggression, nor did they account for a significant proportion of the variance in children's self-reports of aggression. Results for these analyses can be found in Appendix D.

Do age or sex moderate links between baseline RSA, ES and aggression?

Each of the above regressions were examined twice more, first to examine interactions between child age and RSA and ES, and second to examine interactions between child sex and RSA and ES. In the analysis including mother-reported ES, child age significantly moderated the association between baseline RSA and mother-reported aggression (see Table 4). Younger children who had lower baseline RSA tended to be described as more aggressive by their mothers, ß = -0.32, $p < 0.10$; however, this relationship was not significant for older children, ß = 0.20, *ns* (see Figure 1). In the analysis including observed ES, this age X baseline RSA interaction approached significance (see Table 5), reflecting the same difference between younger and older

Table 3

Predicting Children's Aggression from Baseline RSA and Mother Reported Emotion Socialization

	Mother reports of aggression				Children's self-reports of aggression			
	CBCL				MnM			
Variables	R^2	ΔR^2	β	*p*	R^2	ΔR^2	β	*p*
Step 1	.14	.14		.013	.14	.14		.013
Age			-.37	.004			-.37	.003
Sex			.03	ns			-.04	ns
Step 2	.36	.22		.001	.17	.04		ns
BRSA			-.08	ns			-.05	ns
Pos ES			.07	ns			-.12	ns
Neg ES			.49	.000			.11	ns
Step 3	.36	.00		ns	.18	.01		ns
BRSA X Pos ES			.07	ns			-.05	ns
BRSA X Neg ES			.06	ns			-.09	ns
Model Summary	Adj. $R^2 = .28$				Adj. $R^2 = .07$			
	$F(7, 53) = 4.32, p < .01$				$F(7, 53) = 1.65$, *ns*			

Note. CBCL = Child Behavior Checklist; MnM = Me Not Me; BRSA = Baseline RSA; Pos ES = Positive emotion socialization; Neg ES = Negative emotion socialization.

Table 4

Age as a Moderator in Predicting Children's Aggression from Baseline RSA and Mother Reported Emotion Socialization

	Mother reports of aggression				Children's self-reports of aggression			
	CBCL				MnM			
Variables	R^2	ΔR^2	β	*p*	R^2	ΔR^2	β	*P*
Step 1	.14	.14		.013	.14	.14		.013
Age			-.37	.004			-.37	.003
Sex			.03	ns			-.04	ns
Step 2	.36	.22		.001	.17	.04		ns
BRSA			-.08	ns			-.05	ns
Pos ES			.07	ns			-.12	ns
Neg ES			.50	.000			.11	ns
Step 3	.42	.06		ns	.23	.06		ns
Age X BRSA			.25	.028			.20	ns
Age X Pos ES			-.04	ns			-.18	ns
Age X Neg ES			-.06	ns			-.14	ns
Model Summary	Adj. $R^2 = .33$				Adj. $R^2 = .11$			
	$F(8, 52) = 4.65, p < .01$				$F(8, 52) = 1.96, p < .10$			

Figure 1: Age moderates the association between Baseline RSA and Mother Reported Aggression.

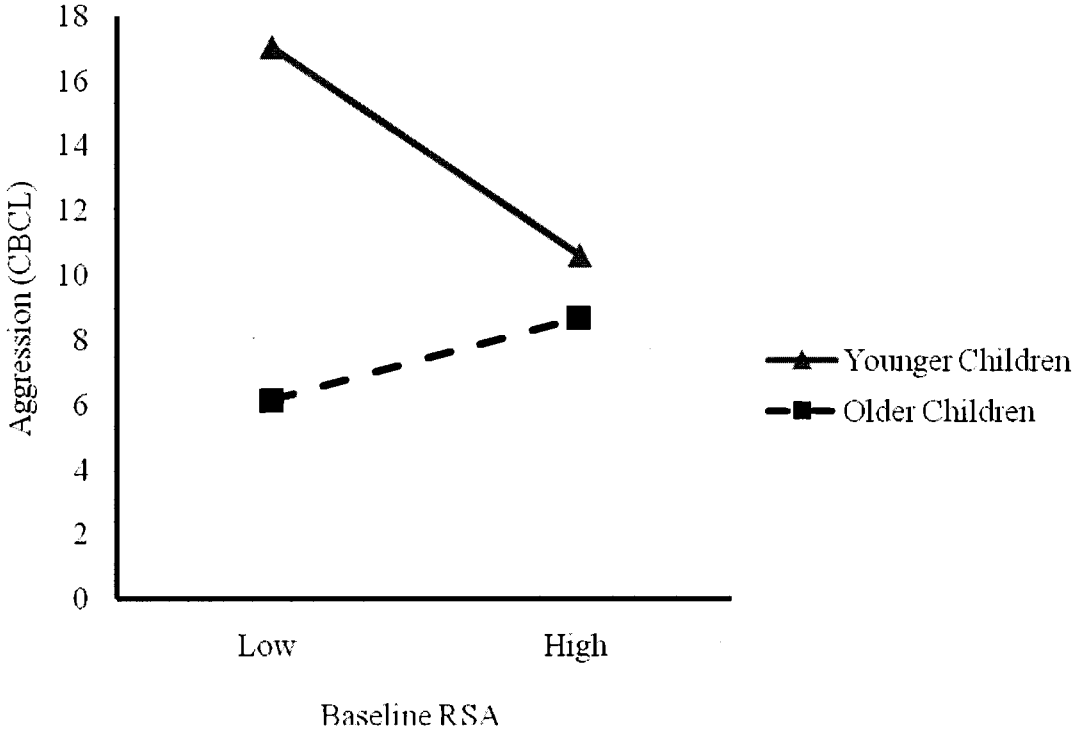


Table 5

Age as a Moderator in Predicting Children's Aggression from Baseline RSA and Observed Maternal Emotion Socialization during Clean-up

	Mother reports of aggression				Children's self-reports of aggression			
	CBCL				MnM			
Variables	R^2	ΔR^2	β	*p*	R^2	ΔR^2	β	*P*
Step 1	.14	.14		.013	.14	.14		.013
Age			-.37	.004			-.37	.003
Sex			.03	ns			-.04	ns
Step 2	.18	.05		ns	.15	.01		ns
BRSA			-.78	ns			-.06	ns
CU Pos ES			-.21	ns			-.05	ns
CU Neg ES			.01	ns			.08	ns
Step 3	.30	.12		.047	.21	.06		ns
Age X BRSA			.21	.09			.20	ns
Age X CU Pos ES			.20	ns			.04	ns
Age X CU Neg ES			-.19	ns			-.18	ns
Model Summary	Adj. $R^2 = .19$				Adj. $R^2 = .09$			
	$F(8, 52) = 2.75, p < .01$				$F(8, 52) = 1.77, ns$			

Note. CBCL = Child Behavior Checklist; MnM = Me Not Me; BRSA = Baseline RSA; CU Pos ES = Observed positive emotion socialization; CU Neg ES = Observed negative emotion socialization.

children. Age did not moderate any of the relations between predictors and child-reported aggression, and sex did not moderate any of the relations between baseline RSA, ES and either measure of aggression (see Appendix D).

Does RSA withdrawal moderate relations between maternal ES and aggression?

RSA withdrawal during AI. Regression analyses were run to predict mother and child reported aggression from children's RSA withdrawal during the AI stimulus and mother reports of ES. In these analyses, children's age and sex were entered at the first step, children's RSA withdrawal during AI as well as mothers' positive and negative ES strategies were entered in the second, and interactions between RSA withdrawal and ES were entered in the third step. RSA withdrawal during AI was not significantly associated with mother-reported aggression, nor did it moderate associations between mother-reported ES and aggression (see Appendix D).

Conversely, children's RSA withdrawal during the AI stimulus was found to account for a significant amount of the variance in self-reports of aggression (see Table 6). Children with less vagal withdrawal, or higher RSA during the AI stimulus relative to baseline, reported themselves as being more aggressive than those children with greater RSA withdrawal to the AI stimulus. RSA withdrawal was also found to moderate the relationship between mother reports of negative ES and aggression (see Figure 2). For children with less vagal withdrawal during the AI stimulus, experiencing more mother-reported negative ES was associated with reporting themselves as being more aggressive, ß = 0.28, $p < 0.10$. The relation between negative ES and aggression was not significant for children who had more vagal withdrawal during the AI stimulus, ß = -0.27, *ns*.

Next, regressions were run to predict mother and child reported aggression from RSA withdrawal during AI and observed measures of mothers ES. Children's age and sex were entered as covariates in the first step, RSA withdrawal during AI and observed ES strategies were entered in the second step, and the interactions between RSA withdrawal and ES were entered in the final step. Neither RSA withdrawal nor observed measures of ES predicted mother reports of aggression. As before, children with low vagal withdrawal during the AI stimulus tended to report themselves as being more aggressive than children with high vagal withdrawal during the presentation of the AI stimulus. Results for this analysis can be found in Table 7.

RSA withdrawal during DG. A regression analysis was run to predict mother and self-reports of aggression from children's RSA withdrawal during DG and mother reports of ES. Children's age and sex were controlled for in Step 1, RSA withdrawal during DG and mother reports of ES were entered in Step 2, and interactions between RSA withdrawal and ES were entered in the final step. The results for these analyses can be found in Table 8. A trend between children's RSA withdrawal during DG and mother reports of aggression was found, ß = -0.20, $p < 0.10$. Children with more RSA withdrawal, or lower vagal tone during the DG task relative to baseline, were reported as being more aggressive by their mothers than children with less RSA withdrawal during this activity. As in previous analyses, reports of mother's negative ES strategies accounted for a significant portion of the variance in children's aggressive behaviour. Children's RSA withdrawal during DG and mother reports of ES did not account for a significant portion of the variance in children's reports of aggression.

Regressions were subsequently conducted to predict mother and child reported

Table 6

Predicting Children's Aggression from RSA withdrawal during AI and Mother Reported Emotion Socialization

	Mother reports of aggression				Children's self-reports of aggression			
	CBCL				MnM			
Variables	R^2	ΔR^2	β	*p*	R^2	ΔR^2	β	*p*
Step 1	.14	.14		.013	.14	.14		.013
Age			-.37	.004			-.37	.003
Sex			.03	ns			-.04	ns
Step 2	.36	.22		.001	.23	.09		.109
RSA AI			-.10	ns			.25	.049
Pos ES			.10	ns			-.19	ns
Neg ES			.51	.000			.04	ns
Step 3	.39	.02		ns	.33	.10		.024
RSA AI X Pos ES			.15	ns			.06	ns
RSA AI X Neg ES			-.07	ns			.33	.007
Model Summary	Adj. $R^2 = 0.30$				Adj. $R^2 = .24$			
	$F(7, 53) = 4.73, p < .01$				$F(7,53) = 3.71, p < .01$			

Figure 2: RSA withdrawal during AI moderates the association between Mother Reported Negative ES and Child Reported Aggression.

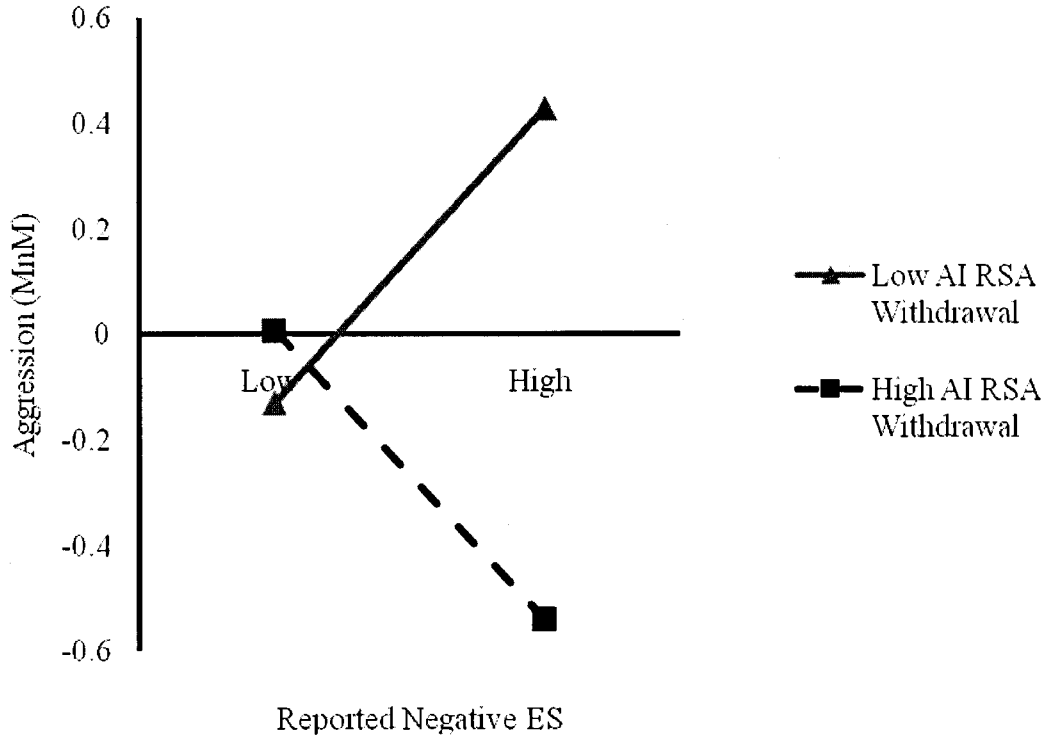


Table 7

Predicting Children's Aggression from RSA withdrawal during AI and Observed Maternal Emotion Socialization during Clean-up

	Mother reports of aggression				Children's self-reports of aggression			
	CBCL				MnM			
Variables	R^2	ΔR^2	β	*p*	R^2	ΔR^2	β	*p*
Step 1	.14	.14		.013	.14	.14		.013
Age			-.37	.004			-.37	.003
Sex			.03	ns			-.04	ns
Step 2	.18	.04		ns	.20	.06		ns
RSA AI			.01	ns			.22	.07
CU Pos ES			-.20	ns			-.04	ns
CU Neg ES			.01	ns			.09	ns
Step 3	.22	.04		ns	.24	.04		ns
RSA AI X CU Pos ES			-.14	ns			-.20	ns
RSA AI X CU Neg ES			.11	ns			-.16	ns
Model Summary	Adj. $R^2 = .11$				Adj. $R^2 = .14$			
	$F(7, 53) = 2.10, p < .10$				$F(7, 53) = 2.35, p < .05$			

Table 8

Predicting Children's Aggression from RSA withdrawal during DG and Mother Reported Emotion Socialization

	Mother reports of aggression				Children's self-reports of aggression			
	CBCL				MnM			
Variables	R^2	ΔR^2	β	*p*	R^2	ΔR^2	β	*p*
Step 1	.14	.14		.013	.14	.14		.013
Age			-.37	.004			-.37	.003
Sex			.03	ns			-.04	ns
Step 2	.39	.25		.000	.17	.03		ns
RSA DG			-.20	.07			-.03	ns
Pos ES			.08	ns			-.12	ns
Neg ES			.48	.000			.11	ns
Step 3	.39	.00		ns	.19	.02		ns
RSA DG X Pos ES			.05	ns			.09	ns
RSA DG X Neg ES			.02	ns			.12	ns
Model Summary	Adj. R^2 = .32				Adj. R^2 = .08			
	F (7, 53) = 4.93, $p < .01$				F (7, 53) = 1.75, *ns*			

aggression from children's RSA withdrawal during DG and observed ES strategies during the clean-up session. Age and sex were controlled for in the first step, RSA withdrawal during DG and observed ES were entered in the second step, and interactions between RSA withdrawal and ES were entered in the last step. In addition to the tendency for children's RSA withdrawal to be inversely related to mother reported aggression, observed positive ES also tended to be inversely related to aggression. Thus, children with mothers who were observed using more positive ES strategies were reported as less aggressive than mothers who used less positive ES strategies. Neither children's RSA withdrawal during the DG task nor observed ES strategies accounted for a significant proportion of the variance in self-reports of aggression. These analyses are presented in Table 9.

Do age or sex moderate links between RSA withdrawal and aggression?

Each of the above regressions were examined twice more, once looking at age interactions and once at sex interactions. Only one moderating effect of age approached significance. Age tended to moderate the relation between RSA withdrawal during the DG task and children's self-reported aggression (see Table 10; see Figure 3). Younger children who showed less RSA withdrawal during the DG task rated themselves as more aggressive, ß =0.38, $p < .10$, than children with more withdrawal. This relationship was not significant for older children, ß = -0.20, *ns*.

There were two significant moderating effects of sex, and a third effect approached significance. In the analysis including RSA withdrawal to DG, sex tended to moderate the relation between mother-reported negative ES and aggression (see Table 11; see Figure 4). The positive relation between mother-reported negative ES and mother-

Table 9

Predicting Children's Aggression from RSA withdrawal during DG and Observed Maternal Emotion Socialization during Clean-up

	Mother reports of aggression				Children's self-reports of aggression			
	CBCL				MnM			
Variables	R^2	ΔR^2	β	*p*	R^2	ΔR^2	β	*p*
Step 1	.14	.14		.013	.14	.14		.013
Age			-.37	.004			-.37	.003
Sex			.03	ns			-.04	ns
Step 2	.23	.09		ns	.15	.01		ns
RSA DG			-.23	.07			-.03	ns
CU Pos ES			-.23	.09			-.04	ns
CU Neg ES			-.04	ns			.07	ns
Step 3	.23	.01		ns	.18	.03		ns
RSA DG X CU Pos ES			.05	ns			.15	ns
RSA DG X CU Neg ES			-.06	ns			.19	ns
Model Summary	Adj. $R^2 = .13$				Adj. $R^2 = .07$			
	$F(7, 53) = 2.28, p < .05$				$F(7, 53) = 1.63, ns$			

Table 10

Age as a Moderator in Predicting Children's Aggression from RSA withdrawal during DG and Observed Maternal Emotion Socialization during Clean-up

	Mother reports of aggression				Children's self-reports of aggression			
	CBCL				MnM			
Variables	R^2	ΔR^2	β	*p*	R^2	ΔR^2	β	*p*
Step 1	.14	.14		.013	.14	.14		.013
Age			-.37	.004			-.37	.003
Sex			.031	ns			-.04	ns
Step 2	.23	.09		ns	.15	.01		ns
RSA DG			-.23	.071			-.03	ns
CU Pos ES			-.23	.086			-.04	ns
CU Neg ES			-.04	ns			.07	ns
Step 3	.27	.05		ns	.22	.07		ns
Age X RSA DG			-.06	ns			-.24	.084
Age X CU Pos ES			.15	ns			.02	ns
Age X CU Neg ES			-.14	ns			-.20	ns
Model Summary	Adj. $R^2 = .16$				Adj. $R^2 = .10$			
	$F(8, 52) = 2.44, p < .05$				$F(8, 52) = 1.80, p < .10$			

Figure 3: Age moderates the association between RSA withdrawal during DG and Child Reported Aggression.

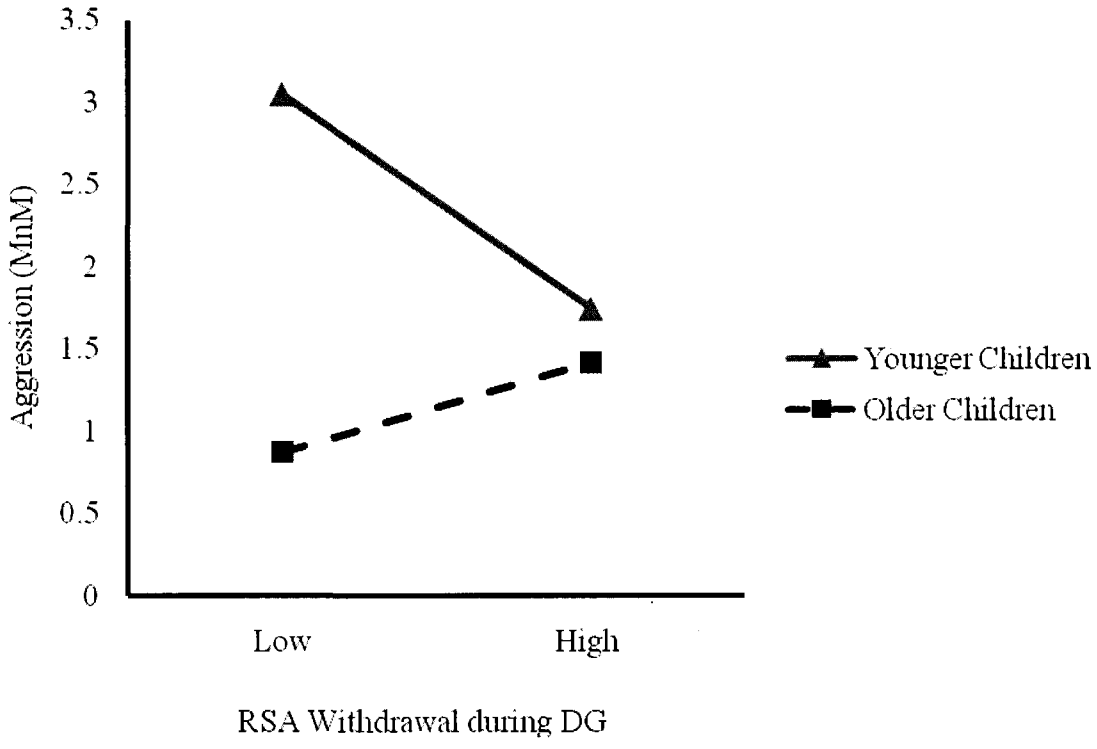
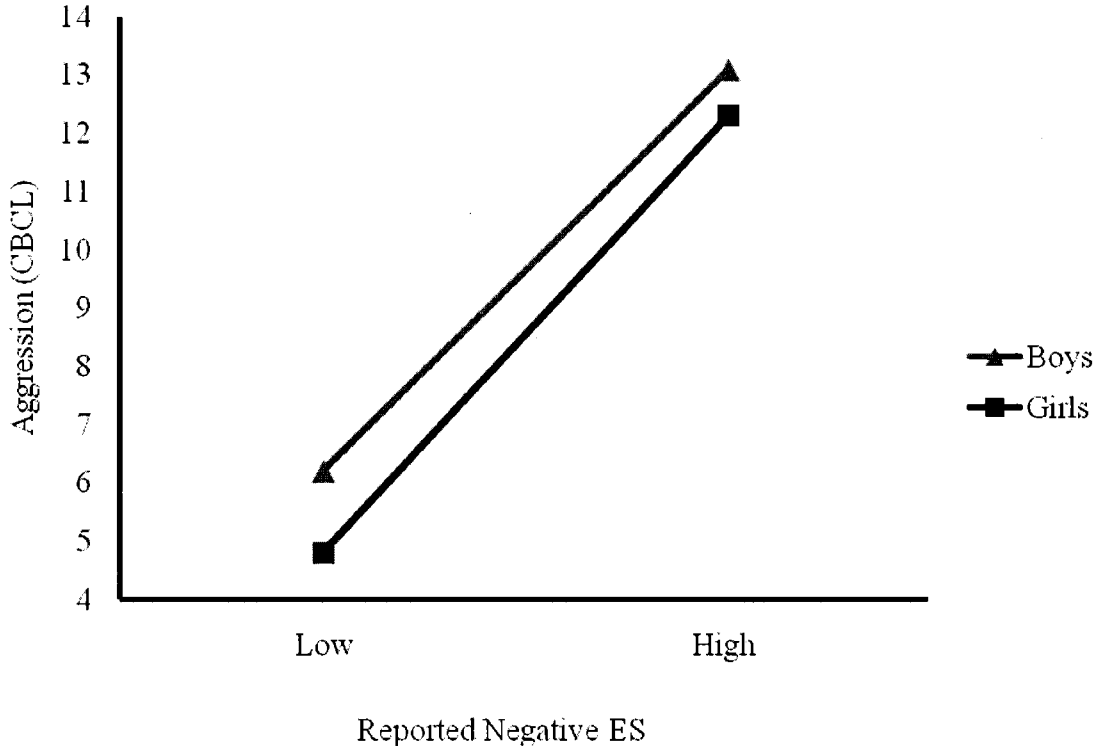


Table 11

Sex as a Moderator in Predicting Children's Aggression from RSA withdrawal during DG and Mother Reported Emotion Socialization

	Mother reports of aggression				Children's self-reports of aggression			
	CBCL				MnM			
Variables	R^2	ΔR^2	β	*p*	R^2	ΔR^2	β	*p*
Step 1	.14	.14		.013	.14	.14		.013
Age			-.37	.004			-.37	.003
Sex			.03	ns			-.04	ns
Step 2	.39	.25		.000	.17	.03		ns
RSA DG			-.20	.068			-.03	ns
Pos ES			.08	ns			-.12	ns
Neg ES			.48	.000			.11	ns
Step 3	.44	.04		ns	.34	.17		.009
Sex X RSA DG			-.14	ns			-.40	.001
Sex X Pos ES			.09	ns			-.06	ns
Sex X Neg ES			.22	.094			-.08	ns
Model Summary	Adj. $R^2 = .35$				Adj. $R^2 = .23$			
	$F(8, 52) = 5.04, p < .01$				$F(8, 52) = 3.29, p < .01$			

Figure 4: The association between mother reported negative emotion socialization and mother reported aggression is stronger for girls than for boys.



reported aggression was stronger for girls, ß = 0.61, $p < 0.05$, than for boys, ß = 0.48, $p < 0.05$. In the analysis including mother-reported ES, sex significantly moderated the relation between RSA withdrawal during AI and child reports of aggression (see Table 12; see Figure 5). Boys with less RSA withdrawal during the AI stimulus reported themselves as being more aggressive than boys with more RSA withdrawal, ß = 0.52, $p < 0.05$. This relationship was not significant for girls, ß = -0.11, *ns*. Similarly, in the analyses for both mother reported and observed ES, sex moderated the relation between RSA withdrawal during the DG task and aggression (see Table 13; see Figure 6). Boys with less RSA withdrawal during the DG task tended to rate themselves as more aggressive than boys with more RSA withdrawal, ß = 0.30, $p < 0.10$. The opposite was true for girls. Girls with more RSA withdrawal during the DG task rated themselves as being more aggressive than girls with less RSA withdrawal, ß = -0.47, $p < 0.05$.

Does dynamic regulation mediate relations between ES and aggression?

Baron and Kenny (1986) have described four steps to test mediation. Within the current study, the first step would require reported and/or observed measures of ES to be correlated with the outcome variable, mother and/or child reported aggression. Step two would require reported and/or observed measures of ES be correlated with the mediator variable, RSA withdrawal during the AI and/or DG tasks. The third step would require the mediator variable, RSA withdrawal during the AI and/or DG, be correlated with the outcome variable, mother and/or child reports of aggression. As described above, these first order correlations between measures of RSA withdrawal, ES and aggression were not established. If Steps 1 through 3 would have been satisfied, Step four of the Baron and Kenny (1986) model of mediation would require that the relationship between ES

Table 12

Sex as a Moderator in Predicting Children's Aggression from RSA withdrawal during AI and Mother Reported Emotion Socialization

	Mother reports of aggression				Children's self-reports of aggression			
	CBCL				MnM			
Variables	R^2	ΔR^2	β	*p*	R^2	ΔR^2	β	*p*
Step 1	.14	.14		.013	.14	.14		.013
Age			-.37	.004			-.37	.003
Sex			.03	ns			-.04	ns
Step 2	.36	.22		.001	.23	.09		ns
RSA AI			-.10	ns			.25	.049
Pos ES			.10	ns			-.19	ns
Neg ES			.51	.000			.04	ns
Step 3	.40	.04		ns	.30	.07		ns
Sex X RSA AI			-.17	ns			-.30	.027
Sex X Pos ES			.01	ns			-.04	ns
Sex X Neg ES			.14	ns			-.10	ns
Model Summary	Adj. $R^2 = .31$				Adj. $R^2 = .19$			
	$F(8, 52) = 4.32, p < .01$				$F(8, 52) = 2.81, p < .05$			

Figure 5: Sex moderates the association between RSA withdrawal during AI and Child Reported Aggression.

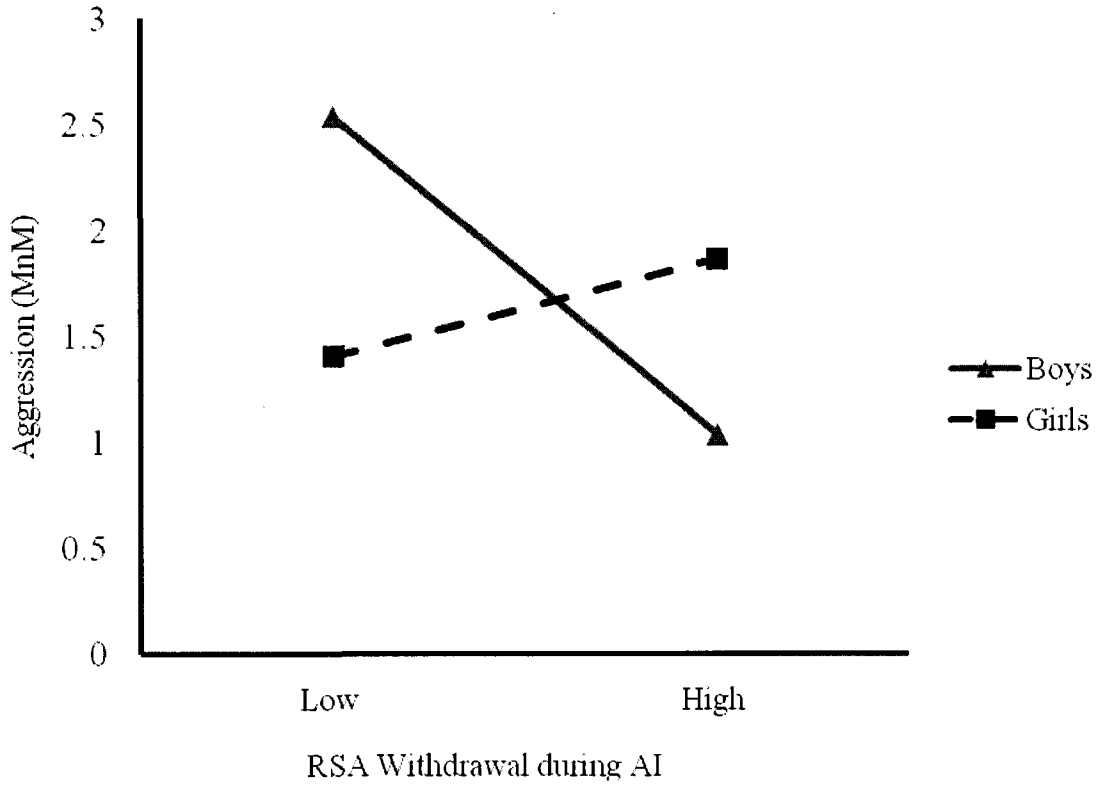
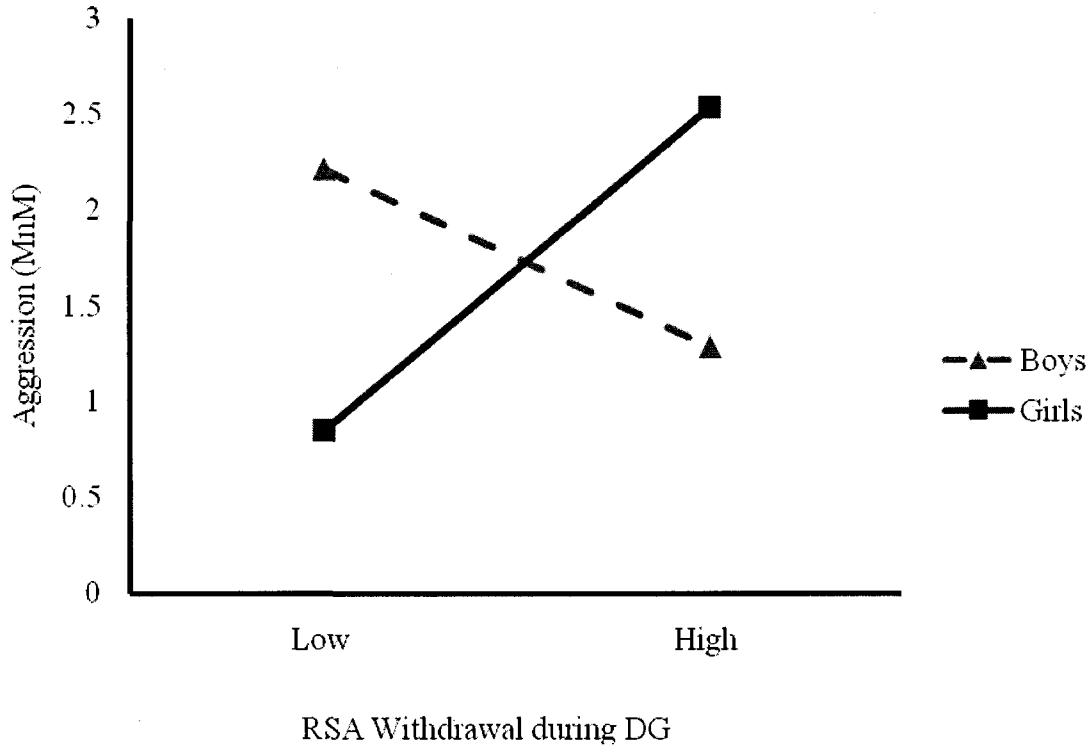


Table 13

Sex as a Moderator in Predicting Children's Aggression from RSA withdrawal during DG and Observed Maternal Emotion Socialization during Clean-up

	Mother reports of aggression				Children's self-reports of aggression			
	CBCL				MnM			
Variables	R^2	ΔR^2	β	*p*	R^2	ΔR^2	β	*p*
Step 1	.14	.14		.013	.14	.14		.013
Age			-.37	.004			-.37	.003
Sex			.03	ns			-.04	ns
Step 2	.23	.09		ns	.15	.01		ns
RSA DG			-.23	.071			-.03	ns
CU Pos ES			-.23	.086			-.04	ns
CU Neg ES			-.04	ns			.07	ns
Step 3	.25	.03		ns	.32	.17		.008
Sex X RSA DG			-.07	ns			-.42	.001
Sex X CU Pos ES			-.17	ns			-.11	ns
Sex X CU Neg ES			-.12	ns			-.06	ns
Model Summary	Adj. $R^2 = .14$				Adj. $R^2 = .22$			
	$F(8, 52) = 2.21, p < .05$				$F(8, 52) = 3.05, p < .01$			

Figure 6: Sex moderates the relationship between RSA withdrawal during DG and Child Reported Aggression.



and aggression be tested while controlling for RSA withdrawal. However, this step was not carried out because the conditions of the first three steps were not met. Thus, based on the current analyses, dynamic vagal regulation did not mediate the relations between maternal ES and aggression.

Discussion

This investigation was conducted to examine children's aggression within a biopsychosocial framework of young children's ER. Researchers have proposed that deficits in ER underlie aggressive behaviour (Keenan, 2000; Keenan & Shaw, 2003). Both the physiological capacity to self-regulate and emotion socialization are important to the development of ER skills (Calkins & Hill, 2007; Fox & Calkins, 2003). However, research has suggested that parental responses to children's emotions might have differential impacts depending on children's physiological capacity for ER (e.g. Hastings & De, 2008). Since prior research had not directly examined links between maternal emotion socialization practices, children's basal and dynamic physiological capacity, and children's aggressive behaviour, the current study examined several hypotheses to test such links. The results underscore the importance of multimethod assessment in the study of psychological phenomena.

One of the primary goals of this investigation was to explore possible mechanisms through which children manifest inappropriate behavioural adjustment. Much research has tied basal and dynamic physiological regulation to ER and adjustment (e.g. Gottman et al., 1996; Calkins et al., 2007). One of the main hypotheses in the current study was that children with poorer physiological regulation would be more aggressive. In the past, both low baseline RSA and inappropriate RSA change in response to stimuli have been

linked to many different adjustment problems, including aggression (e.g. Calkins & Dedmon, 2000; Beauchaine et al., 2007). Although no direct relations between children's baseline RSA and mother or self-reported aggression were found in this investigation, RSA withdrawal was associated with aggression. Children who described themselves as more aggressive tended to show less RSA withdrawal during the anger induction task. In contrast, children who showed more RSA withdrawal during the delay of gratification task were rated as more aggressive by their mothers. These findings might appear to be contradictory, which would be reflective of the inconsistent results in previous research around RSA (e.g. Beauchaine et al., 2007; Calkins et al., 2007; Burgess et al., 2003; Gerlach et al., 2003), but they might be better understood by taking the context of vagal regulation into consideration (Porges, 2007; Hastings et al., 2008).

Different levels of RSA withdrawal have been found to be adaptive depending on the nature of the environmental challenges within which they occur. While strong vagal withdrawal can be maladaptive in situations where fight/flight behaviours are inappropriate, modest RSA withdrawal is considered normal and adaptive in situations that are non-threatening but require focused attention (Lovallo, 2005; Suess, Porges, & Plude, 1994), as it supports the metabolic needs required to appropriately engage with situational demands (Calkins & Keane, 2004). Hence, it is conceivable that different physiological responses would be adaptive in the two tasks used in the current study, an attentional task meant to induce anger, and a behavioural task necessitating self-control of desire. Appropriate regulation in the anger induction task would require a shift from homeostatic functions to *modest* mobilization of physiological resources, manifested as RSA withdrawal, if the normatively expected response of orientation and mild anger was

elicited. Whereas, the delay of gratification task is much more behaviourally challenging, and proper regulation in this context would require less RSA withdrawal, or even RSA augmentation, so that fight/ flight responses would not be engaged. Moreover, excessive vagal withdrawal in response to a *safe* challenge has been suggested to reflect emotional lability, an aspect of aggression (Calkins et al., 2007). Thus, overall, too little RSA withdrawal in the anger induction task and too much RSA withdrawal in the delay of gratification context would undermine appropriate behaviour. The current findings provide support for the idea that adaptive RSA withdrawal should be seen along a continuum and that there may be an optimal range of withdrawal depending on environmental demands (Beauchaine, 2001). In addition, results suggest there may also be some contexts that do not call for any withdrawal (Porges, 2007).

Prior research has also identified maternal emotion socialization as an important contributor to ER and children's adjustment (e.g. Gottman et al., 1996; Hastings & De, 2008). In this study, both mother reported and observed indices of emotion socialization were related to aggressive behaviour. Mothers who described themselves as being punitive to children's emotions also rated their children as high on aggression. This supports the many theories of emotion socialization that identify unsupportive parenting as potentially detrimental to development. Alternatively, mothers who were observed being more accepting and supportive of children's emotions tended to rate their children as less aggressive. While this result was only a trend, it may suggest that supportive and positive maternal emotion socialization strategies are indeed important to adjustment. There is considerable research that suggests coercive emotional exchanges between parent and child in early life can support emotional lability (e.g. Campbell, Pierce,

Moore, Marakovitz, & Newby, 1996; Cole & Zhan-Waxler, 1992; Patterson, Capaldi, & Bank, 1991). For example, in such exchanges, parents and children match each other's arousal level thereby escalating the intensity of the exchange and the opportunity for learning a successful coping response is lost. This high emotional escalation often functions to terminate interactions (e.g. parent buys that attractive toy to appease the angry/frustrated child) and consequently children may learn they can use heightened arousal as a coping mechanism to deal with anger and frustration. Instead, mothers who acknowledge and accept their children's emotions without heightening the emotional experience may be in a better position to teach their children how to appropriately express and modulate their experience (Eisenberg et al., 1996). Children who learn how to regulate and express intense emotions such as anger and frustration are more likely to be able to behave in socially acceptable ways (Eisenberg et al., 1996).

Given that both parenting and physiology have been linked to ER and aggression, the main goal of the current study was to investigate whether vagal regulation would moderate links between emotion socialization and aggression. One finding offered support for this hypothesis. Children with low RSA withdrawal during the anger induction task tended to rate themselves as being more aggressive when they had mothers who reported using more negative emotion socialization techniques, whereas this was not the case for children with high RSA withdrawal. Thus, it was those children who were less able to physiologically regulate themselves who endorsed more aggressive behaviours when they had mothers who were unsupportive of their emotions. This suggests that it would be especially important for children with this vulnerable regulatory physiology to have ample opportunity for supportive emotion socialization of their

emotions, which may have a soothing effect by teaching them how to appropriately cope with strong affect (Gottman, et al., 1996).

Another goal of the study was to examine age and sex as possible moderators of the links between physiological ER, emotion socialization and ER. Only younger children were reported to be more aggressive by mothers when they had lower levels of baseline RSA. Perhaps proper basal RSA regulation is more critical for younger children and poorer physiological regulation puts younger children at a disadvantage and more at risk for using aggressive behaviour as a means to cope with environmental challenge. A second, and somewhat inconsistent, moderating effect of age found that younger children rated themselves as more aggressive when they showed less RSA withdrawal during the delay of gratification task. This relationship was not significant for older children. This finding contrasts results from a recent study by Beauchaine and colleagues (2007) where links between RSA withdrawal and aggression were found for older children, but not for preschool aged children. It has been suggested that the maturation of intrinsic processes lays the foundation for the increasingly complex regulatory skills seen in later childhood and that the preschool years may be a time where systems important to regulation remain malleable (Calkins et al., 2007; Beauchiane et al., 2007). Thus, perhaps the preschool years represent a sensitive period where developing links between physiological regulation and aggression are not yet solidified (Beauchiane et al., 2007). It may be that the previously suggested beneficial role of minimal RSA withdrawal, or RSA augmentation, during the delay of gratification task might pertain particularly to older children.

There were clear sex differences in the way parenting and physiology predicted aggression. Again, support for the idea that unsupportive and punitive emotion socialization may be harmful to adjustment was found in that girls were reported to be more aggressive when they had mothers who described themselves using more negative emotion socialization strategies. This same relationship was also true for boys, however it was slightly weaker. It has been suggested that girls experience a wider variety of emotions and more intensely than boys do, with the exception of certain emotions such as anger and pride (Brody & Hall, 1993). Thus, perhaps negative emotion socialization experiences are slightly more detrimental to girls because emotions might play a larger role in their everyday lives and consequently, their development.

In terms of regulatory physiology, boys with less RSA withdrawal during the anger induction and delay of gratification task reported themselves as being more aggressive than boys with more RSA withdrawal during this task. The opposite was true for girls. Girls with more RSA withdrawal during the delay of gratification task rated themselves as being more aggressive than girls with less RSA withdrawal during this task. As before, it seems that there is an optimal range of RSA withdrawal, some is necessary to engage with challenge, but too much may interfere with adaptive responding when no real threat is present. It is curious that boys' and girls' responses on the delay of gratification task were differentially related to levels of aggression. It might be that different levels of RSA withdrawal have similar impacts on boys and girls. For example, less withdrawal for boys in behaviourally challenging situations may be equally maladaptive as high RSA withdrawal is for girls. Of course, a better understanding of normative and adaptive

decreases, maintenance, or increases in RSA in response to different challenges might help clarify these associations.

A final goal was to explore whether RSA withdrawal would mediate relations between emotion socialization and aggression. No support for this link emerged in the current study. Thus, it seems that vagal withdrawal does not explain links between parenting and aggression. Rather, in line with a biopsychosocial framework, parenting and physiology likely work together to affect developmental outcomes.

Limitations

There are several limitations of the current study that must be considered. First, it must be acknowledged that these analyses were conducted with a relatively small sample size and an advantaged sample. This sample included predominately middle class, Caucasian Canadian families and thus the results cannot be generalized to different populations. Given the small sample size, power issues very likely limited the ability to detect significant associations. It should also be noted that the number of significant findings in the current investigation was not greater than could be expected by chance, and the current findings should therefore be interpreted with caution. Nevertheless, the results found are, overall, in line with the proposed model of ER and aggression.

The multimethod style of measurement of emotion socialization and aggression was a definite strength, as most studies in this area use a single measure for each construct. It should be noted, however, that the parenting measures adopted may not have been the most ideal for targeting reported and observed emotion socialization strategies, which may partially explain their low correspondence. While both capture aspects of emotion socialization, there are instruments and tasks that are better designed to capture this

behaviour. For example, having mothers complete the responses to children's emotions questionnaire (RCE; Hastings & De, 2008) or observed while interacting with their children during a task designed to promote emotion socialization might have been more efficient ways of capturing the construct of emotion socialization.

Lastly, this study is limited in that it is only a correlation study conducted over a brief time period with a single period of assessment, which make it impossible to infer whether the above relations between ER and aggression truly reflect parental and/or physiological influences. Longitudinal studies would be a better fit to inform research on how physiological regulation and emotion socialization affect the development of ER and aggression over time. In addition, research has shown that certain internalizing disorders, such as depression, have been found to correlate highly with aggression (Angold, Costello, & Erkanli, 1999); however, this study did not control for internalizing disorders in its analyses. Future studies would do well to control for internalizing disorders so that they may examine specific links between ER and aggression.

Despite these limitations, the current study has provided evidence to support the importance of vagal regulation and emotion socialization in the study of aggression. Furthermore, both the limitations and significant findings of this work inform future studies in this area.

Future Directions

In order to understand vagal regulation appropriately, it seems necessary to study it within ecologically valid contexts with and without ambiguous threat (Hastings et al., 2008). The current study measured RSA during a single laboratory session. Thus, given the importance of context, there is question to whether such a brief and controlled session

would provide an adequate picture of children's vagal regulation and the quality of emotion socialization they largely receive (Calkins and Keane, 2004). Future studies should measures RSA and observe parents interacting with their children during emotional moments. This would help identify exactly what kinds of parenting emotion socialization strategies (responding vs. distraction) are important to ER and the nature of children's physiological changes during these moments. Attention should also be made to other socializing agents important in the child's life, such as fathers or siblings.

Most research on children's emotional development has been done looking at maternal parenting. However, there is a small amount of research on the role fathers play in children's emotional development and emotion socialization. Most of this work suggests that fathers may contribute less than mothers do to emotional development and their inputs are less associated with children's outcomes (Hastings & De, 2008). Work by Hastings and De (2008) has indeed found that mothers and fathers tend to socialize emotions differently in their children. Mothers were found to be more supporting whereas fathers were likely to ignore their children's emotions and punish the display of negative emotions. However, they found an equal number of associations between maternal and paternal emotion socialization and children's outcomes, although they differed on which strategies had the most influence on outcomes in children with a vulnerable regulatory physiology (low baseline RSA). Fathers' ignoring of children's emotions was most often associated with children's problems, whereas mothers' neglecting of children's emotions was most often related to problems. This not only suggests that both mothers and fathers have unique and important role in the development of emotion, but that these contributions may differ depending on children's basal physiological regulation. Thus, in

future, it will be important to extend the current work to look at links between paternal emotion socialization, dynamic RSA and problem behaviour.

While there are few doubts on the importance of parents in children's emotional development, it is important to remember that children's characteristics may also influence parenting. It is possible that parents select different emotion coaching strategies depending on the behavioural manifestations of children's physiology (Gottman et al., 1996). Additionally, it is quite likely that both influences are present and bidirectional. Longitudinal studies would be an important step in sorting out such effects.

Finally, our understanding of ER and aggression is hampered by our lack of knowledge on the normative development of baseline RSA and RSA withdrawal. For example, this information would be crucial for understanding how much physiological withdrawal is actually adaptive within a given context (e.g. cognitive or emotional challenge) and whether there are normative age and sex differences in such responses. This is an undertaking that must be considered in future work with RSA.

Summary

Despite the limitations of the current work and the need for future research, this study has added to our understanding of the contributions physiological regulation and emotion socialization make to childhood aggression. This work emphasizes the importance of examining physiological regulation within and across contexts. It supports previous work (e.g. Calkins et al., 2007) suggesting that adaptive physiological regulation is supported by RSA withdrawal in non-threatening situations. Children were more aggressive when they displayed low RSA withdrawal, poor physiological regulation, in affectively and behaviourally challenging situations. There was some indication that this

was especially true for children who also experience unsupportive emotion socialization from their mothers, which suggests that extrinsic influences may have more of an impact when internal regulatory resources are weaker. Supportive and responsive responses to children's emotions may therefore be crucial to those who have less vagal regulatory abilities. These results add insight to our understanding of aggression and the different regulatory needs of children. Furthering such work will be important to the development of parenting programs that target the prevention and treatment of aggression.

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Appendix A

Questionnaires

Interviewer: _____ Date: _____
Time: _____ SID: _____

CBCL-X-4: SCREENING 4-yr-olds

Starting Date: ___/___/___

	Not True	Somewhat or sometimes true	Very true or often true
5. Can't concentrate, can't pay attention for long	0	1	2
6. Can't sit still, restless, or hyperactive	0	1	2
8. Can't stand waiting; wants everything now	0	1	2
A. Smiles and laughs often	0	1	2
15. Defiant	0	1	2
16. Demands must be met immediately	0	1	2
18. Destroys things belonging to his/her family or other children	0	1	2
B. Plays active games (running, skipping)	0	1	2
20. Disobedient	0	1	2
27. Doesn't seem to feel guilty after misbehaving	0	1	2
29. Easily frustrated	0	1	2
C. Helps you with chores or tasks	0	1	2
35. Gets in many fights	0	1	2
40. Hits others	0	1	2
42. Hurts animals or people without meaning to	0	1	2
D. Plays quiet games (dolls, board games)	0	1	2
44. Angry moods	0	1	2
53. Physically attacks people	0	1	2
56. Poorly coordinated or clumsy	0	1	2
E. Gets along well with other children	0	1	2
58. Punishment doesn't change his/her behavior	0	1	2
59. Quickly shifts from one activity to another	0	1	2
66. Screams a lot	0	1	2
F. Interested in reading/looking at books	0	1	2
69. Selfish	0	1	2
81. Stubborn, sullen, or irritable	0	1	2
85. Temper tantrums or hot temper	0	1	2
G. Gets excited about going places with you	0	1	2
88. Uncooperative	0	1	2
95. Wanders away	0	1	2
96. Wants a lot of attention	0	1	2
H. Wants to play with other children	0	1	2

Screening Atten. Total Score: _____ T-score: _____
Screening Aggrn. Total Score: _____ T-score: _____
Screening Extlz. Total Score: _____ T-score: _____
Eligible: Y N Group: Low High Pilot

Interviewer: _____ Date: _____
Time: _____ SID: _____

CBCL-X-6: SCREENING 6-yr-olds

Starting Date: ___/___/___

	Not True	Somewhat or sometimes true	Very true or often true
3. Argues a lot	0	1	2
16. Cruelty, bullying, or meanness to others	0	1	2
19. Demands a lot of attention	0	1	2
A. Smiles and laughs often	0	1	2
20. Destroys his/her own things	0	1	2
21. Destroys things belonging to his/her family or others	0	1	2
22. Disobedient at home	0	1	2
B. Plays active games (running, skipping)	0	1	2
23. Disobedient at school	0	1	2
26. Doesn't seem to feel guilty after misbehaving	0	1	2
28. Breaks rules at home, school, or elsewhere	0	1	2
C. Helps you with chores or tasks	0	1	2
37. Gets in many fights	0	1	2
43. Lying or cheating	0	1	2
57. Physically attacks people	0	1	2
D. Plays quiet games (dolls, board games)	0	1	2
63. Prefers being with older kids	0	1	2
67. Runs away from home	0	1	2
68. Screams a lot	0	1	2
E. Gets along well with other children	0	1	2
72. Sets fires	0	1	2
73. Sexual problems*(describe): _____ _____	0	1	2
81. Steals at home	0	1	2
F. Interested in reading/looking at books	0	1	2
82. Steals outside the home	0	1	2
86. Stubborn, sullen, or irritable	0	1	2
87. Sudden changes in mood or feelings	0	1	2
G. Gets excited about going places with you	0	1	2

* *if parent asks for explanation of 73:*

This could be a variety of things, like inappropriate touching, pointing to or talking about other people's private parts, that sort of thing.

SID: _____

CBCL-X-4: SCREENING 6-yr-olds (continued)

Starting Date: ___/___/___

88. Sulks a lot	0	1	2
89. Suspicious	0	1	2
90. Swearing or obscene language	0	1	2
H. Wants to play with other children	0	1	2
94. Teases a lot	0	1	2
95. Temper tantrums or hot temper	0	1	2
97. Threatens people	0	1	2
I. Smiles a lot at people he/she likes	0	1	2
101. Truancy, skips school	0	1	2
104. Unusually loud	0	1	2
106. Vandalism	0	1	2

Screening RuleB. Total Score: _____ **T-score:** _____
Screening Aggrn. Total Score: _____ **T-score:** _____
Screening Extlz. Total Score: _____ **T-score:** _____

Eligible: Y N Group: Low High Pilot

Promoting Positive Development: Phone Notes

PRELIMINARY INFORMATION

DATE: _____ INTERVIEWER: _____

PARENT'S NAME: _____ MOTHER/FATHER

SECOND PARENT'S NAME: _____ MOTHER/FATHER

HOME PHONE #: _(_____)_____

WORK PHONE #: _(_____)_____

HOW DID YOU HEAR ABOUT THE STUDY? _____

QUESTION 1: **How many children?** _____

QUESTION 2: **How old?** **(1)** _____ **(2)** _____ **(3)** _____
If 4 or more children, use NOTES below to record info for others.

QUESTION 3: **Son/Daughter?** **(1)** _____ **(2)** _____ **(3)** _____

Child(ren's) last name:
QUESTION 4: **Name/Names?** **(1)** _____ **(2)** _____ **(3)** _____
_____

QUESTION 5: **Birth date(s)?** **(1)** ____/____/____ (DD MM YY) **(2)** ____/____/____ (DD MM YY)
(3) ____/____/____ (DD MM YY)

QUESTION 6: (if < 5y) **Preschool?** **(1) Y N** **(2) Y N** **(1) Y N**

(if > 5y) **Grade?** **(1)** _____ **(2)** _____ **(3)** _____

QUESTION 7:**Child 1: 1st, 2nd,and 3rd language?** **(1)** _____ **(2)** _____
(3) _____

Child 2: 1st, 2nd,and 3rd language? **(1)** _____ **(2)** _____
(3) _____

Child 3: 1st, 2nd,and 3rd language? **(1)** _____ **(2)** _____
(3) _____

QUESTION 8: **Past studies? Y N**
if Y: _____

QUESTION 9: (woman) **Mother?** **(1) Y N** **(2) Y N** **(3) Y N**

(man) **With mother?** **(1) Y N** **(2) Y N** **(3) Y N**

(see p. 4, if questions)

NOTES:

_____

_____

_____

_____

IS THIS FAMILY ELIGIBLE? Y N

PARENTING QUESTIONNAIRE

This questionnaire includes 81 statements about child-rearing practices. Some of these will describe behaviours you use in parenting your child, and others will describe things that you do not do with your child. Please read each statement and think about how often you engage in the described behaviours with your child. Write in the corresponding number, from 1: "Never" to 5: "Always." Please use the scale provided (1, 2, 3, 4, 5), and provide only one rating for each item.

I exhibit this behaviour:
1= Never
2= Once in a while
3= About half of the time
4= Very often
5= Always

_____ 1. I encourage my child to talk about his/her troubles.

_____ 2. I guide my child by punishment more than by reason.

_____ 3. I know the names of my child's friends.

_____ 4. I find it difficult to discipline my child.

_____ 5. I give praise when my child is good.

_____ 6. I spank when my child is disobedient.

_____ 7. I joke and play with my child.

_____ 8. I withhold scolding and/or criticism even when my child acts contrary to my wishes.

_____ 9. I show sympathy when my child is hurt or frustrated.

_____ 10. I punish by taking privileges away from my child with little if any explanation.

_____ 11. I spoil my child.

_____ 12. I give comfort and understanding when my child is upset.

_____ 13. I yell or shout when my child misbehaves.

_____ 14. I am easy going and relaxed with my child.

_____ 15. I allow my child to annoy someone else.

_____ 16. I tell my child my expectations regarding a behavior before he/she engages in the activity.

_____ 17. I scold and criticize to make my child improve.

_____ 18. I show patience with my child.

_____ 19. I grab my child when he or she is being disobedient.

_____ 20. I state punishments to my child but do not actually do them.

_____ 21. I am responsive to my child's feelings or needs.

_____ 22. I allow my child to give input into family rules.

_____ 23. I argue with my child.

_____ 24. I appear confident about my parenting abilities.

_____ 25. I give my child reasons why rules should be obeyed.

_____ 26. I appear to be more concerned with my own feelings than with my child's feelings.

_____ 27. I tell my child that I appreciate what he/she tries or accomplishes.

_____ 28. I punish by putting my child off somewhere alone with little if any explanation.

_____ 29. I help my child to understand the impact of behavior by encouraging him/her to talk about the consequences of his/her own actions.

_____ 30. I am afraid that disciplining my child for misbehavior will cause my child not to like me.

_____ 31. I take my child's desires into account before asking him/her to do something.

_____ 32. I explode in anger towards my child.

_____ 33. I am aware of problems or concerns about my child in school.

_____ 34. I threaten my child with punishment more often than actually giving it.

_____ 35. I express affection by hugging, kissing, and holding my child.

_____ 36. I ignore my child's misbehavior.

_____ 37. I use physical punishment as a way of disciplining my child.

_____ 38. I carry out discipline after my child misbehaves.

_____ 39. I apologize to my child when I make a mistake in parenting.

_____ 40. I tell my child what to do.

_____ 41. I give in to my child when he or she causes a commotion about something.

_____ 42. I talk it over and reason with my child when he or she misbehaves.

_____ 43. I slap my child when he or she misbehaves.

_____ 44. I disagree with my child.

_____ 45. I allow my child to interrupt others.

_____ 46. I have warm and intimate times together with my child.

_____ 47. When two children, one of whom was mine, are fighting, I discipline my child first and ask questions later.

_____ 48. I encourage my child to freely express him/herself even when disagreeing with me.

_____ 49. I bribe my child with rewards to bring about compliance.

_____ 50. I scold or criticize when my child's behavior didn't meet my expectations.

_____ 51. I show respect for my child's opinions by encouraging him or her to express them.

_____ 52. I set strict, well-established rules for my child.

_____ 53. I explain to my child how I feel about his/her good and bad behavior.

_____ 54. I use threats as punishment with little or no justification.

_____ 55. I take into account my child's preferences when making plans for the family.

_____ 56. When my child asks why he or she had to conform, I state: "Because I said so" or "I am your parent and I want you to".

_____ 57. I appear unsure about how to solve my child's misbehavior.

_____ 58. I explain the consequences of my child's behavior.

_____ 59. I demand that my child do things.

_____ 60. I channel my child's misbehavior into a more acceptable activity.

_____ 61. I shove my child when he or she was disobedient.

_____ 62. I emphasize the reasons for rules.

_____ 63. I often feel angry with my child.

_____ 64. I feel my child is a bit of a disappointment to me.

_____ 65. When I am angry with my child, I let him/her know it.

_____ 66. There is a good deal of conflict between my child and me.

_____ 67. I let my child know how ashamed and disappointed I am when he/she misbehaves.

_____ 68. I control my child by warning him/her about the bad things that can happen to him/her.

_____ 69. I watch closely what my child eats and when he/she eats.

_____ 70. I try to stop my child from playing rough games or doing things where he/she might get hurt.

_____ 71. I worry about the bad and sad things that can happen to a child as he/she grows up.

_____ 72. I worry about the health of my child.

_____ 73. I don't go out if I have to leave my child with a stranger.

_____ 74. I believe it is unwise to let children play a lot by themselves without supervision from grown- ups.

_____ 75. When my child misbehaves, I stop talking to my child until he/she pleases me again.

_____ 76. When my child disagrees with me or doesn't see things my way, I am distant or cool toward him/her.

_____ 77. I tell my child that he/she would behave better if he/she really cared about my feelings.

_____ 78. I tell my child that other children behave better or are nicer.

_____ 79. I tell my child I behaved better than him/her when I was young.

_____ 80. When my child does not live up to my expectations, I suggest he/she should feel guilty or ashamed.

_____ 81. I remind my child of the things I have done for him/her.

Appendix B

Mothers' Behaviour during Clean-up Coding Scheme

Mothers' Behaviour during Clean-Up

ID _____ CODER _____

LAB VISIT DATE (dd.mm.yy) _____ CODING DATE _____

CLEAN-UP START (hh:mm:ss) _____ END _____
(PE leaves) (PE returns)

During each minute of clean-up, rate each maternal behaviour from 1: Absent to 5: Strong.

Codes	0 – 1min	1 – 2min	2 – 3min	3 – 4min	4 – 5min	5 – 6min
STRUCTURE						
CONTROL						
PERMIT						
NEGATIVE						
WARM						

Rating Scale

1	2	3	4	5
Not at all/ Absent	Mild & brief	Clearly present	Consistent, repeated	Strong, frequent

Code Definitions

STRUCTURE
Requests, simple clear directions, reasons/explanations, assist child (*e.g.* help child move farm)

CONTROL
Strong commands/directives, loud/verbal force

PERMIT
Clean (gather objects, put in box), allow child to play, overlook noncompliant/uncooperative

NEGATIVE
Criticism, disapproval, frowning, aggravated tone, threats, physical force

WARM
Warmth, affection, praise, encouragement, smiling

Appendix C

Me not Me Game

New ME NOT ME SCORING

A1.	I like to eat spinach.	ME	NOT ME
2.	I do not like to eat spinach.	ME	NOT ME
B1.	I do not like to eat ice cream	ME	NOT ME
2.	I like to eat ice cream.	ME	NOT ME
C1.	I think it is fun to play.	ME	NOT ME
2.	I do not think it is fun to play.	ME	NOT ME
1a.	I like to help other people.	ME	NOT ME
b.	I do not like to help other people.	ME	NOT ME
2a.	I get sad when I see a girl who can't find anyone to play with.	ME	NOT ME
b.	I do not get sad when I see a girl who can't find anyone to play with.	ME	NOT ME
3a.	I do not feel like crying when I see a boy who is crying.	ME	NOT ME
b.	I feel like crying when I see a boy who is crying.	ME	NOT ME
4a.	I like to help my mother keep our home clean and tidy.	ME	NOT ME
b.	I do not like to help my mother keep our home clean and tidy.	ME	NOT ME
5a.	I do not try to make people feel better when they are sad or upset.	ME	NOT ME
b.	I try to make people feel better when they are sad or upset.	ME	NOT ME
6a.	I get upset when I see a girl being hurt.	ME	NOT ME
b.	I do not get upset when I see a girl being hurt.	ME	NOT ME
7a.	I do not understand why other people get sad or upset.	ME	NOT ME
b.	I understand why other people get sad or upset.	ME	NOT ME
8a.	I do not get upset when I see an animal getting hurt.	ME	NOT ME
b.	I get upset when I see an animal getting hurt.	ME	NOT ME
9a.	I get sad when I see a boy who can't find anyone to play with.	ME	NOT ME
b.	I do not get sad when I see a boy who can't find anyone to play with.	ME	NOT ME
10a.	I think kids without friends probably like to be alone.	ME	NOT ME
b.	I do not think kids without friends probably like to be alone.	ME	NOT ME
11a.	I do not feel like crying when I see a girl who is crying.	ME	NOT ME
b.	I feel like crying when I see a girl who is crying.	ME	NOT ME

12a.	I do not share my cookies and snacks if I see a child who doesn't have any.	ME	NOT ME
b.	I share my cookies and snacks if I see a child who doesn't have any.	ME	NOT ME
13a.	I help other children who don't know how to do things.	ME	NOT ME
b.	I do not help other children who don't know how to do things.	ME	NOT ME
14a.	I get upset when I see a boy being hurt.	ME	NOT ME
b.	I do not get upset when I see a boy being hurt.	ME	NOT ME
15a.	I hug my mother when she is feeling sad.	ME	NOT ME
b.	I do not hug my mother when she is feeling sad.	ME	NOT ME
16a.	I ignore people who bother me when I'm busy.	ME	NOT ME
b.	I do not ignore people who bother me when I'm busy.	ME	NOT ME
17a.	I do not fight other children who push me.	ME	NOT ME
b.	I fight other children who push me.	ME	NOT ME
18a.	I do not think it's hard to finish my work when I don't like it.	ME	NOT ME
b.	I think it's hard to finish my work when I don't like it.	ME	NOT ME
19a.	I need to have things I want right away.	ME	NOT ME
b.	I do not need to have things I want right away.	ME	NOT ME
20a.	I think it's funny when I push other children down.	ME	NOT ME
b.	I do not think it's funny when I push other children down.	ME	NOT ME
21a.	I do not get angry when other people say mean things about me.	ME	NOT ME
b.	I get angry when other people say mean things about me.	ME	NOT ME
22a.	I think about other things while I work.	ME	NOT ME
b.	I do not think about other things while I work.	ME	NOT ME
23a.	I do not take a toy away from another child when I want to play with that toy.	ME	NOT ME
b.	I take a toy away from another child when I want to play with that toy.	ME	NOT ME
24a.	I keep doing my work when my friends are playing and having fun.	ME	NOT ME
b.	I do not keep doing my work when my friends are playing and having fun.	ME	NOT ME
25a.	I like it when other children think that I can beat them up.	ME	NOT ME
b.	I do not like it when other children think that I can beat them up.	ME	NOT ME
26a.	I do not make mistakes because I work too fast.	ME	NOT ME
b.	I make mistakes because I work too fast.	ME	NOT ME

27a.	I like to tease and make fun of some other children.	ME	NOT ME
b.	I do not like to tease and make fun of some other children.	ME	NOT ME
28a.	I switch to something else when my work is too hard.	ME	NOT ME
b.	I do not switch to something else when my work is too hard.	ME	NOT ME
29a.	I do not hit other children when I want to get something from them.	ME	NOT ME
b.	I hit other children when I want to get something from them.	ME	NOT ME
30a.	I say mean things about other children when they make me mad.	ME	NOT ME
b.	I do not say mean things about other children when they make me mad.	ME	NOT ME

Appendix D

Regression Tables

Table D1

Predicting Children's Aggression from Baseline RSA and Observed Maternal Emotion Socialization during Clean-up

	Mother reports of aggression				Children's self-reports of aggression			
	CBCL				MnM			
Variables	R^2	ΔR^2	β	*p*	R^2	ΔR^2	β	*p*
Step 1	.14	.14		.013	.14	.14		.013
Age			-.37	.004			-.37	.003
Sex			.03	ns			-.04	ns
Step 2	.18	.05		ns	.15	.01		ns
BRSA			-.08	ns			-.06	ns
CU Pos ES			-.21	ns			-.05	ns
CU Neg ES			.01	ns			.08	ns
Step 3	.22	.04		ns	.16	.01		ns
BRSA X CU Pos ES			.14	ns			.02	ns
BRSA X CU Neg ES			.22	ns			.08	ns
Model Summary	Adj. $R^2 = .12$				Adj. $R^2 = .05$			
	$F(7, 53) = 2.17$, $p < .05$				$F(7, 53) = 1.41$, *ns*			

Table D2

Sex as a Moderator in Predicting Children's Aggression from Baseline RSA and Mother Reported Emotion Socialization

	Mother reports of aggression				Children's self-reports of aggression			
	CBCL				MnM			
Variables	R^2	ΔR^2	β	*p*	R^2	ΔR^2	β	*P*
Step 1	.14	.14		.013	.14	.14		.013
Age			-.37	.004			-.37	.003
Sex			.03	ns			-.04	ns
Step 2	.36	.22		.001	.17	.04		ns
BRSA			-.08	ns			-.05	ns
Pos ES			.07	ns			-.12	ns
Neg ES			.50	.000			.11	ns
Step 3	.38	.02		ns	.21	.03		ns
Sex X BRSA			-.02	ns			-.13	ns
Sex X Pos ES			.05	ns			-.11	ns
Sex X Neg ES			.17	ns			-.13	ns
Model Summary	Adj. $R^2 = .28$				Adj. $R^2 = .08$			
	F (8, 52) = 3.95, $p < 0.01$				F (8, 52) = 1.68, *ns*			

Table D3

Sex as a Moderator in Predicting Children's Aggression from Baseline RSA and Observed Maternal Emotion Socialization during Clean-up

	Mother reports of aggression				Children's self-reports of aggression			
	CBCL				MnM			
Variables	R^2	ΔR^2	β	*p*	R^2	ΔR^2	β	*P*
Step 1	.14	.14		.013	.14	.14		.013
Age			-.37	.004			-.37	.003
Sex			.03	ns			-.035	ns
Step 2	.18	.05		ns	.15	.01		ns
BRSA			-.08	ns			-.06	ns
CU Pos ES			-.21	ns			-.05	ns
CU Neg ES			.01	ns			.08	ns
Step 3	.21	.03		ns	.17	.02		ns
Sex X BRSA			.01	ns			-.14	ns
Sex X CU Pos ES			-.15	ns			-.07	ns
Sex X CU Neg ES			-.14	ns			-.01	ns
Model Summary	Adj. $R^2 = .09$				Adj. $R^2 = .04$			
	$F(8, 52) = 1.71$, *ns*				$F(8, 52) = 1.34$, *ns*			

Table D4

Age as a Moderator in Predicting Children's Aggression from RSA withdrawal during AI and Mother Reported Emotion Socialization

	Mother reports of aggression				Children's self-reports of aggression			
	CBCL				MnM			
Variables	R^2	ΔR^2	β	*p*	R^2	ΔR^2	β	*P*
Step 1	.14	.14		.013	.14	.14		.013
Age			-.37	.004			-.37	.003
Sex			.03	ns			-.04	ns
Step 2	.36	.22		.001	.23	.09		ns
RSA AI			-.10	ns			.25	.05
Pos ES			.10	ns			-.19	ns
Neg ES			.51	.000			.04	ns
Step 3	.36	.00		ns	.25	.02		ns
Age X RSA AI			-.03	ns			.03	ns
Age X Pos ES			.01	ns			-.16	ns
Age X Neg ES			-.01	ns			-.04	ns
Model Summary	Adj. $R^2 = 0.27$				Adj. $R^2 = .13$			
	$F(8, 52) = 3.71, p < .01$				$F(8,52) = 2.15, p < .05$			

Table D5

Age as a Moderator in Predicting Children's Aggression from RSA withdrawal during AI and Observed Maternal Emotion Socialization during Clean-up

	Mother reports of aggression				Children's self-reports of aggression			
	CBCL				MnM			
Variables	R^2	ΔR^2	β	*p*	R^2	ΔR^2	β	*P*
Step 1	.14	.14		.013	.14	.14		.013
Age			-.37	.004			-.37	.003
Sex			.03	ns			-.04	ns
Step 2	.18	.04		ns	.20	.06		ns
RSA AI			.01	ns			.22	.07
CU Pos ES			-.20	ns			-.04	ns
CU Neg ES			.01	ns			.09	ns
Step 3	.27	.09		.09	.23	.03		ns
Age X RSA AI			-.16	ns			-.07	ns
Age X CU Pos ES			.18	ns			.03	ns
Age X CU Neg ES			-.16	ns			-.16	ns
Model Summary	Adj. $R^2 = .16$				Adj. $R^2 = .11$			
	$F(8, 52) = 2.42, p < .05$				$F(8, 52) = 1.95, p < .10$			

Table D6

Age as a Moderator in Predicting Children's Aggression from RSA withdrawal during DG and Mother Reported Emotion Socialization

	Mother reports of aggression				Children's self-reports of aggression			
	CBCL				MnM			
Variables	R^2	ΔR^2	β	*p*	R^2	ΔR^2	β	*P*
Step 1	.14	.14		.013	.14	.14		.013
Age			-.37	.004			-.37	.003
Sex			.03	ns			-.04	ns
Step 2	.39	.25		.000	.17	.03		ns
RSA DG			-.20	.068			-.03	ns
Pos ES			.07	ns			-.12	ns
Neg ES			.48	.000			.11	ns
Step 3	.40	.01		ns	.20	.03		ns
Age X RSA DG			.08	ns			-.11	ns
Age X Pos ES			.00	ns			-.14	ns
Age X Neg ES			-.03	ns			-.08	ns
Model Summary	Adj. $R^2 = .31$				Adj. $R^2 = .08$			
	$F(8, 52) = 4.34, p < .01$				$F(8, 52) = 1.65, ns$			

Table D7

Sex as a Moderator in Predicting Children's Aggression from RSA withdrawal during AI and Observed Maternal Emotion Socialization during Clean-up

	Mother reports of aggression				Children's self-reports of aggression			
	CBCL				MnM			
Variables	R^2	ΔR^2	β	*p*	R^2	ΔR^2	β	*P*
Step 1	.14	.14		.013	.14	.14		.013
Age			-.37	.004			-.37	.003
Sex			.03	ns			-.04	ns
Step 2	.18	.04		ns	.20	.06		ns
RSA AI			.01	ns			.22	.072
CU Pos ES			-.20	ns			-.04	ns
CU Neg ES			.01	ns			.09	ns
Step 3	.23	.05		ns	.25	.05		ns
Sex X RSA AI			-.19	ns			-.21	ns
Sex X CU Pos ES			-.15	ns			-.09	ns
Sex X CU Neg ES			-.13	ns			-.00	ns
Model Summary	Adj. $R^2 = .11$				Adj. $R^2 = .13$			
	$F(8, 52) = 1.96, p < .10$				$F(8, 52) = 2.10, p < .10$			

Appendix E

Consent Forms

CONSENT FORM: PARENT'S PARTICIPATION IN STUDY ON PROMOTING POSITIVE DEVELOPMENT

I agree to participate in a program of research, titled *Promoting the Positive Development of Children*, being conducted by Dr. Paul D. Hastings of the Department of Psychology of Concordia University. The purpose of the research is to examine the development of positive and negative behaviours in children. Specifically, this study is looking at how children with different personality characteristics respond emotionally and behaviourally to others; how they feel and express empathy and sympathy; how they develop more or less competent social skills in the early school years; and how these skills, emotions and behaviours are related to children's aggression. Part of the research involves looking at the socialization experiences that children receive during interactions with their parents; part of the research involves examining children's physiological, emotional and behavioural reactivity; and part of the research involves asking teachers' to describe children's behaviours at school. The research program will examine how these factors are associated with children's social development over a two-year period.

For this research, I will answer a variety of questions about my child, myself, and my relationship with my child. Some of the questions that I answer will be asked in an interview over the telephone, some will be in questionnaires that I will complete on my own and then will mail to the researchers (or complete on-line), and some will be questions that I will answer during an interview while my child and I visit the laboratory at Concordia University. I will also engage in a series of activities with my child while we are in the laboratory at Concordia University, which will be videotaped.

The telephone interview and the questionnaires about my child will assess the extent to which my child engages in a variety of behaviours or exhibits a variety of characteristics. Some of these could be seen as positive or desirable, and others could be seen as negative or undesirable. The interview conducted while I am visiting the laboratory at Concordia University will be about any problems, difficulties, or areas of concern that I have observed with my child.

The other questionnaires will be about me, and the ways in which I am raising my child. I will complete these questionnaires about my characteristics and my childrearing practices on my own time, either on paper or on-line through an interactive website. If I choose to complete the questionnaires on paper, I will be provided with a stamped, pre-addressed envelope to return them to the researchers. If I choose to complete the questionnaires on-line, I will be assigned a coded number and asked to create a password, so that I will have sole access to my questionnaires on the website.

The visit to the laboratory at Concordia University will last approximately 3 hours. Part of the time my child and I will be in the same room engaging in activities together, and part of the time we will be in adjacent rooms engaging in separate activities. The activities that my child and I will do include playing, tidying the toys, solving a puzzle, using dolls to tell stories, and having a snack. I will also assist the researcher with putting a heart rate monitor on my child, and I will sit with my child while my child

watches a brief, age-appropriate videotape. While I am separated from my child, I will complete an interview about the degree to which my child shows any difficult behaviours, emotional problems, or other areas of concern, and answer some additional questions about myself. The activities completed during the laboratory visit will be videotaped.

One year from now, I will be asked to complete some of the same questionnaires that I am completing this year, by mail or on-line. After one more year (therefore, two years from now), I will complete all the same questionnaires that I am being asked to complete this year, and my child and I will again visit the laboratory at Concordia university to complete the same procedures that we will be doing in our first visit (described previously). By repeating the questionnaires and procedures, the investigators will be able to determine how my child's characteristics, and my child-rearing practices, have grown and changed over a two-year period.

I will also be asked to provide my consent for my child to engage in these research procedures. That consent will be indicated on a separate form. My consent for my child's participation is necessary for my family's participation in this research. As well, I will be asked to give my consent for the investigators to contact my child's teacher, who will be asked to complete some questionnaires about my child's behaviours at school. I have given my verbal assent over the telephone for this, and I may confirm my consent for this by signing in the appropriate place at the end of this consent form. If I do not provide consent for the investigators to contact my child's teacher, then information from my child's teacher will not be used in this study. However, my child and I will still be enrolled in the investigation and will complete the other questionnaires and activities.

I will receive two honorariums as thanks for my willingness to participate in this research, one this year and one at the end of the two-year follow-up procedures. Both honorariums will be $75, each of which I will receive as a cheque when I bring my child to Concordia University.

I understand that I am free to withdraw my consent and discontinue my participation in this research at any time, without any negative consequences. If I withdraw from the study before all activities have been completed, I will receive an honorarium equivalent to the proportion of the activities that I completed. I also understand that I can refuse to do any specific part of the procedures or refuse to answer any specific questions without withdrawing from the study and without any negative consequences.

I understand that my participation in this study will be revealed to my child's teacher. However, in all other respects, my participation in this research will be confidential. That means that the researcher will not reveal my identity in any written or oral reports about this study. I will be assigned a coded number, and that number will be used on all materials collected in this study. My name will not appear on any of these materials. All materials collected in this study will be stored in secure facilities at Concordia University. In addition, I understand that information I provide in the telephone interview and on the questionnaires will not be shared with my child's daycare supervisor or preschool

teacher, unless I make a written request that such information be shared. Similarly, I will not be shown the information provided by my child's teacher, unless the teacher provides written permission for that information to be shared with me.

There is one condition which may result in the researchers being required to break the confidentiality of my participation. There are no questionnaires or procedures in this investigation that inquire about child maltreatment directly. However, by the laws of Québec and Canada, if the researchers discover information that indicates the possibility of child maltreatment, or that my child is at risk for imminent harm, they are required to disclose this information to the appropriate agencies. If this concern emerges, the lead researcher, Dr. Paul Hastings, will discuss the reasons for this concern with me and he will advise me of what steps will have to be taken.

If I have any questions about my rights as a research participant, I am free to contact Concordia University's Office of Research Services, at 514-848-2424 x7481. Ms. Adela Reid will serve as my liaison for this project.

I HAVE CAREFULLY STUDIED THE ABOVE AND UNDERSTAND THIS AGREEMENT. I FREELY CONSENT AND VOLUNTARILY AGREE TO PARTICIPATE IN THIS STUDY.

MY CHILD'S NAME (please print) _____

MY NAME (please print) _____

SIGNATURE _____ DATE _____

WITNESSED BY _____ DATE _____

CONSENT TO CONTACT MY CHILD'S TEACHER

By signing in the space marked AGREE below, I am giving permission for the investigators to contact my child's teacher, in order to send the teacher questionnaires about my child's behaviours at school. If I do not want my child's teacher to be contacted or invited to participate in the study by completing questionnaires, I will put my initials in the space marked DECLINE.

ACCEPT (signature) _____DECLINE (initials) _____

CONSENT FORM: CHILD'S PARTICIPATION IN STUDY ON PROMOTING POSITIVE DEVELOPMENT

I agree to allow my child to participate in a program of research, titled *Promoting the Positive Development of Children*, being conducted by Dr. Paul D. Hastings of the Department of Psychology of Concordia University. The purpose of the research is to examine the development of positive and negative behaviours in children. Specifically, this study is looking at how children with different personality characteristics respond emotionally and behaviourally to others; how they feel and express empathy and sympathy; how they develop more or less competent social skills in the early school years; and how these skills, emotions and behaviours are related to children's aggression. Part of the research involves looking at the socialization experiences that children receive during interactions with their parents; part of the research involves examining children's physiological, emotional and behavioural reactivity; and part of the research involves asking teachers' to describe children's behaviours at school. The research program will examine how these factors are associated with children's social development over a two-year period.

For this research, my child will wear a monitor to record his or her heart rate. My child will wear the monitor on two separate occasions. My child will wear the monitor for about two hours during a visit to Dr. Hastings' laboratory at Concordia University this year, and again for about two hours during a second visit to Dr. Hastings' laboratory at Concordia University two years from now. The heart rate monitor is completely safe and records heart rate from the surface of the skin. The monitor will be held in place on my child's chest using two adhesive electrodes, and it will transmit signals to a small receiver unit. The receiver unit will be placed in a belt-pouch that my child will wear around the waist.

Each of the visits to the laboratory at Concordia University will last approximately 3 hours. Part of the time my child and I will be in the same room engaging in activities together, and part of the time my child will be in an adjacent room engaging in separate activities. The activities that my child and I will do include playing, tidying the toys, solving a puzzle, using dolls to tell stories, and having a snack. I will also assist the researcher with putting the heart rate monitor on my child, and I will sit with my child while my child watches a brief, age-appropriate videotape. While I am separated from my child, my child will work with an experimenter. My child will again use dolls to tell some stories, and will be asked some questions in interviews. My child will be asked about other people's feelings and experiences, and how those make my child feel, and my child will be asked about my child's own behaviours and characteristics. The experimenter will also complete a brief cognitive assessment of my child's verbal and quantitative skills. My child will be given more time to play with toys, and another small snack. The activities completed during the laboratory visit will be videotaped.

As thanks for participating in these activities, my child will receive a couple of small gifts (e.g., toy, doll, book, T-shirt, markers) at the end of each laboratory visit, worth approximately $15.

My child's teacher also will be participating in this research. They will be completing questionnaires that will be used to learn about my child's behaviours and emotions while engaged in the normal activities of school, and about my child's general adjustment.

I understand that I am free to withdraw my consent and discontinue my child's participation in this research at anytime, without any negative consequences. My child also will be asked to give his or her verbal assent to participate in the research, and if my child does not provide assent, then he or she will not be required to participate in the research. I also understand that I can refuse to allow my child, or my child can refuse, to do any specific part of the procedures without withdrawing from the study and without any negative consequences.

I understand that my child's participation in this study will be revealed to my child's teacher. I also understand that my child's teacher will be providing the researcher with information about my child's behaviour at daycare or preschool. However, in all other respects, my child's participation in this research will be confidential. That means that the researcher will not reveal the identity of my child in any written or oral reports about this study. My child will be assigned a coded number, and that number will be used on all materials collected in this study. My child's name will not appear on any of these materials. All of the physiological information, questionnaire data, and videotapes collected in this study will be stored in secure facilities at Concordia University. In addition, I understand that information collected about my child's behaviours, physiological functions, and responses to interview questions will not be shared with my child's teacher, unless I make a written request that such information be shared. Information that my child's teacher provides about my child to the researcher will not be shared with me, unless the teacher provides written permission for this information to be shared.

If I have any questions about my child's rights as a research participant, I am free to contact Concordia University's Office of Research Services, at 514-848-2424 x7481. Ms. Adela Reid will serve as my family's liaison for this project.

I HAVE CAREFULLY STUDIED THE ABOVE AND UNDERSTAND THIS AGREEMENT. I FREELY CONSENT AND VOLUNTARILY AGREE TO ALLOW MY CHILD'S PARTICIPATION IN THIS STUDY.

MY CHILD'S NAME (please print) _____

MY NAME (please print) _____

SIGNATURE _____ DATE _____

WITNESSED BY _____ DATE _____