DEGNAN, KATHRYN AMEY, Ph.D. Developmental Profiles of Aggression Across Early Childhood: Contributions of Emotion Regulation and Maternal Behavior. (2006) Directed by Dr. Susan D. Calkins. 95pp.

Aggressive behavior typically peaks in toddlerhood and decreases by school entry. However, an estimated ten percent of children do not show this normative decline. In addition, persistent aggression in toddlerhood, preschool, and early childhood may develop into disruptive, problem behavior in adolescence and adulthood. The current study examined 318 boys and girls from a sample selected in toddlerhood for externalizing behavior problems. At 2, 4, and 5 years of age mother's reported on children's aggressive behavior. In addition, observed and physiological measures of child temperamental reactivity and emotion regulation and maternal behavior were assessed in toddlerhood. A sub model of SEMM (structural equation mixture modeling), latent profile analysis (LPA; Gibson, 1959), was performed, resulting in 4 longitudinal profiles of aggression: a high profile, a sub-threshold profile, a normative profile, and a low profile. Composites of observed emotion regulation, physiological emotion regulation, and maternal controlling behavior significantly predicted the probability of membership in the profiles. Furthermore, physiological emotion regulation moderated the effects of maternal control and observed emotion regulation on the probability of membership in the profiles. The results reinforce theory that suggests emotion regulation and maternal behavior display moderational relations to aggressive behavior problems. In addition, the findings suggest specific mechanisms operating among multiple indices of emotion regulation and between emotion regulation and maternal behavior in relation to aggressive behavior in early childhood that should be examined in the future.

DEVELOPMENTAL PROFILES OF AGGRESSION ACROSS EARLY CHILDHOOD:

CONTRIBUTIONS OF EMOTION REGULATION

AND MATERNAL BEHAVIOR

by

Kathryn Amey Degnan

A Dissertation Submitted to
the Faculty of The Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

Greensboro
2006

Approved by

____
Committee Chair

APPROVAL PAGE

This dissertation has been approved by the following committee of the
Faculty of The Graduate School and The University of North Carolina at Greensboro.

Committee Chair ______________________________

Committee Members ______________________________

____

____

____March 21, 2006____________
Date of Acceptance by Committee

____March 21, 2006____________
Date of Final Oral Examination

ACKNOWLEDGMENTS

Many people have supported me through my doctoral studies and the writing of this dissertation. I want to thank my advisor, Susan Calkins, who guided me throughout my graduate career and helped me gain a strong foundation in developmental psychology and research. I would also like to thank my committee members, Susan Keane, Jackie White, and Matthew Paradise for their support, their insightful input, and their time. In addition, I would like to thank Daniel Bauer for his statistical consultation.

This project was made possible by multiple grants from the National Institutes of Mental Health to Susan Calkins and Susan Keane and the support of a NIMH pre-doctoral fellowship from the Center for Developmental Science. However, this research would not have been possible without the participation of many families who, for many years, generously gave their time and energy. I would also like to thank the fantastic team I have been able to work with on the RIGHT Track Project.

Throughout my graduate career I have been most fortunate to have the support and guidance of many post-doctoral fellows and fellow graduate students and I am grateful for their support. Specifically, I would like to thank Cindy Smith who has been a great friend and a constant source of support since I entered graduate school. I am also grateful to Rachael McNamara, Michelle Wilkinson, and Caitlin Stone who have been wonderful colleagues and more importantly, friends. I also would like to thank Alysia Blandon for guiding me through the end of this journey. In addition, I want to thank my friends from Mary Washington and Towson for their unending support and understanding over the years.

Most importantly, however, I would like to thank my husband, Matt Degnan, who has been with me throughout this process and has supported me in a myriad of ways too numerous to mention. Without his love and support I never would have thought this accomplishment was possible. Finally, I want to thank my Mom and Dad. They have supported me from “the beginning” and instilled in me a love of learning, an undeniable interest in science, and a sense of pride in my accomplishments. These traits, a loving family, and wonderful friends made it possible for me to achieve this milestone.

TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Aggression is one of the most common problem behaviors seen in children. Almost half of children referred for mental health services are described as disruptive or delinquent (Loeber & Stouthamer-Loeber, 1998), and 25-90% of these cases include reports of aggression (Connor, 2002). Self report data indicate that 85% of boys and 77% of girls under the age of 12 display some form of aggression (Loeber, Farrington, & Petechuk, 2003), and one third to one half of children engage in physical fighting (Connor, 2002). In addition, child aggressors (ages 7-12) are two to three times more likely to become violent and chronic offenders than are adolescent aggressors (Borum, 2003; Loeber et al., 2003). Furthermore, chronic aggressive behavior is resistant to treatment and results in significant costs to society over time (Shaw, Winslow, Owens, Vondra, Cohn, & Bell, 1998). Given the negative effects and stability of aggression, it is important to identify antecedents of this type of behavior. Predictors previously examined in the literature include characteristics of the child, parents, home environment, school environment, and social environment (Coie & Dodge, 1998). Of these predictors, child temperament, emotion regulation, and maternal behavior are the most common factors theoretically linked with aggression in early childhood. Therefore, the present study examined their joint and interactive effects on profiles of aggressive behavior from toddlerhood to school entry.

Aggression

In the study of aggression terms such as violent, disruptive, delinquent, and fighting are frequently used to describe the same behaviors (Connor, 2002). Nevertheless, aggression should not be confused with hostility, frustration, or anger, as they are not always involved in aggressive acts (Berkowitz, 1993). Specifically, hostility is a negative attitude, frustration arises when a person is blocked from an expected reward or goal, and anger includes physiological reactions and involuntary emotional expressions produced by an unpleasant occurrence (Berkowitz, 1993). For this study, aggression was defined as verbal threats, statements, or behaviors intended to cause harm to person or property and less serious behaviors designed to maintain control over others or situations (Achenbach, 1991; 1992).

Some level of aggression is typical of children's early social development and normatively declines across early childhood (Tremblay, 2000). For example, infants demonstrate a 30% decrease in interpersonal conflict across toddlerhood (Connor, 2002). Theoretically, exposure to some conflict helps children develop and practice prosocial strategies to diffuse negative situations. As these strategies develop the frequency and intensity of aggression should decrease (Connor, 2002). However, persistent aggression across early childhood may develop into disruptive, problem behavior in adolescence and adulthood (Broidy et al., 2003; Nagin & Tremblay, 1999). Therefore, it is the maintenance of childhood aggression that is considered maladaptive.

Research on the stability of childhood aggression reveals moderate to high stability coefficients for males (Connor, 2002; Olweus, 1979). Aggression by females is stable, but less frequent than aggression by males (Silverthorn & Frick, 1999). Keenan and Shaw (1997) theorize that biological, psychological, and social factors influence gender differences in the stability of aggression across childhood. They propose two hypotheses regarding the emergence of these differences. One, girls are socialized towards overcontrolling (internalizing) rather than undercontrolling (externalizing) behaviors. Two, girls mature faster biologically, cognitively, and socially. In contrast to this theory, some studies found similar stability in early aggression for males and females (Cummings, Iannotti, & Zahn-Waxler, 1989; Keenan, Shaw, Delliquadri, Giovannelli, & Walsh, 1998). Thus, there are questions concerning when gender differences in aggression emerge and what accounts for these differences, but there is also evidence for similar stability across genders.

Theories of aggression also suggest individual differences in developmental patterns of aggression. Although children may begin with a certain propensity for aggression, that behavioral tendency may be altered by the development of emotion regulation and social skills across childhood. Normatively, children's levels of aggression are believed to peak in toddlerhood and decline across childhood as these developments occur. However, children who exhibit an extreme propensity for aggression and/or do not develop strong emotion regulation capabilities may not show this decline. Empirically, there is some support for these ideas. In a study by Owens and Shaw (2003), the average level of externalizing behavior decreased gradually from two to six years of age, and the rate of decline was negatively related to the level of externalizing behavior at age six. This declining pattern is consistent with normative levels of aggression across childhood. Nevertheless, toddlers who displayed extreme aggression continued to aggress throughout childhood. In addition, Moffitt (1993) posits two developmental subtypes of aggression: one with higher levels in early childhood and stability throughout adulthood (life-course-persistent) and one with increasing levels in adolescence and declining levels in adulthood (adolescent-limited). These aggressive prototypes also were shown to vary in their origins and outcomes including such things as child temperament and parenting behaviors (Moffitt, 2001). On the other hand, Loeber and Stouthamer-Loeber (1998) propose three developmental subtypes of aggression: a life-course type (similar to Moffitt's life-course-persistent type), a limited-duration type (that desists either during preschool or later adolescence), and a late-onset type (for those who begin aggressing in adulthood). Empirically, both multiple and single pathway models fit data on the development of children's antisocial behavior (Loeber & Stouthamer-Loeber, 1998). However, studying a single pathway of aggression may disguise specific trajectories and limit the possible explanations of childhood aggression. In addition, the developmental psychopathology perspective contends that multiple pathways lead to the same outcome (equifinality) and multiple outcomes are derived from the same indicators (multifinality). Since theoretically children may begin with a general propensity that may be altered by development, it makes sense to specify developmental subtypes of aggression. Thus, the existence of multiple pathways was assumed in the current study.

In past studies that assumed multiple pathways of aggression, researchers formed subgroups using a priori assumptions (Moffitt, 1993). However, recent advances in statistical techniques such as semi-parametric mixture modeling, suggest there are multiple developmental subtypes of aggression and allow for pathways to be estimated from the actual data (Nagin, 1999; Jones, Nagin, & Roeder, 2001; Muthén, 2004). These analytic techniques determine natural patterns that exist within the sample examined. It is assumed that the population has a continuous distribution of individual aggression trajectories, but that distribution is immeasurable. Therefore, semi-parametric group-based techniques estimate groups to acknowledge the developmental variation within the population (Nagin & Tremblay, 1999). For instance, studies using these techniques describe distinct developmental subgroups of externalizing behavior across multiple samples. Using high-risk samples of older children, Tremblay and colleagues consistently distinguished three to four trajectories of aggressive behavior (Brame, Nagin, & Tremblay, 2001; Broidy et al., 2003; Nagin & Tremblay, 2001). In addition, three studies have used this technique to examine aggression in younger samples of girls and boys from toddlerhood through age 9 (NICHD, 2004; Shaw, Gilliom, Ingoldsby, & Nagin, 2003; Tremblay et al., 2004). Thus recent research utilizing new quantitative techniques lends empirical support for several patterns of aggression in early childhood.

These trajectory studies of aggression reveal a high and stable problem group, varying types of declining groups, and a low problem group across early childhood using several different samples. However, the factors or mechanisms that distinguish the early chronic trajectories of problem behavior from the normative trajectories are less clear. Previous trajectory studies of aggression and externalizing behaviors in early childhood have examined various indices of child, mother, and family functioning without much overlap among the studies (Hill et al., 2006, Keller, Spieker, & Gilchrist, 2005; NICHD, 2004; Shaw, Gilliom, Ingoldsby, & Nagin, 2003; Tremblay et al., 2004). In addition, the majority of these factors were measured by maternal-report. Only four studies have examined observed measures of maternal and child functioning as predictors of behavior problem trajectories in early childhood including child emotion regulation, child fearlessness, maternal sensitivity, maternal rejecting behavior, and mother-child attachment (Hill et al., 2006, Keller et al., 2005; NICHD, 2004; Shaw et al., 2003). These factors may be best investigated between toddlerhood and kindergarten, a time period when children are developing social skills with peers across a variety of contexts, evidence of gender differences in aggression begin to emerge (Keenan & Shaw, 1997), and interventions may be most successful. Thus, the present study examined observed and physiological measures of reactivity and regulation, and observed maternal behavior in toddlerhood as direct and interactive predictors of the probability of membership in developmental profiles of aggression in early childhood.

Temperamental Reactivity

One antecedent theoretically linked to aggression and typically studied from infancy through the preschool period is temperament. Theoretically, temperament influences a child's development throughout life, is a precursor to personality, and is predictive of behavioral outcomes, such as aggression (Rothbart, Ahadi, & Evans, 2000). Children's temperament includes their reactivity to the environment and their regulation of that reactivity (Cole, Martin, & Dennis, 2004; Rothbart & Bates, 1998). The stable and enduring aspect of temperament is an individual's level of emotional and motor reactivity, which is influenced by regulatory systems over time (Rothbart & Bates, 1998).

Therefore, temperamental reactivity is one of the few characteristics believed to originate from within the child.

Studies using maternal-report of temperament reveal moderate stability of reactivity from infancy to toddlerhood (8- to 36-months of age; Houck, 1999), toddlerhood to preschool (24- to 48-months of age; Lemery, Goldsmith, Klinnert, & Mrazek, 1999), and early to middle childhood (5- to 7-years of age; Rothbart, Ahadi, Hershey, & Fisher, 2001). In addition, laboratory measures of distress also show stability across infancy (Stifter & Fox, 1990) and toddlerhood (Calkins, 2002). Finally, stability is observed between laboratory and parent-report measures of approach behavior, fear, and irritability/frustration in middle childhood (Rothbart, Derryberry, & Hershey, 2000). Theoretically, temperamental dimensions that appear stable across childhood should be associated with an individual's underlying psychobiological reactivity to the environment (Rothbart, Derryberry et al., 2000).

Dimensions of temperamental reactivity are related to several physiological measures, including heart rate (HR), heart period (HP), and heart rate variability (HRV). For example, higher resting HR (lower HP) is related to reactivity in infancy (Stifter, Fox, & Porges, 1989), inhibited behavior in toddlerhood (Kagan, Resnick, & Snidman, 1987), and angry nonverbal behaviors in childhood (Hubbard et al., 2004). Measures of HRV are also related to temperamental reactivity. One such measure (i.e., vagal tone) reflects the influence of the parasympathetic branch of the autonomic nervous system on the heart via the tenth cranial nerve, the vagus (Porges, 1991; Porges, Doussard-Roosevelt, & Maiti, 1994). Biologically, the vagus nerve helps maintain homeostasis by sending negative feedback to the peripheral autonomic nervous system in response to sympathetic nervous system excitation (Porges, 1991; Porges et al., 1994). During conditions without environmental challenge, vagal tone inhibits heart rate and represents an individual's potential responsiveness to the environment. Vagal control of the heart is indexed by respiratory sinus arrythymia (RSA; Porges, 1991), a measure of HRV in the frequency band of breathing (Porges et al., 1994). Compared to HR and HP, which are influenced by both the sympathetic and parasympathetic branches of the autonomic nervous system, RSA is solely influenced by the parasympathetic branch (Porges, 1991). Individual differences in resting RSA reflect differences in a biologically based ability to attend and react appropriately to the environment (Porges, 1991). In childhood, high baseline RSA is related to positive emotional reactivity, while low baseline RSA is related to negative emotional reactivity (Calkins, 1997; Calkins & Dedmon, 2000). In addition, baseline measures of RSA demonstrate stability in infancy, childhood, and adulthood (Bornstein & Suess, 2000; Porges et al., 1994). Given that observed emotionality and baseline RSA are modestly stable across childhood and modestly related to one another, they are reliable measures of temperamental reactivity (Rothbart, Derryberry et al., 2000) and were used in the present study.

Since temperamental reactivity is the behavioral and physiological response to stimuli in the environment (Rothbart, Ahadi et al., 2000), highly reactive children may act aggressively when provoked by a peer or aggravated by an adult (Vitaro, Brendgen, & Tremblay, 2002). Studies using various measures of emotionality found temperamental reactivity is related to aggression in toddlerhood and early childhood (Calkins, 2002;

Hubbard et al., 2002; Rubin, Hastings, Chen, Stewart, & McNichol, 1998). In addition, physiological measures of HR and RSA are related to childhood aggression. For instance, lower heart rate during rest or during an emotion-eliciting event is related to greater aggression in school-aged children (Hubbard et al., 2002; Liew, Eisenberg, Losoya, Fabes, Guthrie, & Murphy, 2003; Raine, Venables, & Mednick, 1997). In addition, higher resting RSA is related to lower externalizing behavior for boys in toddlerhood (Calkins & Dedmon, 2000), middle childhood (Pine et al., 1998), and adolescence (Mezzacappa et al., 1997). Overall, higher resting HR and RSA and lower observed emotionality are associated with fewer externalizing problems in toddlerhood, childhood, and adolescence. However, there is limited research exploring the role of reactivity in longitudinal patterns of problem behavior across childhood. In fact, of two studies examining maternal report of temperamental reactivity in relation to trajectories of aggression or externalizing behavior in early childhood, only one indicated negative reactivity was a significant predictor of chronic aggression (Keller, Spieker, & Gilchrist, 2005; Tremblay et al., 2004). In addition, no studies to date have explored observational or physiological measures of reactivity in relation to trajectories of behavior problems. Therefore, additional research including multiple measures of temperamental reactivity in relation to longitudinal patterns of aggression is needed.

Emotion Regulation

In addition to temperamental reactivity, emotion regulation may influence the development of aggressive behavior. Whereas reactivity is defined as the behavioral and physiological excitation, responsiveness, or arousal of an individual, regulation is defined as the neural or behavioral processes that alter an individual's level of reactivity (Rothbart, Ahadi et al., 2000). Theoretically, regulation occurs at the physiological, attentional, emotional, or behavioral level, and matures later in development than emotional reactivity (Davidson, Putnam, & Larson, 2000). It is described as the child's gradual progression from reliance on caregivers to modulate arousal towards the acquisition of independent regulatory skills (Calkins, 1994; Kopp, 1982). Through both physiological and behavioral factors, children first develop context-dependent strategies to regulate arousal, which later develop into a formal repertoire of skills used to actively regulate emotions and behavior in a variety of contexts (Calkins, 1994; Calkins & Degnan, 2005b). Typically by the end of toddlerhood, because of brain maturation and motor development, children attempt to control arousal and regulate affective expression (Calkins & Degnan, 2005b; Bronson, 1985). By preschool, however, children display more self-initiated regulatory abilities across a range of contexts (Calkins, 1997; Calkins & Dedmon, 2000; Calkins, Dedmon, Gill, Lomax, & Johnson, 2002; Stifter & Braungart, 1995). Theoretically, the ability to regulate emotional reactivity and expression within multiple settings allows positive communication skills to develop and leads to decreases in aggressive behavior over time.

Like research on temperamental reactivity, studies of emotion regulation include observational and physiological measures. Specifically, behavioral indices of emotion regulation measured during situations that have presumed regulatory demands and elicit specific regulatory behaviors are supported in the literature (Cole et al., 2004). That is, measuring behaviors children use to modulate their reactivity requires an environment that is certain to elicit a reaction. For example, episodes that block access to a desirable toy have been used to activate angry reactions (Goldsmith & Rothbart, 1993). This type of episode elicits angry distress expressions that decrease when certain regulatory strategies are observed (Buss & Goldsmith, 1998; Stifter & Braungart, 1995). In toddlerhood and preschool, distraction, help-seeking, or self-soothing behaviors are related to decreased reactivity to frustration/anger (Calkins, 1997; Calkins & Dedmon, 2000; Calkins, Gill, Johnson, & Smith, 1999; Calkins & Johnson, 1998). These behaviors are considered regulatory because they occur more frequently during negative emotion-eliciting episodes compared with neutral or positive emotional expressions (Cole et al., 2004). Additional support for these regulation behaviors is indicated by their modest convergence with physiological regulation measures.

Physiological measures assessed during challenging laboratory situations also index emotion regulation. One physiological construct frequently linked to emotion regulation is vagal tone (VT). When there are external demands the autonomic nervous system stimulates the sympathetic system, by withdrawing vagal input to the heart and other organs in order to promote fight/flight behaviors (Porges et al., 1994). While vagal stimulation delays the onset of the heart beat, lengthening the time between beats (heart period; HP), vagal withdrawal shortens the time period between beats or speeds up the onset of the heart beat (Porges et al., 1994). Under stress or challenge RSA (the accessible measure of VT) typically decreases from baseline (vagal withdrawal; Porges et al., 1994). Therefore, while baseline RSA measures an individual’s capacity to react, decreases in RSA during challenge measures an individual’s level of physiological regulation (Porges et al., 1994). Overall, the withdrawal of vagal input during challenge supports the display of regulatory behaviors and appropriate interactions with the environment (Porges, 1991). Empirically, the decrease in RSA during challenge has been modestly related to the use of emotion regulation skills in infancy and childhood (Calkins, 1997; Calkins & Dedmon, 2000; Calkins et al., 2002; Calkins, Smith, Gill, & Johnson, 1998). For instance, a child who shows a larger decrease in RSA from baseline during a negative emotion-eliciting episode is more likely to display distraction, help-seeking, and self-soothing behaviors, while a child who does not show a decrease in RSA during a challenging episode is more likely to display ineffective behaviors such as orienting to the object of frustration (Calkins, 1997). In addition, children who physiologically regulate appear less negative and exhibit higher levels of social approach (Stifter & Corey, 2001), presumably because they have developed appropriate regulatory behaviors. Theoretically, the use of physiological and behavioral regulation decreases one's level of reactivity and supports socially adaptive behavior. Without this ability to regulate, negative emotion-eliciting situations may lead children to act aggressively.

Emotion regulation is thought to influence aggressive behavior by providing opportunities for positive social development (Keenan, 2000). Children who can regulate their frustration or anger during a peer provocation typically learn how to solve these problems constructively. Since these children are more regulated, they have less arousal to focus on and are able to concentrate on learning positive social skills. Many children who display aggressive behavior may lack the ability to control their high level of reactivity to the environment and, as a consequence, develop fewer regulatory behaviors

(Calkins & Johnson, 1998). For example, a child who is easily frustrated when a toy is taken away may be unable to display and practice the skills of gaze aversion, social referencing, distraction, or self-soothing, which typically reduce the experience and expression of negative affect. After repeated exposures to frustrating events, such a child has limited opportunities to acquire early regulatory behaviors and the likelihood of having a rich repertoire of skills to draw from decreases. Therefore, high levels of reactivity may limit the use, practice, and development of regulatory skills, increasing the propensity for aggressive behavior (Calkins & Degnan, 2005b).

This idea has been supported empirically, with data suggesting that baseline RSA (e.g., temperamental reactivity) is related to the level of physiological regulation (e.g., decrease in RSA from baseline to episode) during frustrating situations in infancy, toddlerhood, and preschool (Calkins et al., 2002; Calkins, 1997; Calkins et al., 1998). In addition, infants with higher levels of frustration display less physiological regulation and fewer emotion regulation behaviors (Calkins et al., 2002). Although the long-term implications of these reactivity-regulation profiles are unknown, children's levels of reactivity and regulation may predict aggressive behavior throughout childhood. Some research indicates both emotion regulation skills and physiological regulation are associated with fewer behavior problems in toddlerhood (Calkins & Dedmon, 2000) and childhood (Eisenberg, Fabes, Nyman, Bernzweig, & Pinuelas, 1994; Eisenberg et al., 1995; Eisenberg, Fabes, & Murphy, 1996). In addition, one recent study revealed that emotion regulation in toddlerhood predicted high, stable levels of externalizing behavior across early childhood (Hill et al., 2006). More research is needed to clarify the role of both temperamental reactivity and emotion regulation in the longitudinal patterns of specific behavior problems, such as aggression. Theoretically, children with higher reactivity should have difficulty developing emotion regulation skills either physiologically or behaviorally and may, in turn, maintain higher levels of aggressive behavior throughout childhood.

Maternal Behavior

Maternal behavior is implicated in models of aggressive behavior as one mechanism by which children develop emotion regulation and socially appropriate behavior. From birth, caregivers assist infants with general state regulation by providing basic necessities (e.g., food and clothing). During the transition to toddlerhood this assistance evolves into more complex social interactions during which children learn to manage their own distress and behavior. Theoretically, children develop these self-management abilities with the support of a positive mother-child relationship (Calkins, 1994). However, toddlers who are prone to negative reactivity and aggressive behavior may elicit negative responses from caregivers. In addition, aggressive or noncompliant preschoolers seem to have mothers who display controlling, rejecting, or harsh parenting behavior (Calkins et al., 1998; Smith, Calkins, Keane, Anastopoulos, & Shelton, 2004). Since relationships are bidirectional in nature (Bell, 1968), it is difficult to separate the direction of these effects. While maternal control might elicit aggressive behavior, the child's behavior also might elicit maternal control. One study found maternal rejecting behavior was associated with a high, chronic trajectory of aggression across early childhood (Shaw et al., 2003). In addition, maternal sensitivity has been associated with a low trajectory of childhood aggression (NICHD, 2004). In general maternal control is associated with poor developmental outcomes and maternal warmth and guidance are associated with positive developmental outcomes (Smith et al., 2004). However, studies examining direct relations between positive and negative parenting and child behavior problems reveal inconsistent results. Researchers may view maternal control as positive or negative for child development. This theoretical difference contributes to the inconsistencies in the literature (Rothbaum & Weisz, 1994). For example, high control is either described as harsh or as consistent limit setting. In contrast, low control is either described as permissive or responsive to the needs of the child. In the present study, maternal control was conceptualized as adult-focused, highly directive behavior, while maternal positivity was conceptualized as child-focused, highly responsive behavior.

Inconsistencies among studies of maternal behavior also may result from a focus on direct parenting-child behavior relations. Instead, maternal behavior may interact with temperamental reactivity and emotion regulation in relation to aggression. In other words, reactivity may influence emotion regulation, but in a specific parenting context (Calkins, 1994; Calkins & Degnan, 2005b). Specifically, mothers who provide sensitive and responsive care may assist frustrated infants in developing regulatory capabilities, which the infants would have difficulty acquiring otherwise. This maternal support along with the development of emotion regulation may, in turn, lead to a decrease in aggression across early childhood. Theoretically, harsh and inconsistent parenting should exacerbate negative temperamental reactivity, while warm and consistent parenting should ameliorate negative temperamental reactivity (Vitaro et al., 2002).

Research examining temperament by parenting interactions reveals that children's negative reactivity usually predicts externalizing or aggressive outcomes when mother are high on control or low on positivity (Bates, Viken, & Williams, 2003 as cited in Rothbart & Bates, 2006; Calkins, 2002; Paterson & Sanson, 1999). In contrast, there is some support for positive effects of maternal control. In one study, mother-report of children's negative reactivity was found to predict externalizing behavior when mothers were low on observed control (Bates, Pettit, Dodge, & Ridge, 1998). These inconsistent results could be because maternal control does not operate the same way in all contexts or with all children. For example, Bates and colleagues (1998) measured maternal control in response to children's potentially harmful actions. The negative effects of maternal control may have been demonstrated if control was measured in relation to a wide range of child behavior. Therefore, in some instances, maternal control is constructive for tempering children's negative reactivity and limiting the display of aggressive behavior. However, in other situations, control exacerbates a negative temperament and increases aggression. For example, a study by Gilliom and colleagues found children who displayed a difficult temperament and whose mothers used more negative control developed less effective strategies for regulating anger when they were of school age (Gilliom, Shaw, Beck, Schonberg, & Lukon, 2002). This difficulty regulating anger could maintain or increase aggressive behavior across childhood by preventing the child from learning positive social behavior. On the other hand, parenting and temperament also may predict aggression when children are not prone to anger. Theoretically, parents of a child with strong, positive approach tendencies may attempt to restrain the child, frustrate the child, and increase the likelihood of aggressive behavior (Derryberry & Reed, 1994). In addition, Calkins and Fox (1992) suggested children whose parents interact with them in a negative and intrusive manner will increase in arousal and aggressive behavior, while children whose parents are responsive and help modulate the children's affective expressions will develop socially appropriate behavior (Beauchaine, 2001).

Maternal behavior also has been related to child emotion regulation (Braungart & Stifter, 1991; Calkins et al., 1998; Calkins, 2002), however, less empirical work has found interactions of maternal behavior and emotion regulation associated with aggressive behavior. One study found children's less adaptive regulation skills predicted externalizing behavior to a greater extent when mothers were observed to be intrusive or hostile (Rubin, Burgess, Dwyer, & Hastings, 2003). In addition, examining the role of positive maternal behavior, another study found that for toddlers who used less adaptive regulatory skills, positive maternal guidance was related to positive peer social play (Degnan & Hungerford, 2003). These findings suggest that mothers who are sensitive and responsive may help children develop appropriate social behavior despite their propensity for displaying poor regulation in specific contexts. On the other hand, negative parenting behaviors might exacerbate these maladaptive regulatory behaviors and lead to the development of inappropriate social behavior, such as aggression. Clearly more research is needed to fully understand the transactional effects between both negative and positive aspects of parenting and children's emotion regulation in relation to aggressive behavior in early childhood. Therefore, in the present study, both maternal control and positivity and child reactivity and emotion regulation were examined as direct and interactive predictors of aggression profiles in early childhood.

Goals and Hypotheses

Although there is support for direct effects of temperamental reactivity, emotion regulation, and maternal behavior on externalizing behavior problems like aggression (Cole, Teti, & Zahn-Waxler, 2003; Denham, Workman, Cole, Weissbrod, Kendziora, & Zahn-Waxler, 2000; NICHD, 2004; Owens & Shaw, 2003; Smith et al, 2004; Tremblay et al, 2004; Diener & Kim, 2004), there is also modest support for interactive effects between child temperamental reactivity or emotion regulation and maternal behavior on aggressive behavior in childhood (Belsky, Hsieh, & Crnic, 1998; Calkins & Johnson, 1998; Chang, Schwartz, Dodge, & McBride-Chang, 2003; Cole et al., 2003). There are few studies, however, that examine observed measures of temperamental reactivity, emotion regulation, and maternal behavior as moderational effects on profiles of aggression across early childhood. Given the negative effects and stability of aggression across childhood, such a study is necessary to determine the factors that contribute to aggressive behavior problems.

Research examining a comprehensive theory of aggression with multiple developmental patterns is limited. The next step in this area is to study the developmental trajectories of aggression at the intra- and inter-individual levels (Tremblay, 2000). Previous research has examined various adult-report and demographic measures of child temperament, maternal depression, family environment, and parenting quality and beliefs, as predictors of trajectories of externalizing behavior across early childhood (Hill et al., 2006; Keller et al., 2005; NICHD, 2004; Shaw et al., 2003; Tremblay et al., 2004).

Studies also have included observational measures of child fearlessness and maternal rejecting behavior (Shaw et al., 2003), emotion regulation (Hill et al., 2006), maternal sensitivity and the home environment (NICHD, 2004), and maternal warmth and mother-child attachment (Keller et al., 2005). However, none of these studies has included observational measures of emotion regulation, maternal behavior, and physiological reactivity and regulation in the same study of aggression across early childhood. Research examining profiles of aggression that are differentially predicted by laboratory measures of temperament, emotion regulation, and maternal behavior should enhance our understanding of this type of disruptive behavior.

The primary goal of this study was to use a semi-parametric group-based approach to examine longitudinal profiles of aggressive behavior from 2 to 5 years of age. Theory supports multiple longitudinal patterns of aggression across childhood due to individual differences in the propensity for aggression and development of socially appropriate behavior (Moffitt, 1993; Loeber-Stouthamer-Loeber, 1998). In addition, these profiles were expected to be similar to those found in past research on behavior problems in early childhood (e.g., Shaw et al., 2003). Specifically, four profiles of childhood aggression were hypothesized to emerge: a high, stable trajectory; a low, stable trajectory; a moderate, declining trajectory; and a moderate, increasing trajectory. Therefore, at two years of age children were expected to be highly aggressive or less aggressive. With age, some high and low aggressors were expected to maintain their levels of aggression, some highly aggressive children were expected to decrease in aggression, and some less aggressive children were expected to increase in aggression.

The second goal was to examine observed and physiological measures of child temperamental reactivity and emotion regulation as predictors of the probability of membership in the profiles. Children prone to high levels of emotional reactivity in toddlerhood were hypothesized to maintain high levels of maladaptive social behavior; however, physiological and behavioral emotion regulation were posited to protect children from developing aggressive tendencies. Specifically, children's observed and physiological reactivity and regulation were expected to differentiate the probability of membership in the profiles. Children with high, stable profiles of aggression were expected to maintain these levels of aggression across childhood because of a proneness to anger and an inability to diffuse negative social situations without aggression. Therefore, these children were expected to display high levels of physiological and emotional reactivity and less physiological and behavioral regulation. In contrast, children with high, declining profiles of aggression were expected to decrease in their maladaptive behavior because of a higher level of emotion regulation, despite their somewhat high level of reactivity. Finally, children in the moderate, increasing and low profiles were expected to have lower levels of physiological and emotional reactivity and higher levels of physiological and behavioral emotion regulation. For the moderate, increasing children, aggressive behavior was expected to be a means to an end. Although they would be able to regulate their temperamental reactivity, they would have learned to use aggression to get what they want. Furthermore, the low profile was expected to be well regulated and low on reactivity.

In addition, although physiological and behavioral measures of reactivity and regulation were expected to predict the probability of membership in the profiles, these measures were not considered synonymous and were examined as separate predictors. It was thought that both measures would display similar predictive effects for profiles described by extreme levels of aggression (high and low), while the effects of the observational measures would be somewhat attenuated for profiles with moderate levels of aggression (moderate-decreasing and moderate-increasing). Previous studies have often treated these measures as overlapping, but the current study wished to examine this relation by exploring their predictive effects separately.

The third goal of the study was to examine maternal controlling and positive behaviors in relation to the probability of membership in the profiles. Overall, the level of aggressive behavior problems was expected to relate positively to the level of maternal control and negatively related to the level of maternal positivity. Therefore, children with high, stable profiles of aggression were expected to have mothers that are highly controlling and somewhat cold. It was expected that these children would maintain their levels of aggression because of a proneness to anger and an inability to regulate that anger. Without a positive and supportive mother-child relationship these children were not expected to learn appropriate regulatory skills and behavior. In contrast, children with high, declining profiles of aggression were expected to decrease their maladaptive behavior by learning to regulate their emotional reactivity. This learning is most likely to occur in a warm and supportive parenting environment. Therefore, children who displayed lower levels of aggression across time were expected to have mothers who were moderately positive and somewhat lower on control. Children in the moderate, increasing profile were expected to have mothers who were both positive and controlling. It is likely these children learned aggressive behavior from their environment. However, since they would not be as aggressive in toddlerhood as those in the high, stable profile, their mothers would not be as negative. Perhaps it is the inconsistency between being positive and controlling that causes these children to display aggressive behavior. Finally, mothers of children in the low profile were expected to be highly positive and low on control. These children were expected to be well-developed and socially skilled, with a warm and supportive parenting environment.

Overall, child temperamental reactivity, emotion regulation, and maternal behavior were all expected to predict the probability of membership in the profiles. The fourth goal of the study was to examine the interactions of reactivity, regulation and maternal behavior in relation to the probability of membership in the profiles. For example, children in the high, declining profile were expected to display high reactivity and high regulation in the context of a positive mother-child relationship. It was assumed that highly reactive children who do not have a positive mother-child relationship would not develop the same level of regulatory ability and would not decline in their level of aggression across early childhood. As another example, children in the moderate, increasing profile were expected to display low reactivity and high regulation, but have mothers who used a lot of control. In this case, it was assumed that children were developing aggressive behavior as a response to feeling over-controlled. In addition, these children could have learned aggressive behavior from the mother's tendency to aggressively control others in her environment.

From a developmental psychopathology perspective three important issues need to be addressed: to account for the concepts of multifinality and equifinality, to account for disordered behavior in the context of development, and to account for interactions between children and their environment (Kuperminc & Brookmeyer, 2005). The current study attempted to address these issues. The concepts of multifinality and equifinality were examined by including multiple child and family factors as predictors of multiple pathways of aggression. In addition, examining these relations from toddlerhood to kindergarten put aggressive behavior in a developmental context by allowing for the study of childhood aggression during a period when social interaction skills and gender differences in aggression begin to emerge. Furthermore, the analysis included interactions of child reactivity and regulation and maternal behavior in order to explore their interactive relations to aggression across early childhood. Overall, recent statistical techniques were used to examine child reactivity and regulation and maternal behavior in toddlerhood as direct and interactive contributors to multiple pathways of aggression across early childhood.

CHAPTER II

METHODS

Participants included 447 2-year old children (215 male, 232 female) obtained from three cohorts as part of a larger ongoing longitudinal study. Sixty-seven percent were European American, 27% were African American, 4% were biracial, and 2% were Hispanic. At age 2, the children were primarily from intact families (77 %) and families were economically diverse with Hollingshead (1975) scores ranging from 14 to 66 (M = 39.56).

Recruitment

The goal for recruitment was to obtain a representative community sample of children who were at risk for developing future externalizing behavior problems. Thus, all cohorts were recruited through child day care centers, the County Health Department, and the local Women, Infants, and Children (WIC) program. Additionally, each gender was screened separately for approximately equal numbers of males and females, and recruitment was targeted to all areas of the county to obtain a sample representative in terms of race and socioeconomic status (SES).

Potential participants for cohorts 1 and 2 (n = 307) were recruited at 2-years of age (cohort 1: 1994-1996 and cohort 2: 2000-2001) and screened using the Child Behavior Checklist (CBCL 2-3; Achenbach, 1992) completed by the mother. Children with an externalizing T-score of 60 or above were selected to be in the *Externalizing Risk* group (n = 143). Those with both externalizing and internalizing T-scores below 60 were selected to be in the *Low Risk* group. Cohort 3 was initially recruited when infants were 6-months of age (in 1998) for their level of frustration based on laboratory observation and parent report (See Calkins et al., 2002, for more information). This cohort was followed from 6-months of age through the infancy and toddler period, and children whose mothers completed the CBCL at 2-years of age were included in the current study (n = 140). Based upon the above described criteria, 21 children were placed in the *Externalizing Risk* group. Cohort 3 had a significantly lower average 2-year externalizing T-score (M = 50.36) compared to cohorts 1 and 2 (M = 54.49), t (445) = -4.32, p = .00. Of the entire sample (N = 447), 164 children met criteria for the *Externalizing Risk* group. There were no significant differences between any cohorts with regard to gender, χ^2 (2, N = 447) = .63, p = .73, race, χ^2 (2, N = 447) = 1.13, p = .57, or 2-year SES, F (2, 444) = .53, p = .59.

Attrition

Of the 447 participants, 399 participated at 4-years of age. Families lost to attrition included: 20 who could not be located, 10 who moved out of the area, 9 who declined participation, and 9 who did not respond to phone and letter requests to participate. There were no significant differences between families who did and did not participate in terms of gender, χ^2 (1, N = 447) = 3.27, p = .07, race, χ^2 (1, N = 447) = .70, p = .40, 2-year SES, t (424) = .81, p = .42, or 2-year externalizing T-score, t (445) = -.36, p = .72. At 5-years of age 365 families participated including 4 that did not participate in the 4-year assessment. Families lost to attrition included: 12 who could not be located, 10 who moved out of the area, 13 who declined participation, and 3 who did not respond to phone and letter requests to participate. Again, there were no significant differences between families who did and did not participate at 5-years in terms of terms of gender, χ^2 (1, *N* = 447) = .76, *p* = .38, race, χ^2 (1, *N* = 447) = .17, *p* = .68, 2-year socioeconomic status, *t* (424) = 1.93, *p* = .06) and 2-year externalizing T-score (*t* (445) = -1.73, *p* = .09).

Procedures

Two-year assessment

Mothers brought their children to the laboratory and were videotaped during several episodes designed to elicit emotion regulation and mother-child interaction. The mother-child dyads were observed during the multiple episodes and videotaped for later coding. All episodes ended early if the child was highly distressed (i.e., cried hard for more than 30 seconds). In addition, mothers were asked to complete multiple questionnaires including the CBCL 2-3 (Achenbach, 1992) and a measure to collect demographic information. At the end of the laboratory visit, mothers were compensated for their time and children were given a small prize for their participation

HP and RSA assessment. At the beginning of the laboratory visit, an experimenter placed three disposable pediatric electrodes in an inverted triangle pattern on the child's chest. The electrodes were connected to a preamplifier and the output from the preamplifier was transmitted to a vagal tone monitor (VTM-I Delta Biometrics, Inc. Bethesda, MD) for R-wave detection. The vagal tone monitor displayed HR throughout the baseline, toy/cookie in box, and teaching episodes and every 30 seconds it computed and displayed RSA values. A data file containing the inter-beat intervals (IBIs) for the entire period of heart rate collection was saved on a laptop computer for later artifact editing (resulting from child movement) and analysis. Physiological indices were not collected during the high chair, freeplay, or clean up episodes.

Baseline episode. After the heart rate electrodes were applied, the child watched a 5-minute segment of the videotape “Spot,” a story about a puppy that explores its neighborhood. While this episode was not a true baseline, as the child’s attention was engaged, it was sufficient to gain a measure of HP and RSA while the child was sitting quietly and showing little affect. Given these children were two years of age, such a stimulus was necessary in order to limit movement artifact in the heart rate data.

Toy/Cookie in box episode. For the first frustration episode, the experimenter either asked the children whether they wanted a snack or to play with an exciting toy. If the child was asked to play with a toy they were permitted to play with the toy for one minute. Then, the experimenter placed the snack or toy in a clear plastic container that the child was unable to open. This part of the episode lasted for two minutes. Throughout this episode, the mother was nearby and was instructed to respond to the child as she normally would, but to limit initiating interaction.

Teaching episode. For the first mother-child interaction episode, the mother was instructed to assist the child during a challenging episode such as a puzzle or shape sorter for three minutes.

High chair episode. For the second frustration episode, the child was placed in a high chair, without any toys or snacks, for 5 minutes. Throughout this episode, the mother was seated nearby and was instructed to respond to her child as she deemed necessary.

Freeplay episode. For the second mother-child episode, a farm or pretend town was provided and the mother was instructed to play with her child as she would at home for four minutes.

Clean up episode. Following the freeplay episode, the mother was instructed to get the child to clean up the toys from the freeplay session. This episode lasted 2 minutes or until all of the toys were put away, whichever happened first.

Four and Five-year assessment

The mothers were requested to accompany their children to the laboratory. While the mothers were in the laboratory, they were asked to complete multiple questionnaires including the CBCL 4-18 (Achenbach, 1991) and the demographic measure given at age 2. For each visit to the laboratory, mothers were compensated for their time and children were given a small prize for their participation.

Measures

Demographics

Mother's open response report of children's race and gender were used to measure whether children were Caucasian or minority and male or female. Mothers also reported their own and the child's father's (if he was contributing to the household) education level, marital status, and type of employment. These measures were used to construct a socioeconomic status score for each laboratory visit based on the Hollingshead Index (1975). Socioeconomic status (SES) scores collected at the 2, 4, and

5 year visits were correlated and averaged across time points ($r = .66$, $p < .01$). Descriptives for the SES measures at each time point are reported in Table 1. Descriptives for the average SES measures are reported in Table 4.

Aggressive behavior problems

The Child Behavior Checklist's (CBCL; Achenbach & Edelbrock, 1983) aggression subscale was used as an index of mother-reported aggressive behavior problems at each age. When the children were two-years of age, mothers completed the CBCL for 2-3 year olds (Achenbach, 1992). When the children were four and five, mothers completed the CBCL for 4 -18 year olds (Achenbach, 1991). Achenbach and colleagues found these scales to be a reliable index of various externalizing and internalizing behavior problems across childhood (Achenbach, Edelbrock, & Howell, 1987). Both versions included items measuring physical aggression and general cruelty toward others. At 2-years of age, the aggression subscale consisted of 15 items such as "Defiant," "Fights," and "Hits others." At 4 and 5 years of age, the aggression subscale consisted of 20 items such as "Argues," "Mean to others," and "Physically attacks people." The mother indicated how true each item was of her child by circling 0 if not true, 1 if sometimes true, or 2 if often true.

Although the CBCL includes T-scores for each subscale, for the purposes of this study the total scores of the aggression subscales were used in order to allow for maximum variation across the sample with a possible range from 0 to 30 for the measure at 2-years of age and 0 to 40 for the measures at 4 and 5-years of age. In addition, the total scores allow for an examination of gender effects, since the 4 and 5 year T-scores are standardized for gender. It should be noted that the range and items of each scale are different, since they measure identifiable and expected aggressive behaviors for either the 2-3 or 4-18 year old age range. For this sample the 4 and 5 year old scores were lower than the 2-year old scores, on average (Table 2). In order to control for the different number of items at each age, the mean of the aggression scores was created by dividing the raw scores by their respective number of items, creating a possible range of scores between 0 and 2 at each age. Averages and standard deviations of the aggression mean scores are in Table 4.

Observed emotion regulation

Prior research has shown relations between emotion regulation and emotion reactivity measures (Calkins & Johnson, 1998; Stifter & Braungart, 1995). Therefore, both types of behaviors were coded from videotapes of the frustration episodes (Toy/Cookie in Box and High Chair). Reactivity was indexed by measures of distress or when the child whined, pouted, fussed, cried, screamed, or tantrummed. It was coded in three ways: (1) *proportion of distress*: the amount of time (in seconds) the child was distressed divided by the total time of the episode; (2) *global negative reactivity*: coded once for the entire episode on a scale from 0, no negative response, to 4, episode ended with the child in extreme distress; and (3) *global episode affect*: coded once for the entire episode on a scale from -3, highly distressed affect, to 3, highly positive affect.

Regulation was indexed by measures of global regulation and the frequency and effectiveness of distraction as a strategy for regulating negative affect. All three were coded once for each episode. *Global regulation* was coded on a scale from 0, no control of distress across the episode, to 4, regulation of distress during most of the episode, and was defined as the use of adaptive behavioral skills in an effort to decrease distress during the episodes. One such behavioral skill, *distraction*, was coded on a scale from 0, not used at all, to 2, often used throughout the episode, and was defined as being focused (for at least 2 seconds) on an object or event other than the object of distress (i.e., looking at posters on the wall, looking at clothing, looking at mom without trying to engage her). The *effectiveness of distraction* was coded, to measure whether the child's distress decreased when distraction was used, on a scale from 0, never used, to 4, strategy use was always effective in decreasing distress.

These measures were thought to best index a child's level of observable reactivity and appropriate regulation skills during episodes with presumed regulatory demands (Calkins, 1997; Stifter & Braungart, 1995). Four coders were involved in the reactivity and regulation coding. They trained by working together on 10 % of the videotaped sessions and independently coding another 10% for reliability purposes. Inter-coder reliability for the proportion of distress measure was excellent (mean $r = .99$, $p < .00$). Reliability Kappas for the ordinal codes ranged from .83 (global regulation) to 1.0 (episode affect and distraction use). Each of the reactivity and regulation codes were correlated and averaged across episodes (average $r = .25$, $p < .00$). Descriptive statistics for each average code are reported in Table 1.

Physiological emotion regulation

Measures of children's HP and RSA during the baseline and Toy/Cookie in Box frustration episodes were obtained by editing the IBI files using MXEDIT software

(Delta Biometrics, Bethesda, MD). To edit the files, the data were scanned for outlier points, relative to adjacent data, and the outliers were replaced by dividing or summing them so they would be consistent with the surrounding data. Only data files in which less than 10% of the data required editing were included in the current study. The Porges (1985) method of analyzing the IBI data was used to calculate RSA. This method applies an algorithm to the sequential HP data. The algorithm uses a moving 21-point polynomial to detrend periodicities in heart period that are slower than RSA. Then, a bandpass filter extracts the variance in HP within the frequency band of spontaneous respiration in young children, 0.24 – 1.04 Hz. The natural log of this variance is taken and reported in units of $\ln(\mathrm{msec})^2$. HP and RSA were calculated every 30 seconds for the baseline and first frustration episodes and the average across the 30-second epochs for each episode was used in subsequent analyses. Data were excluded if the standard deviation for an episode was over 1.0.

Measures of HP and RSA during the baseline and toy/cookie in box episodes were used as indices of physiological reactivity and regulation. Baseline RSA was considered an index of children's propensity for reactivity to the environment (Beauchaine, 2001; Porges, 1991). Difference scores were computed in line with previous research (Calkins, 1997; Moore & Calkins, 2004; Stifter & Corey, 2001) to create indices of arousal and regulation during the frustration episodes. This was done by subtracting HP and RSA during the frustration episode from HP and RSA during the baseline episode. Positive change scores occur when there is a decrease from baseline to episode which for HP reflects an increase in arousal and for RSA reflects attempts to regulate emotion. Negative change scores occur when there is an increase from baseline to episode which for HP reflects a decrease in arousal and for RSA reflects a state that does not require regulation. Descriptive statistics for the measures of HP and RSA during baseline and frustration episodes are reported in Table 1. Descriptive statistics for the change scores are reported in Table 4.

Maternal behavior

Maternal behavior was coded during the mother-child interaction episodes (teaching, freeplay, cleanup) following Smith and colleagues (2004). One coding system examined the implied goals of each maternal statement. *Adult-oriented* goals included initiating a new activity or stopping the child's activity. *Child-oriented* goals included maintaining or encouraging the child's current activity. Frequencies of each maternal goal were coded during each of the mother-child interaction episodes. The duration of episodes varied across dyad, so the frequencies of each type of maternal goal were standardized by dividing the frequencies by the total time of the episode, for each participant, and multiplying this value by the expected time of the episode (teaching episode: 3 minutes, freeplay episode: 4 minutes, cleanup episode: 2 minutes). Four coders were involved in the maternal goals coding. They worked together on 10 % of the videotaped sessions and independently coded another 10% for reliability purposes. The average inter-coder reliability for the maternal goal measures was $r = .86$, $p < .00$.

The second coding system examined global indices of *warmth/positive affect* (displaying positive affect and warmth toward the child), *strictness/punitiveness* (being too strict, demanding, or harsh considering the child's behavior; exerting influence toward completion of the child's activity; displaying a no-nonsense attitude; constantly guiding the child and creating a very structured environment), and *sensitivity/responsiveness* (promptly and appropriately responding to the child's bids). These were coded once for each episode on a 4 or 5 point scale, ranging from low levels of the behavior to high levels of the behavior. Four coders were involved in the maternal global coding. They worked together on 10 % of the videotaped sessions and independently coded another 10% for reliability purposes. Reliability Kappas ranged from .71 (strictness/punitiveness) to .79 (warmth/positive affect). Each of the maternal goals and global codes were correlated and averaged across episodes (average $r = .44$, $p < .00$). Descriptive statistics for each average code are reported in Table 1.

Summary of Measures

The observed emotion regulation, physiological emotion regulation, and maternal behavior measures at 2-years of age and the CBCL (Achenbach, 1991, 1992) subscales of aggression at 2, 4, and 5 years of age were examined in the present study. All three cohorts were included in the present study. The analysis described below accounted for missing data longitudinally, but only included cases with complete predictor/covariate data at 2-years of age. Therefore, of the 447 possible participants, only 318 were available due to missing data at 2-years of age: 97 had technical difficulties with the physiological data collection; 18 could not be contacted by phone to schedule a laboratory visit, but completed questionnaires through the mail; 11 had technical difficulties with the video equipment; and 3 refused to complete socioeconomic information. Thus, the final sample for this study consisted of 318 families, 124 (39%)

with children above the borderline clinical range on the 2-year measure of externalizing behavior and 194 (61%) with children below the borderline clinical range on externalizing behavior. These families were not significantly different from the overall sample by gender (χ^2 (1, N = 447) = .38, p = .54), race (χ^2 (1, N = 447) = .04, p = .85), 2-year socioeconomic status (t (424) = .00, p = 1.0), or 2-year externalizing T-score (t (445) = -.21, p = .84).

Data Analyses Goals

To investigate individual differences in longitudinal patterns of aggression a structural equation mixture model (SEMM) was used. As a semi-parametric group-based approach, SEMM allows for estimation of qualitatively different groups (i.e., classes) when group membership cannot be observed a priori (Bauer & Curran, 2004). Recent work of Nagin and Tremblay (1999) and Muthén (2001) show how SEMM models can be used in testing differential longitudinal patterns of psychological phenomena. In the current study, aggression at age 2 was measured with a different form of the CBCL (age 2-3) than aggression at age 4 and 5 (CBCL 4-18). Thus, linear growth trajectories of aggression were not estimated (e.g. Nagin & Tremblay, 1999) due to the possibility of change in measurement; rather the average level of aggression at each age was estimated independently within each class (i.e., latent profile analysis (LPA), Gibson, 1959). For this reason, classes are referred to as “longitudinal profiles” rather than trajectories. In this study, longitudinal profiles described levels of aggression at 2, 4, and 5 years of age.

One benefit of using a SEMM model such as LPA is that it performs maximum likelihood estimation, which includes all longitudinal observations in a dataset (Little &

Rubin, 1987). This method assumes the data are missing at random and has been recently recommended by methodologists as an appropriate way to accommodate missing data (Schafer & Graham, 2002). As a sub model of SEMM, LPA is a multiple group structural equation model in which the group variable is unobserved. Thus, LPA assumes observed associations are explained by differences in the means of the continuous measures over latent classes (Bauer & Curran, 2004). Within this framework, predictors and outcomes can be estimated simultaneously. Instead of forcing membership in groups and performing multinomial regression analyses, LPA allows for prediction of the probability of membership in profiles to be estimated within the same model as the profiles themselves are estimated. As such, LPA differs from past methods used to identify groups in two ways. First, LPA relies on a formal statistical model rather than an ad-hoc algorithm based on decision rules (e.g., cluster analysis) and allows for flexibility in the model (Everitt & Hand, 1981). Second, the flexibility of model-based LPA allows for the possibility of uncertainty in which classes people may belong to and allows one to predict the *probability* of membership in a group. In other words, unlike cluster analysis, people are not forced into a group so that additional analyses can be performed to examine predictors; rather all of this is performed within one formal statistical model.

The function for LPA takes the general form:

$$\boldsymbol{Y}_{(tik)} = \boldsymbol{\mu}_{(tk)} + \boldsymbol{\varepsilon}_{(tik)}$$

Where $\boldsymbol{\mu}_{(tk)}$ is the class-specific mean for the observed variable $\boldsymbol{Y}$ at time t for class k, and $\boldsymbol{\varepsilon}_{(tik)}$ are within-class individual differences from $\boldsymbol{\mu}_{(tk)}$. $\boldsymbol{\varepsilon}_{(tik)}$ is assumed to be normally distributed within each class with variance $\boldsymbol{\sigma}_{(tk)}$, allowing for potential heteroscedasticity across time and classes. In this case, the $\boldsymbol{Y}$ variables are CBCL aggression mean scores at ages 2, 4, and 5, and the estimated class means $\boldsymbol{\mu}_{(tk)}$ for these variables describe the longitudinal latent profile for each class (See Figure 1 for a pictorial representation).

In the current study, data were analyzed using Version 3.01 of Mplus (Muthén & Muthén, 2004) and models with 3 through 6 profiles were estimated. Determination of best model fit was assessed using Bayesian information Criteria (BIC), where the smallest negative number indicates best fit. This index has been shown to identify the appropriate number of groups in finite mixture models (Keribin, 1997; D'Unger, Land, McCall, & Nagin, 1998) and penalizes the model for the number of parameters, thus guarding against models overfitting the data. Random start values were specified when estimating the model and specific start values were specified only when comparing specific reference groups. When fitting models like these, issues such as convergence are important, especially for more complex models (Hipp & Bauer, in press), and sometimes start values must be specified in order to reach convergence. For this case, the model was relatively simple and random start values resulted in a converged solution.

Latent profile analysis (LPA) is a useful tool for describing individual differences, especially when measures are different across time. Nevertheless, it is important not to reify the latent classes as they do not necessarily represent qualitatively distinct groups in the overall population (Bauer & Curran, 2003). Given this limitation, it is still valuable to use mixture-modeling techniques as they may begin to more accurately represent the complexity of developmental theory compared with traditional variable-based approaches (O'Brien, 2005) and are useful tools for addressing developmental change over time; a goal of developmental science (Magnusson & Cairns, 1996).

CHAPTER III

RESULTS

Preliminary and descriptive analyses are presented, followed by model comparisons for the longitudinal profiles of aggression from 2 to 5 years of age. Finally, SES, observed emotion regulation, physiological emotion regulation, and maternal behavior measures are examined as predictors of the probability of membership in the latent profiles (Figure 1).

Preliminary Analyses and Data Reduction

Given the large number of predictors, preliminary analyses were performed to reduce the number of variables used in the latent profile analysis. Specifically, observational and physiological measures of emotion reactivity and regulation were reduced to two summary scores, representing observed emotion regulation and physiological emotion regulation. In addition, maternal behavior measures were reduced to two summary scores, representing maternal positive and maternal controlling behavior.

Observed and physiological emotion regulation

There are conceptual and empirical arguments for combining the reactivity and regulation constructs in a measure of emotion regulation. Conceptually, reactivity/arousal is part of a response to contextual demands, along with regulatory behaviors/physiological mechanisms used to alter reactivity/arousal (Cole et al., 2004). Empirically, the observed reactivity and regulation measures were significantly intercorrelated at $p < .01$ (See Table 3). Positive r values ranged from .35 to .79. Negative r values ranged from -.30 to -.91. To obtain a single score of *observed emotion regulation* on which higher scores represented high levels of regulation and a low level of distress, each variable was z-scored and averaged to create a final variable. Proportion of distress and global negative affect were reverse scored to match the positive valence of the composite. Cronbach's alpha reliability of the composite was .90. In addition, a confirmatory principal components factor analysis was performed. One factor emerged accounting for 70% of the variance with an eigenvalue of 4.2. This factor loaded positively on global regulation (.92), effectiveness of distraction (.82), distraction (.46), global episode affect (.86), reversed proportion distressed (.88), and reversed global negative affect (.94). The physiological reactivity and regulation measures were also significantly correlated ($r = .74$, $p < .01$). Thus, to obtain a single score of *physiological emotion regulation* on which higher scores represent higher arousal, but the ability to regulate arousal, the two variables were averaged together. The means and standard deviations of these final composite variables are reported in Table 4.

Maternal behavior

Analyses also were performed to reduce the maternal behavior measures. Following Smith and colleagues (2004), a principal components factor analysis with varimax rotation was performed with the average maternal goal and global codes. Two factors emerged and accounted for 77% of the variance overall. The first factor, "maternal positive behavior," accounted for 52% of the variance with an eigenvalue of 2.6. This factor loaded positively on child-oriented statements (.76), global warmth/positive affect (.92), and sensitivity/responsiveness (.86). The second factor, "maternal controlling behavior," accounted for 25% of the variance with an eigenvalue of 1.3. This factor loaded positively on strictness/punitiveness (.87) and adult-oriented statements (.91). The factor scores were saved and used as the two composite variables. Means and standard deviations for these final composite variables are reported in Table 4.

Descriptive Analyses

A two-way MANOVA, with race (Caucasian vs. Minority) and gender, was used to test for group differences on all outcomes variables (aggression at 2, 4, and 5 years of age). There were no significant race or gender differences on the outcomes variables. Thus, in subsequent analyses, gender and race are not included in the model. Correlations between the average socioeconomic status (SES) and all outcome variables (aggression at 2, 4, and 5 years of age) revealed a single significant association. Average SES was negatively related to aggression at 2-years of age ($r = -.17$, $p < .01$). Thus, children rated by their mothers as displaying more aggressive behavior at age 2 also had parents with lower average SES across the early childhood assessments; subsequently, SES was tested in the model.

Latent Profile Model Comparisons

Latent profile models with two, three, four, five, and six profiles were fit to determine the optimal number of profiles to describe aggression from 2 to 5 years of age in the current sample. Model fit was assessed using the Bayesian Information Criterion (BIC), where the smallest negative number (closest to zero) indicates best fit. The BIC for the current sample was -311 for two profiles, -248 for three profiles, -238 for four profiles, -244 for five profiles, and -275 for six profiles. The 4 profile model had the smallest negative BIC and therefore was selected as the best number of aggression profiles for the current sample (Figure 2).

An examination of the 4-profile model indicated this model yielded unique information and had an acceptable number of members in each profile. For profiles with a small number of members there could be danger of a local spurious solution (Hipp & Bauer, in press). For this model, the smallest profile represented 8% of the sample and had similar residual variances to all the other profiles. In addition, the average posterior probabilities of membership ranged from .83 to .96 across profiles, reflecting a high degree of confidence in profile assignment. Finally, the profiles were examined for outliers and normality in a post-hoc analysis. The probabilities for profile membership were saved from the analysis and diagnostic statistics were performed for each profile. Examination of histograms, skewness, and kurtosis indicated, measures of aggression at 2, 4, and 5 years of age were normally distributed, within each profile. Examination of box plots indicated that there were no consistent outliers across each measure of aggression within the profiles. Additionally, of the individuals with a high probability of membership in each profile, 55% of them were female on average, indicating no gender difference in the probability of membership in any of the profiles.

Description of Longitudinal Profiles

For the highest profile, 8% of the sample had a higher probability of membership and on average showed high levels of aggression at age 2 ($M = 1.17$, $sd = .09$), age 4 ($M = 1.04$, $sd = .04$), and age 5 ($M = 1.09$, $sd = .09$). This profile was just below the borderline clinical cutoff at age 2 (1.20 – 1.46; Achenbach, 1992), but by ages 4 and 5 was above the borderline clinical cutoff for boys (0.95 – 1.10; Achenbach, 1991) and girls (0.90 – 1.00; Achenbach, 1991); therefore, it was named the "high" profile. For the second-highest profile, 34 % of the sample had a higher probability of membership and on average showed levels of aggression below the borderline clinical cutoffs, but higher than the two lower profiles at age 2 (M = .84, sd = .11), age 4 (M = .61, sd = .02), and age 5 (M = .61, sd = .04). Although this profile was not within the clinical range of scores, it still evidenced elevated levels at each time-point; therefore it was named the "sub-threshold" profile.

Of the two lowest profiles, for the second-to-lowest one, 44% of the sample had a higher probability of membership and on average still showed some aggressive behavior at age 2 (M = .50, sd = .07), age 4 (M = .30, sd = .02), and age 5 (M = .29, sd = .02). These levels of aggression are lower than those of the profiles above and the largest amount of the sample had a high probability of membership; therefore, it was named the "normative" profile. For the lowest profile, on the other hand, only 14% of the sample had a higher probability of membership and on average displayed extremely low levels of aggression at age 2 (M = .25, sd = .12), age 4 (M = .09, sd = .01), and age 5 (M = .07, sd = .00). This profile was named the "low profile," because of the low levels of aggression and small proportion of the sample.

Prediction of Probability of Membership in Profiles

Predictors of the probabilities of membership in the above profiles were entered in a step-wise fashion. The log likelihoods of each model were compared with the model a step before to determine whether the predictors significantly affected the model. If they did not affect the model they were taken out. First, SES was entered into the model as a covariate, however, comparison of the log likelihoods determined it did not significantly impact the model (χ^2 (3) = 2.6, $p > .05$). In addition, SES did not predict the probability for membership in the profiles; therefore, it was removed from all further analyses. Second, all of the other predictors were entered in the model (observed emotion regulation, physiological regulation, maternal positive behavior, and maternal controlling behavior). Comparison of the log likelihoods determined they significantly impacted the model (χ^2 (12) = 28.9, $p < .01$). In addition, observed emotion regulation, physiological emotion regulation, and maternal control significantly predicted the probability of membership in the profiles. The next model included all of the predictor variables, interactions between maternal behavior measures and the two forms of emotion regulation (observed and physiological), and an interaction term between the two forms of emotion regulation themselves. Interaction terms were calculated by multiplying the two variables together. The comparison of log likelihoods determined the interactions significantly impacted the model (χ^2 (27) = 43.9, $p < .05$). In addition, three of the interactions significantly predicted the probability of membership in the profiles.

A final simplified model was run including only the significant predictors (observed emotion regulation, physiological regulation, and maternal controlling behavior) and interactions (observed emotion regulation x physiological emotion regulation and physiological emotion regulation x maternal controlling behavior). The comparison of log likelihoods determined that removing the predictors was not deleterious to the model (χ^2 (12) = 7.04, $p > .05$). A pseudo R^2 (Pampel, 2000) was calculated and 44% of the variance in aggression across time was accounted for by the predictors in the final model. Planned comparisons with this simplified model were conducted to determine how the predictors or their interactions differentially predicted the probability of membership in the high and low profiles of aggression as compared to the other profiles. There were no significant effects predicting the probability of membership in the sub-threshold profile as compared to the normative profile. Tables 5 and 6 present the results of the high and low profile comparisons in terms of odds ratios and corresponding significance tests, quantified as a *z* for each predictor.

High profile vs. all other profiles

The first planned comparison was between the high profile and the other three profiles (Table 5). Results indicated children's level of observed emotion regulation and physiological emotion regulation predicted the probability of membership in the low profile compared to the high profile. Specifically, for every standard deviation (SD) increase in observed emotion regulation, the odds of membership in the low profile increase 6-fold compared to the high profile. Also, with every SD increase in physiological emotion regulation the odds of membership in the low profile increase almost 2-fold compared to the high profile. Compared to the sub-threshold profile, an interaction between maternal control and children's physiological emotion regulation predicted the probability of membership in the high profile (Figure 3). In addition, an interaction between children's observed emotion regulation and physiological emotion regulation predicted the probability of membership in the high profile compared to the normative profile (Figure 4).

For children with higher levels of physiological emotion regulation, the level of maternal control was negatively related to the odds of membership in the sub-threshold profile compared to the high profile. For example, for those with higher physiological emotion regulation, increases in maternal control decreased the odds of membership in the sub-threshold profile compared to the high profile (Figure 3). In contrast, for children with lower levels of physiological emotion regulation, maternal control was unrelated to the odds of membership in the sub-threshold profile compared to the high profile. However, in relation to the high profile, the level of observed emotion regulation was positively related to the odds of membership in the normative profile, for those with lower levels of physiological emotion regulation. For example, for those with lower physiological emotion regulation, increases in observed emotion regulation increased the odds of membership in the normative profile compared to the high profile (Figure 4). In turn, there was no significant relation between observed emotion regulation and the probability of normative profile membership for children with higher physiological emotion regulation. Therefore, the effect of maternal control and observed emotion regulation on the probability of membership in the high profile, as compared to the sub-threshold and normative profiles, was moderated by the level of physiological emotion regulation the child displayed (See Figures 3 and 4).

Low profile vs. all other profiles

The second planned comparison was between the low profile and the other three profiles (Table 6). Comparisons between the high and low profiles were discussed above and are not repeated. Additional results indicated children's level of observed emotion regulation and maternal control predicted the odds of membership in the sub-threshold profile compared to the low profile. Maternal control also predicted the odds of membership in the normative profile compared to the low profile. Specifically, for every SD increase in observed emotion regulation the odds increase almost 4-fold of membership in the low profile compared to the sub-threshold profile. Also, with every SD increase in maternal control the odds increase 2-fold of membership in the low profile compared to both the sub-threshold and normative profiles.

In addition, an interaction between children's observed and physiological emotion regulation predicted the odds of membership in the normative profile compared to the low profile (Figure 5). For children with high physiological emotion regulation, the level of observed emotion regulation is negatively related to the odds of membership in the normative profile compared to the low profile. For example, for children with high physiological emotion regulation, increases in observed emotion regulation decreased the odds of membership in the normative profile compared to the low profile (Figure 5). In contrast, for children with low physiological emotion regulation, the level of observed emotion regulation was not significantly related to the odds of membership in the normative profile compared to the low profile. Therefore, the effect of observed emotion regulation on the odds of membership in the normative and low profiles is moderated by the level of physiological emotion regulation (See Figure 5).

Summary of Results

Overall, measures of observed emotion regulation, physiological emotion regulation, and maternal control predicted the probability of membership in the four profiles. There were no effects of SES or maternal positivity. However, as observed emotion regulation increased the odds of membership in the low profile increased as well, 6-fold compared to the high profile and 4-fold compared to the sub-threshold profile. Also, as physiological emotion regulation increased the odds of membership in the low profile increased as well, 2-fold compared to the high profile. As maternal control increased the odds of membership in the low profile increased as well, almost 2-fold as compared to the sub-threshold profile and over 2-fold compared to the normative profile. Finally, there were significant interactions between physiological emotion regulation and maternal control and physiological emotion regulation and observed emotion regulation that also predicted the probability of membership in the four profiles.

Specifically, for children with higher levels of physiological emotion regulation, the level of maternal control was negatively related to the odds of being in the sub-threshold profile compared to the high profile. In addition, for children with lower levels of physiological emotion regulation, observed emotion regulation was positively related to the odds of being in the normative profile compared to the high profile. Finally, for children high on physiological regulation, observed regulation was negatively related to the odds of being in the normative profile as compared to the low profile. Therefore, children's level of physiological emotion regulation moderated the effects of both maternal control and observed emotion regulation on the probability of membership in various profiles.

CHAPTER IV

DISCUSSION

The current investigation explored whether child and maternal factors distinguished profiles of aggression across early childhood for a sample of girls and boys. Specifically, measures of observed emotion regulation, physiological emotion regulation, and maternal controlling behavior significantly predicted the probability of membership in the profiles. In addition, physiological emotion regulation moderated the effects of maternal control and observed emotion regulation on the probability of membership in the profiles. The current results support theory suggesting that emotion regulation and maternal behavior both directly relate to aggressive behavior problems and also that children's emotion regulation moderates the effects of maternal behavior on aggressive behavior problems (Bates & McFayden-Ketchum, 2000; Calkins, 1994; Calkins & Degnan, 2005b). In addition, the findings highlight specific mechanisms that may influence the relations among the multiple indices of emotion regulation, maternal behavior, and aggressive behavior in early childhood.

Longitudinal profiles of aggressive behavior from 2 to 5 years of age were examined using a semi-parametric, group-based, statistical approach. Specifically, a high profile, a low profile, a moderate-declining profile, and a moderate-increasing profile were hypothesized to emerge. Theoretically, multiple developmental patterns in aggressive behavior are expected due to individual differences including the development of behavioral regulation skills and general propensity for aggressive reactivity to the environment across childhood (Moffitt, 1993; Loeber & Stouthamer-Loeber, 1998). Thus, children may display varying levels of aggression in toddlerhood that are maintained or altered by developmental changes such as increases in emotion regulation. The latent profile analysis identified 4 profiles of aggression: a *high* profile, representing high levels of aggression reaching borderline clinical levels by age 5; a *sub-threshold* profile, representing an elevated level of aggression at age 2 and more moderate levels at ages 4 and 5; a *normative* profile, representing moderate levels of aggression at age 2 and lower levels at ages 4 and 5; and a *low* profile, representing low levels of aggression at each age. The high, sub-threshold (moderate-declining), and low profiles were consistent with hypotheses. In contrast, a normative profile was identified instead of the hypothesized moderate-increasing profile. Multiple studies substantiate the high, low, and sub-threshold profiles of aggression in early childhood (NICHD, 2004; Shaw et al., 2003; Tremblay et al., 2004), but only one study of older children has demonstrated a moderate-increasing aggression trajectory (Broidy et al., 2003). Whereas the current study attempted to replicate this finding in a younger sample of children, the current results revealed a normative profile, suggesting that increases in children's aggressive behavior may not be displayed until after early childhood.

Overall, the profiles identified in the current study are similar in terms of number and composition to those found in past research on trajectories of aggression in early childhood. For example, using a 5-item scale of aggression with a low-income sample of boys from 2 to 8 years of age, Shaw and colleagues (2003) also identified 4 trajectories: a chronic group (6%), a high-desister group (38%), a moderate-desister group (42%), and a low group (14%). In the studies that have used a semi-parametric approach to examine aggression across early childhood, there is consistent evidence for a high group, a moderate group, and a low group; with the high group typically representing 3-14% of the sample (NICHD, 2004; Shaw et al., 2003; Tremblay et al., 2004). The present study identified 4 profiles, the highest of which represented 8% of the sample. Thus, there seems to be some consistency in the patterns of aggression in early childhood across different studies. In order to further understand these specific developmental pathways of aggression, differential predictors of these patterns were explored.

Past research has predicted externalizing behavior trajectories across early childhood using maternal-report of child temperament and observed measures of child fearlessness and emotion regulation (Hill et al., 2006; Keller et al., 2005; Shaw et al., 2003; Tremblay et al., 2004). However, no study to date has examined both observed and physiological indices of temperamental reactivity and emotion regulation as predictors of aggressive profiles. In the current study, observational and physiological measures of temperamental reactivity and emotion regulation were hypothesized to differentially predict the probability of membership in the profiles. Although reactivity and regulation were originally conceptualized as separate constructs, preliminary analyses indicated they were highly correlated; therefore, these measures were combined into indices of observed emotion regulation and physiological emotion regulation. Theoretically, both reactivity and regulation are involved in the process of responding to a challenging situation (Cole et al., 2004; Hill et al., 2006). Measures of both emotional reactivity and regulation indicate whether the challenge elicited an expected emotional reaction and whether there was an effort to modulate that reaction. Without both indices, it is unclear whether emotion regulation occurred (Cole et al., 2004).

Although reactivity and regulation were highly correlated within measurement type (i.e., observed or physiological), the indices of physiological and observed emotion regulation were only modestly related ($r = .19$, $p < .05$). Prior research also demonstrates modest associations between physiological and observable measures of emotion regulation (Calkins, 1997; Calkins & Dedmon, 2000; Stifter & Corey, 2001). This suggests that physiological regulation may underlie the development of behavioral strategies, but they do not directly map onto one another. Behavioral responses are multiply determined; thus, the degree to which an individual is engaged in active physiological coping is only one influence on such processes (Calkins, 1997). In the present study observed and physiological emotion regulation were expected to differentially predict the probability of membership in the profiles and were analyzed as separate predictors in the model.

The current study revealed that observed and physiological measures of emotion regulation differentiated the profiles. Compared with the low profile, probability of membership in the high profile was predicted by lower observed and physiological emotion regulation and probability of membership in the sub-threshold profile was predicted by lower observed emotion regulation. The emotion regulation measures did not directly distinguish the normative profile from the two highest profiles. Overall, toddlers with greater observed and physiological emotion regulation displayed lower levels of aggression over time than children with lower observed and physiological emotion regulation. These findings support the hypothesis that children's emotion regulation affects their level of aggression in early childhood. Past research also has found higher observed or physiological emotion regulation predicted fewer behavior problems in toddlerhood (Calkins & Dedmon, 2000) and childhood (Eisenberg et al., 1994, 1995, 1996; Hill et al., 2006). These findings extend the current literature by examining the role of physiological regulation in profiles of aggression across early childhood.

Theoretically, emotion regulation, both behavioral and physiological, assists children in learning positive social skills by regulating their distress and allowing them to practice socially appropriate behavior (Keenan, 2000). Although social skills were not measured directly in the present study, the results suggest that children in the low profile should display well-developed social skills given the association with higher observed and physiological emotion regulation. Whereas children who are easily distressed are more likely to focus on their negative affect, children who are not as easily distressed can focus on social cues in the environment and learn how to behave appropriately (Derryberry & Reed, 1994). For example, children who are taught to be more self-regulated demonstrate greater understanding of other's emotions (Denham & Burton, 1996). In turn, this ability to focus on social cues such as other's emotions should support the development of more socially appropriate behavior. In addition, aspects of the social environment influence how children learn positive skills and if they will use them in future interactions (Calkins, 1994).

Evidence indicates that maternal behavior affects the development of both physiological and behavioral emotion regulation skills in toddlerhood (Calkins & Fox, 2002; Calkins et al., 1998). In order to explore the association between maternal behavior and childhood aggression, maternal controlling and positive behavior during interactions with children were examined in relation to the probabilities of membership in the aggressive profiles. In the current study, high maternal positivity was expected to be associated with lower levels of aggression; however, it was unrelated to the probabilities of membership in any of the profiles. In addition, high maternal control was expected to predict the probability of membership in the higher aggression profiles. Findings indicated that higher maternal control predicted the probability of membership in the low profile compared with the sub-threshold and normative profiles. These results are contrary to the hypotheses and to past findings. For instance, Shaw and colleagues found higher maternal rejecting behavior predicted the probability of membership in the chronic trajectory (Shaw et al., 2003). The current results suggest that maternal control can be beneficial when associated with lower levels of aggressive behavior.

Overall, there were few direct effects of maternal behavior on the probability of membership in the profiles, suggesting that maternal control and positivity may interact with children's levels of emotion regulation in relation to aggressive behavior in early childhood. In fact, the effect of maternal behavior may depend on the child's temperament and regulatory style (Calkins, 1994; Derryberry & Reed, 1994; Kochanska, 1993). A child who is approach-oriented and dysregulated might become frustrated and aggressive when restrained by caregivers. In contrast, a child who is more avoidanceoriented and well-regulated might become inhibited and elicit intrusive behavior from caregivers. The effects of positive maternal behavior also may vary with the child's temperament and regulatory style. For instance, a mother who is overly positive and permissive with a dysregulated child may exacerbate the problem behavior. In contrast, a mother who is positive with a well-regulated child is supporting adaptive behavior. Furthermore, maternal behavior may display weaker effects with children who exhibit moderate reactivity and regulatory styles (Derryberry & Reed, 1994).

To explore the possible interactive effects of maternal behavior on children's aggressive behaviors, interactions between emotion regulation and maternal behavior were examined as predictors of the probability of membership in the profiles. Specifically, interactions of observed and physiological emotion regulation and maternal controlling or positive behavior were hypothesized to predict profile the probability of membership in the two mid-level profiles. However, observed emotion regulation did not interact with maternal behavior to predict the probability of membership in the profiles, and there were no significant interactions with maternal positivity and either form of emotion regulation. Consistent with expectations, physiological emotion regulation did moderate the effect of maternal control on the probability of membership in the sub-threshold profile. Specifically, children with higher physiological emotion regulation were over 7 times more likely to be in the sub-threshold profile, rather than the high profile, when maternal control was low than when it was high (see Figure 1). This finding suggests that physiologically well-regulated children are better able to develop socially appropriate behavior when mothers are not as controlling. For well-regulated children, maternal control may be considered overly controlling and could communicate a lack of trust in the child's behavior (Calkins & Fox, 2002; Derryberry & Reed, 1994). Because these children may wish to demonstrate their own self-initiated control, they may become frustrated in response to maternal control and display higher levels of aggressive behavior. Furthermore, for less physiologically regulated children, maternal control did not differentiate between the high and sub-threshold profiles. It is likely that for these children their lower level of regulation is driving their aggressive behavior regardless of their mother's level of control.

Additional results revealed that indices of physiological and observed emotion regulation interacted with each other to predict the probability of membership in the normative profile compared with the high and low profiles. Specifically, children with lower physiological emotion regulation were over 3 times more likely to have a normative profile, rather than a high profile, when their observed emotion regulation was high, than when it was low (see Figure 2). On the other hand, children with higher physiological regulation were more likely to have a normative profile overall. Thus, children who cannot regulate physiologically but are able to regulate behaviorally may display more normative levels of aggression across early childhood. Theoretically, children would be expected to learn this pattern in the presence of a warm and positive caregiving environment (Beauchaine, 2001; Calkins, 1994); however, the current results do not show predictive effects of positive maternal behavior at 2-years of age. For the present study, maternal positivity was assessed during situations that may not have elicited negative reactivity from the child. An examination of maternal behavior during emotion-eliciting episodes may have provided measures of emotion socialization practices which might be more closely related to the development of behavioral regulatory skills. An alternative explanation is that other maternal behaviors, such as maternal sensitivity, displayed earlier in infancy, may be related to observable emotion regulation skills in toddlerhood and predict lower aggression across early childhood. Lending support for this theory, the NICHD Study of Early Child Care (2004) found maternal sensitivity measured at 6-months of age differentiated high and low aggression trajectories. Future research should examine what environmental characteristics seem to support behavioral regulation, especially when physiological regulation is low. A study of maternal behavior across multiple types of situations and across time might clarify what type of environment is necessary for the development of regulation skills and competent social behavior.

Physiological regulation also interacted with observed emotion regulation to predict the probability of membership in the normative profile compared with the low profile. Specifically, children with higher physiological emotion regulation were over 12 times more likely to have a normative profile, rather than a low profile, when their observed emotion regulation was low, than when it was high. This suggests that greater physiological regulation alone does not eliminate aggressive behavior altogether. On the other hand, the combination of higher physiological and observed emotion regulation increased the probability of membership in the low profile. Children in the low profile may exhibit an extremely low level of aggression and an extremely high level of regulation. Theoretically, the low profile may display abnormally low levels of aggression for early childhood because of a tendency to be physiologically and behaviorally overregulated. Although children's self-regulatory abilities are evident in toddlerhood, they typically continue to develop throughout the early school years (Posner & Rothbart, 2000). Thus, children who are highly, and perhaps overly, regulated in toddlerhood may demonstrate risk for internalizing disorders. In addition, findings also indicated that the low profile was associated with higher maternal control. Research on children with internalizing behavior problems posits that overregulation results in social withdrawal and inhibited behavior (Calkins & Fox, 2002; Zahn-Waxler, Klimes-Dougan, & Slattery, 2000). In turn, mothers of inhibited children are likely to display more intrusive and oversolicitous behavior than mothers of uninhibited children (Rubin, Cheah, & Fox, 2001; Rubin, Hastings, Stewart, Henderson, & Chen, 1997). This tendency to take charge of the interactions may assist their child with participating or protect their child from feeling anxious; however, it prevents the child from exposure to multiple contexts and reinforces the anxious behavior. In general, higher child regulation and more maternal control predicted low levels of aggression. These results could be describing a group of well adjusted children or a group at risk for internalizing problems. In turn, the normative profile may include well-regulated children displaying normative levels of aggression or children who are moderately regulated and displaying moderate levels of aggression. The outcomes associated with these profiles are unknown. Future work examining outcomes of the aggressive profiles is necessary to provide a greater understanding of the differential developmental pathways of aggression.

Summary and Implications

As hypothesized, four profiles of children's aggressive behavior from 2 to 5 years of age were differentiated by observed and physiological emotion regulation and maternal controlling behavior. In addition, physiological emotion regulation interacted with both maternal control and observed emotion regulation to predict the probability of membership in the profiles. The probability of membership in the profiles differed in important ways based on both maternal and child behavior during toddlerhood. Overall, children in the high profile displayed low observed and physiological emotion regulation, and in some instances had higher maternal control. Children in the sub-threshold profile displayed lower observed emotion regulation and in some instances had lower maternal control. Children in the normative profile displayed moderate physiological emotion regulation, but in some instances lower observed emotion regulation, and had low maternal control. Finally, children in the low profile displayed high observed and physiological emotion regulation and had high maternal control. These findings support theory and research suggesting direct and interactive effects of emotion regulation and maternal behavior on aggressive behavior problems (Bates & McFayden-Ketchum, 2000; Calkins, 1994; Calkins & Degnan, 2005b). Furthermore, the results suggest that future investigations should examine the transactional mechanisms between emotion regulation, maternal behavior, and specific levels of behavior problems in early childhood.

The current results are consistent with a developmental psychopathology perspective (Kuperminc & Brookmeyer, 2005; Sroufe & Rutter, 1984). Inherent to this perspective are three challenges for the field: to account for the concepts of multifinality and equifinality, to account for disordered behavior in the context of development, and to account for the interactions between child characteristics and the environment (Kuperminc & Brookmeyer, 2005). The present study accounted for each of these challenges to some extent. Within the present findings are examples of both multifinality and equifinality. The concept of multifinality suggests that specific factors may operate differently resulting in different outcomes over time, while the concept of equifinality suggests that similar outcomes may result from multiple factors or pathways (Sroufe & Rutter, 1984). Presently, in some instances maternal control increased the probability of membership in both the low and the high aggression profiles, supporting the concept of multifinality. In addition, emotion regulation and maternal control both predicted the probability of membership in the low and sub-threshold profiles, supporting the concept of equifinality. The second challenge, to account for disordered behavior in the context of development, was also addressed by examining developmentally appropriate measures of aggressive behavior across time. In addition, measuring profiles that included the level of aggression at multiple time points, took developmental context into account by realizing that levels of aggression at one time point might operate differently from persistent levels across early childhood. Finally, in support of the third challenge, child emotion regulation interacted with maternal behavior to predict the profiles of aggression. In the study of child behavior problems, interaction effects are frequently discussed, but there are fewer empirically demonstrated. Thus, the current findings add to this literature in important ways. Unfortunately, the present study did not examine the specific mechanisms that lead emotion regulation, maternal behavior, and their interaction to predict certain levels of aggression in early childhood. Given that maternal control predicted both high and low profiles, an analysis examining the different processes by which these distinct outcomes occur is an important next step. Nevertheless, the current expected and unexpected findings both support the developmental psychopathology framework and suggest process-oriented mechanisms to examine in future work.

One unexpected finding was that in some instances higher maternal control predicted the probability of membership in both the high and low profiles. Typically, parental control is conceptualized as a risk factor for externalizing problems, but the current study found protective effects for control in the low profile. Theoretically, parental control may contribute to both externalizing and internalizing behavior problems through different transactional processes involving child reactivity and regulation (Calkins, 1994; Kochanska, 1991). Although there are distinct differences between externalizing and internalizing behavior problems, they both are associated with high reactivity. For externalizing problems this reactivity is displayed as anger or frustration, while for internalizing problems it is displayed as fear or anxiety. In addition, high reactivity influences the development of emotional and behavioral regulation across early childhood through its interaction with the environment (Calkins, 1994; Calkins & Fox, 2002; Kochanska, 1991). For children with externalizing behavior problems, maternal control may elicit anger and resentment that results in rejecting the initial request and poor social development (Kochanska, 1991). In contrast, for children with internalizing behavior problems, maternal control may prevent the development of self-regulation techniques by limiting exposure to a variety of situations (Rubin et al., 1997). In this case, mothers may be overly directive and intrusive in order to prevent their child from failure or performance anxiety. However, this limits the child's ability to develop self-regulatory behavioral skills and may reinforce an anxious temperament. Continued follow-up of these profiles to examine the outcomes and the transactional mechanisms by which maternal control and child emotion regulation relate to both types of behavior problems is necessary. Through interactive effects of maternal control and child emotion regulation, maternal control operates as both a risk and a protective factor for child behavior problems. Maternal control that is responsive and sensitive to the child's needs for structure and assistance should ameliorate both externalizing and internalizing behavior problems. However, when maternal control is intrusive and insensitive children may increase or maintain their problem behavior (Calkins, 1994; Kochanska, 1991; Rubin et al, 1997). Overall, the current findings suggest avenues for future research on parental behavior within samples with specific behavioral profiles across early childhood.

Another unexpected finding was the interaction of observed and physiological emotion regulation predicting the probability of membership in the profiles. Although physiological systems may underlie the display and development of reactivity and regulatory behaviors, they do not directly map onto one another. Empirically, the two sets of processes are only modestly related (Calkins, 1997; Calkins & Dedmon, 2000; Calkins & Degnan, 2005a; Stifter & Corey, 2001). Behavioral responses are multiply determined; thus, the degree to which an individual is engaged in active physiological regulation is only one influence on such processes (Calkins, 1997). Examining them separately, the present study suggests physiological and behavioral emotion regulatory abilities are separate constructs in toddlerhood. However, the findings indicate that higher levels of either one may protect children from high, stable profiles of aggression across early childhood. In an effort to uncover the specific processes involved in emotion regulation, future research needs to explore the transactional effects of physiological and behavioral regulatory systems as possible risk and protective mechanisms for adaptive social development throughout early childhood. In addition, these investigations should examine how maternal behavior interacts with these regulatory systems to assist or impede positive social development.

Overall, the analysis used in the current study (i.e., latent profile analysis) improves on past methods used to identify groups, which were error-prone or based on ad-hoc algorithms (e.g., cluster analysis), rather than formal statistical models. LPA also allows for uncertainty in profile assignment, predicts the probability of membership in a profile, and describes behavior over time even when the measurement of that behavior changes. In addition, these findings would not have been captured with cross-sectional or variable-oriented analyses. For example, maternal control is not associated with higher aggression; rather, it is associated with extreme levels (high and low) of aggressive behavior across early childhood. Similarly, non-linear relations were found between observed emotion regulation and the probability of membership in the normative profile. Thus, LPA allows for the description of multiple patterns of aggression during early childhood and the differentiation of those patterns with multiple indices of child and family functioning.

Limitations

Although the present study has contributed to the current literature by illuminating the complex relations among maternal behavior, emotion regulation, and profiles of aggression, limitations linked to the investigation need to be addressed. Despite the use of observational measures of emotion regulation and maternal behavior, other indices of the child and the mother-child relationship would have strengthened the current findings. For instance, although the current study included measures of HP and RSA, the addition of a purely sympathetic arousal measure might have clarified the relations between physiology and behavior. While RSA is considered a purely parasympathetic measure, HP is influenced by both the sympathetic and parasympathetic branches of the autonomic nervous system. Although HP and RSA were highly correlated in the present study, including a measure of sympathetic influence on the heart (e.g., Pre-ejection period) might have allowed for a more precise analysis of the physiological processes involved in reactivity and regulation to the environment. Moreover, an examination of multiple physiological and behavioral indices, measured during different emotion-eliciting episodes, would provide an opportunity to analyze regulatory mechanisms across multiple contexts.

In addition, an assessment of maternal behaviors during different emotion-eliciting episodes would permit the examination of specific emotion socialization practices. Although maternal control may be associated with both externalizing and internalizing behavior problems, a more detailed analysis may illuminate differences in how control is portrayed or utilized. For example, an examination of maternal behavior and child regulation during both fearful and frustrating episodes may help clarify the relations between maternal behavior, child emotion regulation, and behavior problems. A child who is prone to externalizing behavior may appear more reactive to the frustrating episode and elicit more maternal control in that context. In contrast, a child who is prone to internalizing behavior may appear more reactive to the fear episode and elicit more maternal control in that context.

Child behavior during the mother-child interactions also was not included in the present study. Interactions are bidirectional processes in which all members affect each other in a reciprocal manner (Bell, 1968). Thus, including the child's responses to maternal control may have clarified the relation of maternal control to the child's the probability of membership in a particular profile. For instance, children with externalizing behavior problems may respond to maternal control with noncompliance, whereas children with internalizing behavior problems may respond to maternal control with compliance. Future investigations of the bidirectional processes within the mother-child relationship may highlight the different mechanisms leading to different types of behavior problems.

In addition to these measurement issues, the current study was somewhat limited by the sample and LPA analysis used. Although SEMM is a useful analysis for longitudinal data, the classes (profiles) do not necessarily represent qualitatively distinct groups in the general population. Instead, they represent patterns that exist within the sample examined (Bauer & Curran, 2004). The present sample was over-selected for externalizing behavior problems and thus, the current results may not be generalizable to a randomized sample. Therefore, it is necessary to replicate and confirm these results with other samples before establishing strong conclusions. In addition, because of the selection criteria, 8% of the sample was included in a high, stable profile of aggression from 2 to 5 years of age. Studies using samples at high-risk for behavior problems are limited but necessary to examine the factors involved in the stability of childhood aggression (Shaw et al., 2003). A sample with a greater percentage of high aggressors would be useful, but it would be difficult to obtain while maintaining a large community sample. The profiles identified in the current at-risk community sample will only become established with repetition and confirmation in other samples. Thus, future work should examine similar child and maternal factors in relation to aggressive behavior using samples with different demographic constellations.

REFERENCES

Achenbach, T. M. (1991). *Manual for the child behavior checklist/4-18 and 1991 profile*. Burlington, VT: Department of Psychiatry, University of Vermont.

Achenbach, T. M. (1992). *Manual for the child behavior checklist/2-3 and 1992 profile*. Burlington, VT: Department of Psychiatry, University of Vermont.

Achenbach, T. M. & Edelbrock, C. (1983). *Manual for the child behavior checklist and revised child behavior profile.* Burlington, VT: University of Vermont, Department of Psychiatry.

Achenbach, T. M., Edelbrock, C., & Howell, C. T. (1987). Empirically based assessment of the behavioral/emotional problems of 2- and 3-year-old children. *Journal of Abnormal Child Psychology,* 15, 629-650.

Bates, J. E. & McFayden-Ketchum, S. (2000). Temperament and parent-child relations as interacting factors in children's behavioral adjustment. In V. J. Molfese & D. L. Molfese (Eds.), *Temperament and Personality Development Across the Life Span* (pp. 141-176). Mahwah, NJ: Lawrence Erlbaum Associates.

Bates, J. E., Pettit, G. S., Dodge, K. A., & Ridge, B. (1998). Interaction of temperamental resistance to control and restrictive parenting in the development of externalizing behavior. *Developmental Psychology, 34,* 982-995.

Bauer, D. J. & Curran, P. J. (2003). Overextraction of latent trajectory classes: Much ado about nothing? Reply to Rindskopf (2003), Muthén (2003), and Cudeck and Henly (2003). *Psychological Methods, 8,* 384-393.

Bauer, D. J. & Curran, P. J. (2004). The integration of continuous and discrete latent variable models: Potential problems and promising opportunities. *Psychological Methods, 9,* 3-29.

Beauchaine, T. (2001). Vagal tone, development, and Gray's motivational theory: toward an integrated model of autonomic nervous system functioning in psychopathology. *Development and Psychopathology, 13,* 183-214.

Bell, R. Q. (1968). A reinterpretation of the direction of effects in studies of socialization. *Psychological Review, 75,* 81-95.

Belsky, J., Hsieh, K. H., & Crnic, K. (1998). Mothering, fathering, and infant negativity as antecedents of boys' externalizing problems and inhibition at age 3 years: differential susceptibility to rearing experience? *Development and Psychopathology, 10,* 301-319.

Berkowitz, L. (1993). *Aggression: Its causes, consequences, and control*. Philadelphia, PA: Temple University Press.

Bornstein, M. H. & Suess, P. E. (2000). Child and mother cardiac vagal tone: Continuity, stability, and concordance across the first 5 years. *Developmental Psychology, 36*, 54-65.

Borum, R. (2003, November). Assessing risk of violence in adolescents. Seminar presented at the Bi-annual meeting of the North Carolina Psychological Association, Chapel Hill, NC.

Brame, B., Nagin, D. S., & Tremblay, R. E. (2001). Developmental trajectories of physical aggression from school entry to late adolescence. *Journal of Child Psychology and Psychiatry, 42*, 503-512.

Braungart, J. M. & Stifter, C. A. (1991). Regulation of negative reactivity during the Strange Situation: Temperament and attachment in 12-month-old infants. *Infant Behavior and Development, 14,* 349-364.

Broidy, L. M., Nagin, D. S., Tremblay, R. E., Bates, J. E., Brame, B., Dodge, K. A. et al. (2003). Developmental trajectories of childhood disruptive behaviors and adolescent delinquency: a six-site, cross-national study. *Developmental Psychology, 39,* 222-245.

Bronson, W. C. (1985). Growth in the organization of behavior over the second year of life. *Developmental Psychology, 21,* 108-117.

Buss, K. A. & Goldsmith, H. H. (1998). Fear and anger regulation in infancy: Effects on the temporal dynamics of affective expression. *Child Development, 69,* 359-374.

Calkins, S. D. (1994). Origins and outcomes of individual differences in emotion regulation. In N. A. Fox (Ed.) Emotion regulation: Behavioral and biological considerations. *Monographs for the Society for Research on Child Development, 59(2-3, Serial No. 240),* 53-72.

Calkins, S. D. (1997). Cardiac vagal tone indices of temperamental reactivity and behavioral regulation in young children. *Developmental Psychobiology, 31,* 125-135.

Calkins, S. D. (2002). Does aversive behavior during toddlerhood matter? The effects of difficult temperament on maternal perceptions and behavior. *Infant mental health journal, 23,* 381-402.

Calkins, S. D. & Dedmon, S. E. (2000). Physiological and behavioral regulation in two-year-old children with aggressive/destructive behavior problems. *Journal of Abnormal Child Psychology, 28,* 103-118.

Calkins, S. D., Dedmon, S. E., Gill, K. L., Lomax, L. E., & Johnson, L. M. (2002). Frustration in infancy: Implications for emotion regulation, physiological processes, and temperament. *Infancy, 3,* 175-197.

Calkins, S. D. & Degnan, K. A (2005a, April). *Temperament and adjustment in preschool: The role of physiological and behavioral response to frustration*. Poster presented at the Biennial Meeting of the Society for Research in Child Development, Atlanta, GA.

Calkins, S. D. & Degnan, K. A. (2005b). Temperament in early development. In R. Ammerman (Ed.), *Comprehensive Handbook of Personality and Psychopathology*, Vol 3: Child Psychopathology. New York: Wiley.

Calkins, S. D. & Fox, N. A. (2002). Self-regulatory processes in early personality development: A multilevel approach to the study of childhood social withdrawal and aggression. *Development and Psychopathology, 14,* 477-498.

Calkins, S. D., Gill, K. L., Johnson, M. C., & Smith, C. L. (1999). Emotional reactivity and emotional regulation strategies as predictors of social behavior with peers during toddlerhood. *Social Development, 8,* 310-334.

Calkins, S. D. & Johnson, M. C. (1998). Toddler regulation of distress to frustrating events: temperamental and maternal correlates. *Infant Behavior and Development, 21,* 379-395.

Calkins, S. D., Smith, C. L., Gill, K. L., & Johnson, M. C. (1998). Maternal interactive style across contexts: Relations to emotional, behavioral, and physiological regulation during toddlerhood. *Social Development, 7,* 350-369.

Chang, L., Schwartz, D., Dodge, K. A., & McBride-Chang, C. (2003). Harsh parenting in relation to child emotion regulation and aggression. *Journal of Family Psychology, 17,* 598-606.

Coie, J. D. & Dodge, K. A. (1998). Aggression and antisocial development. In W. Damon & N. Eisenberg (Eds.), *Handbook of child psychology: Vol. 3. Social, emotional, and personality development* (5th ed., pp. 779-862). New York: Wiley.

Cole, P. M., Martin, S. E., Dennis, T. A. (2004). Emotion regulation as a scientific construct: Methodological challenges and directions for child development research. *Child Development, 75,* 317-333.

Cole, P. M., Teti, L. O., & Zahn-Waxler, C. (2003). Mutual emotion regulation and the stability of conduct problems between preschool and early school age. *Development and Psychopathology, 15*, 1-18.

Connor, D. F. (2002). *Aggression and antisocial behavior in children and adolescents: Research and treatment*. New York: The Guilford Press.

Cummings, E. M., Iannotti, R. J., & Zahn-Waxler, C. (1989). Aggression between peers in early childhood: individual continuity and developmental change. *Child Development, 60,* 887-895.

Davidson, R. J., Putnam, K. M., & Larson, C. L. (2000). Dysfunction in the neural circuitry of emotion regulation - a possible prelude to violence. *Science, 289,* 591-594.

Degnan, K. A. & Hungerford, A. E. (2003, April). *Predicting toddlers' self-regulation and peer behavior from infant temperament and maternal behavior*. Poster presented at the Biennial Meeting of the Society for Research in Child Development, Tampa, FL.

Denham, S. A., Workman, E., Cole, P. M., Weissbrod, C., Kendziora, K. T., & Zahn-Waxler, C. (2000). Prediction of externalizing behavior problems from early to middle childhood: the role of parental socialization and emotion expression. *Development and Psychopathology, 12,* 23-45.

Derryberry, D. & Reed, M. A. (1994). Temperament and the self-organization of personality. *Development and Psychopathology, 6,* 653-676.

Diener, M. L. & Kim, D. (2003). Maternal and child predictors of preschool children's social competence. *Applied Developmental Psychology, 25,* 3-24.

D'Unger, A., Land, K., McCall, P., & Nagin, D. (1998). How many latent classes of delinquent/criminal careers? Results from mixed Poisson regression analyses of the London, Philadelphia, and Racine cohort studies. *American Journal of Sociology, 103,* 1593-1630.

Eisenberg, N., Fabes, R. A., & Murphy, B. C. (1996). Parents' reactions to children's negative emotions: relations to children's social competence and comforting behavior. *Child Development, 67*, 2227-2247.

Eisenberg, N., Fabes, R. A., Murphy, B. C., Maszk, P., Smith, M., & Karbon, M. (1995). The role of emotionality and regulation in children's social functioning: a longitudinal study. *Child Development, 66,* 1360-1384.

Eisenberg, N., Fabes, R. A., Nyman, M., Bernzweig, J., & Pinuelas, A. (1994). The relations of emotionality and regulation to children's anger-related reactions. *Child Development,* 65, 109-128.

Everitt, B. & Hand, D. J. (1981). *Finite mixture distributions.* New York: Chapman & Hall.

Gibson, W. A. (1959). Three multivariate models: Factor analysis, latent structure analysis and latent profile analysis. *Psychometrika, 24,* 229-252.

Gilliom, M., Shaw, D. S., Beck, J. E., Schonberg, M. A., & Lukon, J. L. (2002). Anger regulation in disadvantaged preschool boys: strategies, antecedents, and the development of self-control. *Development and Psychopathology, 38,* 222-235.

Goldsmith, H. H. & Rothbart, M. K. (1993). *The laboratory temperament assessment battery: Locomotor version 2.02(LAB-TAB).* University of Wisconsin.

Hill, A. L., Degnan, K. A., Calkins, S. D., & Keane, S. P. (2006). Profiles of externalizing behavior problems for boys and girls across preschool: The roles of emotion regulation and inattention. *Manuscript submitted for publication.*

Hipp, J. R. & Bauer, D. J. (in press). Local solutions in the estimation of growth mixture models. *Psychological Methods.*

Hollingshead, A. B. (1975). *Four-factor index of social status*. New Haven, CT: Yale University.

Houck, G. M. (1999). The measurement of child characteristics from infancy to toddlerhood: Temperament, developmental competence, self-concept, and social competence. *Issues in Comprehensive Pediatric Nursing, 22*, 101-127.

Hubbard, J. A., Smithmyer, C. M., Ramsden, S. R., Parker, E. H., Flanagan, K. D., Dearing, K. F. et al. (2002). Observational, physiological, and self-report measures of children's anger: relations to reactive versus proactive aggression. *Child Development, 73,* 1101-1118.

Jones, B. L., Nagin, D. S., & Roeder, K. (2001). A SAS procedure based on mixture models for estimating developmental trajectories. *Sociological Methods and Research, 29*, 374-393.

Kagan, J., Resnick, J. S., & Snidman, N. (1987). The physiology and psychology of behavioral inhibition in children. *Child Development, 58*, 1459-1473.

Keenan, K. (2000). Emotion dysregulation as a risk factor for child psychopathology. *Clinical Psychology: Science and Practice,* 7, 418-434.

Keenan, K. & Shaw, D. (1997). Developmental and social influences on young girls' early problem behavior. *Psychological Bulletin, 121,* 95-113.

Keenan, K., Shaw, D., Delliquadri, E., Giovannelli, J., & Walsh, B. (1998). Evidence for the continuity of early problem behaviors: application of a developmental model. *Journal of Abnormal Child Psychology, 26,* 441-452.

Keller, T. E., Spieker, S. J., & Gilchrist, L. (2005). Patterns of risk and trajectories of preschool problem behaviors: A person-oriented analysis of attachment in context. *Development and Psychopathology, 17*, 349-384.

Keribin, C. (1997). Consistent estimation of the order of mixture models. *The Indian Journal of Statistics, 62*, 49-66.

Kochanska, G. (1991). Socialization and temperament in the development of guilt and conscience. *Child Development, 62,* 1379-1392.

Kochanska, G. (1993). Toward a synthesis of parental socialization and child temperament in early development of conscience. *Child Development, 64,* 325-347.

Kopp, C. B. (1982). Antecedents of self-regulation: A developmental perspective. *Developmental Psychology, 18,* 199-214.

Kuperminc, G. P. & Brookmeyer, K. A. (2005). Developmental psychopathology. In R. Ammerman (Ed.), *Comprehensive Handbook of Personality and Psychopathology*, Vol 3: Child Psychopathology. New York: Wiley.

Lemery, K. S., Goldsmith, H. H., Klinnert, M. D., & Mrazek, D. A. (1999). Developmental models of infant and childhood temperament. *Developmental Psychology, 35,* 189-204.

Liew, J., Eisenberg, N., Losoya, S. H., Fabes, R. A., Guthrie, I. K., & Murphy, B. C. (2003). Children's physiological indices of empathy and their socioemotional adjustment: Does caregivers' expressivity matter? *Journal of Family Psychology, 17,* 584-597.

Little, R. J. & Rubin, D. B. (1987). *Statistical analysis with missing data.* New York: John Wiley and Sons.

Loeber, R., Farrington, D. P., & Petechuk, D. (2003). *Child delinquency: Early intervention and prevention.* Washington, D.C.: U.S. Department of Justice, Office of Justice Programs, Office of Juvenile Justice and Delinquency Prevention.

Loeber, R. & Stouthamer-Loeber, M. (1998). Development of juvenile aggression and violence. Some common misconceptions and controversies. *American Psychologist, 53,* 242-259.

Magnusson, D. & Cairns, R. B. (1996). Developmental science: Toward a unified framework. In G. H. Elder Jr. & R. B. Cairns (Eds.), *Developmental science*. (pp.7-30). New York, NY, US: Cambridge University Press.

Mezzacappa, E., Tremblay, R. E., Kindlon, D., Saul, J. P., Arseneault, L., Seguin, J. et al. (1997). Anxiety, antisocial behavior and heart rate regulation in adolescent males. *Journal of Child Psychology and Psychiatry, 38,* 457-469.

Moffitt, T. E. (1993). Adolescence-limited and life-course-persistent antisocial behavior: A developmental taxonomy. *Psychological Review, 100*, 674-701.

Moffitt, T. E. & Caspi, A. (2001). Childhood predictors differentiate life-course persistent and adolescent-limited antisocial pathways among males and females. *Development and Psychopathology, 13*, 355-375.

Moore, G. A. & Calkins, S. D. (2004). Infants' vagal regulation in the still-face paradigm is related to dyadic coordination of mother-infant interaction. *Developmental Psychology, 40,* 1068-1080.

Muthén, B. (2001). Latent variable mixture modeling. In G. A. Marcoulides & R. E. Schumacker (eds.), *New Developments and Techniques in Structural Equation Modeling* (pp. 1-33). Mawah, NJ: Lawrence Erlbaum Associates.

Muthén, B. (2004). Latent variable analysis: Growth mixture modeling and related techniques for longitudinal data. In D. Kaplan (ed.), *Handbook of quantitative methodology for the social sciences* (pp. 345-368). Newbury Park, CA: Sage Publications.

Muthén, L. & Muthén, B. (2004). *Mplus 3.0 user's guide.* Los Angeles: Author.

Nagin, D. (1999). Analyzing developmental trajectories: A semiparametric, group-based approach. *Psychological Methods, 4*, 139-157.

Nagin, D. & Tremblay, R. E. (2001). Parental and early childhood predictors of persistent physical aggression in boys from kindergarten to high school. *Archives of General Psychiatry, 58,* 389-394.

NICHD Early Child Care Research Network (2004). Trajectories of physical aggression from toddlerhood to middle childhood: Predictors, correlates, and outcomes.

Monographs for the Society for Research on Child Development, 69(4, Serial No. 278).

O'Brien, M. (2005). Studying individual and family development: Linking theory and research. *Journal of Marriage and Family, 67,* 880-890.

Olweus, D. (1979). Stability of aggressive reaction patterns in males: a review. *Psychological Bulletin, 86,* 852-875.

Owens, E. B. & Shaw, D. S. (2003). Predicting growth curves of externalizing behavior across the preschool years. *Journal of Abnormal Child Psychology, 31,* 575-590.

Pampel, F. C. (2000). *Logistic regression: A primer.* (Sage University Paper Series on Quantitative Applications in the Social Sciences, Series no. 07-132). Thousand Oaks, CA: Sage.

Paterson, G. & Sanson, A. (1999). The association of behavioural adjustment to temperament, parenting, and family characteristics among 5-year-old children. *Social Development, 8,* 293-309.

Patterson, G. R. (1993). Orderly change in a stable world: The antisocial traits as a chimera. *Journal of Consulting and Clinical Psychology, 61,* 911-919.

Pine, D. S., Wasserman, G. A., Miller, L., Coplan, J. D., Bagiella, E., Kovelenku, P. et al. (1998). Heart period variability and psychopathology in urban boys at risk for delinquency. *Psychophysiology, 35,* 521-529.

Porges, S. W. (1985). *Method and apparatus for evaluating rhythmic oscillations in aperiodic physiological response systems*. United States patent no. 4520944.

Porges, S. W. (1991). Vagal tone: Autonomic mediator of affect. In J. A.Garber & K. A. Dodge (Eds.), *The Development of Affect Regulation and Dysregulation* (pp. 111-128). New York: Cambridge University Press.

Porges, S. W., Doussard-Roosevelt, J. A., & Maiti, A. K. (1994). Vagal tone and the physiological regulation of emotion. *Monographs for the Society for Research on Child Development, 59,* 167-187.

Posner, M. I. & Rothbart, M. K. (2000). Developing mechanisms of self-regulation. *Development and Psychopathology, 12,* 427-441.

Raine, A., Venables, P. H., & Mednick, S. A. (1997). Low resting heart rate at age 3 years predisposes to aggression and age 11 years: Evidence from the Mauritius Child Health Project. *Journal of the American Academy of Child and Adolescent Psychiatry, 36,* 1457-1464.

Rothbart, M. K., Ahadi, S. A., & Evans, D. E. (2000). Temperament and personality: origins and outcomes. *Journal of Personality and Social Psychology, 78,* 122-135.

Rothbart, M. K., Ahadi, S. A., Hershey, K. L., & Fisher, P. (2001). Investigations of temperament at three to seven years: The children's behavior questionnaire. *Child Development, 72,* 1394-1408.

Rothbart, M. K. & Bates, J. E. (1998). Temperament. In W. Damon & N. Eisenberg (Eds.), *Handbook of child psychology: Vol. 3. Social, emotional, and personality development* (5th ed., pp. 105-176). New York: Wiley.

Rothbart, M. K. & Bates, J. E. (2006). Temperament. In W. Damon, R. Lerner, & N. Eisenberg (Eds.), *Handbook of child psychology: Vol 3. Social, emotional, and personality development* (6th ed.). New York: Wiley.

Rothbart, M. K., Derryberry, D., & Hershey, K. L. (2000). Stability of temperament in childhood: Laboratory infant assessment to parent report at seven years. In V. J.Molfese & D. L. Molfese (Eds.), *Temperament and Personality Development Across the Life Span* (pp. 85-119). Mahwah, NJ: Lawrence Erlbaum Associates.

Rothbaum, F. & Weisz, J. R. (1994). Parental caregiving and child externalizing behavior in nonclinical samples: A meta-analysis. *Psychological Bulletin*, 116, 55-74.

Rubin, K. H., Burgess, K. B., Dwyer, K. M., & Hastings, P. D. (2003). Predicting preschoolers' externalizing behaviors from toddler temperament, conflict, and maternal negativity. *Developmental Psychology, 39,* 164-176.

Rubin, K. H., Cheah, C. S. L., & Fox, N. A. (2001). Emotion regulation, parenting, and display of social reticence in preschoolers. *Early Education and Development, 12*, 97-115.

Rubin, K. H., Hastings, P., Chen, X., Stewart, S., & McNichol, K. (1998). Intrapersonal and maternal correlates of aggression, conflict, and externalizing problems in toddlers. *Child Development, 69,* 1614-1629.

Rubin, K. H., Hastings, P. D., Stewart, S. L., Henderson, H. A., & Chen, X. (1997). The consistency and concomitants of inhibition: Some of the children, all of the time. *Child Development, 68,* 467-483.

Scarpa, A. & Raine, A. (1997). Psychophysiology of anger and violent behavior. *Anger, Aggression, and Violence, 20,* 375-394.

Schafer, J. L. & Graham, J. W. (2002). Missing Data: Our view of the state of the art. *Psychological Methods, 7,* 147-177.

Shaw, D. S., Gilliom, M., Ingoldsby, E. M., & Nagin, D. S. (2003). Trajectories leading to school-age conduct problems. *Developmental Psychology, 39,* 189-200.

Shaw, D. S., Winslow, E. B., Owens, E. B., Vondra, J. I., Cohn, J. F., & Bell, R. Q. (1998). The development of early externalizing problems among children from low-income families: a transformational perspective. *Journal of Abnormal Child Psychology, 26,* 95-107.

Silverthorn, P. & Frick, P. J. (1999). Developmental pathways to antisocial behavior: the delayed-onset pathway in girls. *Development and Psychopathology, 11,* 101-126.

Smith, C. L., Calkins, S. D., Keane, S. P., Anastopoulos, A. D., & Shelton, T. L. (2004). Predicting stability and change in toddler behavior problems: contributions of maternal behavior and child gender. *Developmental Psychology, 40,* 29-42.

Sroufe, L. A. & Rutter, M. (1984). The domain of developmental psychopathology. *Child Development, 55,* 17-29.

Stifter, C. A. & Braungart, J. M. (1995). The regulation of negative reactivity in infancy: Function and development. *Developmental Psychology, 31,* 448-455.

Stifter, C. A. & Corey, J. M. (2001). Vagal regulation and observed social behavior in infancy. *Social Development, 10,* 189-201.

Stifter, C. A. & Fox, N. A. (1990). Infant reactivity: Physiological correlates of newborn and 5-month temperament. *Developmental Psychology, 26*, 582-588.

Stifter, C. A., Fox, N. A., & Porges, S. W. (1989). Facial expressivity and vagal tone in 5- and 10-month-old infants. *Infant Behavior and Development, 12*, 127-137.

Tremblay, R. E. (2000). The development of aggressive behavior during childhood: What have we learned in the past century? *International Journal of Behavioral Development*, 24, 129-141.

Tremblay, R. E., Nagin, D. S., Seguin, J. R., Zoccolillo, M., Zelazo, P. D., Boivin, M. et al. (2004). Physical aggression during early childhood: trajectories and predictors. *Pediatrics, 114,* e43-e50.

Vitaro, F., Brendgen, M., & Tremblay, R. E. (2002). Reactively and proactively aggressive children: antecedent and subsequent characteristics. *Journal of Child Psychology and Psychiatry, 43,* 495-505.

Zahn-Waxler, C., Klimes-Dougan, B., & Slattery, M. J. (2000). Internalizing problems of childhood and adolescence: Prospects, pitfalls, and progress in understanding the development of anxiety and depression. *Development and Psychopathology, 12,* 443-466.

APPENDIX A

TABLES

Table 1.

Descriptive Statistics of Covariates and Predictors

Measures	N	Min	Max	*M*	*Sd*
		2-year Measures			
Socioeconomic Status	318	14.00	66.00	39.56	10.82
Proportion of Distress	318	0.00	0.98	0.11	0.17
Global Negative Affect	318	0.00	4.00	0.75	0.85
Global Episode Affect	318	-3.00	2.00	-.11	0.78
Distraction	318	0.50	2.50	1.71	0.36
Effectiveness of Distraction	318	0.50	3.00	2.77	0.45
Global Regulation	318	0.00	4.00	3.32	0.84
Baseline HP	318	373.57	721.18	548.17	51.78
Frustration HP	318	359.92	694.20	517.00	47.15
Baseline RSA	318	1.10	8.79	5.49	1.27
Frustration RSA	318	1.45	8.57	4.89	1.16
Child-Centered Statements	318	2.00	35.19	18.66	5.73
Adult-Centered Statements	318	6.67	41.11	20.03	5.95
Global Warmth/Positive Affect	318	1.00	4.00	3.12	0.76

Table 1 (cont'd).

Descriptive Statistics of Covariates and Predictors

Measures	N	Min	Max	*M*	*Sd*
2-year Measures (cont'd)					
Global Strictness/Punitiveness	318	1.00	4.00	2.48	0.64
Global Responsiveness/Sensitivity	318	1.00	4.00	3.27	0.67
4-year Measures					
Socioeconomic Status	252	17.00	66.00	41.98	10.82
5-year Measures					
Socioeconomic Status	276	14.00	66.00	42.76	10.75

Table 2.

Descriptive Statistics of 2, 4, and 5-year Aggression Total CBCL Scores

Measures	N	Min	Max	*M*	*Sd*
2-year Aggression Total	318	0.00	29.00	10.04	5.68
4-year Aggression Total	274	0.00	28.00	8.93	5.97
5-year Aggression Total	252	0.00	33.00	8.73	6.84

Table 3.

Inter-correlations of Reactivity and Regulation Measures at 2-years of Age

	Negative reactivity	Episode affect	Distraction	Distraction Effectiveness	Global Regulation
Proportion of distress	.77**	-.71**	-.26**	-.59**	-.78**
Negative reactivity		-.81**	-.35**	-.67**	-.91**
Episode affect			.30**	.65**	.77**
Distraction				.43**	.35**
Distraction Effectiveness					.67**

Table 4.

Descriptive Statistics of Final Composite Variables and Average Aggression Scores

Measures	N	Min	Max	*M*	*sd*
Mean SES (2, 4, 5 years of age)	318	-2.44	2.49	-0.02	1.00
Observed Emotion Regulation	318	-3.28	1.01	0.02	0.76
Physiological Emotion Regulation	318	-3.72	2.75	0.01	0.94
Maternal Positive Behavior	318	-3.10	1.77	-0.02	1.01
Maternal Controlling Behavior	318	-2.01	2.43	0.00	0.96
2-year Mean Aggression	318	0.00	1.93	0.67	0.38
4-year Mean Aggression	274	0.00	1.40	0.45	0.29
5-year Mean Aggression	252	0.00	1.65	0.44	0.34

Table 5.

Odds Ratios With the High Profile as Comparison

Measure	β	SE	*z*	Odds Ratio
Sub-Threshold profile				
Observed Emotion Regulation (ER)	0.51	0.30	1.70	1.66
Physiological ER	0.46	0.26	1.77	1.59
Maternal Control	-0.36	0.29	-1.23	0.70
Observed ER x Physiological ER	-0.27	0.31	-0.86	0.77
Physiological ER x Maternal Control	-0.72	0.28	-2.60**	0.49 (2.06)
Normative profile				
Observed Emotion Regulation (ER)	0.44	0.27	1.61	1.55
Physiological ER	0.56	0.24	2.30*	1.74 (.57)
Maternal Control	-0.43	0.28	-1.54	0.65
Observed ER x Physiological ER	-0.54	0.26	-2.06*	0.58 (1.71)
Physiological ER x Maternal Control	-0.49	0.26	-1.89	0.61
Low profile				
Observed Emotion Regulation (ER)	1.80	0.59	3.06**	6.07 (.16)
Physiological ER	0.65	0.28	2.33*	1.91 (.52)
Maternal Control	0.32	0.35	0.93	1.38
Observed ER x Physiological ER	0.21	0.40	0.52	1.23
Physiological ER x Maternal Control	-0.54	0.35	-1.55	0.59

* p < .05, ** p < .01, ***p < .001, Note: Odds ratios in parentheses are reciprocal and refer to odds of membership in the high profile.

Table 6.

Odds Ratios With the Low Profile as Comparison

Measure	β	SE	*z*	Odds Ratio
		Sub-threshold profile		
Observed Emotion Regulation (ER)	-1.30	0.56	-2.33*	0.27 (3.65)
Physiological ER	-0.19	0.21	-0.86	0.83
Maternal Control	-0.68	0.26	-2.57*	0.51 (1.96)
Observed ER x Physiological ER	-0.47	0.38	-1.26	0.62
Physiological ER x Maternal Control	-0.19	0.31	-0.60	0.83
		Normative profile		
Observed Emotion Regulation (ER)	-1.37	0.56	-2.45*	0.26 (3.92)
Physiological ER	-0.09	0.21	-0.45	0.91
Maternal Control	-0.76	0.31	-2.47*	.47 (2.13)
Observed ER x Physiological ER	-0.75	0.37	-2.04*	0.17 (5.74)
Physiological ER x Maternal Control	0.04	0.33	0.13	1.04

* p < .05, ** p < .01, ***p < .001, Note: Odds ratios in parentheses are reciprocal and refer to odds of membership in the low profile.

APPENDIX B

FIGURES

Figure 1. Longitudinal Latent Profile Analysis Model

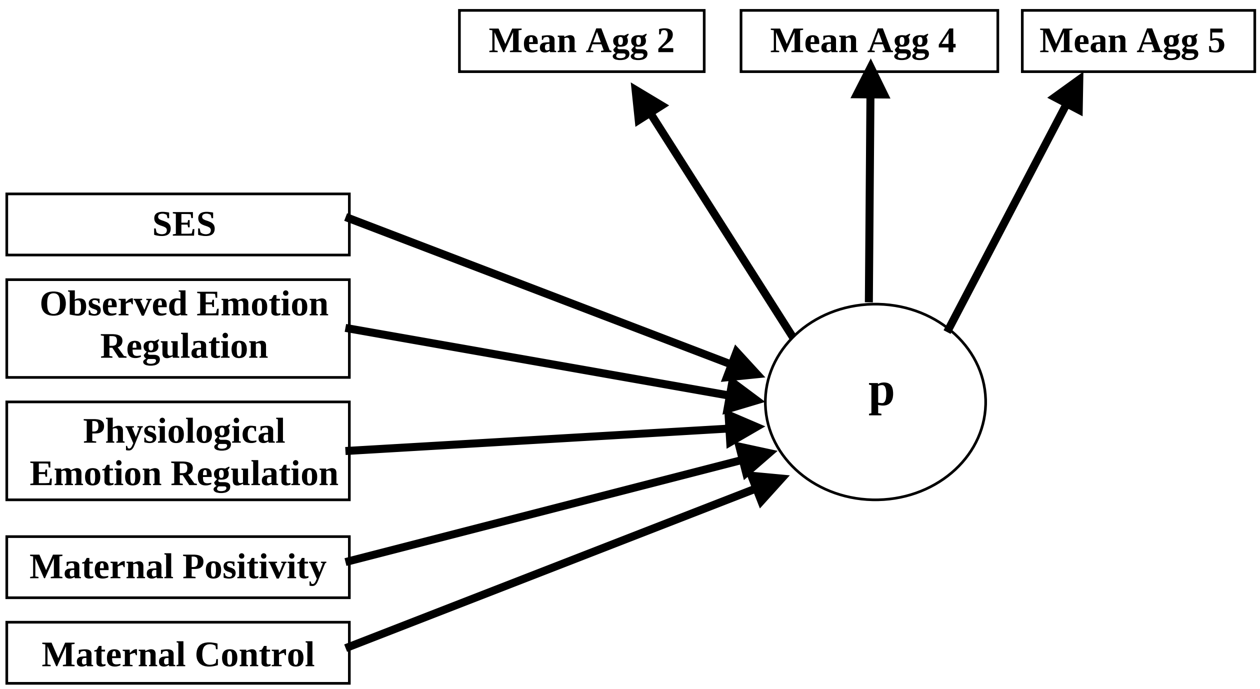
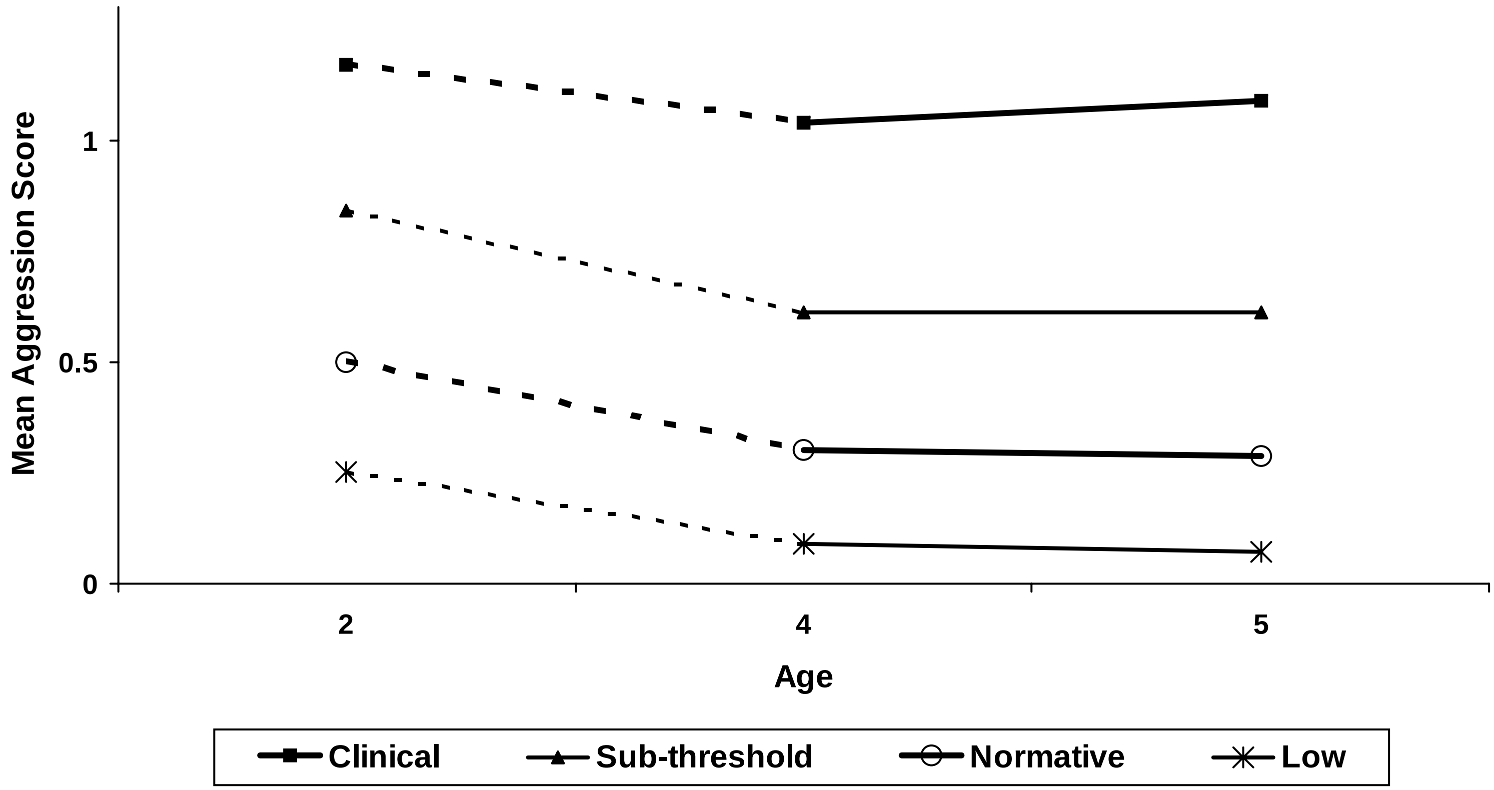


Figure 2. Trajectories of Aggression from 2 to 5 Years of Age



Note: Dotted lines represent the change in measurement between 2 and 4 years of age.

Figure 3. Log-odds of Membership in Sub-threshold Profile (vs. High Profile):
Maternal Control by Physiological Emotion Regulation

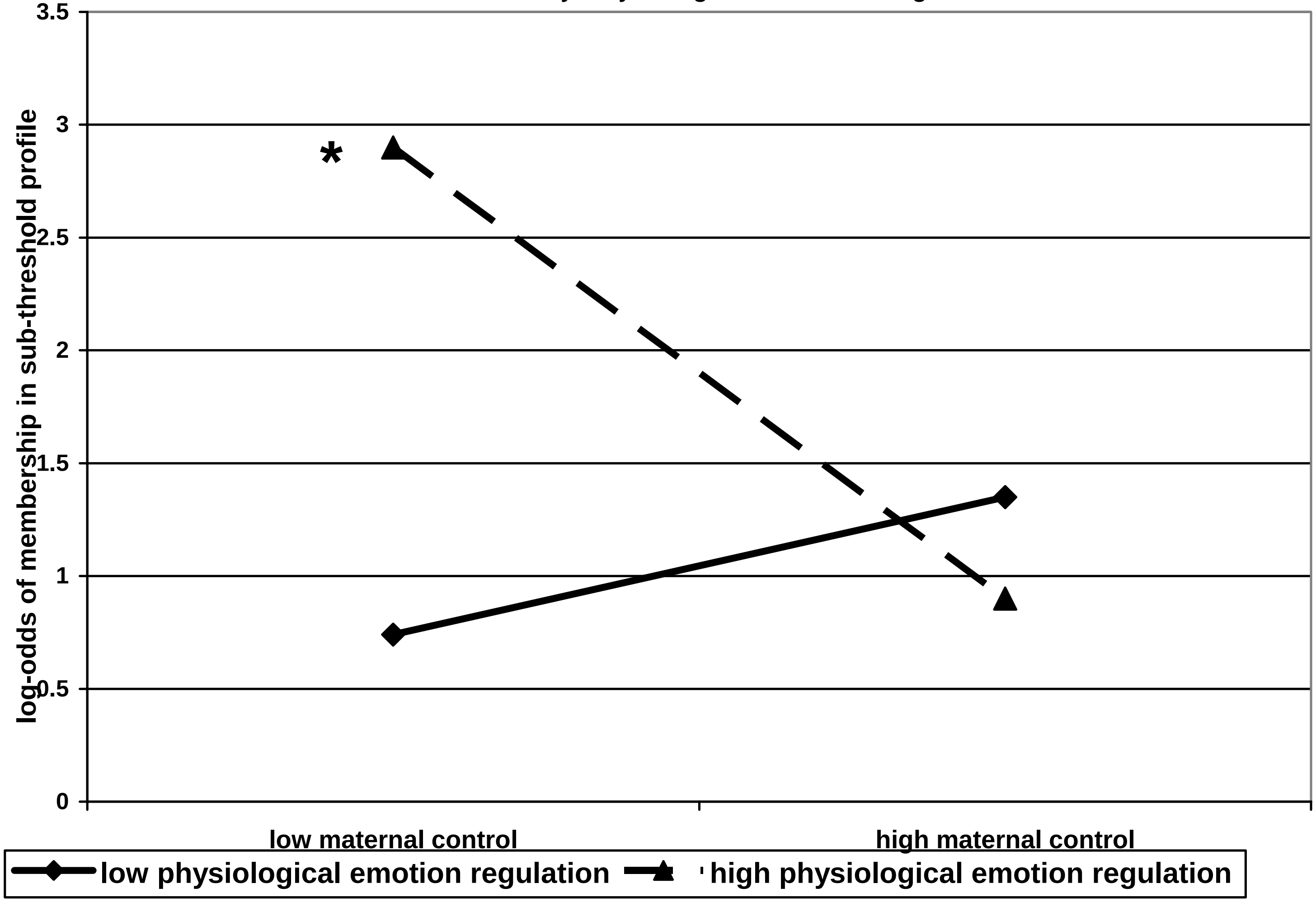


Figure 4. Log-odds of Membership in Normative Profile (vs. High Profile): Observed Emotion Regulation by Physiological Emotion Regulation

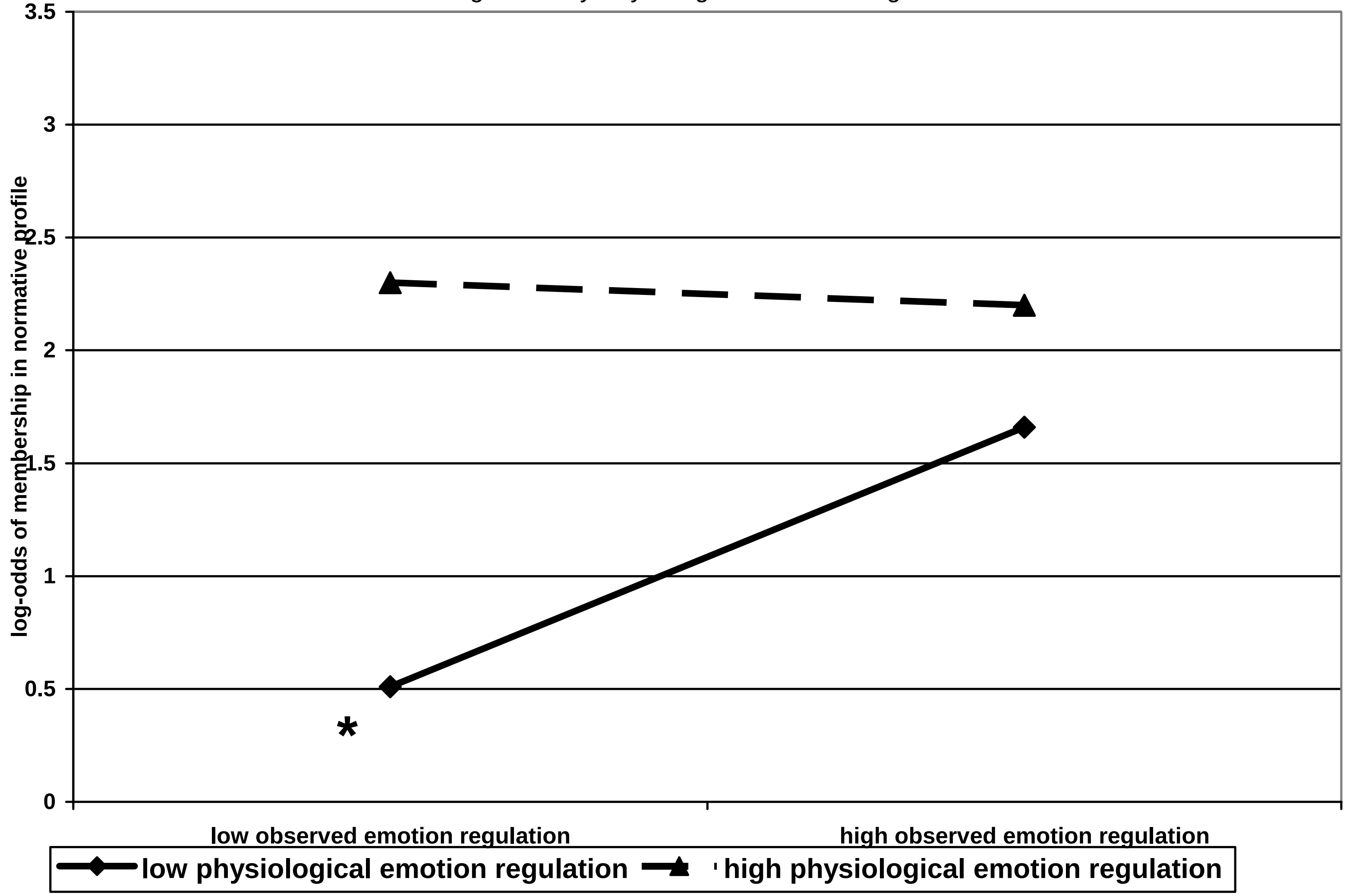


Figure 5. Log-odds of Membership in Normative Profile (vs. Low Profile): Observed Emotion Regulation by Physiological Emotion Regulation