AN ABSTRACT OF THE THESIS OF

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Samuel Vuchinich

This study posited that maturational growth in emotion regulation should be associated with reduction in hyperactivity during the transition into adolescence. The longitudinal design assessed emotion regulation and hyperactivity in an urban community sample of children in three waves, at ages 10.6, 11.6, and 12.6 years. A parallel growth curve model tested whether the initial level and growth in emotion regulation were associated with decreases in hyperactivity. The analysis statistically controlled for gender, parent education, and externalizing behaviors. Results indicated that increases in emotion regulation across the 3-year study were associated with substantial decreases in hyperactivity. Initial level of hyperactivity was associated with growth in emotion regulation. Thus there was some evidence of a reciprocal effect. Covariates had some significant associations on initial levels. This is the first study to find a strong dynamic linkage between emotion regulation and hyperactivity during the transition to adolescence. Future research should focus on the nature of reciprocal effects between emotion regulation and hyperactivity. Implications of the study are also discussed.

# Emotion Regulation and Hyperactivity During the Transition into Adolescence

by
Kendra M. Lewis

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Dean of the Graduate School

I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

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Kendra M. Lewis, Author

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# CONTRIBUTION OF AUTHORS

As co-authors, Dr. Samuel Vuchinich assisted in the design of this study and manuscript. He also provided editorial comments and suggestions in the writing of this manuscript. Dr. Alan Acock offered additional statistical design and interpretation input. Dr. Randal Day provided the data for this study.

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# DEDICATION

I dedicate this to my nephews Chase, Cole, and Connor. You bring me so much joy, and inspire me everyday to make the world a better place for you.

I also dedicate this to my nephew Brendan, whose life was much too short. You taught our family the true meaning of life and love, and will be in our hearts forever.

Finally, I dedicate this to my nephew on the way, and to my future nephews and nieces. Each of you is a blessing, and bring happiness and hope to our family.

# Emotion Regulation and Hyperactivity During the Transition to Adolescence

# Emotion Regulation and Hyperactivity During the Transition to Adolescence

## Chapter 1: General Introduction

It is well known that some children have a behavior disorder that causes them to be hyperactive (Barkley, 2003). This involves excessive fidgeting, squirming, talking, running, climbing, an inability to play quietly, and seeming to be driven by a motor (APA, 1994). Most children and adolescents engage in some of these behaviors some of the time. But for hyperactive children, they do *several* of these behaviors *most* of the time. Research has identified several factors that contribute to the emergence of hyperactivity in children. These include individual characteristics such as genetics, environmental and contextual factors such as food additives and parent-child attachment, as well as other factors such as brain injuries (National Institute of Mental Health, 2008; Finzi-Dottan, Manor, and Tyano, 2006). The present study focused on factors that influence the level of hyperactivity in the transition to adolescence. Motivation for this study comes from research that has shown that adolescent hyperactivity has been linked to several negative outcomes including substance abuse, antisocial personality disorder, and academic achievement issues (Elkins, McGue, and Iacono, 2007; Thapar, van dee Bree, Fowler, Langely, Whittinger, 2006; and Gresham, Lane, and Beebe-Frankenberger, 2005). As a result of these findings, there has been an increased interest in researching the processes that lead to hyperactivity, as well as factors that influence change in hyperactivity in childhood and adolescence.

Hutchinson, Pearson, Fitzgerald, Bateman, Gant, Grundy, et al. (2001) suggested that hyperactive children may be described as overactive, restless, and impulsive. There is a substantial amount of research on the predictors of hyperactivity (Barkley, 2003). Recently, advances in our understanding of self-regulation have led to increased interest in the role of emotion and emotion regulation on hyperactivity and Attention Deficit Hyperactivity Disorder (Martel, 2009; Martel & Nigg, 2006; Melnick and Hinshaw, 2000). The proposed study will contribute to this work by using a longitudinal design to test whether emotion regulation in childhood and change in emotion regulation from childhood to adolescence influences change in hyperactivity from childhood to adolescence. The next section provides definitions of key terms and reviews current research and theory on hyperactivity and emotion regulation.

*Hyperactivity and emotion regulation*

Emotion regulation is generally defined as how emotions are managed and controlled (Gross & Thompson, 2007). Some researchers state that emotion regulation involves both the internal regulation of an emotion, as well as the external expressivity of emotions and behavior that is propelled by emotions (Thompson, 1994; Eisenberg, Champion, & Ma, 2004). For the purpose this study, emotion regulation will be defined as the process of internally controlling emotions as well as external emotional expressions.

Mullin and Hinshaw (2007) and Fabes, Gaertner, and Popp (2006) both stated that children whose emotions are under-regulated are prone to externalization problem

behaviors. For example, Fabes, et al. (2006) stated that children low in behavior and emotion regulation and the capacity to cope with the environment are likely to have poor social competency and behavior problems. This could be due to the child's inability to control their emotional and behavioral reactions. In turn, this inability could impact a child's social skills as well as the capability to control physical reactions to arousing stimuli. Similarly, Larson and Prizmic (2004) stated, "affective states influence subsequent behavior, experience, and cognition" (p.41). Finally, Eisenberg, Cumberland, Spinrad, Fabes, Shepard, Reiser, et al. (2001) suggested that children act out because they are unable to properly regulate anger and frustration. This suggests that emotion regulation may play a role in hyperactivity.

*Outcomes of Hyperactivity*

Before we can comprehend the relationship between hyperactivity and emotion regulation, we must first understand each separately. Over the last 100 years, the disorder of hyperactivity and its symptoms have undergone many name changes, and *hyperactivity* has commonly been used to be synonymous with *ADHD* (see Barkley, 1981; Fischer, Barkley, Smallish, and Fletcher, 2002). For this reason, most research that has been conducted on hyperactive children generally involves children who have been diagnosed with ADHD or have symptoms of this disorder. Part of the reason for this is that the DSM-IV clinical definition of hyperactivity is considered as a sub-type of *ADHD-predominantly hyperactive*. The DSM-IV currently uses the following as criteria for diagnosing a child with sub-type: "Often fidgets with hands or feet or squirms in seat", " Often leaves seat in classroom or in other situations in which

remaining seated is expected", "Often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness)", "Often has difficulty playing or engaging in leisure activities quietly", "Is often "on the go" or often acts as if "driven by a motor", and "Often talks excessively" (American Psychiatric Association, 1994, pp. 84) It is easy to see how a child with these characteristics would have trouble maintaining attention and why the early research would link inattention and hyperactivity together. Recent research, however, measures these two constructs separately (see Gresham, Lane, and Beebe-Frankenberger, 2005; Hundt, Kimbrel, Mitchell, Nelson-Gray, 2008), suggesting that they are not part of the same underlying disorder. Indeed one proposal for the new DSM-V diagnoses is that a clear distinction be made between hyperactivity and inattention (American Psychiatric Association, 2010). Because it reflects a more current view on these disorders, this study focused on hyperactivity, or in terms of DSM IV, predominately hyperactive ADHD. This study did not examine a clinical sample, but rather assessed hyperactivity in a community sample, where it appears in less extreme form. As a result of historical convention much of the research on hyperactivity includes measures of hyperactivity and ADHD. The literature discussed below will emphasize studies that have addressed hyperactivity directly, though some relevant material considers the general ADHD category.

Hyperactivity and ADHD is associated with a variety of behavioral, academic, and delinquent outcomes (Shelton and Barkley, 1995; Vitaro, Brendgen, Larose, and Tremblay, 2005; Simonoff, Elander, Holmshaw, Pickles, Murray, and Rutter, 2004).

One common problem associated with hyperactivity is other behavioral disorders, such as conduct disorder, aggression, or oppositional and defiant behavior (Shelton and Barkley, 1995; Barkley, 2003). Biederman, Newcorn, and Sprich (1991) stated that some have theorized that the association between hyperactivity and aggression or conduct disorder may be comorbid because they are different varieties of the same disorders, have common vulnerabilities, or that one may be an early manifestation of comorbidity with the other. Indeed, Fontaine, Carbonneau, Barker, Vitaro, Hebert, Côte, et al. (2008) found that children with high trajectories of hyperactivity and physical aggression reported higher physical and psychological aggression in intimate relationships. These reports emphasize that hyperactivity may not be the sole issue, but that a child may experience other problems in addition to hyperactivity.

In addition to conduct disorders, several recent studies have found associations between hyperactivity and crime. Theoretically, it has been suggested that hyperactivity and other antisocial tendencies such as temperament, aggression, impulsivity, and social withdrawal are all potential risk factors for criminality, and that longitudinal studies have shown antisocial orientations to set children on a different developmental trajectory (Leschied, Chiodo, Nowicki, and Rodger, 2008). For example, Thapar, van dee Bree, Fowler, Langley, and Whittinger (2006) found that ADHD in childhood predicted the development of antisocial behavior, and Simonoff, Elander, Holmshaw, Pickles, Murray, and Rutter (2004) concluded that childhood hyperactivity predicted adult antisocial personality disorder, and that childhood hyperactivity predicted juvenile defense and related to conduct disorder, which

predicted later crime. In turn, Leschied, Chiodo, Nowicki, and Rodger (2008) found hyperactivity, along with aggression and conduct disorder, to be a predictor of later involvement in crime. Similarly, Johansson, Kerr, and Andershed (2005) reported that prison inmates had a history of hyperactivity and conduct problems. These studies support the notion that hyperactivity is associated with both antisocial personalities and crime, and show the severity of negative outcomes that can occur with childhood hyperactivity. This demonstrates the importance of understanding the many dimensions of hyperactivity in order to properly treat and prevent these damaging outcomes from occurring.

Another commonly reported outcome of hyperactivity and ADHD is substance abuse. Biederman, Wilens, Mick, Milberger, Spencer, and Faraone (1995) suggest that the link between ADHD and substance abuse may be due to the link between both ADHD and substance use to mood and anxiety disorders. That is, people with ADHD may also have comorbid mood and anxiety disorders, and those with mood and anxiety disorders have increased risk for substance abuse. Therefore, it is reasonable to assume that there are associations between ADHD and substance use. Fontaine, Carbonneau, Barker, Vitaro, Hebert, Côte, et al. (2008) reported that in children with high trajectories of hyperactivity and physical aggression were more likely to report nicotine use. Similarly, another study stated that hyperactivity/impulsivity predicted substance abuse, and nicotine and cannabis dependence (Elkins, McGue, and Iacono, 2007). Biederman, Faraone, Monuteaux, Bober, and Cadogen (2004) found ADHD in adults to be associated with alcohol and substance abuse. These studies again show

the negative outcomes of hyperactivity and the importance of early interventions to hopefully prevent substance abuse and dependence.

There is evidence that suggests associations between hyperactivity and cognition and achievement. For example, hyperactivity in kindergarten was related to lower rates of high school graduation (Vitaro, Brendgen, Larose, and Tremblay; 2005). In addition, Gresham, Lane, and Beebe-Frankenberger (2005) showed that sixth graders with hyperactivity-impulsivity-inattention problems had low academic competence. Another study reported that children with ADHD were more likely than children without ADHD to produce grammatically incorrect responses, theoretically owing to their difficulties with response inhibition (Engelhardt, Ferreira, and Nigg, 2009). These studies establish that hyperactivity and ADHD affect multiple facets of a person's life, not just conduct and behavior. Furthermore, research has shown that hyperactivity and ADHD can persist into adulthood (Kessler, Adler, Barkley, Biederman, Conners, Faraone, et al., 2005; Lara, Fayyad, Graaf, Kessler, Aguilar-Gaxiola, Angermeyer, et al., 2009). These results express the importance of continuing to research hyperactivity and ADHD in adolescence and adulthood and not assuming that the child "will grow out of it".

These outcomes reveal the wide variety of associations and issues of hyperactivity. These problems do not only occur in childhood or one developmental domain, but rather across the lifespan and into biological, cognitive, and behavioral areas of life. For example, a hyperactive child may be unable to sit still in class and become known as a troublemaker. In adolescence, this "labeled" child may become

involved with alcohol and drugs. Finally, as an adult, these hyperactive tendencies and substance abuse may have influenced this person to develop an antisocial personality or, at the extreme, lead to criminal activities. Although this is only a hypothetical situation, the literature has shown that this is a possible trajectory of a person with hyperactive tendencies in childhood, and emphasizes the numerous negative outcomes of such tendencies. Similarly, emotions and emotion regulation are crucial in our everyday lives, and can have an impact over all domains. It is important to understand what emotion regulation is, how it develops, and how it relates to other control and regulation processes before we can examine its role in hyperactivity.

*What is Emotion Regulation?*

Thompson (1994) defined emotion regulation as "extrinsic and intrinsic processes responsible for monitoring, evaluating, and modifying emotional reactions...to accomplish one's goals" (p. 27-28). Emotion regulation can be seen as the driving force behind one's ability to manage their cognitions and behaviors. McClelland, Ponitz, Messersmith, and Tominey (in press) state that cognition "occurs under optimal emotional conditions" and that "there is no situation void of emotional importance" (p. 8). For example, children who are unable to control their emotions have been found to be more likely to have behavior problems (Graziano, Reavis, Keane, and Calkins, 2006).

The development of emotion regulation is influenced by both nature and nurture. On the nature side is a child's temperament, or individual differences in regulation and reactivity of attention, behaviors, and emotions. These differences are

biologically based, but impacted by genetics and experience as the child grows (Rothbart and Bates, 1998). A component of temperament that has been studied in relation to emotion regulation is *effortful control*. Effortful control is "the ability to inhibit a dominant response to perform a subdominant response" (Rothbart and Bates, 1998, p.129), or a person's ability to voluntarily shift attention or focus, as well as inhibit inappropriate behavior, also termed *attentional control* and *inhibitory control* (Eisenberg, Champion, & Ma, 2004). The term effortful control has sometimes been used to be synonymous with self-regulation (Rothbart, Ahadi, Hershey, and Fisher, 2001), and emotion regulation is a component of self-regulation (see McClelland, Ponitz, Messersmith, and Tominey, in press).

Research has found involvement of executive functioning (EF) in effortful control (Eisenberg & Spinrad, 2004). Executive function consists of cognitive processes, including "planning, working memory, set shifting, error detection and correction, and the inhibitory control of prepotent responses" (Zelazo and Cunningham, 2007, 135). These processes are crucial in intentional emotion regulation. McClelland, Ponitz, Messersmith, and Tominey (in press) point out that aspects of EF facilitate children's abilities to pay attention and control their behavior, and that while emotion and cognition are internal processes, an "individual's overt behavior...represent[s] how these processes interface with the outside world", (p. 43). Mares, McLuckie, Schwartz, and Saini (2007) found that parent and teacher reported executive functioning deficits, primarily inhibition, were risk factors for hyperactivity-impulsivity, and Wåhlstedt, Thorell, and Bohlin (2008) reported that children with EF

impairments had significantly higher teacher reported hyperactivity and inattention than children without EF impairments.

More recently, research has begun to discuss *reactive control* and behavioral inhibition. Reactive control refers to the more automatic and less voluntary system responses, and may be linked to motivation and emotion (Eisenberg and Morris, 2002). Martel and Nigg (2006) found reactive control, but not effortful control or negative emotionality, to be related to child hyperactivity-impulsivity. It is, however, difficult to separate the two concepts completely, and effortful control may also still have a hand in reactive control (Derryberry and Rothbart, 1997). For example, Eisenberg, Cumberland, Spinrad, Fabes, Shepard, Reiser et al. (2001) found that children with externalizing problems to be low in effortful control, and high in impulsivity, a marker of reactive control. The studies presented demonstrate that both effortful and reactive control are a part of our ability to regulate emotions and can have an impact on our behavior patterns.

In addition to temperament, our nurture, or environment, also influences the development of emotion regulation. For example, an infant's emotions are first managed and controlled by a parent or caregiver (Thompson & Lagattuta, 2006). In time, as an infant begins to understand more about the world around him, he can internalize his parent's management and eventually is able to regulate his emotions without the assistance of his parent. In early childhood, the child can be observed as physically regulating his emotions by moving away from the arousing stimuli or avoiding situations that provoke negative emotions. During middle childhood, a child

is able to internally regulate his emotions, such as shifting attention and focus of thoughts away from the unpleasant, rousing stimuli (Thompson & Lagattuta, 2006).

Poor emotion regulation is associated with a variety of outcomes across the lifespan. For example, children with poor emotion regulation have lower social competency, as well as risk being rejected by peers (Fabes, Gaertner, and Popp, 2006; Thompson and Lagattuta, 2006). In addition, during childhood, emotion regulation has been shown to be important for academic achievement (Thompson and Lagattuta, 2006). Several studies, such as those mentioned previously, have found associations between emotion regulation and externalizing behaviors (see also Cole, Zahn-Waxler, Fox, Usher, Welsh, 1996). Denollet, Nyklícek, and Vingerhoets (2008) discussed a variety of health issues that can arise from poorly regulated emotions. For example, emotional suppression leaves unresolved emotions lingering and building up inside a person, and this can eventually lead to fainting in reaction to arousing stimuli. In addition, chronic, long-lasting negative emotionality may lead to acute, but life-threatening cardiac issues (Denollet, Nyklícek, and Vingerhoets, 2008). This stresses the importance of optimal regulation to lower risks of such health problems. The outcomes discussed above indicate the substantial role of emotion regulation in our lives. It affects our thoughts, expressivity, behavior, academics, social network, and health. Proper regulation of emotions is crucial for optimal development and may play a critical role in hyperactivity.

*Emotion regulation and hyperactivity*

Recently, more researchers have begun to consider the connections between

emotion regulation and hyperactivity. Gnaulati (2008) suggested that emotion regulation (or dysregulation) is a crucial component of ADHD. Barkley (1997) theorizes that behavioral inhibition sets the stage for proper executive functioning, including affect regulation, and that if these are not working optimally, a child (or adult) cannot exhibit motor control. Some research has been conducted to show that these associations do exist. For example, Melnick and Hinshaw (2000) showed that boys with comorbid ADHD and aggression had more maladaptive emotion regulation than boys with ADHD only or boys without behavioral problems. Walcott and Landau (2004) found similar results, that boys with ADHD had more issues in controlling their emotions, as well as concealing their emotions than boys without ADHD. Maedgen and Carlson (2000) compared and found differences in emotion regulation and social functioning in children with different subtypes of ADHD. This study, however, did not include children with ADHD, predominantly hyperactive-impulsive subtype.

These studies establish the links between externalizing problem behaviors such as hyperactivity and emotion regulation. There is some question about the causal direction of associations between emotion regulation and hyperactivity. Cognitive control systems such as inhibition are often researched in relation to hyperactivity and other externalizing behaviors, but as Martel (2009) points out, these systems are developed after emotions and emotion displays are already present in a young child. It is not unreasonable to assume that these emotions play a role in the cognitive control systems or behavior expression. Melnick and Hinshaw (2000) suggested that because

of the importance of emotion regulation in social functioning, and the lack of social skills in children with ADHD, emotion regulation may have an underlying role in problem behaviors. The present study aims to assist in better understanding the causal influences of emotion regulation on hyperactivity in children who are transitioning into adolescence.

*Covariates*

Thompson and Lagattuta (2006) point out that children learn about how to regulate their emotions in a family setting. Therefore, when studying the effects of emotion regulation, it is important to include family or parent covariates into the model. Several studies researching self-regulation or disruptive behaviors have used parent education as a control variable and found it to be significant a significant predictor (see Ponitz, McClelland, Jewkes, Connor, Farris, and Morrison, 2008; Vitaro, Brendgen, Larose, and Tremblay; 2005). Given that emotion regulation and hyperactivity (lack of behavioral inhibition) are subcomponents of self-regulation, it is reasonable to include this variable into the model.

Several studies have found gender differences in emotion regulation and experiences (Blanchard-Fields, Stein, Watson, 2004; Eisenberg, Cumberland, Spinrad, Fabes, Shepard, Reiser, et al., 2004). Children who discuss emotions more frequently and in depth have a greater understanding of emotions (Thompson and Lagattuta, 2006). Therefore, theoretically these children can better regulate their emotions. Parents, however, are more apt to discuss emotions in more detail and greater focus with girls than boys (Thompson and Lagattuta, 2006). It is reasonable to assume that

girls may be better at regulating emotions. Consistent with this theory, Eisenberg, Valiente, Morris, Fabes, Cumberland, Reiser, et al. (2003) found that teachers reported girls to have higher emotion regulation and less externalization problems than boys. In contrast, Valiente, Eisenberg, Shepard, Fabes, Cumberland, Losoya, et al. (2004) found there to be no gender differences in child self-report emotional expression or reaction. In addition, it is well known that boys are referred more often than girls for ADHD (Barkley, 2006). Romano, Tremblay, Farhat, and Côte (2006) found in a population sample that boys were two times more likely than girls to be in a high or persistent hyperactivity trajectory. It is important to note that because externalization problems are higher in boys, most of the research on the associations between emotion regulation and hyperactivity has been studies in boys (e.g., Melnick and Hinshaw, 2000; Walcott and Landau, 2004), and we cannot be sure that the patterns are similar in girls (Mullin and Hinshaw, 2007). The present study provided an opportunity to further explore the relationship between emotion regulation, hyperactivity, and gender.

Some studies have found that externalizing behaviors have been associated with emotion regulation (Cole, Zahn-Waxler, Fox, Usher, and Welsh, 1996; Fabes, Gaertner, and Popp, 2006). Externalizing behaviors can include, but are not limited to drug use, delinquency, and risky sexual behaviors (Cooper, Shaver, and Collins, 1998). Because aggression, conduct disorder, and substance use have been found to be associated with hyperactivity as well (Barkley, 2003; Elkins, McGue, and Iacono, 2007; Fontaine, Carbonneau, Barker, Vitaro, Hebert, Côte, et al., 2008), externalizing behaviors have also been included in the present model. It is proposed that higher

levels of emotion regulation will be associated with lower levels of externalizing behaviors, while higher levels of hyperactivity will be associated with higher levels of externalizing behaviors.

*Transitions*

Adolescence is a time of rapid transformation. There have been conflicting findings in longitudinal studies regarding the stability of regulation, emotionality, and hyperactivity during the transition from late childhood to early adolescence. Several studies have shown that hyperactivity is not just a problem in childhood (Barkley, 1998; Kessler, Adler, Barkley, Biederman, Conners, Faraone, et al., 2005; Lara, Fayyad, Graaf, Kessler, Aguilar-Gaxiola, Angermeyer, et al., 2009). Larson, Moneta, Richards, and Wilson (2002) reported that younger adolescents (ages 10-14) were less stable in their self-reported daily emotional experiences than older adolescents (ages 13-18). Because emotion regulation can influence expression and experience of emotion (Thompson, 1994; Eisenberg, Champion, and Ma, 2004), this finding suggests that emotion regulation may change during the teenage years. In contrast, Murphy, Eisenberg, Fabes, Shepard, and Guthrie (1999) stated that regulation was fairly stable across time in children ages four to 12, and Raffaelli, Crockett, and Shen (2005) found that self-regulation did not significantly change between middle childhood and adolescence. These studies focused on only self-regulation and emotion or hyperactivity, and those studies that found hyperactivity or emotional experiences to change during adolescence did not address the outcomes or effects of these changes occurring. The present study aimed to fill this gap by examining the

possible changes in emotion regulation and its effects on hyperactivity.

The current study took the perspective that emotion regulation and hyperactivity will not be stable during the transition into adolescence. As presented above, emotion regulation, effortful control, and executive functioning play a role in behavior inhibition (McClelland, Ponitz, Messersmith, and Tominey, in press; Mares, McLuckie, Schwartz, and Saini, 2007; Wåhlstedt, Thorell, and Bohlin, 2008). It has been noted, however, that the area of the brain that controls executive functioning, the prefrontal cortex, is not fully developed in adolescence (Keating, 2004). Similarly, Martel (2009) pointed out that the parts of the limbic system that elicit emotions are developed before the ability to effortfully control these emotions, consequently putting children and teens at greater risk for emotional problems. In addition, Graber (2004) stated that while emotion regulation skills do develop during childhood, they continue to mature into adolescence in reaction to the novel experiences of this time. Therefore, it is reasonable to expect that because of the early development of emotions and later development of the prefrontal cortex, an adolescent's emotion and cognitive related processes will continue to have an influence over one's behavior, as it does in childhood. Children are entering into puberty, a time characterized by uncertainty and doubt. There are a plethora of physical, maturational, and cognitive changes occurring simultaneously (Susman & Rogol, 2004; Keating, 2004). Some theorists propose that the novelty of the experiences of puberty characterize this as a stressful transition (Susman & Rogol, 2004). A variety of studies have made associations between pubertal, maturational changes and emotionality, indicating that these

biological changes influence emotions and affect (Susman & Rogol, 2004). Therefore, it is reasonable to believe that there may be changes in a child's emotion regulation during this transition, and that these changes may impact hyperactivity.

*Theoretical foundation*

Many theories and fields have examined self-regulation, each time defined slightly differently or with various emphases. This study takes the view of the Relational Developmental Systems Perspective (Lerner, 2006). This perspective states that development is a "relation between the individual and the complex ecology" (Lerner, 2006, 10). In addition to emphasizing the importance of the complex relationship between an individual and his or her context on development, and because history (time) is the broadest level of context, this theory also points out that changes in developmental trajectories can occur across the life span. To apply this to the present study, children's regulation of emotion and behavior is considered contingent on not only their environment, but also their place in time as well. External events (environment) that are unique to transitional age periods (time) may influence a child's self-regulation. Both the stimuli in a child's environment and his or her developmental phase may influence their ability to regulation his or her emotions, thoughts, and behaviors. Specifically, the transitional period in which this study is set may provide unique and novel experiences to children. These experiences can influence changes in regulation of emotion, further leading to changes in hyperactivity,

*Hypotheses*

Given the literature presented here, the present study proposed that emotion

regulation plays a critical role in hyperactivity. Specifically, children who do not optimally regulate their emotions are more likely to have higher hyperactivity levels. Furthermore, children who increase their emotion regulation in the transition to adolescence should experience reduced hyperactivity during that period.

## Methods

### *Study sample*

The data for this study came from the Flourishing Families Project (FFP). Data were collected in a large urban city in the northwest US. This is a longitudinal study of families and family life, with a total of three waves to date. Data were collected one year apart. The variables used in this study were child-reported measures of emotion regulation, hyperactivity, and externalizing behaviors during family member interviews, as well as parent reports of education levels. All families had a child between the ages of 9 and 14 at Wave 1, with the average age being 11.5 years (Day, 2009). To focus specifically on the transition from late childhood to early adolescence, the age range at each wave was reduced to concentrate on specific developmental phases. This decreased the sample size to 257. The mean age of the children was 10.6 years at Wave 1, 11.6 years at Wave 2, and 12.6 years at Wave 3. Fifty-four percent of the children in this sample were female, and 95% of the parents in the reduced sample were mothers. Seventy percent of the families in this sample were two-parent, married families, and the median annual household income was $60,000. Approximately 66% of the parents earned a Bachelor's degree or higher, 27% has some college or an Associate's degree, and 7% had a high school diploma or

less. Sixty-nine percent of the families reported themselves as European American, 7% African American, 23% multi-ethnic, and less than 1% Asian American and Other.

*Purpose of the Flourishing Families Project*

The goal of the Flourishing Families Project is to further understanding of family life. Specifically, the project aims to focus on "how economic distress, family and couple processes, and parental investment" (Day, 2009, p. 1) influence both positive and negative adolescent outcomes, such as hope, school achievement, risky sexual behavior, and depression. In general, the FFP hypothesizes that families who experience economic distress may also experience changes in couple and parent-child relationships. These changes may then influence adolescent health and behaviors (Day, 2009). Although the current study focused on adolescent outcomes, important family and individual dynamics were included into the model that have been shown to influence these outcomes.

*Data collection*

Data for FFP was collected in a large city in the Northwest United States. Most families were recruited through a telephone database survey, and some through snowball sampling, or family referral. Using the database, FFP project leaders identified families that matched the SES and racial stratification of the local school districts. To be eligible, families had to have at least one child between the ages of 10 and 14. Once these families were identified, they were first sent a recruitment letter, followed by visits and calls to confirm eligibility and willingness to participate. Finally, appointments were set for the family interviews. These interviews consisted

of in-home questionnaires to at least one parent (both if possible) and target child, as well as videotaped family interactions. Data was collected by interns who live in the targeted area, and receive six months of training prior to data collection. Graduate students and faculty members, also in the targeted area, supervised the interns. Interns collected data in pairs, and receive six months of training. In addition, families in this study were given $200 for their participation; $175 went to the parent(s) and $25 to the target child (Day, 2009)

*Missing Data*

Experienced researchers closely supervised data collection for the Flourishing Families Project. There is little missing data, as data collectors screened questionnaires for double marking and missing answers (Day, 2009). Five of the nine variables or scales had missing values; however, within those that did, there were no more 1.6% missing. Therefore, 96.5% of the participants had complete data. Given the small proportion of missing values it could be considered missing completely at random (MCAR). Models will be estimated using maximum likelihood estimation (Mplus 5) under the missing at random assumption so that all available data are utilized.

*Measures*

*Child's emotion regulation* was measured by 4 indicators on a scale from 1 (not true at all) to 4 (always true). These indicators are: "I have a hard time controlling my temper"; "I get so frustrated I feel ready to explode"; "I get upset easily"; and "I am afraid I will lose control over my feelings". These items were reverse coded for easier

interpretability, so that higher scores indicate more emotional control.

*Child's hyperactivity* was measured by 3 indicators on a scale from 1 (not true at all) to 4 (always true). These indicators are: "I get fidgety after a few minutes if I am supposed to sit still"; "I have a hard time sitting still during important tasks"; and "I find that I bounce my legs or fiddle with objects". Higher scores indicate higher hyperactivity.

These items are part of the Self-Regulation scale created by Novak and Clayton (2001). The Flourishing Families Project employed a modified version, using 13 of the original 30 items. The items make up three subscales of emotion regulation, planning, and hyperactivity. The present study used seven of the 13 items, focusing on questions related to emotion regulation and hyperactivity. These data were collected at all three waves. Scores on each item within the subscales were totaled, giving each child an overall score at that scale for every wave. Wave scores were then averaged, creating single indicators of emotion regulation and hyperactivity at Waves 1, 2, and 3 (see Novak and Clayton, 2001; Moilanen, 2007; for similar procedures). The alphas for the emotion regulation scale were .77, .83, and .84, at Wave 1, 2, and 3. For hyperactivity, the alphas were .78, .82, and .86, respectively.

*Covariates.* This model includes three family variables as covariates: Parent education, child gender, and child externalizing behaviors. *Parental education* was measured by the primary parent's self-report of their education level on a scale from 1 (less than high school) to 7 (advanced degree: PhD, PsyD, JD, etc.) at wave one.

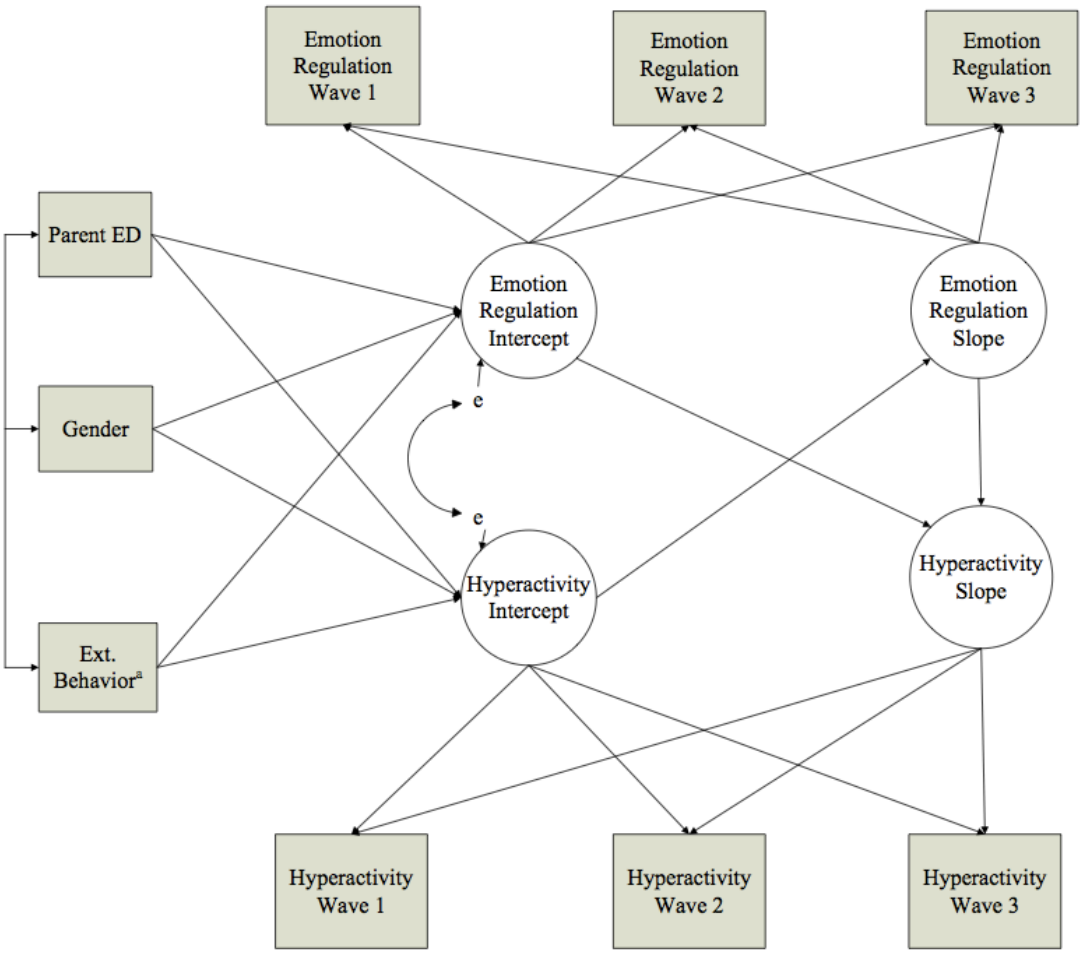
*Child externalizing behaviors* was measured by child self-report on their

delinquent behaviors. These questions are a part of the Child Behavior Checklist Youth Self-Report (Achenbach, 1991), delinquency subscale. This scale consisted of nine items on a scale of 0 (not true) to 2 (often true) and example items include "I disobey at school", "I use alcohol or drugs", and "I steal things from places other than home". Similar with other studies (Eisenberg, Gershoff, Fabes, Shepard, Cumberland, Losoya, et al., 2001; Romano, Tremblay, Farhat, Côte, 2006) the nine items were summed so that higher scores on the scale indicate more delinquent behaviors. The alpha for these items is .61. Given the high proportion of children that reported "not true" to these items (nearly 60%), the scale was then dichotomized, so that a score of "0" indicated "not true" for any of the delinquent behaviors and "1"indicated that the child said "somewhat true" or "often true" to at least one of the items.

*Analysis Plan*

Growth curve models examine the longitudinal observations of a measure of individuals in terms of an intercept that represents the initial level of the variable at time 1, and the slope over time, change in individuals per one unit of time (Hox, 2010). They further allow estimates of the effects of covariates on the intercept and slope. While analytic interest focuses on two variables that are changing over time, a parallel growth curve model is used to test whether the intercept and slope of one variable is associated with the intercept and slope of a second variable as shown in Figure 1(Hox, 2010; Chung, White, Hipwell, Stepp, Loeber, 2009; Stoolmiller, Gerrard, Sargent, Worth, Gibbons, 2009).

Figure 1. Proposed Parallel Process Growth Curve.




*Note*: [a]Ext. Behaviors= Externalizing Behaviors.

Three covariates were used to predict the intercept levels of emotion regulation and hyperactivity. These are parental education, child gender, and externalizing behaviors. Overall, this model proposed that 1) higher levels of emotion regulation at Time 1 will be associated with a decrease in hyperactivity from Time 1 to Time 3, and 2) that an increase in emotion regulation from Time 1 to Time 3 will be associated with a decrease in hyperactivity from Time to Time 3.

# Chapter 2

## Emotion Regulation and Hyperactivity During the Transition to Adolescence

Kendra M. Lewis, Samuel Vuchinich, Alan Acock, Randal Day

## ABSTRACT

This study posited that maturational growth in emotion regulation should be associated with reduction in hyperactivity during the transition into adolescence. The longitudinal design assessed emotion regulation and hyperactivity in an urban community sample of children in three waves, at ages 10.6, 11.6, and 12.6 years. A parallel growth curve model tested whether the initial level and growth in emotion regulation were associated with decreases in hyperactivity. The analysis statistically controlled for gender, parent education, and externalizing behaviors. Results indicated that increases in emotion regulation across the 3-year study were associated with substantial decreases in hyperactivity. Initial level of hyperactivity was associated with growth in emotion regulation. Thus there was some evidence of a reciprocal effect. Covariates had some significant associations on initial levels. This is the first study to find a strong dynamic linkage between emotion regulation and hyperactivity during the transition to adolescence. Future research should focus on the nature of reciprocal effects between emotion regulation and hyperactivity. Implications of the study are also discussed.


Keywords: *emotion regulation, hyperactivity, adolescence*

Hyperactivity has long been recognized as a behavioral pattern in childhood and adolescence (Barkley, 1981). This behavioral problem is expressed as excessive forms of fidgeting, squirming, an inability to play quietly, and seeming to be driven by a motor (APA, 2000). In its extreme form the pattern represents a clinical DSM-IV-TR diagnosis: "predominantly-hyperactive ADHD sub-type "(APA, 2000). There is considerable interest in this behavioral pattern because of its association with negative outcomes, such as conduct disorder, substance use, and low academic achievement (Elkins, McGue, and Iacono, 2007; Thapar, van dee Bree, Fowler, Langely, Whittinger, 2006; and Gresham, Lane, and Beebe-Frankenberger, 2005). There are various estimates of prevalence of hyperactivity in children in the US. In the context of medical diagnosis, the prevalence of hyperactivity and combined hyperactivity/inattention subtypes of the ADHD mental health disorder has been estimated as 4.2% in a nationally representative sample (Froehlich, Lanphear, Epstein, Barbaresi, Katusic, Kahn, 2007), though that diagnostic criteria requires evidence of psychological maladjustment beyond hyperactive behavior. Recent research has more carefully distinguished the components of self-regulation, including emotion, behavior, and cognitive regulation (McClelland, Ponitz, Messersmith, and Tominey, in press). This line of work suggests a close linkage between emotion regulation and hyperactivity. The present study focused on developmental changes in hyperactivity from late childhood to early adolescence in a community sample. Previous studies have found a developmental decrease in hyperactivity as children age, that was stopped or reversed due to the environmental pressures inherent in the transition from

grade school to middle school for children in the US (Langberg, Epstein, Altaye, Molina, Arnold, and Vitiello, 2008). We tested the hypotheses that initial levels of emotion regulation and increases in emotion regulation during the transition to adolescence are associated with decreases in hyperactivity during this period

Hutchinson, Pearson, Fitzgerald, Bateman, Gant, Grundy, et al. (2001) suggested that hyperactive children may be described as overactive, restless, and impulsive. Over the last 100 years, the disorder of hyperactivity and its symptoms have undergone many name changes, and *hyperactivity* has commonly been used to be synonymous with *ADHD* (see Barkley, 1981; Fischer, Barkley, Smallish, and Fletcher, 2002). Part of the reason for this is that the DSM-IV clinical definition of hyperactivity is considered a sub-type of ADHD. Inattention and hyperactivity are both components of this disorder, but recent research has measured these two constructs separately (Gresham, Lane, and Beebe-Frankenberger, 2005; Hundt, Kimbrel, Mitchell, Nelson-Gray, 2008). Because it reflects a more current view on these disorders, this study focused on hyperactivity, or in terms of DSM-IV, predominately hyperactive-impulsive ADHD. This study did not examine a clinical sample, but rather assessed hyperactivity in a community sample, where it appears in less extreme form. As a result of historical convention much of the research on hyperactivity includes measures of hyperactivity and ADHD. The literature discussed below will emphasize studies that have addressed hyperactivity directly, though some relevant material considers the general ADHD category.

*Outcomes of hyperactivity*

Much of the research in this area is motivated by the multitude of studies showing that hyperactivity and ADHD are associated with a variety of behavioral, academic, and delinquent outcomes (Vitaro, Brendgen, Larose, and Tremblay, 2005; Simonoff, Elander, Holmshaw, Pickles, Murray, and Rutter, 2004). These include problems that begin in childhood, such as conduct disorder, aggression, or oppositional and defiant behavior (Shelton and Barkley, 1995; Barkley, 2003), as well as problems that emerge through adolescence, such as antisocial behavior, conduct disorder, crime, and substance abuse (Thapar, van dee Bree, Fowler, Langley, and Whittinger, 2006; Simonoff, Elander, Holmshaw, Pickles, Murray, and Rutter, 2004; Leschied, Chiodo, Nowicki, and Rodger, 2008; Johansson, Kerr, and Andershed, 2005; Elkins, McGue, and Iacono, 2007). These studies show the severity of negative outcomes that can occur with childhood hyperactivity and demonstrates the importance in understanding how it changes over time.

In addition to these delinquent behaviors, there is evidence to suggest that there are associations between hyperactivity and cognition and achievement. For example, hyperactivity in kindergarten was related to lower rates of high school graduation (Vitaro, Brendgen, Larose, and Tremblay; 2005) and hyperactivity-impulsivity-inattention problems were associated low academic competence (Gresham, Lane, and Beebe-Frankenberger, 2005). These studies establish that hyperactivity and ADHD affect multiple facets of a person's life, not just conduct and behavior. Furthermore, research has shown that hyperactivity and ADHD can persist into adulthood (Kessler,

Adler, Barkley, Biederman, Conners, Faraone, et al., 2005; Lara, Fayyad, Graaf, Kessler, Aguilar-Gaxiola, Angermeyer, et al., 2009). These results debunk the once-believe myth that the child "will grow out of it".

*Outcomes of emotion regulation*

Similar to hyperactivity, emotion regulation affects multiple domains. Although it has been defined in many ways, for the purpose this study, emotion regulation is defined as the process of internally controlling emotions as well as external emotional expressions (Thompson, 1994; Eisenberg, Champion, & Ma, 2004). Low levels of emotion regulation have been found to be associated with lower social competency, peer rejection, externalizing behaviors, and health issues (Fabes, Gaertner, and Popp, 2006; Cole, Zahn-Waxler, Fox, Usher, Welsh, 1996; Denollet, Nyklícek, and Vingerhoets, 2008). Research on emotion regulation has focused on effortful and reactive control, components of a person's temperament (Rothbart and Bates, 1998; Derryberry and Rothbart, 1997; Eisenberg and Morris, 2002), which involves executive functioning (Eisenberg & Spinrad, 2004). Studies have shown that children with executive function deficits are at risk for hyperactivity (Mares, McLuckie, Schwartz, and Saini, 2007; Wåhlstedt, Thorell, and Bohlin, 2008). Additionally, Martel and Nigg (2006) found low reactive control, but not effortful control, to be related to child hyperactivity-impulsivity.

*Emotion Regulation and Hyperactivity*

Eisenberg, Cumberland, Spinrad, Fabes, Shepard, Reiser, et al. (2001) suggested that children act out because they are unable to properly regulate anger and frustration,

and it has been found that children who are unable to control their emotions are more likely to have behavior problems (Graziano, Reavis, Keane, and Calkins, 2006). Given these links between behaviors and emotions, more researchers have considered the connections between emotion regulation and hyperactivity. Gnaulati (2008) suggested that emotion regulation (or dysregulation) is a crucial component of ADHD. Some research has tested whether these associations do exist. For example, Melnick and Hinshaw (2000) showed that boys with comorbid ADHD and aggression had more maladaptive emotion regulation than boys with ADHD only or boys without behavioral problems. Maedgen and Carlson (2000) compared and found differences in emotion regulation and social functioning in children with different subtypes of ADHD. This study, however, did not include children with ADHD predominantly hyperactive-impulsive subtype.

These studies establish the links between externalizing problem behaviors such as hyperactivity and emotion regulation. There is some question, however, about the causal direction of associations between emotion regulation and hyperactivity. Cognitive control systems such as inhibition are often examined in relation to hyperactivity and other externalizing behaviors, but as Martel (2009) points out, these systems are developed after emotions and emotional displays are already present in a young child. It is not unreasonable to assume that these emotions play a role in the development of cognitive control systems or behavior expression. Melnick and Hinshaw (2000) suggested that because of the importance of emotion regulation in social functioning, and the lack of social skills in children with ADHD, emotion

regulation may have an underlying role in problem behaviors. The present study seeks to further the current understanding of the potentially causal influences of emotion regulation on hyperactivity in children transitioning into adolescence.

*Transitions*

Late childhood and early adolescence is a time of rapid transformation in some domains. Thompson and Meyer (2007) suggested that "emotion regulation develops dramatically during childhood and adolescence" (249). Yet, there have been conflicting findings in longitudinal studies regarding the stability of regulation and emotionality during the transition from late childhood to early adolescence. Larson, Moneta, Richards, and Wilson (2002) reported that younger adolescents (ages 10-14) were less stable in their self-reported daily emotional experiences than older adolescents (ages 13-18). In general, studies have found that regulation to be fairly stable (Murphy, Eisenberg, Fabes, Shepard, and Guthrie, 1999; Raffaelli, Crockett, and Shen, 2005). Yet, emotion regulation, effortful control, and executive functioning play a role in behavior inhibition (Mares, McLuckie, Schwartz, and Saini, 2007; Wåhlstedt, Thorell, and Bohlin, 2008). It has been noted that the area of the brain that controls executive functioning, the prefrontal cortex, is not fully developed in adolescence (Keating, 2004). Similarly, Martel (2009) pointed out that the parts of the limbic system that elicit emotions are developed before the ability to effortfully control these emotions, consequently putting children and teens at greater risk for emotional problems. In addition, Graber (2004) reported that while emotion regulation skills do develop during childhood, they continue to mature into

adolescence in reaction to the novel experiences of this time.

Though hyperactivity often persists into adulthood (Kessler, Adler, Barkley, Biederman, Conners, Faraone, et al., 2005; Lara, Fayyad, Graaf, Kessler, Aguilar-Gaxiola, Angermeyer, et al., 2009), several studies found evidence of a maturational decline in hyperactivity symptoms from childhood to adolescence (see Langberg, Epstein, Altaye, Molina, Arnold, and Vitiello, 2008, for review), perhaps as a result of brain development. The same study, however, presented new longitudinal data showing that hyperactivity is still malleable in early adolescence. Indeed initial declines in hyperactivity were halted or reversed when children made the transition to middle school, between ages 11 and 13 years, a well-known developmental stressor. This research highlights the importance of our study, which considers whether growth in emotion regulation during this crucial period is associated with reductions in hyperactivity.

To provide statistical control for variables known to be linked with hyperactivity and emotion regulation, our analysis included effects for parental education, child gender, and externalizing behaviors as covariates. Parent education has been found to be a significant predictor of self-regulation or disruptive behaviors (Ponitz, McClelland, Jewkes, Connor, Farris, and Morrison, 2008; Vitaro, Brendgen, Larose, and Tremblay; 2005). Higher levels of parental education are anticipated to be associated with higher levels of emotion regulation and lower levels of hyperactivity at Wave 1. Additionally, there is some discrepancy in findings regarding gender differences in emotion regulation and experiences (Blanchard-Fields, Stein, Watson,

2004; Eisenberg, Cumberland, Spinrad, Fabes, Shepard, Reiser, et al., 2001; Valiente, Eisenberg, Shepard, Fabes, Cumberland, Losoya, et al., 2004). It is well known that boys are referred more often than girls for ADHD (Barkley, 2006), and are more likely to be hyperactive than girls (Romano, Tremblay, Farhat, and Côte, 2006). Yet, because most of the research on the associations between emotion regulation and hyperactivity has been studies in boys (e.g., Melnick and Hinshaw, 2000; Walcott and Landau, 2004), we cannot be sure that the patterns are similar in girls (Mullin and Hinshaw, 2007). The present study provides an opportunity to further explore the relationship between emotion regulation, hyperactivity, and gender. Finally, some studies have found that externalizing behaviors to be associated with emotion regulation (Cole, Zahn-Waxler, Fox, Usher, and Welsh, 1996; Fabes, Gaertner, and Popp, 2006). Externalizing behaviors can include, but are not limited to drug use, delinquency, and risky sexual behaviors (Cooper, Shaver, and Collins, 1998). Because aggression, conduct disorder, and substance use have been found to be associated with hyperactivity as well (Barkley, 2003; Elkins, McGue, and Iacono, 2007), externalizing behaviors have also been included in the present model. It is proposed that higher levels of emotion regulation will be associated with lower levels of externalizing behaviors, while higher levels of hyperactivity will be associated with higher levels of externalizing behaviors.

*Hypotheses*

Given the literature presented on the uniqueness of the transitional adolescence period, this study anticipated that increases in emotion regulation would be associated

with decreases in hyperactivity. In addition, this study also hypothesized that children with higher levels of emotion regulation at Wave 1 would experience decreases in hyperactivity over time.

## Methods

### *Study sample*

The data for this study came from the Flourishing Families Project (FFP). Data were collected in a large urban city in the northwest US. This is a longitudinal study of families and family life, with a total of three waves to date. Data were collected one year apart. The variables used in this study were child-reported measures of emotion regulation, hyperactivity, and externalizing behaviors during family member interviews, as well as parent reports of education levels. All families had a child between the ages of 9 and 14 at Wave 1, with the average age being 11.5 years (Day, 2009). To focus specifically on the transition from late childhood to early adolescence, the age range at each wave was reduced to concentrate on specific developmental phases. This decreased the sample size to 257. The mean age of the children was 10.6 years at Wave 1, 11.6 years at Wave 2, and 12.6 years at Wave 3. Fifty-four percent of the children in this sample were female, and 95% of the parents in the reduced sample were mothers. Seventy percent of the families in this sample were two-parent, married families, and the median annual household income was $60,000. Approximately 66% of the parents earned a Bachelor's degree or higher, 27% has some college or an Associate's degree, and 7% had a high school diploma or less. Sixty-nine percent of the families reported themselves as European American,

7% African American, 23% multi-ethnic, and less than 1% Asian American and Other.

*Missing Data*

Experienced researchers closely supervised data collection for the Flourishing Families Project. There is little missing data, as data collectors screened questionnaires for double marking and missing answers (Day, 2009). Five of the nine variables or scales had missing values; however, within those that did, there were no more 1.6% missing. Therefore, 96.5% of the participants had complete data. Given the small proportion of missing values it could be considered missing completely at random (MCAR). Models will be estimated using maximum likelihood estimation (Mplus 5) under the missing at random assumption so that all available data are utilized.

*Measures*

*Child's emotion regulation* was measured by 4 indicators on a scale from 1 (not true at all) to 4 (always true). These indicators are: "I have a hard time controlling my temper"; "I get so frustrated I feel ready to explode"; "I get upset easily"; and "I am afraid I will lose control over my feelings". These items were reverse coded for easier interpretability, so that higher scores indicate more emotional control.

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*Covariates.* This model includes three variables as covariates: Parent education, child gender, and child externalizing behaviors. *Parental education* was measured by the primary parent's self-report of their education level on a scale from 1 (less than high school) to 7 (advanced degree: PhD, PsyD, JD, etc.) at wave one. *Child externalizing behaviors* was measured by child self-report on delinquent behaviors. These questions are a part of the Child Behavior Checklist Youth Self-Report (Achenbach, 1991), delinquency subscale. This scale consisted of nine items on a scale of 0 (not true) to 2 (often true) and example items include "I disobey at school", "I use alcohol or drugs", and "I steal things from places other than home". Similar to other studies (Eisenberg, Gershoff, Fabes, Shepard, Cumberland, Losoya, et al., 2001; Romano, Tremblay, Farhat, Côte, 2006) the nine items were summed so that

higher scores on the scale indicate more delinquent behaviors. The alpha for these items is .61. Given the high proportion of children that reported "not true" to these items (nearly 60%), the scale was then dichotomized, so that a score of "0" indicated "not true" for any of the delinquent behaviors and "1"indicated that the child said "somewhat true" or "often true" to at least one of the items.

The data was analyzed in Mplus using a parallel process growth curve model. Growth curve models examine longitudinal observations of a measure of individuals in terms of an intercept that represents the initial level of the variable at time 1, and the slope over time change in individuals per one unit of time (Hox, 2010). They further allow estimates of the effects of covariates on the intercept and slope. When analytic interest focuses on two variables that are changing over time, a parallel growth curve model is used to test whether the intercept and slope of one variable is associated with the intercept and slope of an second variable as shown in Figure 1 in Appendix A (Chung, White, Hipwell, Stepp, Loeber, 2009; Stoolmiller, Gerrard, Sargent, Worth, Gibbons, 2009).

Overall, this model tested whether 1) higher levels of emotion regulation at Wave 1 are be associated with a decrease in hyperactivity from Wave 1 to Wave 3, and 2) that an increase in emotion regulation from Wave 1 to Wave 3 is associated with a decrease in hyperactivity from Wave 1 to Wave 3.

## Results

Figure 2 (presented in Appendix A) shows the estimated model. In addition to testing the effects of emotion regulation at Wave 1 and changes over time on the

changes in hyperactivity, the model also tested the possible reciprocal effect of hyperactivity at Wave 1 on changes in emotion regulation (Stoolmiller, Gerrard, Sargent, Worth, Gibbons, 2009). Variable correlations can be found in Table 1; means and standard deviations are shown in Table 2, both presented in Appendix A.

The overall parallel process growth curve model had adequate fit, $\chi^2$ (21)= 51.981, $p$<.001, CFI = .945 RMSEA =. 076, SRMR = .038. Kline (2005) stated that a CFI above .90 and an SRMR under .10 is an indicator of good fit, an RMSEA between .05 and .08 is reasonable. Table 3 presents the unstandardized and standardized coefficients; Figure 2 presents the model with standardized coefficients (both can be found in the Appendix). The intercept and slope of each longitudinal measure were correlated (i.e., the intercept of emotion regulation was correlated with the slope of emotion regulation). In preliminary analyses, these correlations were not significant; therefore, for the present model these errors were set at zero. These correlations are not represented in the figure.

All of the covariates had a significant effect on either emotion regulation or hyperactivity or both, as predicted. Parent education had a significant effect on emotion regulation ($\beta$ = .18, $p$ < .01) but not hyperactivity, indicating that higher levels of parent education were associated with higher levels of emotion regulation at wave 1. Gender, with male being coded as "1", had a significant effect on emotion regulation ($\beta$=.19, $p$< .01), but not on hyperactivity. This illustrates that males reported higher levels of emotion regulation at wave 1, but that there are no gender differences in reporting hyperactivity. Child externalizing behaviors had a significant

effect on emotion regulation (β= -.40, $p$< .001) and hyperactivity (β=.29, $p$< .001), demonstrating that higher levels externalizing behaviors are associated with lower levels of emotion regulation and higher levels of hyperactivity at Wave 1.

There was not a significant effect of the initial level of emotion regulation on the change in hyperactivity; children's initial level of emotion regulation does not significantly impact their change in hyperactivity. The change (slope) of emotion regulation had a significant negative effect on the change (slope) in hyperactivity (β=-.42 $p$< .01). As predicted, increases in emotion regulation were associated with decreases in hyperactivity. In addition, the effect of hyperactivity at Wave 1 had a significant effect on the change in emotion regulation (β= .28, $p$< .05), indicating that emotion regulation increases somewhat over time in those who report higher hyperactivity at Wave 1.

## Discussion

Recent research has become interested in exploring emotion regulation in hyperactive children. Using a parallel process growth curve, we examined the effects of emotion regulation on hyperactivity as children grow into adolescence. This study found a significant effect of the increase in emotion regulation as a child transitions into adolescence to be associated with a decrease in hyperactivity, thus providing strong evidence supporting Hypothesis 2. This finding is consistent with other literature that has found emotion regulation impairments in hyperactive children (Melnick and Hinshaw, 2000; Martel and Nigg, 2006; Wehmeier, Schacht, Barkley, 2010). For example, Walcott and Landau (2004) found that boys with ADHD had

more issues in controlling their emotions, as well as concealing their emotions than were boys without ADHD. This finding also supports the suggestion of Langberg, Epstein, Altaye, Molina, Arnold, and Vitiello (2008) that other functions are related to hyperactivity during this sensitive time. The present study, however, goes beyond these cross-sectional associations to show for the first time that, as predicted, *changes* in emotion regulation are associated with *changes* in hyperactivity during the transition to adolescence.

The study found a strong predicted negative association between emotion regulation and hyperactivity at Wave 1. However, Wave 1 emotion regulation did not predict change in hyperactivity, thus there was no support for Hypothesis 1. It is possible that emotion regulation, or the psychological consolidation of different aspects of self regulation, is changing so rapidly that Wave 1 levels of emotion regulation are not relevant to hyperactivity a year or two later (Thompson & Meyer, 2007).

Our model included evidence of a reciprocal effect, as Wave 1 hyperactivity was positively associated with change in emotion regulation. Though not predicted, this positive association could result from a ceiling effect in emotion regulation. As evidenced by the strong negative Wave 1 correlation between emotion regulation and hyperactivity, children with lower hyperactivity at Wave 1 have higher emotion regulation at Wave 1. Thus they may have less room for improvement in emotion regulation, than those who start with lower levels of emotion regulation. In any event it may be useful to consider that there may be a reciprocal effect between emotion

regulation and hyperactivity, rather than emotion regulation having a casual effect on hyperactivity. Extreme low or high activity in particular parts of the brain could lead to deficits in both hyperactivity and emotion regulation. Both hyperactivity and poor emotion regulation may be influencing one another, indicating that the causal path in our model from change in emotion regulation to change in hyperactivity might actually be a reciprocal effect.

Covariates had significant effects in the expected direction. Higher parental education was associated with higher child emotion regulation. Externalizing behaviors were found to be related to both emotion regulation and hyperactivity. These findings are consistent with the current literature (Cole, Zahn-Waxler, Fox, Usher, Welsh, 1996; Fabes, Gaertner, and Popp, 2006; Elkins, McGue, and Iacono, 2007). These focused primarily on children, and this study replicated the findings in an older age group. This stresses the importance of optimal emotion regulation and management of hyperactivity because of their continued associations with externalizing behaviors in adolescence.

The present study found a gender effect, in that boys self-reported higher emotion regulation than girls, but there were no gender differences in report of hyperactivity. Fisher, Manstead, Evers, Timmers, and Valk (2004) stated women are expected to display emotions, and that a stereotype exists that men are rational and women are emotion. However, gender roles and schemas are social constructs and cognitive changes throughout childhood and adolescence may shape one's ideas of gender appropriate roles and behaviors. These constructs may explain some of the

gender differences in adolescent self-report. Specifically, a girl may feel that because society says it is appropriate for her to express emotions, then she need not be as in control as a boy. In contrast, boys may sense that emotionality is a sign of weakness or not being masculine, and therefore report that they are more regulated and in control.

This study was not without limitations. First, the measurement of the two primary constructs in this study included relatively few items. Although they are key items with good internal consistency, use of more items would have made the measures more reliable, and assessed more diverse aspects of emotion regulation and hyperactivity. Second, the measures of emotion regulation and hyperactivity are self-report. Boys and girls may be aware of the social stereotypes of their gender and feel the need to report levels of emotion regulation and hyperactivity in accordance with the appropriate gender. Thompson and Meyer (2007), however, point out the struggles of measuring emotion regulation in infants and young children because self-report is not a viable option, and therefore researcher must rely on external expression of emotion or observer report. In older children, as in this sample, self-report eliminates the complications that can arise when interpreting behavioral expressions of emotion. A third limitation is that the sample for this study was mostly urban middle-class families. Because hyperactivity and emotion regulation do vary by ethnic and socioeconomic category, the associations found in our model may vary as well. Therefore, findings cannot be generalized beyond this sample.

There are several suggestions for future research from the present study. First,

the field should continue to examine the relationship between emotion regulation and hyperactivity to gain a better understanding about the casual directions. One way to do this is to test the possible reciprocal effects found in this paper. Second, gender differences in emotion regulation and hyperactivity have been widely established in the literature (Eisenberg, Valiente, Morris, Fabes, Cumberland, Reiser, et al., 2003; Romano, Tremblay, Farhat, and Côte, 2006). Most of these studies and reports, however, have relied on external measures or observations for measurement. Given the sensitive time period on which this study focused, children and teens are subject to family, peer, and media socialization regarding their gender. These gender constructs may be influencing the children's reports about emotion regulation and hyperactivity. These findings suggest that future research consider parent report, teacher report and peer report on gender roles and constructs and the influence it has on how teens view their ability to control emotions and hyperactivity.

This study has several implications. Increases in emotion regulation were shown to decrease hyperactivity. Therefore, interventions that promote growth in emotion regulation could potentially also decrease an adolescent's hyperactivity. Further, these preventions should not only focus on emotion regulation, but also externalizing behaviors, as this study has shown these behaviors to be associated with emotion regulation and hyperactivity. In addition, if females indeed do have poorer emotion regulation during adolescence, programs and preventions should teach young girls emotion management during this transition.

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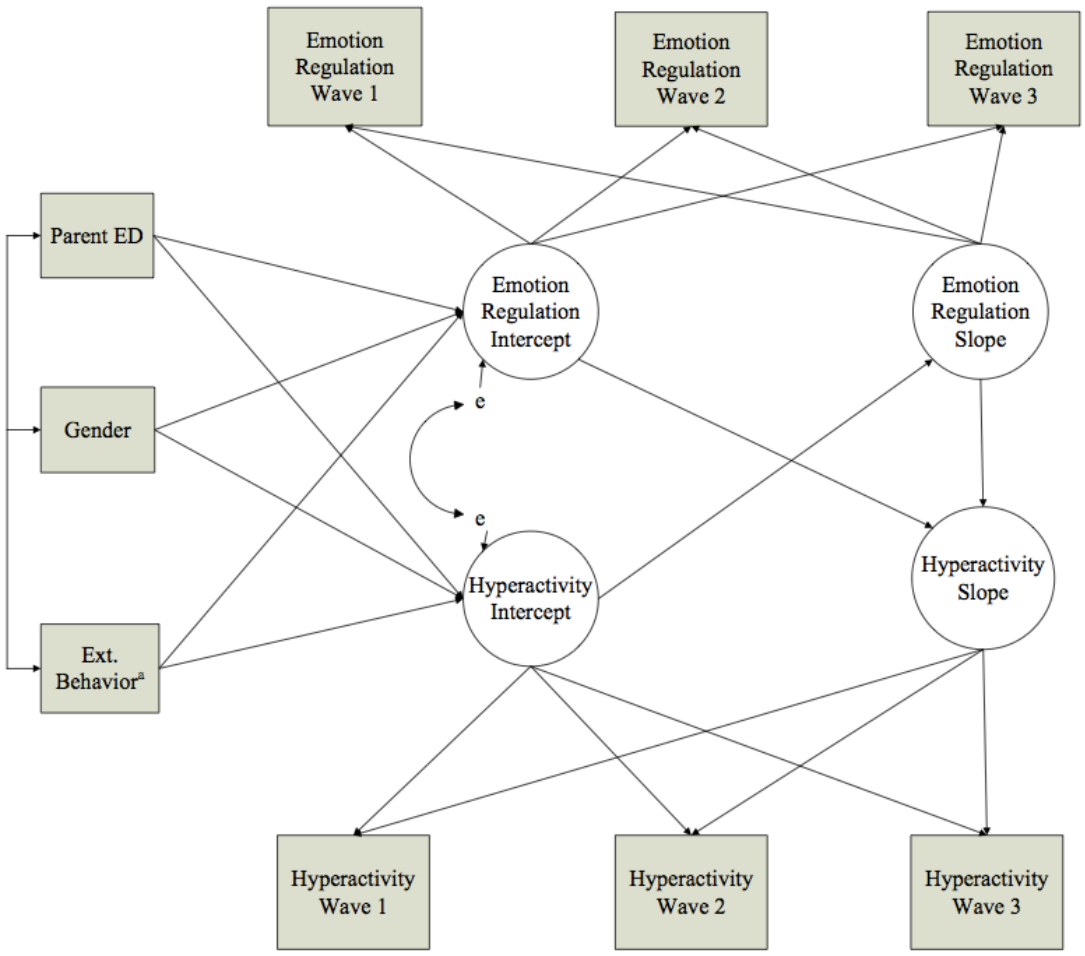
Appendix A

Figure 2.1 *Parallel Process Growth Curve.*




*Note*: [a]Ext. Behaviors= Externalizing Behaviors.

Table 2.1 *Child Variables and Covariates: Correlations (N = 257)*

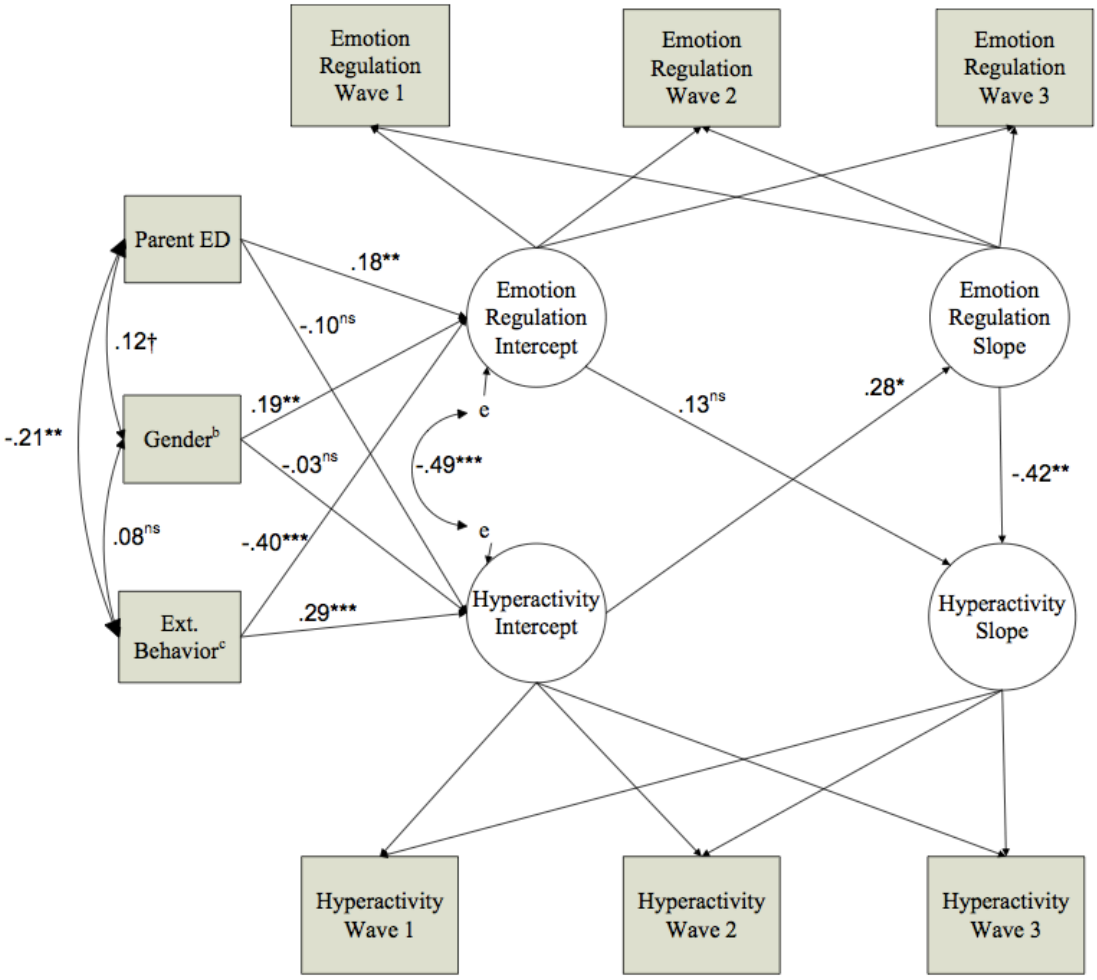
| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 1. Emotion Regulation Wave 1 | – | | | | | | | | |
| 2. Emotion Regulation Wave 2 | .55*** | – | | | | | | | |
| 3. Emotion Regulation Wave 3 | .52*** | .61*** | – | | | | | | |
| 4. Hyperactivity Wave 1 | -.37*** | -.25*** | -.23*** | – | | | | | |
| 5. Hyperactivity Wave 2 | -.25*** | -.31*** | -.14* | .54*** | – | | | | |
| 6. Hyperactivity Wave 3 | -.21*** | -.21*** | -.27*** | .45*** | .62*** | – | | | |
| 7. Parental Education | .21*** | .21*** | .25*** | -.12* | -.11† | -.12† | – | | |
| 8. Child Gender (Male =1) | .11† | .19** | .18** | -.07 | .09 | .00 | .12† | – | |
| 9. Externalizing Behaviors | -.34*** | -.31*** | -.26*** | .21*** | .24*** | .22*** | -.21*** | .07 | – |

† $p < .10$ $p < .05$. **$p < .01$. ***$p < .001$

Table 2.2. *Child Variables and Covariates: Means and Standard Deviations (N = 257)*

| Variable | Mean | Standard Deviation | Range |
|---|---|---|---|
| 1. Emotion Regulation Wave 1 | 2.79 | .66 | 1-4 |
| 2. Emotion Regulation Wave 2 | 2.95 | .70 | 1-4 |
| 3. Emotion Regulation Wave 3 | 2.94 | .73 | 1-4 |
| 4. Hyperactivity Wave 1 | 2.39 | .79 | 1-4 |
| 5. Hyperactivity Wave 2 | 2.31 | .86 | 1-4 |
| 6. Hyperactivity Wave 3 | 2.44 | .89 | 1-4 |
| 7. Parental Education | 4.63 | 1.43 | 1-7 |
| 8. Child Gender (Male =1) | 0.45 | 0.50 | 0-1 |
| 9. Externalizing Behaviors | 0.41 | 0.50 | 0-1 |

Figure 2.2 *Parallel Process Growth Curve of Emotion Regulation and Hyperactivity (N=257)*[a]




*Note:* [a]Preliminary analysis showed that correlations between the intercept and slope of Emotion Regulation, as well as the intercept and slope of Hyperactivity were insignificant ($p > .40$); therefore, these parameters were set to 0 and not shown in the above figure. [b]Gender is coded Female =0 and Male =1. [c]Ext. Behaviors= Externalizing Behaviors.

† $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 2.3 *Unstandardized, Standardized Parallel Process Growth Curve Model Results (Standard Errors in Parentheses; N = 257)*

| *Parameter Estimates* | *Unstandardized* | *Standardized* |
|---|---|---|
| Covariate Effects on Intercept of Emotion Regulation | | |
| Parent Education | 0.07 (0.02) | 0.18** |
| Gender | 0.20 (0.07) | 0.18** |
| Externalizing Behaviors | -0.42 (0.07) | -0.40*** |
| Covariate Effects on Initial Level of Hyperactivity | | |
| Parent Education | -0.04 (0.03) | -0.10 |
| Gender | -0.03 (0.09) | -0.03 |
| Externalizing Behaviors | 0.37 (0.09) | 0.29*** |
| Correlation of Covariates | | |
| Parent Education and Gender | 0.09 (0.05) | 0.12† |
| Parent Education and Externalizing Behaviors | -0.15 (0.05) | -0.21** |
| Gender and Externalizing Behaviors | 0.02 (0.01) | 0.08 |
| Correlation of Intercepts of Emotion Regulation and Hyperactivity | -0.103(0.03) | -0.49*** |
| Effect of Emotion Regulation Intercept on Hyperactivity Slope | 0.07 (0.06) | 0.13 |
| Effect of Hyperactivity Intercept on Emotion Regulation Slope | 0.09 (0.04) | .28* |
| Effect of Emotion Regulation Slope on Hyperactivity Slope | -0.66 (.30) | -0.42** |
| Residual Variance of Emotion Regulation Intercept | 0.20 (0.03) | 0.75*** |
| Residual Variance of Emotion Regulation Slope | 0.03 (0.01) | 0.92*** |
| Residual Variance of Hyperactivity Intercept | 0.35 (0.05) | 0.89*** |
| Residual Variance of Hyperactivity Slope | 0.07 (0.02) | 0.80*** |

*Note:* $\chi^2$ (21) = 51.984, $p < .001$; CFI = .945; RMSEA = .076; SRMR= .038.
† $p < .10$ *$p < .05$. **$p < .01$. ***$p < .001$

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