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Measures of Effortful Regulation for Young Children

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Abstract

Emotion-related regulation is a topic of increasing interest among researchers, yet there is little agreement on ways to measure emotion regulation in young children. In this paper, we first consider important conceptual distinctions in regard to the different types of emotion-related regulation and control. Next, we describe a number of ways researchers have assessed children's regulation. We also present data from the Toddler Emotional Development project, in which laboratory-based measures of effortful regulation were used. In this section, we highlight the measures that show promise (and those that did not work well). Future directions for research on the measurement of effortful regulation are presented.

Many investigators who want to assess emotion-related regulation share the assumption that emotion usually is adaptive and functional in nature (Campos, Mumme, Kermoian, & Campos, 1994). However, it is also recognized that emotional experience can sometimes be unregulated or internally dysregulating, and that the expression of emotion in ways that are inappropriate in a given context can have a negative effect on a child's social behavior and development (e.g., Cole, Mischel, & Teti, 1994). Moreover, it is generally agreed that the *modulation* of emotional reactions often is important for optimal performance on tasks and in social contexts. Indeed, it has become increasingly clear that children's abilities to regulate the experience and expression of emotion are associated with a range of important developmental outcomes for children, such as their social competence, adjustment, and academic outcomes (e.g., Blair, 2002; Eisenberg, Fabes, Guthrie, & Reiser, 2000; Eisenberg, Spinrad, & Sadovsky, in press; Kochanska & Knaack, 2003; Rothbart & Bates, 1998, in press).

Emotion regulation has been defined in diverse ways (see Cole, Martin, & Dennis, 2004, and related commentaries). For example, Cole et al. (2004) argued that, "Emotion regulation refers to changes associated with activated emotions. These include changes in the emotion itself… or in other psychology processes (e.g., memory, social interaction). The term emotion regulation can denote two types of regulatory phenomena: emotion as regulating and emotion as regulated" (p. 320). Kopp and Neufeld (2003) asserted that "emotion regulation during the early years is a developmental process that represents the deployment of intrinsic and extrinsic processes--at whatever maturity level the young child is at--to manage arousal states for: (a) affective biological and social adaptations, and b) to achieve individual goals." Thompson (1994) defined emotion regulation as the "extrinsic and intrinsic processes responsible for monitoring, evaluating, and modifying emotional reactions, especially their intensive and temporal features, to achieve one's goals" (pp. 27–28). Based on these and others' ideas regarding emotion regulation (e.g., Campos et al., 1994; Cole, et al., 1994), we define emotion-related self-regulation as the process of initiating, avoiding, inhibiting, maintaining, or

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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). Thus, our definition of emotion, unlike that of Cole et al. (2004), differentiates between regulation *of* emotion and *by* emotion; moreover, unlike some investigators, we include the modulation of emotion-related behavior (and not just internal states) in this broad definition. The regulation of the behavior associated with emotional reactivity is what many (albeit not all) developmental scientists attempt to assess in their research.

In this paper, we discuss issues relevant to the measurement of emotion-related regulation in young children. Then we review some measures of regulatory processes used with young children and their merits.

Conceptual Distinctions in Regard to Emotion-Related Regulation/Control

In thinking about the measurement of emotion-related regulation, it is useful to make at least three types of distinctions. The first is between the regulation of internal states (including feelings, physiological processes, cognitions, and perceptual processes) and the regulation of overt manifestations of an emotion. Although this distinction is somewhat artificial, it is a useful heuristic in terms of thinking about the target of the regulation. The second distinction is between more effortful types of control (viewed as part of regulation) and more passive, less voluntary types of control. The third and final distinction is between proactive (antecedent) regulation or coping and regulation/coping that occurs in response to, or as part of, an evocative situation. Proactive coping or antecedent emotion regulation occurs prior to the emotion-eliciting occasion and serves to minimize, change, or even prevent (or induce) the emotion-eliciting event and/or associated emotion (Aspinwall & Taylor, 1997; Gross, 1999). Most measures of regulation used with young children pertain to the regulation of emotion associated with emotion that has already occurred or is in process.

Emotion Regulation versus Emotion-Related Behavioral Regulation

As already noted, we believe emotion-related regulation (sometimes labeled emotion regulation or self-regulation for brevity) involves the modulation (broadly defined) of both the internal experience of emotion and its outwardly expression. We (e.g., Eisenberg, Fabes, Guthrie, & Reiser, 2000) have defined emotion-related regulation as including both elements but also have differentiated between the two for heuristic purposes. Thus, *emotion regulation* is defined as the process of initiating, maintaining, modulating, or changing the occurrence, intensity, or duration of internal feeling states and emotion-related motivations and physiological processes, often in the service of accomplishing one's goals (Eisenberg & Morris, 2002). Mechanisms involved in emotion regulation include attentional processes (e.g., attention shifting and focusing), cognitive constructions or appraisals (e.g., Mischel & Baker, 1972; Mischel, 2000), and sometimes even overt behaviors such as inhibiting movement toward an evocative object (Rothbart & Derryberry, 1981).

In contrast, *emotion-related behavioral regulation* (henceforth labeled behavioral regulation for brevity) is defined as "the process of initiating, maintaining, inhibiting, modulating, or changing the occurrence, form, and duration of behavioral concomitants of emotion, including observable facial and gestural responses and other behaviors that stem from, or are associated with, internal emotion-related psychological or physiological states and goals" (Eisenberg et al., 2000, p. 138). It generally involves the voluntary, effortful inhibition or activation of behavior linked to emotion and the overt expression of emotion.

Clearly, emotional and behavioral regulation are intimately related. For example, attentional processes play some role in how behavior is managed and expressed. Nonetheless, the heuristic distinction helps to better pinpoint what aspect of control is of interest or being assessed.

Measures of emotion-related regulation often differ considerably. For example, typical measures of emotion regulation are those involving control of attention (e.g., computer games involving attention shifting or focusing or Stroop tasks; see Gerardi-Caulton, 2000; Kochanska, Murray, & Harlan, 2000; Nigg, 2000) or adults' reports (or self-reports) of children's abilities to shift and focus attention or cope by using cognitive distraction (e.g., thinking about something that is not distressing; Eisenberg, Cumberland, et al., 2001; Rothbart, et al., 2001; Sandler, Tein, & West., 1994). In contrast, measures of behavioral regulation typically include tasks that assess (or adults' reports of) children's abilities to start and stop movements or slow down movement on command (e.g., Blair, 2003; Kochanksa, Murray, & Harlan, 2000; Oosterlaan & Sergeant, 1996, 1998; Rothbart, Ahadi, Hershey, & Fisher, 2001), lower their voice (whisper) when asked (Kochanska et al., 2000), or mask the expression of emotion (e.g., Cole, Zahn-Waxler, & Smith, 1994; Saarni, 1984).

Effortful versus Less Voluntary Modes of Control

A number of investigators believe that well-regulated individuals are not overly controlled or undercontrolled (Block & Block, 1980; Cole et al., 1994). Rather, well-regulated people have the ability to respond to the ongoing demands of experience with a range of responses that are socially acceptable and sufficiently flexible to allow for spontaneity as well as the ability to delay spontaneous reactions as needed (Cole, Michel et al., 1994). Accordingly, it is important to distinguish between voluntary, effortful regulation and less voluntary types of control/inhibition, although there may not be a categorical distinction (i.e., there may be a continuum on which effortfully controlled and less voluntarily elicited control processes can be located, depending on the relative influence of different aspects of neurological functioning; see below).

It is useful to think of *control* as a superordinate category that includes both voluntary and reactive (or less voluntary) inhibition. Whether control is adaptive or not often depends on the degree to which it is voluntarily modulated or is due to reactive tendencies (including emotion, approach and avoidance tendencies, and activity level) that are difficult to modulate. Accordingly, we define self-regulation as including the ability to effortfully (voluntarily) inhibit behavior as needed, as well as other capacities (e.g., the ability to activate behavior or shift and focus attention as needed). Because regulation can be willfully managed and is flexible, it generally is viewed as adaptive (although it is possible that some youth may overregulate intentionally). In contrast, aspects of inhibition (or the lack thereof—that is, involuntary approach behavior) that are less voluntary or so automatic that they are not usually under voluntary control are less flexible than regulation and would be expected to result in rigid, often inappropriate behavior (Cole, Michel et al., 1994, Cicchetti, Ackerman, & Izard, 1995; Eisenberg & Morris, 2002).

At a conceptual level, voluntary control or regulation overlaps substantially with Rothbart's construct of *effortful control* (EC), defined as "the efficiency of executive attention, including the ability to inhibit a dominant response and/or to activate a subdominant response, to plan, and to detect errors" (Rothbart & Bates, in press). Measures of EC (including Rothbart's) typically involve *attentional regulation* (e.g., the ability to voluntarily focus attention as needed) and/or behavioral regulation (e.g., the ability to effortfully inhibit behavior as appropriate, called *inhibitory control*). Although not usually mentioned in some discussions of EC, the ability to activate behavior when one does not desire to do so (*activational control*; e.g., get moving on a task in the morning when it would be nicer to stay in bed; Ellis & Rothbart, 1999; Early Adolescent Temperament Scale-Revised) also is an aspect of the construct of EC.

EC is believed to involve executive functioning in the cortex, especially the anterior cingulate gyrus (Mirsky, 1996; Posner & DiGirolamo, 2000). This part of the brain appears to be involved in executive attention and subjective feelings of voluntary control of thoughts and feelings, and comes into play when resolving conflict, correcting errors, and planning new actions (Posner & Rothbart, 1998).

Derryberry and Rothbart (1997) discussed the difference between effortful and more passive or reactive types of responding; they suggested that behavioral inhibition (including constrained behavior and wary reactions to novel or challenging situations) involves reactive anxiety or fear and reflects passive rather than effortfully controlled behavior. At the other extreme of passive control is reactive impulsive behavior that is not voluntarily controlled and reflects approach tendencies and/or reward dominance (i.e., the tendency to move toward rewards; also see Mezzacappa, Kindlon, Saul, & Earls, 1998, and Nigg, 2000). Both of these forms of involuntary control—that is, overcontrol and impulsivity-- have been linked to a variety of behavioral and emotional problems in children (e.g., Biederman et al., 1990; Eisenberg, Cumberland, et al., 2001; Kagan, Snidman, Zentner, & Person, 1999; Rothbart & Bates, 1998).

A number of theorists have discussed the neurological bases of inhibited and impulsive types of responses. For example, Gary (1975, 1987; Gray & MacNaughton, 2000) has argued that there is a Behavioral Inhibition System (BIS) that is activated in situations involving novelty and stimuli signaling punishment or frustrative nonreward, and the Behavioral Activation System or BAS, which involves sensitivity to cues of reward and cessation of punishment. Fowles (1987), Patterson and Newman (1993), DePue and Collins (1999), and others have proposed variations on Gray’s BAS/BIS systems, but numerous researchers believe there are separate (albeit related) social withdrawal and social facilitation or approach systems. According to Gray (Pickering & Gray, 1999), impulsive behavior is associated with high BAS and relatively low BIS functioning, whereas the BIS system inhibits behavior (e.g., due to fear of punishment). Such reactive systems appear to be seated primarily in subcortical systems (e.g., the amygdala for inhibition and mesolimbic dopamine pathways for approach; Cacioppo, Gardner, & Berntson, 1999; Pickering & Gray, 1999). Thus, research and theory pertaining to the biological bases of these systems suggest that the neurological bases of EC (regulation) and more reactive types of control/undercontrol are different.

Although EC involves the executive attention and other skills that are extremely limited in infancy, it develops rapidly in the first four years of life. Improvement in inhibitory control is seen in the first year (e.g., Putnam & Stifter, 2002), and considerable improvement in inhibitory control is seen between 22 and 33 months (Kochanska, Murray, & Harlan, 2000) and at about 44 months (Reed, Pien, & Rothbart, 1984). Attentional EC seems to show modest advances in the early months of life and at 18 months, but becomes considerably better in the 3rd year of life (Posner & Rothbart, 1998). EC continues to develop in childhood (Murphy et al., 1999) and into adulthood (Williams et al., 1999). As EC increases in the 2nd to 4th years of life, we expect it to increasingly modulate the overt expression of reactive tendencies so relations between reactive control and developmental outcomes become weaker with age, especially if variance in outcomes due to the effects of EC on outcomes is controlled. Indeed, children with a relatively inhibited versus impulsive style may be better able to exercise their EC (Aksan & Kochanska, 2004). Nonetheless, children in the late preschool years and early school years with internalizing problems such as social withdrawal exhibit deficits in attentional EC relative to nondisordered children, although as they move through school they no long show such deficits (Eisenberg, Cumberland, et al., 2001; Eisenberg, Sadovsky et al., 2005). Thus, even though EC is related to higher cortical functioning, it is possible to assess its emergence and relation to other developmental outcomes in the early years of life.

Proactive versus Reactive Regulation and Coping

A third distinction among aspects of emotion-related regulation/control pertains to when the regulation occurs--prior to the elicitation of emotion and emotion-related physiological responding or in response to an event likely to elicit emotion. Most research on emotion-related children's regulation or coping pertains to how they deal with their emotion (and related behavior) in the evocative situation as it is potentially being elicited or shortly thereafter, while the emotion would be expected to occur. This type of regulation/coping is reactive, not in the sense of reactive control, but in terms of it being elicited as part of the emotional reaction (or in a situation in which it is likely to be elicited) or thereafter. However, emotional experience and related physiological and cognitive responses can be regulated long before they occur.

Processes and behaviors that serve to prevent, manage, and modulate emotional reactions and emotion-related behaviors prior to an evocative situation have been labeled as by Gross (1999) as antecedent emotion regulation (Gross, 1999) and by Aspinwall and Taylor (1997) as proactive coping. Proactive coping is the narrower construct and is defined as "efforts undertaken in advance of a potentially stressful event to prevent it or to modify its form before it occurs" (Aspinwall & Taylor, 1997, p. 417). It is viewed as nearly always active and as not involving positive reappraisals (thinking about something in a more positive light) or other methods of internal emotion soothing. Examples of proactive coping include selecting situations to avoid negative emotion or stress or to maximize positive experiences (e.g., a shy person declining an invitation to a large party), or seeking information prior to an event in order to influence its outcome. For example, a shy person might plan social activities that do not involve strangers. Thus, proactive coping includes what has been called nichepicking, which refers, for example, to a person avoiding situations in which undesired emotion is likely to become activated and choosing settings in which desired emotions are likely (Campos, Frankel, & Camras, 2004; Eisenberg & Spinrad, 2004). In contrast, antecedent emotion regulation is defined as involving both proactive coping (e.g., the selection or modification of situations) and emotion regulation processes such as attention deployment or cognitive change (e.g., managing emotional reactions before they occur by using attention and cognitive processes to choose the situations that are focused upon and how they are interpreted; Gross, 1999). For example, people can change their perceptions of events or stimuli prior to encountering them by not attending to them or by reframing them in a positive way.

Unfortunately, as yet there are few measures of antecedent emotion regulation or proactive coping in childhood, partly because it is difficult for observers to know which overt behaviors are chosen by a child to modify evocative situations before they occur. Moreover, it is difficult to assess regulation/coping that occurs prior to an event if the target individuals cannot report on their planning, intent, and other mental processes. Young children, for example, generally have difficulty accurately reporting their use of attention in selecting situations to think about.

Thus, the measures we discuss generally do not tap antecedent emotion regulation/proactive coping. Campos et al. (2004), however, suggested that an example of proactive coping is shy children who hang back and do not join social groups until they are comfortable. The effectiveness of such nichepicking, in the short run if not in the long run, is illustrated by Gunnar's (1994) finding that inhibited children exhibit less of a cortisol response when they enter a new preschool than do bolder children (but more of a response later in the school year). Thus, it may be possible to use observational methods to assess some aspects of reactive regulation/control in the early years, although it may not be evident if this control is intentional and effortful or merely the result of reactive control (less voluntary inhibition) to a potentially punishing and anxiety-inducing situation.

Measures of Effortful Regulation for Children

The distinction between EC and reactive control is useful when thinking about what various measures of "regulation" that are used with children might actually tap. The hallmark of EC is being able to shift and focus attention, and inhibit or activate behavior, as required in a particular situation, especially when one does not really want to do so. However, it is quite possible that when rewards or punishments are involved in a given task, performance may also tap reactive inhibition or approach. In the remainder of this paper, we describe a number of ways researchers have assessed children's EC, including a discussion of tasks used in the Toddler Emotional Development project.

Kochanska's Battery for Assessing Effortful Control

Grazyna Kochanska has developed batteries of measures to use with toddlers, preschoolers, and young school-age children. Typically she has administered a battery of these measures and then has computed an aggregate score because the various indexes tend to be intercorrelated. Moreover, Kochanska and Knaack (2003) have found considerable consistency in EC across time. Kochanksa has published numerous papers including these measures—we simply summarize briefly the types of measures, their typical interrelations, and some of the major findings.

Kochanska's measures typically target five components of EC: a) delaying (e.g., waiting for a pleasant event), slowing down gross and fine motor activity (e.g., walking or drawing), suppressing/initiating activity to a signal (e.g., games in which the child produces a response to one signal and inhibits it to another), effortful attention (Stroop-like paradigms, which require ignoring a dominant perceptual feature of a stimulus in favor of a subdominant feature), and lowering voice (whispering).

Kochanska has found that reliabilities on these tasks generally are high, with most kappas being .80 or higher and other types of reliabilities being equally high. At 22 months, a battery of these types of measures, when combined into a composite, had an alpha of .42 (average item-total correlation was .27); at 33 months, the alpha was .77 (average item-total correlation was .42; Kochanska, Murray, & Harlan, 2000); and at 45 months the alpha was .79 (Kochanska, Coy, & Murray, 2001). The EC composite was longitudinally stable from 22 to 33 months ($r = .44$), from 33 to 45 months ($r = .80$), and from 22 to 45 months ($r = .22$) (Kochanska et al., 2001, Kochanska et al., 2002). Moreover, the composite correlated significantly with parents' reports of children's inhibitory control (e.g., correlations with mothers' and fathers' reports of EC at 33 months were both .45; Kochanska et al., 2000). Finally, in a series of studies, Kochanska has found conceptually meaningful links between her measures of EC and indices of conscience, emotionality, and adjustment (e.g., Kochanska & Knaack, 2003; Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996; Kochanska, Murray, & Coy, 1997; Kochanska et al., 1998, 2000, 2001).

Mischel's Delay of Gratification Task

Slightly different delay tasks have been used with preschool and older children with success. For example, Mischel and colleagues developed the classic delay task in which children are told that if they wait for the experimenter to return (a considerable period of time), they will receive a larger price (e.g., more food) than if they do not want to wait to consume (or receive) the prize (e.g., Mischel. 1974; Mischel & Baker, 1972; Shoda, Mischel, & Peake, 1990). Several findings from this work are noteworthy. First, when children are not provided with strategies for delaying and the rewards were in view, preschool children's ability to delay was related to their academic and cognitive competence and their ability to cope with frustration in adolescence and into adulthood (Mischel, 2000; Mischel, Shoda, & Peake, 1988; Shoda et al., 1990). Moreover, this task or modifications thereof appear appropriate for use with elementary school children (Ayduk et al., 2000; Krueger, Caspi, Moffitt, White, & Stouthamer-Loeber, 1996). Similar to Kochanksa's tasks, it is possible that the task taps both attentional control (Shoda et al., 1990) and impulsivity.

Executive Functioning Tasks

A number of investigators consider some measures of executive functioning to tap self-regulation (e.g., Blair, 2003; Gerardi-Caulton, 2000). Many of these tasks are very similar to Kochanska's Stroop task (which require ignoring a dominant perceptual feature in favor of a subdominant feature, such as naming a small fruit when its picture was embedded in a picture of a different large fruit); they also resemble some of her other tasks that require the child to suppress a prepotent response. Because executive attention is involved in EC, these measures would seem to tap EC.

Blair (2003) used two measures that were somewhat similar to Kochanska's suppression/activation of movement tasks with 3- to 5-year-old head-start children. On one task, children were told to use a dowel to tap twice when the experimenter tapped once and to vice versa. The other task was Gerstadt, Hong, and Diamond's (1994) Stroop-like day-night measure, in which children were shown a black cared with white stars and a moon and asked to say "day" and a white card with a bright yellow sun and asked to say "night". On both tasks, children are asked to inhibit a prepotent response while holding in mind the rule for the correct response. Both Gerstadt et al. (1994) and Blair obtained evidence that performance on this sort of measure increases with age; Blair also found that a composite of the two measures was related to verbal intelligence. Many of Blair's head start children did fairly well on the task (66% correct), although there was considerable variability. In contrast, Gerstadt et al. (1994) reported relatively poor performance for children under age 5.

Gerardi-Caulton (2000) used a similar task with 24 to 36 month olds. Children were asked to push a bottom that showed (in an illustration above the button) the same picture as that presented on a computer screen. However, sometimes that picture on the computer screen was on the same side of the computer as the correct response button, whereas sometimes it was on the other side. Performance on this task increased with age and was related to individual differences in measures of EC, including high levels of caregiver-reported attention focusing or attention shifting and scores on Kochanska's tower and snack delay tasks (although correlational analyses were not computed with children younger than 30 months due to their relatively poor performance on the task). Children who responded slower and more accurately on the computer task tended to have higher scores on the behavioral measures of EC. This latter finding suggests that Geraldi-Caulton's task measured impulsivity as well as EC.

In studies of executive functioning abilities, investigators often have not related their measures to indices of quality of socioemotional functioning. Blair's composite score on his executive functioning measures correlated at about $p < .10$ (2-tailed test) with high levels of teacher-reported on-task behavior and high vagal tone, and marginally negatively with vagal suppression; the composite was unrelated to teacher-reported social competence. Thus, it is not yet clear if measures such as these are very useful for predicting developmental outcomes of young children.

Eisenberg's Puzzle Box Task

We have developed another task that we have used successfully with children aged 4 to about junior high age—a puzzle box task that, like many of Kochanska's measures, probably assesses a combination of attentional persistence, inhibitory control, and impulsivity. Children are instructed to try to assemble a wooden puzzle in a large box without looking at it. A cloth covers the front; children slip their arms through sleeves to get into the box. The cloth can be lifted up so that a child can cheat by looking. Children are told that if they finish the puzzle within 5 minutes, they will receive an attractive prize, and that they can call the experimenter back by ringing a bell if they finish in less than 5 minutes. The experimenter leaves the room and children's persistence on the task and cheating each are timed unobtrusively (via a hidden camera). Interrater reliabilities for the numbers of seconds for each generally are .97 or higher. Because some children cheat and finish the task early, the proportion of time persisting and the proportion of time cheating are each computed by dividing the number of seconds spent for each by the total amount of time spent on the task.

This measure (persistence only or persistence minus cheating) fairly consistently correlates with parents' and teachers' reports of children's EC (on Rothbart's Child Behavior Questionnaire, 2001) and groups with these reports on a latent construct in structural equation modeling, especially prior to adolescence (e.g., Cumberland, Eisenberg, & Reiser, 2004; Eisenberg et al., 1997, 2000, 2003, 2004). The measure of persistence correlates about .45 over two years time in elementary school (Eisenberg et al., 2000). It also correlates with personality resiliency in preschoolers (Cumberland et al., 2004), peers' nominations for sociometric status (liking) and helpfulness in early elementary school (especially for children high in negative emotionality; Eisenberg et al., 1997), adults' reports of kindergartners' to third graders' adjustment (low externalizing behavior; Eisenberg et al., 1996; Valiente et al., 2002), and social competence (as reported by parents and teachers; Eisenberg et al., 1997) in early elementary school. It also correlates with teachers' reports of ego control and social competence in grades 2 to 5 (primarily for children prone to negative emotion; Eisenberg et al., 2000). In grades 4 to 7, persistence on this task continues to correlate with teachers' and parents' reports of high EC, high resiliency, relatively few externalizing problems, and low negative emotionality (Eisenberg, Valiente et al., 2003; Valiente et al., 2003).

An advantage of this measure is that it works well with preschoolers and elementary school children. Moreover, there is empirical evidence that this task alone appears to be a good measure of control. A disadvantage is that its use requires videotaping, leaving the child alone, and the presence of the puzzle box. Thus, it cannot be easily used in the home, although it can be used in laboratories or in preschools in which it is possible to videotape children without their knowledge (or in a laboratory van). In addition, as already noted, this task may tap both EC and/or impulsivity, which could be a problem if one wishes to relate it to internalizing problems (Eisenberg, Cumberland, et al., 2001). Although this measure has been used with samples including about 15–28% minorities, it has not been examined with samples of only minorities. However, its relation to other variables does not seem to vary with socioeconomic status, and there is no reason to believe that it is not valid with minority populations.

The Toddler Emotional Development Project

We have recently attempted to differentiate EC vs. reactive control (RC) in our longitudinal work with young toddlers. Although Kochanska has created a battery of EC tasks for use with young children, the entire battery is relatively time consuming. Thus, we used some of her tasks that we thought tapped EC or a combination of EC and RC, and we also added tasks of sustained attention. Because Kochanska has always used a composite index of EC in her analyses, one goal of this work is to determine the usefulness of some of the individual measures.

In the Toddler Emotional Development (TED) project, we assessed toddlers at two time points (when toddlers were approximately 18 and 30 months of age). The laboratory procedures were designed to measure EC and RC, as well as toddlers' proneness to negative emotions (sadness, fear, anger), physiological responding, emotion understanding, and social competence. The laboratory visits lasted approximately 1.5 hours and the procedures were coded from videotape. In order to understand issues surrounding the measurement and development of EC in young children, we considered toddlers' ability to delay gratification, control motor behavior, and to sustain attention. In addition to the laboratory measures, we also obtained reports from mothers and caregivers (a nonparental caregiver or another adult who knew the child) of children's EC.

The initial laboratory assessment involved 247 toddlers (137 boys, 110 girls; ages 16.8 to 20.0 months, *M* = 17.8 months) and their mothers; 216 toddlers (119 boys, 97 girls; ages 27.2 to 32.0 months, *M* = 29.8 months) and their mothers participated at Time 2. The majority of the children were Caucasian (86%), although African American (3%), Asian (1%), and Native American (2%) children were also represented (8% of children were missing race data). In terms of ethnicity, 13% of children were of Hispanic background, and the remainder of the sample was non-Hispanic. Annual family income ranged from less than $15,000 to over $100,000, with the average income at the level of $45,000–60,000. Parents' education ranged from 8^{th} grade to the graduate level; average number of years of formal education completed by both mothers and fathers was approximately 14 years (2 years of college). At the first assessment, over half (59%) of all mothers were employed (82% of these full-time) as were most (96%) fathers (93% of these full-time). The majority (85%) of parents were married, and had been married from less than one year to 25 years (*M* = 5.9, years, *SD* = 3.8). Approximately half (48%) of the children had siblings, and 42% of all children were firstborns.

Delay of Gratification

The delay of gratification tasks in this study were based on Kochanska's EC battery, where children are asked to wait for a reward. The ability to wait for a prize/snack is likely to tapEC, but the lack of ability may reflect either low EC or a strong reactive approach to rewards (i.e., impulsivity). Thus, it is important to determine at young ages, whether delay of gratification measures are related to other indices of EC.

Snack Delay—The Snack Delay task was used at 18 and 30 months (with goldfish crackers at 18 months and M&M's at 30 months). Children were presented with a placemat that had pictures of hands and were told to "put their hands on the pictures of the hands." Then, the snack was placed at the top-center of the mat, and a clear plastic cup was placed over the snack. The toddler was instructed to wait to pick up the cup and eat the snack until the experimenter (E) rang a bell. Practice trials were conducted to ensure that the child understood the task. After the practice e trials, four trials were conducted. In these trials, halfway through each delay the E picked up the bell as if to ring it, but did not ring it until the delay time had expired. The delays were 10, 20, 30, and 15 seconds. Scores for this task ranged from 1 to 9, with 1 indicating that the child ate the snack right away, a 2 was scored if toddlers ate the snack after the experimenter lifted the bell, a 3 indicated that the child touched (but did not eat the snack) in the first half of the trial, a 4 indicated that the child touched the snack during the second half of the trial, a 5 was scored if the toddler only touched the cup during the first half, a 6 was coded if the child touched the cup during the second half of the trial, and 7 indicating that the child waiting the entire trial to eat the snack. Up to 2 extra points were given if the child kept their hands on the mat.

At 18 months of age, toddlers' average score was 2.60 (*SD*=1.74; range = 1 to 8). Twenty-five percent of the 18-month olds waited for the experimenter to ring the bell for at least one trial. As expected, children had much better delay skills at 30 months and had an average score of 6.21 (*SD*=2.60; range = 1 to 9); Seventy-nine percent of these children waited the for the experimenter to ring the bell. Toddlers' performance on this task was not stable over time, $r(202) = .03$, $p = ns$.

Regardless of the fact that 18-month-olds had relatively poor delay skills, toddlers' ability to delay was positively, albeit modestly, related to mothers' and caregivers' ratings of EC. Specifically, toddlers' delay at 18 months was positively related to mothers' reports of attention shifting, $r(220) = .17$, $p < .01$ and caregivers' reports of inhibitory control, $r(158) = .26$, $p < .01$. Similarly, at 30 months, toddlers' ability to wait for a snack was positively correlated with mothers' and caregivers' reports of inhibitory control, *r*s(207, 142) = .29 and .28, *p*s < .01, and caregivers' reports of attention shifting, $r(139) = .16$, $p = .05$. Thus, it appears that at both 18 and 30 months of age, toddlers' performance on the snack delay task had reasonable variability and was related in expected ways to adults' reports of EC. In work with low-income preschool children, McCabe and colleagues (McCabe, Rebello-Britto, Hernandez, & Brooks-Gunn, 2004) found that the majority (91%) of children were successful at waiting for a snack using this procedure. Thus, children's performance on this task likely reaches a ceiling by preschool age and is not a useful measure for older preschool children.

Gift delay—When toddlers were 30 months old, we included another delay of gratification task assessing toddlers' ability to wait for a gift (Kochanska et al., 1996). In this situation, the experimenter brought a gift to the child in a colorful gift bag. Placing the gift on the table in front of the child, the child was asked to wait in his or her chair and not to touch the bag until the experimenter came back with a bow. Then, the experimenter left the room for 3 minutes. The toddlers' performance on this task was coded using a 5-point scale. A score of 1 was given if the child pulled the gift from the bag, a 2 indicated that the child put his/her hand into the bag, a score of 3 was given if the child peeked in the bag, a 4 was given if the child touched the bag but did not peek, and a 5 indicated that the child did not touch or peek in the bag.

Twenty-nine percent of the 30-month-old children waited for the experimenter to return before touching the gift bag. The mean score on this task was 3.14 (*SD*=1.54; range =1–5). Thirty-month-olds performance on this task was positively related to both mothers' and caregivers' ratings of inhibitory control, *r*s(206, 143) = .17 and .21, *p*s < .05 for mother and caregiver reports, respectively. In addition, toddlers who had higher scores on the snack delay also tended to have better delay skills in the gift bag paradigm, $r(211) = .44$, $p < .01$. These findings support the use of this measure in young children. Not only was it related to other indices of delay, but performance was also related to adults' reports of behavioral control. In addition, in work with mostly minority preschool children, McCabe and Brooks-Gunn (2002) also found this task to be useful.

Dinky toys—At 30 months of age, we conducted Kochanska's dinky toys task (Kochanska et al., 1996). In this task, the child is asked to place his or her hands on knees while choosing on prize from a box filled with small toys. The instructions are for the child to "tell" the experimenter which toy he or she wanted without touching or pointing to the toy. We conducted two trials of this task. Toddlers were scored from 0 to 6, with 0 indicating that the child immediately grabbed the toy, 1 indicating that the child waiting at least two seconds before grabbing the toy, 2 indicating that the child touched the toy, but did not pull it out of the box, 3 indicating that the child pointed to the toy, 4 indicating that the child removed hands from lap, 5 indicating that the child moved his/her hands, but the but kept them on his/her lap, and 6 indicating that toddlers waited with their hands on their laps. Toddlers did not perform well at this task (*M* = 1.14; *SD*=1.03). The range of scores was from 0 to 5.5. Interestingly, we also coded the children's understanding of the task, and nearly all children were observed to understand the task at least somewhat (97%). Language ability was not related to performance on the task.

Regardless of the fact that the task was extremely difficult for 30-month-olds, toddlers' performance on the dinky toys task was positively related to their snack delay and gift bag performance, rs(209) = .16, and .14, *p*s < .05, and was positively (albeit marginally) related to caregivers' reports of attention focusing and inhibitory control, *r*s (141, 142) = .15 and .14, *p*s < .10.

In sum, children's delay ability was related across all three contexts (snack, gift, dinky toys) and was related to adults' reports of EC. Thus, although these measures may also tap children's reactive undercontrol (because a reward/prize was available), it appears that at these young ages, children who wait for food/prizes are seen by adults as having high levels of EC.

Motor Control

Rabbit/Turtle—At 30 months, we assessed children's ability to control their motor behavior using Kochanska's rabbit/turtle procedure. In this task, children were instructed to slow down their motor activity by maneuvering a turtle (slowly) and a rabbit (fast) down along a curved path through a "meadow" to a barn. There were two trials for each figure and scores for each figure were averaged across the trials. The average time through the paths were 4.35 seconds (*SD*=3.07) for the rabbit trials and 4.52 seconds (*SD*=3.29) for the turtle task. A difference score between rabbit and turtle trials was computed (a positive score indicated that children were slower for turtle). In addition, toddlers' ability to negotiate the curves (keeping the figure on the mat, following the general curve) was coded. Difference scores between the rabbit and the turtle trials for the 30-month data ranged from –12.5 to 14.0 (*M*=.18; *SD*=2.87). Forty-five percent of the toddlers were slower for on the turtle trials, but a much smaller percentage of children substantially slowed down their motor activity. For example, only 32% of the toddlers slowed their motor behavior by 1 second or more and only 18% slowed by 2 or more seconds. It is also important to note that 8% of the children refused to maneuver the figures along the path, resulting in missing data for these children.

This measure appeared to be a somewhat purer measure of EC (because no reward was involved); however, in our study toddlers' performance on this task was unrelated to other observed measures of EC and to either mothers' or caregivers' reports of EC. However, toddlers' ability to negotiate the curves (i.e., whether the child followed the path with the figure) was positively related to mothers' ratings of attentional focusing, *r*(196) = .18, *p* < .01 and was at least marginally positively related to their ability to delay during the snack delay, dinky toys, and gift delay *r*s (202, 199, 200) = .16,.16, and .13, *p*s < .05, .05 and .06. Moreover, this measure of motor control also was positively related to toddlers' latency to look in the gift bag, put their hand in the bag, open the gift or leave their seat, rs(201 to 202) = .15 to .20, ps < .05. Kochanska and colleagues have used the difference score measure successfully as part of an EC composite (it was at least moderately correlated with the battery score, *r*s ranged from .25 to .49 at several ages). Perhaps staying on the path is a better measure of motor control for younger children (our sample was slightly younger than Kochanska's) Controlling the speed of motor behavior may involve different and more advanced skills than staying on the path. We have used the rabbit and turtle measure in our follow-up assessments and will examine the development of this skill over time and its relation to other indices of EC at later ages.

Sustained Attention Measures

Blocks/Beads—To measure the child's ability to focus attention, we used the block/beads paradigm from the Laboratory Temperament Assessment Battery (Lab-TAB; Goldsmith & Rothbart, 1999). These tasks were designed to be relatively boring, and toddlers' attention/persistence with the task was coded. Specifically, at 18 months, toddlers were seated in a high chair and presented with 8 large "Lego Baby" blocks for a period of three minutes. At 30 months, toddlers' were instructed to sort beads into same colored buckets (red, yellow, blue) for three minutes. Mothers were seated behind their toddlers and instructed to complete questionnaires during these tasks. At both ages, the duration of attending to and manipulating the objects were coded.

Toddlers tended to attend to the blocks for around 2 of the 3 minutes and they increased in their ability to attend to boring toys over time (*M*s=120.44 and 143.69 seconds, *SD*s = 45.17 and 37.12 for 18 and 30 month, respectively. In addition, toddlers' attention in the block/bead task was somewhat stable over time, $r(207) = .15$, $p < .05$. In relation to other indices of EC, our findings indicated that 18-month-old toddlers' attention during the block task was unrelated to other observed measures of EC; nor was it associated with adults' reports of attentional or behavioral control. Interestingly, we found that many toddlers became distressed during portions of this task (51% at 18 months), and toddlers' attention to the blocks was negatively related to their distress, *r*s(243) = −.60 and −.46, *p*s < .01 for anger and sadness, respectively. Thus, it is possible that this task should not be viewed as a "neutral" task because it was designed to be boring (it was common for the toddlers to throw the blocks in anger). Children also may have become distressed by the mother's unavailability or sitting in the high chair. Thus, this measure may not be a clean measure of toddlers' attentional abilities at 18 months of age.

At 30 months of age, toddlers' attention to/manipulation of beads during the bead-sorting task was at least marginally positively related to mothers' reports of attention shifting and focusing, *r*s (207, 204) = .12 and .17, *p*s < .07 and .05, for attention shifting and focusing, respectively. In addition, there was an unexpected negative relation to toddlers' performance on the snack delay, $r(212) = -.16$, $p < .02$. Thus, this task may not be very useful for 30 month olds.

Attention to neutral video—At 18months, we also measured focused attention to a neutral film depicting baby faces to upbeat music. The film lasted 3 minutes, and toddlers' attention to the video was coded during the last minute of the film (*M*=29.54 seconds, *SD*=15.44). Similar to the blocks measure, toddlers' observed attention was unrelated to other measures of EC, and we found a large percentage of toddlers expressed at least mild distress during this portion of the film (34% at 18 months). Because the film was relatively pleasant, the negative emotion was likely due to refusal to sit in the high chair, mothers being unavailable (they were seated behind the child and occupied with questionnaires), or the placement of physiological electrodes (which was done immediately before the films). It is important to note that children were soothed after the electrode placement and were in a neutral state at the beginning of the film; however, many children were observed pulling on their electrode leads and were bothered by the electrode placement during the film.

Interestingly, when examining the subsample of children who did not express any negative emotion during the last minute of the film, we found that toddlers' attention during this segment was positively related to mothers' reports of attention focusing, $r(95) = .22$ $p < .05$. Thus, observing toddlers' attention during a neutral film is a promising measure when children are likely to be comfortable in the laboratory situation. Because Kochanska and Knaack (2003) found that their measures of EC became more interrelated and traitlike with age from 22 to 45 months, it is possible that these measures will correlate with other indices of EC at older ages.

Summary and Future Directions

In summary, there are numerous measures of regulation that can be used with young children and elementary school children. Kochanska's battery of measures is highly recommended (particularly the delay tasks with young toddlers), and measures of sustained attention may be promising under non-aversive conditions. Eisenberg's puzzle box task has also proved useful with old preschool children, as have the Stroop-like executive functioning tasks with 3- to 5-year-olds. Which task is best probably depends on the amount of time one has for administration, the setting, and the age of the child.

We believe that an important task for the future is to try to better differentiate between control that is effortful and inhibition that is due to reactive processes. It may never be possible to fully differentiate between impulsivity and EC because children with EC can partially modulate the expression of impulsive tendencies and behavior. Thus, a child may fail at a delay of gratification task due to both high impulsivity and low EC. Those who delay are likely high on EC, but it is difficult to assess the degree to which they are impulsive. Similarly, children who do well on tasks such as not peeking at a gift being wrapped likely are high in EC, but they also may be fearful of the experimenter and inhibited in the novel situation. If this were true, inhibition may contribute to the child's failure to look at the experimenter wrapping the gift.

It is important to consider which tasks are most likely to tap impulsivity and/or inhibited behavior and which are more immune to their influence. As already noted, tasks that involve rewards or punishment are quite likely to partly assess reactive impulsivity and inhibition, respectively. In our work, these measures were related to adults' reports of EC and Kochanska has included such measures as part of her EC composite; however, in recent work she has used them as indices of impulsivity (Aksan & Kochanska, 2004). Tasks that involve motor movements (e.g., drawing a circle fast or slowly, walking a line fast or slowly) may be somewhat less affected by impulsive approach to rewarding situations and inhibition, although we found that they may have been too difficult for young children. Performance on these tasks also may be influenced by reactive control. For example, inhibited children who feel constrained when doing novel tasks may move more slowly, which would results in perhaps better performance on tasks requiring the child to slow down. Moreover, their inhibition may then provide them with more time than other children to process adults' comments, for example, when doing Simon Says types of tasks. For example, Aksan and Kochanska (2004) found that children who were inhibited at age 14 and 22 months in a situation involving novel toys and who responded with fear to novel scary faces were relatively high in their performance on the Bird and Dragon task, in which the child is told to do what the nice bird puppet says (e.g., "touch your nose") but to suppress acting on the instructions coming from a dragon hand puppet. The relation of early inhibition to later inhibitory control was through inhibited children's low impulsivity on tasks in which children were asked to keep a candy on his/her tongue without eating it and to not peek while a gift was wrapped and then wait to open a gift in a colorful bag until the experimenter brought the bow. It is debatable if reactions to a fear-inducing stimulus are the same as behavioral inhibition; moreover, Aksan and Kochanska (2004) found that fearfulness, but not inhibited behavior with novel toys, was correlated with performance on the bird and dragon task. Nonetheless, inhibited children may have taken longer to respond to the bird and dragon task due to their fearfulness (and perhaps their inhibition), which allowed them to perform better. Impulsivity/inhibition may contribute less to performance on measures of EC if the tasks and experimenter are familiar; this is an issue to examine in future work.

Perhaps it will be possible to statistically tease apart EC and impulsivity. In the Toddler Emotional Development project, we also have measured reactive approach and control. We are measuring children's speed of approach and positive affect toward similar objects being used in some of the aforementioned regulation tasks. For example, we simply put down in the child's view a wrapped gift box that is similar to the gift box that children later will be told not to touch and the plastic see-through box holding the toys for the dinky toys task. Preliminary analyses with the 30-month data suggest that toddlers' positive affect (but not physical approach) toward the "similar" dinky toys or gift bag was at least marginally negatively related to latency to touch the dinky toys in the first trial and latency to touch the gift bag, $r(206, 209) = -.16$ and $-.16$, $ps < .06$ and $.05$, for dinky toys and gift bag, respectively. Thus, we have some (albeit minimal) evidence that positive affect towards these objects in a situation in which they are not told to restrain themselves should be used as a covariate in analyses for the gift opening and dinky toy tasks. We also are looking at the unique effects of measures of impulsivity and EC when predicting developmental outcomes such as social competence and adjustment. We often have found unique effects in studies with older children (e.g., Eisenberg et al., 2000; Eisenberg et al., 2004), suggesting that the two constructs are not entirely overlapping and that each has some predictive power independent of the other.

Blair (2003) found that measures of preschoolers' cognitive executive skills involving suppressing primed responses (e.g., tapping once when the experimenter tapped twice and tapping twice when the experimenter tapped once) were unrelated to adult-report measures of behavioral inhibition and behavioral approach tendencies; moreover, these measures correlated differently with teachers' ratings of social competence and on-task behavior. For example, executive functioning was positively related to on-task behavior and unrelated to social competence (e.g., cooperation, initiating interactions in a positive manner, sympathy, listening, labeling feelings appropriately); behavioral inhibition (including proneness to anxiety and worry) was negatively related to on-task behavior and positively related to social competence; and approach tendencies were unrelated to either measure. It would be interesting to determine if similar differences were obtained if both approach/inhibition tendencies and executive functioning (effortful cognitive control) were assessed with behavioral tasks. In general, there is a need for additional development of clean behavioral measures of EC (i.e., regulation), impulsivity, and inhibitory control, as well as adult-report measures. It will take creative thinking and a multi-measure approach to better differentiate between children's self-regulation and their apparent control due to their inhibition (versus impulsivity) during testing.

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