Research Review: A new perspective on attention-deficit/hyperactivity disorder: emotion dysregulation and trait models

Michelle M. Martel
Psychology Department, University of New Orleans, USA

Attention-deficit/hyperactivity disorder (ADHD) is a common example of developmental psychopathology that might be able to be better understood by taking an emotion regulation perspective. As discussed herein, emotion regulation is understood to consist of two component processes, emotion (e.g., positive and negative emotionality) and regulation (e.g., effortful and reactive forms of control), which interact with one another at the behavioral level. Review of work to date suggests that the heterogeneous behavioral category of ADHD may encompass two distinct kinds of inputs: inattentive ADHD symptoms may be primarily associated with breakdowns in the regulation side, whereas hyperactivity-impulsive ADHD symptoms may be associated with breakdowns in the emotionality side. It is argued that breakdowns in control may be a signature for ADHD specifically, while increased negative emotionality may serve as non-specific risk factors for disruptive behavior disorders, explaining their comorbidity. Increased understanding of the interrelations and interactions of component emotion regulation processes may elucidate developmental, sex, and neural mechanisms of ADHD and associated comorbid disruptive disorders. **Keywords:** Emotion, emotion regulation, ADHD, disruptive behavior, temperament.

Attention-deficit/hyperactivity disorder (ADHD) is a common example of developmental psychopathology that, although typically studied through the lens of cognitive control, might be able to be better understood by taking an emotion regulation perspective. ADHD is a behavioral disorder present by age 7, characterized by excessive inattention-disorganization (e.g., ‘often fails to give close attention to details’ or ‘makes careless mistakes in schoolwork, work, or other activities’) and/or hyperactivity-impulsivity (e.g., ‘often fidgets with hands or feet,’ ‘squirms in seat,’ or ‘often has difficulty awaiting turn’; APA, 2000). There are currently three subtypes of the disorder: a predominantly inattentive subtype (ADHD-PI), characterized by six or more symptoms of inattention, a predominantly hyperactive-impulsive subtype (ADHD-PHI), characterized by six or more symptoms of hyperactivity-impulsivity, and a combined subtype (ADHD-C), characterized by six or more symptoms in both domains (American Psychiatric Association, 2000). ADHD is commonly comorbid with other childhood disruptive behavior disorders like oppositional-defiant disorder (ODD) and conduct disorder (CD; American Psychiatric Association, 2000). ADHD follows a developmental trajectory with difficulties with impulse control arising earlier in life than difficulties with attention (Olson, 1996). Owing to its early development, ADHD is often considered to be a trait-like characteristic (Braaten & Rosen, 1997; Nigg, Blaskey, Huang-Pollock, & John, 2002a). In fact, recent research suggests that ADHD is best conceptualized as a dimensional trait, rather than a categorical diagnostic category (Haslam et al., 2006). Initial evidence suggests that individuals with ADHD are often characterized by extreme affective traits like negative emotionality (Martel & Nigg, 2006; Nigg et al., 2002a, 2002b). Thus, increased understanding of the role of emotion and regulation processes in ADHD may be able to shed light on etiology and mechanisms of this disorder.

As a starting point, the current paper will first review definitions of emotion regulation, as well as the complexities inherent in these definitions and associated measurement procedures. A literature review will be conducted on studies addressing relations among emotional regulation (including emotion-related traits), disruptive behavior disorders, and ADHD. Sex effects on emotional regulation processes relevant to disruptive behaviors will be discussed. Emotion regulation models of disruptive behaviors and ADHD will be presented. Finally, limitations of previous work and guidelines for future work will be discussed.

**Emotion regulation**

Empirical study of emotion and emotion regulation is, in some senses, the Holy Grail of psychological study (LeDoux, 1996). Although most laypeople recognize the important role of emotion in daily life, historically, researchers have been reluctant to delve into this illusive and seemingly irrational psychological process. However, two influential books written in the 1990s emphasized the importance of emotions in rational thought processes (Damasio, 1994) and set about describing the neurobiological basis of emotion and emotion regulation (LeDoux, 1996). Although Damasio examined human patient neuropsychological performance on the
Gamblers, while studying rat performance on fear conditioning tasks following well-defined experimental lesions, these two researchers came to strikingly similar and complementary conclusions: emotion and its regulation are distinct and yet often intertwined during day-to-day life (e.g., Adolphs et al., 1999; Bachevalier & Adolphs, 2001; Bachevalier et al., 2003). Since this research was conducted, there has been much interest in emotion regulation, but definitions of this construct remain unclear, despite consensus that definitional clarity is needed.

The role of emotion in emotion regulation complicates definition (Campos, Frankel, & Camras, 2004). Most developmental work on emotion and emotion regulation has been based on careful observation and interval coding of child emotion, emotion expressiveness, and emotion regulation, as well as related parent-child interactions, measured during laboratory tasks designed to emulate real-life situations and/or experimentally induce natural mood states (e.g., a competitive game, a task that requires the child to wait for the mother to complete work before he/she can open a gift; Chaplin, Cole, & Zahn-Waxler, 2005; Cole, Teti, & Zahn-Waxler, 2003; Cole, Zahn-Waxler, Fox, Usher, & Welsh, 1996; Eisenberg et al., 1996; Eisenberg, Fabes, Guthrie, & Reiser, 2000a). Based on this work, a recent definition of emotion refers to it as ‘appraisal-action readiness stances’ (Cole, Martin, & Dennis, 2004; p. 320) which connotes both an evaluating and an action-readiness component of emotion. A second, somewhat overlapping, definition emphasizes functionality and defines emotion as the process of registering the significance of an event, with magnitude and urgency stressed as two important components of emotional responses (Campos et al., 2004).

Emotions have at least two potential roles; they regulate and are regulated (Cole et al., 2004; Cole, Michel, & Teti, 1994). Regulatory emotion refers to changes that come about because of emotion (e.g., a child’s anger leading to conflict with peers) while regulated emotion refers to changes in valence of emotion (Cole et al., 2004; e.g., a child soothes him/herself or makes a sad playmate smile). Individual differences in regulated emotion have been linked to later behavior problems (Cole et al., 1996; Cole, Zahn-Waxler, & Smith, 1994). An alternative, yet somewhat overlapping, definition of emotional regulation is the act of modifying any process that generates emotion or any behavioral manifestations of emotion (Campos et al., 2004; e.g., use of self-soothing strategies). Seeing these definitions as overly broad, Eisenberg and colleagues argued for a definition of emotion-related self-regulation as ‘the process of initiating, avoiding, inhibiting, maintaining, or modulating the occurrence, form, intensity, or duration of internal feeling states, emotion-related physiological, attentional processes, motivational states, and/or the behavioral concomitants of emotion in the service of accomplishing affect-related biological or social adaptation or achieving individual goals’ (Eisenberg & Spinrad, 2004, p. 338).

Eisenberg’s notion of emotion-related behavioral regulation, alternatively called behavioral regulation or reactive control, is frequently found to interact with the trait of negative emotionality (i.e., the culmination of a diverse set of negative emotions including anger, sadness, and worry) in predicting behavioral outcomes such as social functioning and problem behavior (Eisenberg et al., 2000a). Specifically, negative emotionality moderates the relationship between emotional-related behavioral regulation and both positive and negative outcomes (e.g., social competence; externalizing behavior) with stronger relationships found for those higher in negative emotionality (Eisenberg et al., 1996, 2000b). Based on this definition, emotion-based behavioral regulation is likely only one component of the broader concept of emotional regulation. The definition of emotion regulation used in the current paper is most in line with this perspective in that emotion- and regulation-related temperament/personality traits (e.g., negative/positive emotionality, effortful control) are seen as one way to gain purchase on the broader, more complex concept of emotion regulation. Emotion- and regulation-related temperament/personality traits may provide one means by which to understand specific components of emotion regulation. Since emotion regulation and temperament theorists claim much of the same domain, discussion of the similarities and differences between emotion regulation and traits may facilitate development of alternative conceptualizations and description, as well as enrich measurement strategies.

Emotion and regulation: one process or two?

The fundamental question regarding emotion and regulation concerns whether we conceive them as one or two processes. Although most definitions of emotion regulation conceptualize emotion and regulation as dissociable from one another, this idea is being increasingly critiqued. One-factor models of emotion regulation may, in fact, be better supported (Campos et al., 2004), despite the fact that it is possible to break down one-factor models into their component processes (e.g., emotions, regulation processes). The structure of emotion regulation may, in fact, depend critically on the level of analysis examined. While emotion and regulation may be inseparable when examined at the behavioral level, they may be distinguishable at the neural level (Goldsmith & Davidson, 2004). One complicating factor is that temporal relations between emotion and regulation are almost certainly bidirectional (Bridges Denham, & Ganiban, 2004; Cole et al., 2004).

Study of the neurobiology of emotion and regulation may shed some light on the distinctiveness of these processes. The neurobiology of emotions has been extensively studied. Negative emotion (i.e., avoidance) and positive emotion (i.e., approach) have received most emphasis in regard to neurobiological underpinnings, in part due to their important evolutionary functions (Gray, 1981; Nigg, 2006). Negative and positive emotionality are also believed to be the first emotionally
Emotion regulation and disruptive behavior disorders

Emotion dysregulation can be viewed as critically important in the development and clinical expression of disruptive behavior disorders and ADHD, although this is a relatively under-examined perspective. Although deficits in cognitive control are most frequently studied in relation to ADHD in school-age children, examination of emotion dysregulation may be particularly useful in younger children, due to the earlier emergence of emotionality systems (vs. control systems). Study of emotion regulation deficits in young children may elucidate early longitudinal pathways to these disorders, as well as sex differences in these pathways.

One study addressed part of this question by examining the relation of preschoolers’ expressive control of emotion with risk for developing general disruptive behavior disorders (Cole et al., 1994). Cole and colleagues (1994) gave preschoolers an undesirable prize and coded subsequent negative affect (i.e., anger, sadness, worry, and disgust) and behavior (i.e., active self-regulation, passive tolerance, and disruptive behavior) in the examiner’s presence and absence. Sex differences were found in children’s reactions to the undesirable prize. Boys at high risk for disruptive behavior disorders showed more negative emotion in the examiner's presence than boys at low risk, although boys at low risk had comparable levels of negative emotion as boys at high risk in the examiner's absence. For the at-risk boys, anger predicted subsequent oppositionality. In contrast, at-risk girls exhibited less negative affect in the examiner’s absence than low-risk girls. Thus, sex differences were evident in affective response and emotion regulation for children at high risk for the development of disruptive behavior disorders. Decreased emotional regulation of anger predicted increased disruptive behavior symptoms for males, and increased ‘minimization of negative emotion’ predicted disruptive behavior symptoms for females.

Measurement of emotion regulation

In the scientific literature, emotion regulation is most commonly examined during frustration-eliciting paradigms, and emotion regulation is commonly characterized using affective and behavior coding. One frustration-eliciting paradigm consists of giving an undesirable prize as a reward (Cole, 1986; Saarni, 1984). Another frustration-eliciting paradigm consists of asking children to construct a model or puzzle that is missing several critical pieces (e.g., Melnick & Hinshaw, 2000). Affective coding frequently involves the coding of negative facial expressions, such as anger, sadness, and worry. Behavioral coding generally focuses on emotion regulation strategies such as problem-solving, help-seeking, emotion expression, and disruptive behavior (e.g., Cole, Zahn-Waxler, and Smith, 1994b; Melnick & Hinshaw, 2000). The measurement of emotional regulation differs dramatically between studies.

Emotion regulation and ADHD

An additional question concerns whether emotion regulation deficits are specific to ADHD or other disruptive behavior disorders or whether they explain the comorbidity among these disorders. Only one study has examined the role of emotion regulation in ADHD specifically. Melnick and Hinshaw (2000) examined emotion regulation strategies in 45 school-aged boys with ADHD with and without comorbid aggression as compared to 34 boys without problem behaviors. Each child participated in a frustration-eliciting task with one parent during which they were asked to solve a puzzle that was missing two pieces; a behavioral coding system was used to code child behavior during the task. A subgroup of the children with ADHD, the subgroup with ADHD and comorbid aggression, had more maladaptive emotion regulation compared to the other children.
Specifically, children with ADHD with high levels of aggression focused more on the negative aspects of the task, engaged in less accommodation (i.e., cognitive reframing), and exhibited more intense emotional expression (e.g., slamming fist, sighing; Melnick & Hinshaw, 2000).

Walcott and Landau (2004) also found that boys with ADHD exhibited more ineffective emotion regulation than boys without ADHD, although they did not examine or control for comorbid aggression. In this study, cognitive disinhibition and emotion regulation was examined in a sample of 49 boys aged 6 to 11 with and without ADHD. Cognitive disinhibition was measured via Stop Signal Reaction Time (i.e., a measure of how much time is needed to successfully inhibit a motor response) from the Stop Task (Walcott & Landau, 2004). Emotion regulation was examined with a competitive version of the task used by Melnick and Hinshaw (2000; described above). In this task, children were asked to solve a puzzle in which two pieces were missing, and they were asked to do it faster than a confederate competitor. In addition, half of the children were asked to mask their frustration from the confederate competitor. Behavioral coding was used to assess emotional reaction and emotion regulation. Boys with ADHD exhibited more ineffective emotion regulation than boys without ADHD, exhibited by more negative responses and immobilized behavior. They also had more difficulty trying to regulate their emotional display when instructed. Precompetition cognitive disinhibition predicted a small, but statistically significant, amount of emotion dysregulation during the competitive peer task.

Maedgen and Carlson (2000) found that children with ADHD-C had less effective emotion regulation than children with ADHD-PI and children without ADHD, although comorbid aggression was not examined. Emotion regulation and emotion expression was assessed in 16 children with ADHD-C, 14 children with ADHD-PI, and 17 non-ADHD comparison children during a prize paradigm (Maedgen & Carlson, 2000). In this prize paradigm, children were asked to rank order a list of prizes. Then, they were presented with a desirable prize following one task and an undesirable prize following a second task. Behavioral coding was used to assess positive behavior (e.g., smiling), negative behavior (e.g., frowning) and emotional regulation (measured in the same way as by Melnick and Hinshaw [2000; above]). In this study, children with ADHD-C expressed more negative behavior during the disappointing condition of the task and more positive behavior overall. Children with ADHD-C were also judged to be more intense, more interested, and less effective in their emotional regulation than other children. Other research suggests that children with ADHD differ from other children in other emotion-related abilities, including emotion appraisal skills, recognition of facial expressions of emotion, and subjective experience of emotion (Norvilitis et al., 2000; Scime & Norvilitis, 2006; Singh et al., 1998; Wigal et al., 1998). Again, however, most studies did not control for comorbid aggression.

### Emotion- and regulation-related traits and ADHD

In addition to research on emotion regulation, some research has addressed the relations among childhood disruptive behavior disorders, ADHD, and emotion-related traits like negative emotionality, neuroticism, and extraversion (i.e., outward directed sociability, related to positive emotionality). Since there is considerable controversy about whether childhood traits are best captured by temperament and personality constructs, findings from both domains will be presented herein. It should be noted that recent theory suggests that temperament and personality can and possibly should be integrated in children due to similarities between the two domains (Shiner, 2005). Negative emotionality has been linked to neuroticism; surgency and high-intensity pleasure has been linked to extraversion, and effortful control has been linked to conscientiousness (reviewed by Shiner & Caspi, 2003). Evidence also supports the trait of agreeableness in children, although the trait of openness to experience to has been found less consistently in this age range (reviewed by Shiner & Caspi, 2003). Further, temperament and personality traits are thought to be hierarchically organized with higher-order factor structures (e.g., three-factor models) believed to subsume lower-order factor structures (e.g., five-factor models), thus allowing for both three- and five-factor models to explain phenoms at different levels of abstraction (Digman, 1997; Markon, Krueger, & Watson, 2005).

Overall, children with disruptive behavior disorders are characterized by increased negative emotionality (especially anger and frustration) and neuroticism, increased high-intensity pleasure and extraversion, and low agreeableness (Eisenberg et al., 2001; Huey & Weisz, 1997; Lynam et al., 2005; Oldehinkel et al., 2004; Sanson & Prior, 1999). Children with ADHD have been likewise characterized by high negative emotionality and neuroticism, positive emotionality and sometimes extraversion, as well as low agreeableness compared to children without ADHD (Parker, Majeski, & Collin, 2004; White, 1999). Further, there is substantial evidence that disruptive behavior disorders and ADHD in particular are associated with poor regulation, whether conceptualized as effortful control or conscientiousness (e.g., Eisenberg et al., 2001; Olson et al., 2005; Parker et al., 2004). Despite the utility of mapping these associations, these studies are less informative about specificity of relations between traits and disruptive behaviors because they did not examine these disruptive behaviors in isolation.

Several studies examined specific relations among traits and disruptive behavior symptoms. In a study of adults, inattentive ADHD symptoms were significantly related to higher neuroticism, lower openness, and lower conscientiousness, while hyperactive-impulsive ADHD symptoms were linked to higher neuroticism, higher extraversion, lower agreeableness, and lower conscientiousness (Parker et al., 2004). At least two studies have attempted to examine specific relations between disruptive behaviors and traits by isolating
disruptive symptom domains from one another. A study that examined the Big Five Factors in an adult sample found that inattentive ADHD symptoms were specifically related to low conscientiousness, whereas hyperactive-impulsive ADHD symptoms and oppositional-defiant symptoms were related to low agreeableness (Nigg et al., 2002b). A study that examined temperament traits in a clinical child sample found that inattention was related to effortful control, hyperactivity-impulsivity was related to reactive control, and opposition-defiance was related to negative emotionality (Martel & Nigg, 2006). Thus, children with ADHD appear to be characterized by high levels of negative emotionality and low levels of control as a group, but more specific associations can be seen at the symptom level.

Further, relations between traits and clinical symptoms may exhibit developmental changes or interactive effects. While childhood remitting or persisting ADHD is related to low levels of control or conscientiousness, ADHD that persists into adolescence is also characterized by increased neuroticism and decreased agreeableness (Miller et al., 2008), although it should be noted that comorbidity was not examined in this study. Finally, some research has found that control processes interact with emotion-related traits like negative emotionality in relation to disruptive behavior disorders and ADHD (Eisenberg et al., 2000b; Martel & Nigg, 2006).

Sex differences in emotion- and regulation-related traits relevant to disruptive behavior disorders

Although sex differences in emotion regulation processes are underexplored, sex differences in emotion- and regulation-related traits are well established. Similar to the sex-biased prevalence rate observed in childhood psychopathology, early childhood traits also show substantial sex differences, and these traits are related to preschool psychopathology (Lavigne et al., 1996). A meta-analysis on gender differences in temperament in children between the ages of 3 months and 13 years indicates that girls typically exhibit higher levels of effortful control, while boys exhibit higher levels of positive affect (Else-Quest et al., 2006). In regard to the development of sex differences in traits, data are limited. Some data suggests that boys exhibit higher levels of negative emotionality (e.g., irritability) in toddlerhood and that girls develop higher levels of trait control during early childhood with the advent of language development (Sanson & Prior, 1999). However, sex differences in traits appear early and map onto early-appearing sex differences in the prevalence rates of common forms of psychopathology like ADHD.

Emotion regulation models of disruptive behavior disorders and ADHD

Maladaptive emotion and regulation processes may exhibit specific linkages with psychopathological symptom domains, and mapping such linkages may enable more accurate prediction of risk for developmental psychopathology (Lynam & Widiger, 2007; Widiger & Trull, 2007). It may be possible to link emotion regulation processes with specific disruptive behavior symptom domains in such a way as to shed light on the high levels of comorbidity evidenced among the disruptive behavior disorders. As shown in Figure 1, high negative emotionality may increase risk for all disruptive behavior disorders. More specific linkages, however, may be seen between (dis)agreeableness and conduct disorder, between high reactive control/negative emotionality and oppositional-defiant disorder, between low control and ADHD inattention, and between high positive emotionality and ADHD hyperactivity-impulsivity. Thus, the ADHD symptom domain of inattention may be more specifically related to control, while the ADHD symptom domain of hyperactivity-impulsivity may be more related to affectively driven forms of control, sharing some overlap with oppositional-defiance through this trait linkage. Such shared relations among traits may lead to the comorbid conditions and symptomatology frequently seen in children.

Several possible models of emotion regulation process associations with ADHD and other childhood disruptive behavior disorders could be proposed. Three- and five-factor models will be emphasized in the current paper. These models are meant to be illustrative of a general logic that can guide work going forward. Because little work has examined specific relations between symptom domains and emotion regulation processes, these models must be considered preliminary and subject to refutation.

The first model, shown in Figure 2, is a three-factor trait model of ADHD. As suggested by previous work (e.g., Martel & Nigg, 2006), low effortful control may be most specifically related to increased inattentive symptoms of ADHD. In contrast, high positive and negative emotionality may be more specifically related to high hyperactive-impulsive ADHD symptoms. These emotion-related traits may also be related to oppositional-defiance and conduct problems in a developmental progression, shown in Figure 3. While negative emotionality may be a risk factor for hyperactive-impulsive ADHD symptoms, it may also be directly related to

Figure 1 Emotion and regulation process model of disruptive behavior disorders and comorbidity

© 2009 The Author
Journal compilation © 2009 Association for Child and Adolescent Mental Health.
oppositional-defiance. However, positive emotionality may be a risk factor only for hyperactivity-impulsivity and influence oppositional-defiance only indirectly. Then, oppositional-defiance may increase risk for later conduct problems through the aforementioned trait characteristics.

A five-factor model framework can also be conceived, shown in Figure 4. Based on work by Nigg (2006) et al. (2002b) and Lynam et al. (2005), conscientiousness appears to be related to inattention, while high neuroticism, low agreeableness, and high extraversion are related to hyperactivity-impulsivity. High neuroticism and low agreeableness may directly increase risk for oppositional-defiance, as well as having indirect effects through hyperactivity-impulsivity. High neuroticism, disagreeableness, and/or low conscientiousness may also lead to conduct problems (Nigg, 2006). Thus, trait models can be proposed that appear to account for established patterns of comorbidity among childhood psychopathology, as well as specific relations among traits and psychopathology. Whether these models are feasible or helpful in terms of predicting later behavior problems or explaining diagnostic symptoms and criteria remains to be tested.

**Figure 2** Three-factor trait model of ADHD

**Figure 3** Three-factor developmental trait model of ADHD and other disruptive behavior disorders

**Figure 4** Five-factor trait model of ADHD and other disruptive behavior disorders

**Limitations of previous work**

Work to date on emotion regulation and ADHD has notable limitations. Little research has examined specific relations between ADHD and emotion regulation. Most prior studies have examined relations between emotion regulation and childhood disruptive behavior disorders with little attention to the extensive comorbidity among disorders. Research on emotion regulation in children with ADHD has often not attended to the comorbid aggression seen in many of these children (for exceptions, see Martel & Nigg, 2006; Melnick & Hinshaw, 2000). For this reason, it is difficult to know which aspects of emotion dysregulation are specifically related to ADHD.

Longitudinal changes in emotion regulation are not well mapped. Little research has attended to sex differences in emotion regulation as they are related to the sex-biased prevalence rates of childhood psychopathology. Finally, the pervasiveness of emotion dysregulation and extreme emotion-related traits in children with developmental psychopathology has not been studied at the individual level (using person-centered data analytic strategies), although it clearly has implications for mapping pathways to developmental psychopathology.

The relations among emotions, emotion-related traits, emotional regulation, and cognitive control are not well mapped. Distinctions between these domains may be useful for componential analysis, but – at the behavioral level – these distinctions may be more semantic than real. The borders between emotional and control processes may be more fluid than has previously been acknowledged. Yet, developmental changes in these processes’ manifestations and interaction may be related to age-related changes in rates of developmental psychopathology.
One methodological issue that must be carefully considered in the study of relations among emotion regulation, cognitive control, and psychopathology is item and rater overlap. A handful of studies have examined item overlap between temperament and psychopathology and determined that relations typically hold even controlling for this overlap (e.g., Lemery, Essex, & Smider, 2002; Lengua, West, & Sandler, 1998; Martel & Nigg, 2006). However, item overlap between temperament traits and symptoms must continue to be diligently evaluated within specific research studies. A related issue is overlap among raters completing temperament and symptom ratings. Overlap among raters may artificially inflate relations among temperament traits and symptoms and should be avoided, if at all possible.

Guidelines for future work

There are a number of directions for future work. Continued clarification of the concept of emotion regulation is needed. The development of standardized paradigms for the measurement of emotion regulation would be enormously helpful in clarifying relations between emotion regulation and psychopathology. Distinctions between related constructs like emotion, regulation, emotion- and regulation-related temperament/personality traits, and cognitive control need better definition. Integration of ideas/constructs across fields of related research, such as social/personality and clinical psychology, are imperative to allowing work to move forward under a unified front.

Increased attention to relations between emotion regulation and specific forms of psychopathology would be illustrative, especially as these relations develop over time. For example, is effortful control specifically related to inattention or is it a broader risk factor for disruptive behaviors? The elucidation of longitudinal relations among emotion regulation and specific forms of psychopathology will be important. For example, is the relation between reactive control and oppositional-defiance mediated by hyperactivity-impulsivity? Mediational analyses conducted within a longitudinal sample would help clarify these issues.

Examination of relations between psychopathology and emotion regulation at the group and individual level would also be helpful. Sex and age differences may be important to consider. Further, patterns of emotion regulation problems may be useful in identifying more homogeneous subgroups of children with ADHD. For example, are all children with ADHD characterized by maladaptive emotion regulation? Are there subgroups of children with ADHD who are characterized by certain patterns and combinations of extreme traits and/or poor cognitive control? Person-centered data analysis would aid in the examination of these kinds of questions.

Finally, increased study of relations among temperament, cognitive control, and psychopathology would be helpful in order to clarify associations among these domains. In these studies, item and rater overlap should be avoided, if possible, or at least carefully considered, if not. Increased utilization of behavioral observation and/or cognitive assessment would be useful in this regard to lessen item and rater overlap.

Conclusion

Study of emotion regulation processes may improve understanding of the development and structure of disruptive behavior disorders and ADHD. Emotion regulation can be understood as two related and potentially interactive developmental processes: emotion and regulation. These processes have been associated with disruptive behavior disorders in general and ADHD in particular, although little work has examined specificity between emotional regulation processes and disruptive behavior symptom domains. The current paper proposed several models of emotion- and regulation-related process associations with disruptive behavior disorders with the intent of elucidating mechanisms of single and comorbid disorder development. While high negative and positive emotionality may be associated with disruptive behavior disorders in general, explaining their comorbidity, deficient control processes may be specifically associated with ADHD, and low agreeableness may be specifically associated with oppositional-defiant and conduct problems. Of course, these models require empirical test. In this vein, limitations of previous work on emotion regulation and ADHD were discussed, and directions for future work were advanced.

Acknowledgements

The author wishes to acknowledge Drs. Joel Nigg, Paul Frick, and Elizabeth Shirtcliff for invaluable discussion and comments on the draft.

Correspondence to

Michelle M. Martel, University of New Orleans, Psychology Department, 2005 Geology & Psychology Building, 2000 Lakeshore Drive, New Orleans, LA 70148, USA; Tel: 504-280-6776; Fax: 504-280-6049; Email: mmartel@uno.edu
Key points

- Study of emotion regulation may improve understanding of development of disruptive behavior disorders and ADHD.
- Emotion regulation can be understood as two related and potentially interactive developmental processes: emotion and regulation.
- The current paper proposed several models of emotion- and regulation-related process associations with disruptive behavior disorders.
- While high negative emotionality may be associated with disruptive behavior disorders in general, explaining their comorbidity, deficient control processes may be specifically associated with ADHD inattention, and low agreeableness may be specifically associated with oppositional-defiant and conduct problems.
- Use of these models may guide future work on developmental, sex, and neural mechanisms of ADHD and associated comorbid disruptive behavior disorders.

References


Emotion, regulation, and ADHD


Manuscript accepted 25 February 2009