

Do the associations between exuberance and emotion regulation depend on effortful control?

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Abstract

Temperamentally exuberant children may be at risk for emotion regulation problems, but this may also depend on their capacity for effortful control. To examine this issue, we assessed 72 typically-developing 3- to 5-year-olds. Child exuberance, effortful control, and emotion regulation were assessed via maternal report and observations of child behavior. Emotion regulation problems were elevated among children showing high exuberance and among children showing low effortful control. However, during a disappointing task, children with high exuberance showed stable, elevated levels of organized emotion regulation regardless of effortful control; for children with low exuberance, only those who also showed high effortful control showed comparable levels of organized emotion regulation. Implications for understanding risk and resilience associated with exuberance are discussed.

Keywords

effortful control, emotion regulation, exuberance, temperament

Emotion regulation is among the core capacities developing in early childhood. It involves the ability to modify the intensity and time course of emotional experiences and expressions in order to maintain behavioral organization and meet goals (Cole, Martin, & Dennis, 2004; Thompson, 1994). While there is a growing body of research on emotion regulation and emotional adjustment among shy and inhibited children (e.g., Kagan, 1999), much less is known about exuberant children: those who show enhanced behavioral approach in novel social situations, high positive affect, sensation-seeking, and heightened reward sensitivity. Exuberance shows continuity over early childhood. In a study of the continuity of temperamental inhibition and exuberance, Fox and colleagues (2001) found that among a group of children classified as exuberant in infancy, close to half continued to show high sociability, low fear, and high approach to novelty at four years of age compared to their more inhibited counterparts.

Exuberance is likely to have developmental advantages, including greater positive affect, persistence in the face of obstacles, and enhanced social skills (Carver, 2004; Dennis, 2006), but exuberant children may also be at risk for problems with emotion regulation such as increased impulsivity and dysregulation when their goals are blocked or when they are disappointed (Dennis, 2006; Putnam & Stifter, 2005; Rydell, Berlin, & Bohlin, 2003). Effortful control capacities like inhibitory and attentional control may reduce exuberant children's risk for disrupted emotion regulation (Derryberry & Rothbart, 1997). However, very few studies have focused on the interplay between exuberance and effortful control in relation to emotion regulation in early childhood (Dennis, 2006; Stifter, Putnam, & Jahromi, 2008). This gap in research must be addressed to fully articulate the unique challenges and potential risks faced by exuberant children, as well as the developmental strengths exuberance confers. The goal of the current study was to examine this issue in a group of typically developing

preschool-age children by testing whether associations between effortful control and emotion regulation differ for children varying in temperamental exuberance.

Exuberance and emotion regulation

Highly exuberant children are outgoing and approachful: they show heightened sensitivity and drive for rewards, excited anticipation for pleasurable activities, and behavioral approach to novelty (Carver, Sutton, & Scheier, 2000; Derryberry & Rothbart, 1997; Putnam & Stifter, 2005; Rydell et al., 2003). In addition to facilitating the expression of positive affect, exuberance may also facilitate expression of negative emotions, particularly those related to the blocking of rewards (e.g., frustration) and the loss of rewards (e.g., disappointment) (Carver, 2004; Harmon-Jones & Allen, 1998; Higgins, 1997). Exuberance may also be associated with behavior problems and difficulty regulating distress during frustrating and disappointing situations (Putman & Stifter, 2005; Scerbo, Raine, O'Brien, Chan, Rhee, & Smiley, 1990). For example, studies with young children show that approachful children show more distress during a frustrating task (Dennis, 2006), and that exuberance in early childhood predicts concurrent and longitudinal externalizing problems (Eisenberg et al., 1996; Putnam & Stifter, 2005; Rydell et al., 2003; Stifter et al., 2008). However, not all exuberant children are at risk for emotional and behavioral problems. Risk

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may also depend upon the development of capacities which help to modulate emotional reactivity, such as effortful control.

Effortful control

Effortful control—the ability to inhibit irrelevant but salient information in favor of relevant but less salient stimuli or responses—is rapidly developing during the preschool and early school age periods (Brophy, Taylor, & Hughes, 2002; Kochanska, Tjebkes, & Forman, 1998; Pennington & Ozonoff, 1996; Posner & Rothbart, 2000). Effortful control encompasses a range of control capacities, including a child's ability to consciously direct attention and inhibit behavior (Posner & Rothbart, 2000). Thus, children who show strong effortful control capacities are able to modulate and focus their attention in the presence of distracters (Casey, Tottenham, & Fossella, 2002) and inhibit prepotent or well-learned behaviors in favor of new behaviors (Kochanska, Murray, & Coy, 1997).

Effortful control contributes to how children regulate emotion and adjust to negative life events (Buckner, Mezzacappa, & Beardslee, 2003; Kochanska et al., 1998). For example, children who can inhibit behavior under emotional demands show greater conscience (Kochanska, 1997), and are perceived by their parents as more socially skilled and better able to manage negative emotions during adolescence (Shoda, Mischel, & Peake, 1990). Children who are emotionally distressed but who can shift attention away from a tempting prohibited item are better able to comply, wait, and resist temptation (Cole, 1986; Putnam, Spritz, & Stifter, 2002). Performance on tasks related to attentional control, like flanker tasks, is associated with less frustration and anger (Gerardi-Caulton, 2000) and more positive adjustment (Mezzacappa, 2004; Rueda, Fan, & McCandliss, 2004). Effortful control may influence the effectiveness of emotion regulation in relation to exuberance because it supports the flexible enactment of regulatory strategies and the effective modulation of arousal (Derryberry & Rothbart, 1997; Kochanska, 1997; Stifter & Braungart, 1995).

Emotion regulation and the interplay between exuberance and effortful control

Although both temperamental exuberance and effortful control are thought to contribute to a child's ability to regulate emotions, few studies have examined them conjointly. Temperament theory suggests that reactive and regulatory aspects of temperament are independent (Derryberry & Rothbart, 1997). Therefore, although some highly reactive children may have greater difficulty exercising effortful control (Calkins, Dedmon, Gill, Lomax, & Johnson, 2002), other highly reactive children might be able to recruit effortful control in order to modulate that reactivity. That is, highly exuberant children who show relatively mature effortful control may display fewer problems with dysregulation. Consistent with this, one study showed that greater inhibitory control predicted later social competencies in preschoolers, but only if children were highly exuberant (Fox & Henderson, 2000).

However, only a handful of studies have tested whether associations between exuberance and emotion regulation vary with effortful control. In a recent study of temperamental approach (Dennis, 2006), we found that affective soothability, but not inhibitory control, predicted emotional self-regulation among high approach children; the inverse was true for children showing low approach. Another study examined whether associations between exuberance

and problem behaviors were moderated by executive functions or emotion regulation (Stifter et al., 2008). They found that executive functions were not related to problem behaviors in exuberant children, but that exuberant children who expressed more positive or neutral affect versus negative affect were less likely to show internalizing and externalizing problems.

Findings from these studies suggest that control capacities, like effortful control, may not have a significant impact on emotion regulation or problem behaviors among typically developing exuberant children. Instead, it may be that normative, well-regulated exuberance, rather than independent effortful control capacities, organizes a child's behavior during emotional challenges via a strong focus on goal attainment which fosters persistence and task-focused behavior. Children with low exuberance, because they have weaker approach drives, may rely more on effortful control to direct and organize behavior during emotional challenges. Thus, exuberant children might be best thought of as simultaneously having characteristic regulatory strengths (positive affect and persistence) and vulnerabilities (poor emotion regulation, frustration, and externalizing problems). The goal of the present study was to examine whether effortful control influences the expression of these strengths and vulnerabilities.

Because exuberance reflects approach motivation, it is associated with the organization of behavior (i.e., approachful behavior towards rewards and social novelty). Thus, in the study of exuberance and emotion regulation, it is important to measure emotion regulation not only in terms of emotional characteristics such as valence but in terms of the organization of a child's actions during an emotional challenge - how appropriate and productive actions are in a given context. This allows for the possibility that negative emotions (e.g., frustration) can be associated with organized actions (e.g., task persistence) and that positive emotions (e.g., joy) can be associated with disorganized actions (e.g., inappropriate silliness). The coding system used in the present study (Hall & Cole, 2007, March) differentiates positive and negative emotional tone from the organization of behavior, including organized versus disorganized, and goal-directed versus off-task behavior. This system thus avoids confounding the emotional valence of an action with its organizational quality, and provides the opportunity to test whether certain emotional states are consistently related to the organizational quality of a child's behavior.

The present study

The present study examined a question that has received little empirical attention: *Do children with relatively low versus high levels of exuberance show different patterns of emotion regulation, and does this depend on their effortful control capacities?* Exuberance was measured in terms of maternal report of excitement and sensitivity for rewards and in terms of observed behavioral approach to a novel experimenter. Effortful control was measured via maternal report of inhibitory control, observed verbal inhibitory control, and observed attentional control (performance on a flanker task). Emotion regulation was measured via maternal report and as observed emotional tone and organization of preschool children's behavior during two emotional challenges relevant to approach in early childhood: a frustrating task and a disappointing task. Child verbal IQ was also measured to control for the potential influence of intelligence on emotion regulation. In addition, child social skills and internalizing and externalizing problems were measured in

order to examine whether emotion regulation variables were related to child risk for problems with social adjustment.

First, it was predicted, consistent with previous findings (Dennis, 2006), that greater effortful control would be linked to enhanced emotion regulation, particularly for children showing relatively low levels of exuberance. Second, it was predicted that greater exuberance would be associated with both regulatory strengths and vulnerabilities: exuberant children were expected to show reduced negative affect and more positive affect, as well as more appropriate and organized goal-directed behaviors consistent with the motivational drive to approach desired outcomes; on the other hand, exuberant children might also show more dysregulation as measured via maternal report and observed disorganized behavior since poorly regulated exuberance could create risks for emotional and behavioral disruptions. We tested whether effortful control moderates the association between high exuberance and these emotion regulation outcomes. Third, to examine the significance of emotion regulation measures for child well-being, we tested whether emotion regulation measures correlate with maternal report of child social skills and problem behavior.

Method

Participants

Participants were 82 preschoolers, recruited through fliers sent to preschools in New York City. There were 45 3-year-olds (25 females), 29 4-year-olds (13 females), and eight 5-year-olds (four females). Of the children, 32 (39%) were Caucasian, 13 (15.9%) were Hispanic, 13 (15.9%) were African American, two (2.4%) were Asian, and 22 (26.8%) were identified by their mothers as “Other” ethnicities. Mean ages were: for 3-year-olds, 43 months, $SD = 4$ months, for 4-year-olds, 54 months, $SD = 3$ months, and for 5-year-olds, 63 months, $SD = 4$ months. Mean family income was \$105,365 ($SD = \$82,060$), and ranged between \$10,400 and \$500,000. Ten mothers chose not to report income, and five reported being students, unemployed, or both. Each preschooler and mother spent approximately 120 minutes in the laboratory room for young children as part of a larger collaborative study.

Due to computer failure, 10 videotaped observations were lost, leaving 72 observations. There were 42 3-year-olds (22 females; M age in months = 42.71, $SD = 3.61$), 25 4-year-olds (12 females; M age in months = 54.34, $SD = 3.38$), and five 5-year-olds (one female; M age in months = 63.57, $SD = 3.78$). A team of undergraduate research assistants were trained to conduct laboratory sessions and to code videotaped recordings of the sessions to generate data for analyses.

Child exuberance

Child exuberance was measured in two ways: social approach to novelty, and maternal report of temperamental reward sensitivity. Child social approach during the introduction to the lab and to a novel experimenter was observed. Upon entering the experimental room, a research assistant introduced the child to the experimenter and the experimenter asked the child three questions pertaining to whether he or she had ever been to the laboratory before, thought his or her visit to the lab would be fun, and the type of games he or she liked to play—giving the child up to 20 seconds to make a response to each question before the following question was asked. The experimenter remained emotionally neutral, silent and

maintained eye contact throughout the 1-minute long novel situation. After this period, the experimenter played with the child, interacting freely. Social approach was quantified as the latency to approach the novel experimenter during the 1-minute question period (ranging from 0 seconds reflecting immediate approach (e.g., speaking to the experimenter immediately upon being introduced) to 60 seconds (reflecting absence of approach). Social approach could be verbal (speaking to the experimenter) or behavioral (approaching or sitting at the table where the experimenter sat).

Exuberance was also evaluated via maternal report of child approach temperament. Mothers completed the 195-item Children’s Behavior Questionnaire (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001), designed to assess temperament for children ages 3 to 7. Mothers rated their children on a 7-point Likert scale. The *Approach* scale ($\alpha = .76$) consists of 13 items that measure excitement and positive anticipation for rewards and pleasurable activities. The CBQ has well-established internal consistency, validity, and test-retest reliability (Rothbart, Ahadi, Hershey, & Fisher, 2001).

Effortful control capacities

Effortful control was quantified via three measures: observed verbal inhibitory control, maternal reported inhibitory control, and observed attentional control.

Observed verbal inhibitory control. The whisper task was used to assess verbal inhibitory control, and was taken from the Effortful Control Battery (Kochanska, 1997). The child was instructed to whisper the names of 12 cartoon characters, presented consecutively as color pictures (e.g., Big Bird, Elmo, and Mickey Mouse). During the first six trials, the experimenter whispered task directions to the child; during the next three, the experimenter spoke the directions to the child in a normal voice, and during the final three, the experimenter yells while querying the child about each picture. The resulting task score was the percent of trials during which the child successfully whispered. Inter-rater agreement was 100%.

Maternal reported inhibitory control. Inhibitory control was also assessed via maternal report using the CBQ (Rothbart et al., 1994). The Inhibitory Control scale ($\alpha = .82$) consists of 13 items that measure the capacity to plan and to suppress inappropriate approach responses under instructions or in novel or uncertain situations.

Observed attentional control. Attentional control was measured using a child version of the Attention Network Test (ANT; Mezzacappa, 2004; Rueda et al., 2004). This task is a cued version of the classic flanker task. It requires children to indicate whether a central stimulus points left or right. The central stimulus is flanked by either congruently or incongruently directed stimuli. Thus, this task reflects executive attention because it involves conflict monitoring and conflict resolution. Cues prior to each trial of the task allow for measurement of multiple attention systems, and thus three scores can be derived from the ANT: alerting, orienting, and executive conflict resolution. However, these scores were not used in the present study because we wished to focus on basic accuracy during the core flanker task as a more general measure of

attentional control. The ANT was presented via E-Prime (Version 1.2) software on an IBM-compatible personal computer. Participants viewed the screen from a distance of 65 cm, and responses were collected via two buttons on the mouse. Participants indicate with one of two alternative button presses whether the central cartoon target figure points left or right (a fish, a mouse, and a bird). The target is surrounded on the left and right by four “flanker” stimuli and appears randomly either above or below the fixation point (+) in the center of the screen. Congruent flanker stimuli are cartoon figures that are pointing in same direction. Incongruent flanker stimuli point in the opposite direction. Children completed a six-trial full-feedback practice block followed by three experimental blocks. There were 32 trials per block. The total percentage of accurate trials was used as the attentional control score.

Child verbal IQ

Child verbal ability was measured using the Peabody Picture Vocabulary Test - Revised (PPVT-R; Dunn & Dunn, 1981), a widely used test of receptive language skills and a proxy for verbal IQ. The PPVT-R was administered by trained research assistants. Age-standardized scores revealed a range of ability ($M = 106$, $SD = 16$, range 70–146).

Observations of child emotion regulation

Observed child emotion regulation was measured during two emotionally challenging tasks: a frustrating task, in which the experimenter repeatedly critiqued the child’s drawing, and a disappointing task, in which the child is given a wrapped present to open, but finds that the box is empty.

The *Impossibly Perfect Circles task* (IPC) was designed to elicit frustration or distress and provide the opportunity to observe child persistence in response to adult negative feedback (Laboratory Temperament Assessment Battery; Goldsmith & Rothbart, 1996). For 3½ minutes, the experimenter repeatedly asked the child to draw a “perfect” circle, and critiqued every circle for its imperfections. Critiques were specific, but did not include information on how to rectify the problem (e.g., “That one is too flat; draw another one”). After the final circle was drawn, the experimenter deemed it a success, praised the child, and gave the child a certificate.

The *Box Empty task* (BE) was designed to elicit disappointment and distress (Laboratory Temperament Assessment Battery; Goldsmith & Rothbart, 1996). The child was given a wrapped present and told that it contained a toy for them to keep. The child was instructed to unwrap the present. He or she was then left alone in the room for one minute to unwrap and open the present, only to discover that the box was empty. This allowed for observation of a child’s response to the empty box in a non-social context. At the end of the minute, the experimenter returned to the room, but remained silent for ten seconds, allowing time for the child to react to the situation in a social context. The experimenter then informed the child that the toy was left out of the box by mistake when it was wrapped, and the child was given a toy to take home, and allowed time to play with the toy. The entire procedure took approximately 2 minutes.

Coding

Emotion regulation. Emotion regulation was measured using the Global Emotion Regulation Coding System (Hall & Cole,

2007, March), which codes emotion regulation in terms of both predominant emotional state and behavioral organizational quality within a defined time epoch (in the present study, epochs varied from 30 to 60 seconds). Coders first determine overall emotional state of the child. Emotional state was determined based on a child’s facial expressions, vocal tone, and postural cues. There were three types of emotions: (a) positive, including facial displays and verbalizations of happiness, exuberance, pleasure, smiling, widened eyes, raised eyebrows, high pitch, laughter, playful teasing; e.g., “You’re silly!”; (b) negative, including displays of distress, irritation, sadness, anger, tense body, frowning, pressed lips, harsh/raised voice, sighing, groaning, drooping eyes; and (c) neutral, including calm, tired, matter-of-fact, relaxed posture, quiet, knitted brows in concentration, lack of communication of emotion.

After the emotional state is determined, coders indicate the organizational quality of the child, reflecting the appropriateness and productivity of the child’s behavior in the context of the task. There were four organizational qualities: (a) organized-on task, in which behaviors are organized and directed towards the goals of the task; e.g., appropriate task focused behavior, relevant interactions, organized activity; (b) organized-off task, in which behaviors are organized with actions that are not directed to the goals of the task; e.g., appropriately engaging in another activity; (c) disruptive, in which behaviors are associated with disorganized actions that are inappropriate; e.g., problematic behavior, throwing toys, leaving room, disobeying experimenter; and (d) immobilized, in which behaviors are associated with “shutting down”, including inactivity, withdrawal from or lack of responsivity towards the task, and ignoring the experimenter. Specific examples of organizational quality are shown in Table 1. The goal of the Impossibly Perfect Circles task was to persistently draw circles until the experimenter judged the circle to be perfect. The goal of the Box Empty task was to open the wrapped box and play with the present; since the box was empty, behavior was coded in reference to the goal of repairing the situation.

Emotion regulation variables were created by combining emotional tone (positive, negative, neutral) with behavioral organizational (organized-on task, organized-off task, disruptive, and immobilized) for a total of 12 possible codes. One emotion regulation variable was assigned for each of four epochs for the Impossibly Perfect Circles task (three 60-second and one 30-second epoch) and for each of five epochs for the Box Empty task (three 30-second and one 40-second epoch for recovery). Frequency of each emotion regulation variable was used in analyses below. Behaviors that are organized, both on- and off-task, are considered more adaptive and appropriate compared to disruptive or immobilized behaviors.

Interrater agreement. Three coders were trained to code emotion regulation until they reached 85% agreement. Reliability was then calculated based on 21.5% of the videotapes which were randomly chosen. The average Cohen’s kappa coefficient for interrater agreement was .81 (ranging from .60–1.00) reflecting good to excellent agreement.

Maternal report of child emotion regulation

Mothers reported on child emotion regulation using the Emotion Regulation Checklist (ERCL; Shields & Cicchetti, 1995). The ERCL is a 24-item questionnaire rated on a 4-point Likert scale. It is designed to measure regulatory processes such as affective lability, intensity, valence, flexibility, and situational appropriateness. The

Table 1. Examples of organizational quality for Impossibly Perfect Circles and Box Empty tasks

Organizational quality	Impossibly Perfect Circles	Box Empty
Organized-on task	Child follows promptings to draw, interacts appropriately with experimenter, or seeks information about the task.	Child follows experimenter's instructions, unwraps box, opens and looks inside box, or requests information about missing gift.
Organized-off task	Child does not pay attention to experimenter, draws something other than circles but is not oppositional, or wanders around the room.	Child plays with something else besides the box, or wanders around the room.
Disruptive	Child does not let experimenter finish stating instructions, draws on table, throws paper and/or marker, rips paper, repeatedly demands to draw on other side of paper, opens the door, or leaves the room.	Child does not let experimenter finish stating instructions, grabs box from experimenter, throws box, opens the door, or leaves the room.
Immobilized	Child stops or does not complete the task, appears to "shut down", does not make eye contact, or ignores or does not respond to experimenter.	Child does not unwrap the box, appears to "shut down", does not make eye contact, or ignores or does not respond to experimenter.

measure typically yields 1 to 3 scales (e.g., Shields & Cicchetti, 1997, 1998). We calculated three scores based on developers' guidelines: *emotion dysregulation* ($\alpha = .81$), comprised of eight items focusing on the dysregulation of exuberance, such as "is prone to having disruptive outbursts of energy and exuberance", "takes pleasure in the distress of others", and "is impulsive"; *negative lability* ($\alpha = .80$), comprised of eight items such as "exhibits wide mood swings", "is prone to angry outbursts/tantrums easily", and "responds angrily to limit-setting by adults"; and *positive regulation* ($\alpha = 0.49$), comprised of eight items such as "is a cheerful child", "responds positively to neutral or friendly overtures by adults", and "responds positively to neutral or friendly overtures by peers". Due to the low internal consistency of positive regulation, only emotion dysregulation and negative lability were included in analyses reported below.

Child adjustment

Mothers reported on child social skills and problems using the Social Skills Rating System (SSRS; Gresham & Elliott, 1990). The SSRS is a 49-item measure designed to assess both typically developing and clinical populations. Each subscale is calculated as summed frequency ratings (0 = never, 1 = sometimes, 2 = very often). The social skills scale ($\alpha = .90$) is derived from 40 items, such as "helps with household tasks without being asked", and "follows household rules". Internalizing and externalizing problems were measured separately. The externalizing scale ($\alpha = .81$) is derived from six items such as "has temper tantrums" and "disobeys rules or requests". The internalizing scale ($\alpha = .55$) is derived from four items such as "Says nobody likes him or her" and "acts sad or depressed". The SSRS has demonstrated test-retest, inter-rater, and construct validity (Gresham & Elliot, 1990).

Results

Preliminary analyses

Data aggregation. The correlation between observed and maternal-reported approach just missed significance, $r(72) = .22$,

$p = .06$. Effortful control capacities were moderately to substantially positively inter-correlated (maternal reported inhibitory control and observed verbal inhibitory control, $r(72) = .40, p < .001$; maternal reported inhibitory control and observed attentional control, $r(72) = .23, p < .05$; and observed verbal inhibitory control and observed attentional control, $r(72) = .36, p < .01$), suggesting both unity and diversity of control capacities. These three scores were standardized and averaged into a single effortful control aggregate score. Similarly, a single exuberance score was computed as the average of standardized observed social approach and maternal report of temperamental approach and reward sensitivity.

Inspection of the number of children showing each type of observed emotion regulation code (see Table 2) reveals that fewer than 20% of children showed organized-off task, disruptive, or immobilized behaviors. Only the positive organized-on task and neutral organized-on task behaviors were shown by a majority of children in both tasks. In addition, Chi Square analyses revealed that only positive and neutral emotional expressions significantly co-occurred with organized-on task behaviors, $\chi^2(6, N = 72) = 19.18, p = .004$. Therefore, one emotion regulation score was calculated, separately for the Impossibly Perfect Circles and Box Empty tasks, which summed the frequency of all organized-on task behaviors across positive and neutral emotional tones. These two emotion regulation scores were used in all analyses below. Because we were also interested in examining emotional tone, we calculated a separate emotional tone score for each task, which averaged emotional expressions (positive and negative) across organizational qualities.

Although the number of children showing either organized off-task, disruptive, or immobilized behaviors were too few to include in the regression analyses reported below, independent samples t-tests showed that girls versus boys and younger versus older children (3- compared to 4- and 5-year-olds) did not differ in the frequency of these off-task or disorganized (disruptive or immobilized) behaviors.

Descriptive statistics. Table 3 presents means, standard deviations, medians, and ranges for all variables; correlations among the variables are reported in Table 4.

Table 2. Number and percentage of children showing each type of emotion regulation ($n = 72$)

	Impossibly Perfect Circles		Box Empty	
	Frequency	Percentage	Frequency	Percentage
<i>Organized-on task</i>				
Positive	48	67%	57	79%
Negative	10	14%	16	22%
Neutral	51	71%	61	85%
<i>Organized-off task</i>				
Positive	11	15%	1	0.01%
Negative	1	0.01%	1	0.01%
Neutral	7	10%	2	0.03%
<i>Disruptive</i>				
Positive	2	0.03%	0	0
Negative	6	0.08%	0	0
Neutral	2	0.03%	1	0.01%
<i>Immobilized</i>				
Positive	0	0	0	0
Negative	2	0.03%	0	0
Neutral	4	0.06%	1	0.01%

Correlations: exuberance, effortful control, and emotion regulation. Exuberance was not significantly correlated with effortful control, highlighting the independence of the two dimensions.

More exuberant children, however, were also reported by mothers to be more dysregulated and show greater negative lability, whereas children showing high effortful control showed fewer of these problems with emotion regulation, and showed more organized-on task behaviors during both emotional challenges. Positive emotion was correlated across tasks, suggesting moderate stability of positive emotional expressiveness; organized-on task behaviors, however, were not correlated across tasks, suggesting context-independent emotion regulation. In addition, children who evidenced more on-task behaviors during the IPC and BE tasks showed fewer negative emotions during those same tasks.

We were also interested in examining whether exuberance varied with child emotional expressions during the two tasks. More exuberant children expressed fewer negative emotions during the BE task. This suggests that, although mothers reported that exuberant children had more problems with emotion regulation, this was not detectable in terms of expressed negative emotion during the disappointing task. Indeed, if reduced negative emotion is a hallmark of effective emotion regulation, then more exuberant children were showing better emotion regulation in this context.

Correlations: social skills and internalizing/externalizing problems. Children who displayed greater effortful control had better social skills. However, children showing greater effortful control and social skills had fewer externalizing problems, but children showing greater exuberance had greater externalizing problems.

Correlations: age and IQ. Older children showed greater effortful control, organized on-task behaviors during the IPC task, positive expressed emotion during the BE task, and child verbal IQ. Since age may account for a significant portion of the variance, it was included as a covariate in the regression analyses reported below. In addition, children with higher IQs showed greater effortful control, better social skills and less mother-reported dysregulation, at the level of a trend. Verbal IQ was not correlated with exuberance. When regressions

included IQ as a covariate, results were the same, and thus are not included in analyses reported below.

Correlations: emotion regulation and adjustment. To confirm that the measures of emotion regulation were relevant to behavioral and affective risk, we examined correlations between the emotion regulation scores (organized-on task behaviors during the two emotional challenges, and maternal report of emotion dysregulation and negative lability) and maternal report of social skills, internalizing problems, and externalizing problems.

Organized-on task behaviors during either the Impossibly Perfect Circles or Box Empty task were not significantly correlated with social skills or problems. Emotion dysregulation and negative lability, however, showed expected associations with social skills and problems: children showing greater dysregulation and negative lability showed fewer social skills and more externalizing problems. Negative lability was positively correlated with internalizing problems.

Testing study hypotheses: predicting emotion regulation

It was predicted that greater effortful control would be associated with enhanced emotion regulation, and that this effect may be more pronounced for children showing relatively low exuberance. It was also predicted that greater exuberance would be associated with greater dysregulation but also greater goal-directed and organized behavior.

Interaction effects were tested for via 11 hierarchical regressions with each of the eight emotion regulation measures (observed organized-on task behavior, positive emotion, and negative emotion during both tasks, maternal report of dysregulation, and maternal report of negative lability) and the three measures of child adjustment (social skills, internalizing problems, and externalizing problems) as a dependent variable (DV). We examined whether child exuberance moderated the association between effortful control and each DV. In these analyses, age (in months) was entered in the first step to control for potential age-related changes in emotion regulation and adjustment, the effortful control aggregate score was entered in the second step, the exuberance aggregate score was

Table 3. Descriptive statistics for exuberance, effortful control, emotion regulation, and adjustment

	M	SD	Median	Range
<i>Exuberance</i>				
Maternal report of approach	5.28	0.65	5.38	3.75–6.92
Observed social approach	18.80	25.09	5.50	0–60
Exuberance aggregate	0.01	0.78	–0.04	–1.30–2.07
<i>Effortful control</i>				
Maternal report of inhibitory control	4.55	0.65	4.61	1.92–6.42
Observed verbal inhibitory control (% whisper)	8.76	3.35	9.00	0–12.
Observed attentional control (% accuracy)	0.44	0.22	0.40	0.03–0.97
Effortful control aggregate	0.03	0.76	0.07	–1.84–1.80
<i>Emotion regulation</i>				
Observed organized—on task activity IPC task	3.04	1.13	3	0–4
Observed organized—on task activity BE task	4.51	0.81	5	2–5
Maternal report of dysregulation	2.08	0.54	2.13	1.13–3.50
Maternal report of negative lability	1.70	0.46	1.63	1–3.25
<i>Observed emotion expressions</i>				
Positive emotion IPC task	1.61	1.47	1	0–4
Negative emotion IPC task	0.35	0.74	0	0–3
Positive emotion BE task	1.83	1.46	2	0–5
Negative emotion BE task	0.32	0.65	0	0–2
<i>Maternal report of child adjustment</i>				
Social skills	52.55	9.35	53.00	25–76
Externalizing problems	4.76	2.43	5.00	0–10
Internalizing problems	1.05	1.21	5.00	0–5

Note. IPC = Impossibly Perfect Circles task. BE = Box Empty task. Scores in the IPC task could range from 0–4, whereas scores in the BE task could range from 0–5. Observed organized—on task behaviors include only those with a positive or neutral emotional tone.

Table 4. Correlations among variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Exuberance	–	–.06	–.11	.21†	.07	–.16	.06	–.25*	.29*	.34**	–.04	.24*	–.10	.08	.02
2. Effortful control		–	.20†	.19	.09	.01	.14	–.14	–.48**	–.39**	.49**	–.34**	.05	.44**	.46**
3. Organized—on—IPC			–	.12	.15	–.49**	.10	–.02	–.01	–.02	.07	.12	–.08	.24*	.10
4. Organized—on—BE				–	.02	–.12	.04	–.78**	–.03	.15	.05	.04	–.02	.16	.20
5. Positive emotion—IPC					–	–.17	.53**	–.02	–.07	.00	–.05	.12	–.11	.05	.12
6. Negative emotion—IPC						–	–.12	.09	–.14	–.12	.03	–.24*	.18	–.08	.03
7. Positive emotion—BE							–	.03	–.23†	.01	.08	.04	.06	.25*	.09
8. Negative emotion—BE								–	.02	–.15	–.02	.01	.11	–.12	–.18
9. Dysregulation									–	.58**	–.48**	.64**	.09	–.05	–.22†
10. Negative lability										–	–.53**	.65**	.30**	–.08	–.16
11. Social skills											–	–.34**	–.11	.04	.29*
12. Externalizing												–	.20†	.08	–.10
13. Internalizing													–	.00	.00
14. Age in months														–	.29*
15. Verbal IQ															–

Note. IPC = Impossibly Perfect Circle task. BE = Box Empty task. * $p < .05$; ** $p < .01$; † $p < .10$.

entered in the third step, and the interaction term (exuberance X effortful control) was entered in the fourth step.

If the interaction term’s contribution to R^2 was significant ($p < .05$), the interactions were plotted using simple regression equations. These recast the significant interactions as the regression of one criterion on one predictor (Aiken & West, 1991). The criterion on the y-axis was plotted against three levels of the predictor (effortful control), 1 SD below the mean (low), the mean, and 1 SD above the mean (high). Plotted regression lines represent three levels of the moderator variable (exuberance; 1 SD below the mean, the mean, and 1 SD above the mean). For all steps of the analyses, predictor variables were centered to reduce problems of lack of invariance of regression coefficients and multicollinearity. Tables 5

and 6 show regression coefficients for significant regression equations when all variables were entered.

Observed organizational quality. Predictors explained significant variance in organized-on task behaviors (Table 5). As predicted, there was a significant interaction between exuberance and effortful control for organized-on task behaviors during the Box Empty task. As seen in Figure 1, as effortful control increased, on-task behaviors also increased, but only among children showing relatively low exuberance; highly exuberant children showed stable, elevated levels of organized-on task behaviors across levels of effortful control. The difference

Table 5. Significant hierarchical regressions for observed emotion regulation ($n = 71$)

	B	SE B	β	ΔR^2
<i>Organized—on task BE</i>				
Age	.01	.01	.05	.02
EC	.29	.14	.26*	.02
Exuberance	.17	.12	.16	.05
Exuberance X EC	-.37	.14	-.32**	.09**
<i>Negative emotion BE</i>				
Age	.00	.01	-.04	.01
EC	-.16	.12	-.18	.01
Exuberance	-.19	.10	-.22†	.06†
Exuberance X EC	.15	.12	.16	.02

Note. IPC = Impossibly Perfect Circles task. BE = Box Empty task. * $p < .05$; ** $p < .01$; *** $p < .001$; † $p < .10$.

between the slopes for the low and high exuberance groups was significant at $t(71) = 2.92$, $p < .01$.

Observed expressed emotions. Exuberant children showed fewer negative emotions during the Box Empty task, although this effect was reduced to the level of a trend when all steps were entered (Table 5).

Maternal report of emotion dysregulation and negative lability. Both exuberance and effortful control accounted for significant variance in maternal report of child dysregulation and negative lability, but in different directions (Table 6). As predicted, more exuberant children showed greater dysregulation and negative lability, whereas children with greater effortful control showed fewer such problems with emotion regulation. The interaction between exuberance and effortful control did not reach significance.

Discussion

The goal of the present study was to examine whether typically developing children with relatively low versus high levels of exuberance show different patterns of emotion regulation, and whether this depends on their effortful control capacities. Consistent with previous research (Dennis, 2006), findings suggest that effortful control supports effective emotion regulation, and in some contexts, this may be particularly true for children showing low exuberance. Moreover, highly exuberant children, regardless of their effortful control capacities, may be at risk for problems with emotion regulation; nevertheless, exuberance may support organized on-task behaviors during an emotional challenge. This study is thus part of the growing body of evidence documenting the complex associations between temperamental exuberance and emotional adjustment in children.

Associations between exuberance and emotion regulation suggest this temperamental quality is associated with both strengths and vulnerabilities (Derryberry & Rothbart, 1997). Specifically, exuberant children showed greater emotion dysregulation and negative lability as reported by mothers. On the other hand, exuberant children also showed fewer negative emotions during the BE task. It is logical to then assume that some other factor, such as effortful control, should explain which exuberant children show regulatory

Table 6. Significant hierarchical regression analyses for maternal report variables ($n = 71$)

	B	SE B	β	ΔR^2
<i>Emotion dysregulation</i>				
Age	.01	.01	.18	.00
Effortful control (EC)	-.42	.09	-.57***	.29***
Exuberance	.17	.07	.25*	.06*
Exuberance X EC	.02	.08	.03	.00
<i>Negative lability</i>				
Age	.00	.01	.05	.00
Effortful control (EC)	-.19	.07	-.31*	.12**
Exuberance	.16	.06	.29*	.11**
Exuberance X EC	-.08	.07	-.14	.02

Note. * $p < .05$; ** $p < .01$; † $p < .10$.

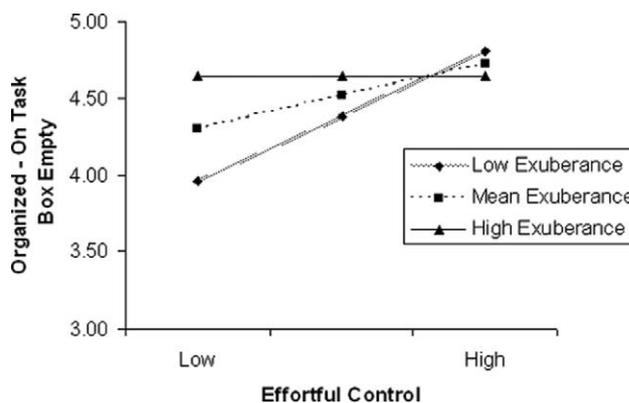


Figure 1. Simple regressions plotting organized-on task behavior during the Box Empty task as a function of child effortful control and exuberance. Note. Lines refer to values for children showing low (1 SD below the mean), average, or high (1 SD above the mean) levels of exuberance.

strengths and which show vulnerabilities. Indeed, children who showed greater effortful control in this study also showed fewer problems with emotion dysregulation and negative lability. However, highly exuberant children who had strong effortful control did not show better emotion regulation. Instead, consistent with our previous study (Dennis, 2006), it was children who showed low exuberance and low effortful control who had the most difficulty initiating organized on-task behaviors during the BE task. Exuberant children, regardless of the strength of their effortful control, showed similar levels of behavioral organization during this disappointing task (and comparable to children showing low exuberance and high effortful control). This suggests that, although exuberance itself was not significantly associated with greater organized behavior during the two emotional challenges, exuberant children were as organized as children showing high effortful control. It is important to note, however, that in this typically-developing sample possible restricted variability in exuberance and emotion regulation may have prevented us from detecting significant effects. For example, scores for organized-on task behavior during the Box Empty task were positively skewed, with the highest possible value being 5. This might suggest a ceiling effect, which could have prevented effects emerging at high levels of exuberance.

The significant interaction effect raises several possibilities. First, it may be that exuberance and effortful control contribute independently to emotion regulation. Indeed, correlations between exuberance and effortful control approached zero. Therefore, some exuberant children have strong effortful control capacities, whereas others have more difficulty with effortful control; but effortful control in this group of preschoolers did not appear to confer protection against problems with emotion regulation among exuberant children. This could be because other factors, such as control capacities or executive functions not measured in the present study, are more relevant to emotion regulation. Another possibility is that children in this study did not show extreme enough levels of exuberance. The impact of effortful control may not be detectable unless children show very high reactivity, which may prompt more disruptive or poorly organized behavior which requires greater effortful control to modulate. Indeed, in our previous study, soothability predicted emotional self-regulation among highly approachful children (Dennis, 2006), suggesting that the quality of exuberance (easily soothable versus difficulty calming down) rather than an independent set of control capacities is most critical for predicting emotion regulation. It will be important for future research to compare a range of effortful control, regulatory, and affective capacities in relation to exuberance and adjustment, as well as characterize both normative and atypical levels of exuberance.

Findings also suggest a framework in which exuberance and its underlying motivational drives to approach rewards and novelty organize the regulation of emotion and behavior. That is, consistent with the affective evaluation hypothesis (Luu & Tucker, 2004), exuberant reactivity may serve to regulate behavior. Thus, a typically developing exuberant child may have been more likely to show appropriate, goal-directed behaviors during frustrating and disappointing tasks, such as persistently pursuing a goal. Although mothers reported that their exuberant children showed more general problems with emotion regulation, observations of exuberant children in the present study suggest that they may also be able to “harness” motivational drives to maintain appropriate task-focused behaviors even when they were disappointed by the empty box. Children with low exuberance may not have similar motivational resources and may require high effortful control to promote well-organized emotion regulation and task-focused behavior.

Although this interaction between exuberance and effortful control is suggestive, relatively few significant interactions emerged. As noted above, one reason for the dearth of interaction effects may be that there was a restricted range of exuberance and emotion regulation among the present study’s participants. Task characteristics might in part account for this. For example, the Impossibly Perfect Circles task may not have heightened exuberance-related motives and emotions as intended, thus reducing the degree to which it was an emotional challenge for exuberant children. This task involves criticism of the child by the experimenter, and thus taps sensitivity to negative feedback, which might be more relevant to avoidance and inhibition rather than exuberance. Another reason for the few significant interactions may be that by controlling for age, some interaction effects were obscured. Correlations showed that effortful control capacities increased with age. Thus, if the sample size had been large enough to divide into younger and older preschoolers, interactions between exuberance and effortful control may have been significant mainly among older preschoolers. Another possibility is that younger and older preschoolers are relying on

different effortful control capacities. Three-year-olds may recruit more reactive and automatic capacities whereas by age 4, children are starting to more actively recruit effortful control processes (Eisenberg et al., 2005).

We also examined whether measures of emotion regulation were associated with social skills and adjustment problems. Whereas maternal report of dysregulation and negative lability were associated with reduced social skills and increased internalizing and externalizing problems, observed organized-on task behavior was not associated with these maternal-report measures. This may indicate that the observational measure of emotion regulation was not sensitive enough to capture individual differences in emotion regulation, or that the two tasks were not sufficiently challenging to elicit a range of child emotions and emotion regulation. It may also be that shared method variance partially accounts for the significant associations between maternal report of emotion regulation problems and measures of adjustment.

Positive and neutral on-task behaviors occurred more often than any other combination of affect and behaviors. Thus, preschool children appear capable of displaying appropriate social behavior during emotional challenges, and may use positive affect to maintain goal-directed actions. These patterns of affect and action may eventually become characteristic of emotion regulation across development and develop into adult coping or personality styles (Cole, Michel, & Teti, 1994). Unfortunately, children in the present study did not show a wide range of affect-organized behavior combinations, and thus organization codes were collapsed across emotion types. Perhaps when facing relatively mild emotional challenges, such as the tasks used in the present study, children at this point in development are able to modulate emotion and behavior adequately such that the full range of affect and behavior is not easily observable. Future research should include a wider age range and more challenging emotional contexts.

In addition to the observational data loss, there were several methodological challenges. First, data were correlational. Longitudinal studies and experimental manipulations are needed to tease apart causal effects, and will provide information about how child capacities at different developmental periods predict emotion regulation across the lifespan. Second, children were normatively developing, and thus we cannot assess the interplay between more extreme levels of exuberance and emotion regulation. Lastly, future research on exuberance should measure other temperamental or environmental risk factors that may influence emotion regulation.

In summary, this study was among the few to examine the interplay between exuberance and effortful control in relation to emotion regulation. Results document both strengths and vulnerabilities associated with exuberance. This interplay between reactivity and control processes has been targeted in both the behavioral and neuroscience literatures with the goal of identifying basic building blocks for emotion regulation. Such an approach has the potential to increase our understanding of processes underlying emotion regulation and dysregulation in typically developing and clinical populations, and inform the development of more effective prevention and intervention efforts.

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