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Emotion-Related Self-Regulation and Its Relation to Children's Maladjustment

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Abstract

The development of children's emotion-related self-regulation appears to be related to, and likely involved in, many aspects of children's development. In this review, the distinction between effortful self-regulatory processes and those that are somewhat less voluntary is discussed, and literature on the former capacities is reviewed. Emotion-related self-regulation develops rapidly in the early years of life and improves more slowly into adulthood. Individual differences in children's self-regulation are fairly stable after the first year or two of life. Such individual differences are inversely related to at least some types of externalizing problems. Findings for internalizing problems are less consistent and robust, although emotion-related self-regulation appears to be inversely related to internalizing problems after the early years. Self-regulatory capacities have been related to both genetic and environmental factors and their interaction. Some interventions designed to foster self-regulation and, hence, reduce maladjustment, have proved to be at least partially effective.

Keywords

regulation; effortful control; executive function; adjustment; socialization

INTRODUCTION

Research on the topic of children's emotion-related self-regulation has increased exponentially in the past 15 years. A significant proportion of this research pertains to the relation of emotion-related regulation to children's maladjustment. Indeed, the concept of emotion-relevant regulation has assumed a central role in the field of developmental psychopathology, which provides a framework for understanding the role of normal developmental processes in both adaptive and maladaptive developmental outcomes. Researchers working within this framework examine, for example, the conditions under which normal development is compromised and risk factors can be exacerbated or buffered so that they are likely to result in atypical versus typical developmental trajectories, respectively (Cicchetti & Cohen 2006). In both the developmental sciences and a developmental psychopathology framework, emotion regulation and its component skills are viewed as basic capacities that can foster either typical and even positive development or

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atypical developmental outcomes, depending on their articulation and other social, dispositional, and biological resources available to the child.

In the first generation of research, prior to the early 1990s, most relevant research involved reports of children's regulatory capacities and its potential correlates, often obtained from the same source/reporter at a single assessment. In contrast, current research on the topic is often multi-method, multi-reporter, and longitudinal in design. In this review, we discuss conceptual issues in thinking about emotion-relevant self-regulation and provide an overview of findings on its relation to children's maladjustment. To provide a context, we also briefly review the development of emotion-related self-regulation and its genetic and socialization correlates. In our review, we focus primarily on studies examining effortful regulatory processes in childhood rather than on research with adults or the large literature on reactive undercontrol (impulsivity or disinhibition) or overcontrol (e.g., behavioral inhibition). In addition, given space constraints and our orientation, we focus more on the developmental research and externalizing and internalizing problems than on specific diagnoses or specific externalizing problems, although there are substantial and rich literatures on control/regulation and some conditions such as attention deficit/hyperactivity disorder (ADHD) (see, for example, Martel et al. 2009, Nigg 2006) and adolescents'/young adults' alcohol and drug abuse. Moreover, in reviewing relevant research, priority generally was given to the inclusion of recent rather than older articles.

Emotion-Related Self-Regulation: Conceptual Issues

Definitions of emotion regulation abound in the developmental literature and are not highly consistent (Cole et al. 2004). Typical examples include the following:

> [T]he intra- and extraorganismic factors by which emotional arousal is redirected, controlled, modulated, and modified to enable an individual to function adaptively in emotionally arousing situations (Cicchetti et al. 1991, p. 15).

> [P]rocesses used to manage and change if, when, and how (e.g., how intensely) one experiences emotions and emotion-related motivational and physiological states, as well as how emotions are expressed behaviorally (Eisenberg et al. 2007a, p. 288).

There is some disagreement regarding whether the same term should include extrinsic as well as intrinsic processes (the former is exemplified by parents helping young children to regulate their emotions; Eisenberg & Spinrad 2004). Investigators also seem to disagree in regard to what extent they view emotion regulation as adaptive (e.g., Kopp & Neufeld 2003) or do not make that assumption (Gross & Thompson 2007).

Eisenberg & Spinrad (2004) argued that although both extrinsic and intrinsic factors are undoubtedly involved in emotion regulation, it is useful to differentiate between regulation that comes from outside the self (e.g., the parent) and self-regulation that involves intrinsic processes. In this review, we focus primarily on emotion-related self-regulatory processes (henceforth called emotion regulation for brevity), as defined above by Eisenberg et al. (2007a). Our definition is consistent with Gross & Thompson's (2007) conceptual discussion in which emotion regulation includes situation selection, situation modification, attentional deployment, cognitive change, and response modulation.

Because it is extremely difficult to differentiate emotionality from its regulation (Cole et al. 2004), we and other investigators often find it useful to focus on the processes involved in emotion regulation rather than on the amount of emotion experienced or expressed (which is why we use the term "emotion-related" regulation rather than emotion regulation). Many of the capacities involved in emotion regulation appear to have a temperamental basis. Temperamental self-regulatory capacities are often labeled as effortful control, 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 2006, p. 129). Effortful control includes the abilities to shift and focus attention as needed (including shifting attention from threatening stimuli/thoughts and focusing on neutral or positive ones), to inhibit inappropriate behavior (i.e., inhibitory control), to activate or perform an action when there is a strong tendency to avoid it (i.e., activation control; Evans & Rothbart 2007, Rothbart et al. 2001), and some executive functioning skills (in addition to executive attention) involved in integrating information and planning. Effortful control is believed to be grounded primarily in processes in the anterior cingulate gyrus and regions of the prefrontal cortex (e.g., Fan et al. 2005, Posner & Rothbart 2007).

As argued by Gross & Thompson (2007), many processes involved in the modulation of emotion undoubtedly are typically automatic, and many of these may be difficult to bring to consciousness or to voluntarily manage. They have chosen to view emotion regulation as a "continuum from conscious, effortful and controlled regulation to unconscious, effortless, and automatic regulation" (Gross & Thompson 2007). Nonetheless, Eisenberg and colleagues (e.g., Eisenberg et al. 2005a, 2009e) have argued that it is useful to differentiate the truly self-regulatory processes involved in effortful control from other aspects of control (or the lack thereof) that seem to be primarily involuntary or so automatic that they are often difficult to bring under voluntary control. This distinction between voluntary and less voluntary control is similar to that made by Carver (2005) in his discussion of constraint and impulse, to Mischel's distinction between cold and hot processing systems (Mischel & Ayduk 2004), and to Rothbart et al.'s (2001) distinction between effortful control and surgency—including impulsivity and approach—versus shyness. Many responses affecting emotion may be automatic but not necessarily uncontrollable (Bargh & Williams 2007); others may not be automatic or, if they are, are subject to effortful control if needed. Just as people do not consciously and effortfully control all their actions when driving a car, they are not always aware of self-regulatory processes. However, if necessary, the automatic action of driving is likely to become more conscious and voluntary. Thus, it is useful to differentiate those behavioral and cognitive/attentional responses that can be effortfully controlled if needed (even if they usually are not) from those that are more difficult to control and to label them differently [Eisenberg & Morris (2002) suggested using the broader term "control" for the inclusive continuum].

Eisenberg and her colleagues (e.g., Eisenberg & Morris 2002, Eisenberg et al. 2004b) have used the term "reactive control processes" to refer to relatively involuntary motivational approach and avoidance systems of response reactivity that, at extreme levels, reflect impulsive undercontrol or rigid overcontrol, respectively [also see Carver's (2005) discussion of impulse versus constraint]. These aspects of responding correspond to the behavioral (rather than emotional) components of temperamental reactivity in Rothbart's temperament theory, but they likely are associated in some ways and in some situations with emotional reactivity (Derryberry & Rothbart 1997). Measures of these constructs typically tap (but are not confined to): (*a*) impulsivity: speed of response initiation (including surgent approach behaviors; see Nigg 2000 for further discussion of related constructs and systems); and (*b*) overcontrol (rigid, inflexible behavior) or behavioral inhibition (slow or inhibited approach, distress, or subdued affect in situations involving novelty or uncertainty; Eisenberg & Morris 2002). These aspects of reactive control overlap conceptually with Gray's (Pickering & Gray 1999) Behavioral Activation System (BAS, which involves sensitivity to cues of reward or cessation of punishment) and Behavioral Inhibition System (BIS, which is activated in situations involving novelty and stimuli signaling punishment or frustrative nonreward). These aspects of functioning clearly affect emotion and behavior in some contexts, albeit often in nonoptimal and somewhat inflexible ways. However, both impulsivity and behavioral inhibition may have some advantages at some ages or in some

contexts; for example, some impulsivity has been positively associated with ego resiliency in children, likely because rigid, overly controlled behavior is not conducive to approaching new toys and people and spontaneous social interactions (Eisenberg et al. 2002). Similarly, an inhibited style (e.g., slow approach to new objects) may be associated with more anticipatory attention in infancy (which is linked to self-soothing regulatory activities; Sheese et al. 2008), and the fear associated with such inhibition has been linked to higher levels of effortful inhibitory control in young children (Aksan & Kochanska 2004). Moreover, automatic, unconscious, and uncontrolled responding to emotion-relevant stimuli or cognitions sometimes may be more reliable and effective than more conscious responses (Bargh & Williams 2007). However, most psychological research on actual unconscious emotion-regulation responses has been conducted with adult study participants, probably because of the nature of the experimental requirements, so relatively little is known about the adaptive value of the automatic, unconscious control-related reactions of children.

Pickering & Gray (1999), among others (e.g., Nigg 2000), have argued that approach and avoidance motivational systems related to impulsive and overly inhibited behaviors, respectively, are centered in subcortical systems such as Gray's BIS and BAS. Even if these subcortical bases are intimately associated in complex ways with cortical functioning (see Goldsmith et al. 2008, Ochsner & Gross 2007), the neural bases of these systems appear to be somewhat different from those involved in effortful control.

Empirical data support the distinction between effortful/voluntary and reactive control processes. In research on children's temperament, reactive overcontrol and/or undercontrol appears to load on a different factor in confirmatory factor analyses than does either effortful control or negative emotionality (e.g., Rothbart et al. 2001). Similarly, Eisenberg et al. (2004b) and Valiente et al. (2003), with different samples of children, have obtained separate (albeit negatively correlated) latent constructs for effortful and reactive control. Moreover, the distinction between voluntary, effortful self-regulation and less voluntarily regulated responding has proved useful when predicting maladjustment (e.g., often each provides some unique prediction of maladjustment; see below).

THE DEVELOPMENT OF EMOTION REGULATION

Changes in regulation and effortful control are evident in the first few years of life. Kopp & Neufeld (2003) suggested a shift over time from external to internal sources of control. Children are viewed as progressing from simple modulation of arousal (either reflexively as newborns or by using sensorimotor abilities in early infancy) to behavioral control in which children are able to regulate their behavior without external monitoring. Thus, young infants are thought to rely almost exclusively on caregivers to regulate their emotions and gradually, over time in the first years of life, to learn how to calm themselves (i.e., self-regulation). Moreover, Kopp and Neufield suggested that these changes occur in concert with motor and cognitive maturation (e.g., goal-directed behavior, representational thinking).

Various modes of early regulation have been found to reduce distress in young children. For example, self-soothing behaviors, such as thumb sucking, have been found to reduce negativity in response to frustrating events at 5 and 10 months of age (Stifter & Braungart 1995). The ability to disengage gaze from a stimulus also appears to serve a regulatory function in young infants (Crockenberg & Leerkes 2004), and a similar strategy, reorienting attention, appears to be effective for toddlers (Grolnick et al. 1996). The orienting network appears early in development and may serve as the primary regulatory system until the executive network is more fully developed (Posner & Rothbart 2007). Consistent with this idea, positive affect during infancy has a substantial correlation with the duration of orienting of attention (Putnam et al. 2008). In terms of development, Braungart-Rieker &

Stifter (1996) found increases in children's communication and decreases in avoidance between 5 and 10 months of age in response to a frustrating arm-restraint procedure, suggesting a more sophisticated means of regulation with age.

Researchers also have noted that effortful control processes and executive functioning (rather than specific reactions to distress) appear to increase with age. One important aspect of effortful control involves the ability to focus attention. Focused attention is marked by sustained and active engagement with a stimulus or task (Ruff & Rothbart 1996). Infants demonstrate the capacity to sustain attention by 8 to 10 months of age (Kochanska et al. 1998), and between 9 and 18 months of age, attention is thought to become more voluntary (Ruff & Rothbart 1996). During the toddler and preschool years, children show increased levels of sustained attention and are able to concentrate for longer periods (Kannass et al. 2006, Ruff & Capozzoli 2003).

Infants and preschoolers improve in a variety of aspects of executive functioning that are part of, or related to, effortful control (see also Garon et al. 2008). Diamond (1991), for example, has shown that around 12 months of age, infants are able to reach for a target not in their line of sight, demonstrating that they are able to coordinate reach and vision and attend to both. This ability is believed to involve the execution of intentional behavior and planning and the resistance of more automatic action tendencies (Diamond 2002). Additional measures of rudimentary executive functioning also have been developed, including the use of visual sequence tasks to assess anticipatory looking. Anticipatory looking refers to the act of looking to the location of a target prior to its appearance in that location. Sheese et al. (2008) found that anticipatory looking was observable in infancy (6- and 7-month-olds) and was related to more cautious responses to novelty. In addition, Rothbart et al. (2003) found that anticipatory looking in 24- and 30-month-old children was related to better conflict resolution in a visual spatial-conflict task and to parents' reports of children's effortful control.

According to Posner & Rothbart (1998), another transition in the development of executive attention (and inhibition of related behavior) can be seen around 30 months of age. Researchers have measured executive attention and effortful inhibition of behavior using a Stroop-like task that requires toddlers to switch attention and inhibit behavior accordingly. Posner & Rothbart (1998) reported that children showed significant improvement in performance on this task by 30 months of age and performed with high accuracy by 36 to 38 months of age. Moreover, toddlers' ability on this sort of task was positively related to parents' ratings of attention-shifting abilities (Gerardi-Caulton 2000).

Another component of effortful control is the ability to effortfully inhibit behavior upon command (inhibitory control). This skill is not very evident until 24 to 36 months of age (Gerardi-Caulton 2000). Kochanska et al. (2000) developed a comprehensive battery of effortful control tasks designed to measure five components of effortful control: delaying, slowing down motor activity, suppressing or initiating activity to signal, lowering voice, and effortful attention. Using longitudinal data, they demonstrated that there are significant gains in effortful control between 22 and 33 months of age. Other researchers have shown that the ability to effortfully inhibit behavior on tasks such as "Simon Says" appears to improve between 36 and 48 months of age, with the most marked improvements between 36 and 41 months (Jones et al. 2003, Posner & Rothbart 1998, Reed et al. 1984).

Among the many tasks to measure inhibitory control in children, the ability to delay gratification has been used extensively and can be measured at relatively young ages. In such tasks, children typically are asked to delay eating a desirable food until signaled or are given a choice of receiving a small reward immediately or waiting to receive a larger

reward. Increases in length of time children can wait for a treat are evident from age 24 months to 4 years (Carlson 2005, Kochanska et al. 2000, Li-Grining 2007). Because delay tasks offer a reward, researchers have argued that this task may tap both effortful and reactive control (Eisenberg & Spinrad 2004), although Spinrad et al. (2007) found that delay abilities loaded with adults' reports of effortful control on a latent factor at 18 and 30 months of age, and delay tasks have been used as indicators of effortful control in Kochanska's full battery of tasks (Kochanska & Knaack 2003, Kochanska et al. 2000).

Further improvements in effortful control/executive functioning occur in late preschool (e.g., Mezzacappa 2004). For example, researchers have found improvements in children's responses to the day-night task between age 3.5 and 7 years (Diamond et al. 1997), in which children are required to say "day" when the experimenter holds up a black card with stars and to say "night" when the experimenter holds up a white card with a bright sun. Similarly, Diamond & Taylor (1996) found increases in correct responses to Luria's peg-tapping task with age, particularly between 3.5 and 4 years of age, in which children have to inhibit the tendency to imitate the experimenter by tapping twice when the experimenter taps once and vice versa. On a flanker task, children's ability to manage their attention and integrate information regarding where to look (and minimize the effect of conflicting cues) improved until age 7 (Rueda et al. 2004). Using a battery of 17 executive functioning tasks collected across 9 studies, Carlson (2005) found an increase in performance between 3 and 5 years of age on the majority of the tasks.

Moreover, effortful control continues to improve in the school years and may even continue to develop at a slower pace into adulthood (Leon-Carrion et al. 2004, Murphy et al. 1999, Rueda et al. 2004), although improvement on one measure of executive attention increased until age 7 but not from age 8 to adulthood (Rueda et al. 2004). Crone et al. (2006) noted improvement in perseveration and distraction errors during task shifting from age 8–10 years through age 12–14 years or 16–18 years, respectively (also see Crone et al. 2004). In a study of change across the lifespan, Williams and colleagues (1999) found the speed of inhibitory process during a stop-signal procedure became faster (and more effective) throughout childhood (between 6–8 years and 9–12 years), but there was little change throughout adulthood.

STABILITY OF EMOTION REGULATION/EFFORTFUL CONTROL

Interestingly, there are relatively few data on the stability of effortful control in the early years of life. Stability of attention span has been observed in young toddlers, and parents' ratings of duration of orienting and attentional focusing have been substantially correlated across infancy and toddlerhood (Gaertner et al. 2008, Putnam et al. 2008), although Putnam et al. (2008) found that the relation of orienting in infancy with effortful control at age 2 was not significant. Notably, Kannass et al. (2006) found consistency in attention across two different tasks at 31 months of age and moderate stability in attention between 9 and 31 months but not between 7 and 31 months, suggesting that shifts in developing attentional systems may be occurring between 7 and 9 months.

Individual differences in the broader construct of effortful control are also relatively stable in the early years. Kochanska and colleagues found that effortful control observed at 22 months substantially predicted effortful control at both 33 (Kochanska et al. 2000) and 45 months (Kochanska & Knaack 2003; also see Li-Grining 2007, Spinrad et al. 2007). Moreover, early focused attention has been shown to predict later effortful control (Kochanska et al. 2000).

Stability in effortful control from early childhood to adolescence also has been documented. Teachers' and parents' reports of aspects of effortful control have been found to be relatively stable over four, or sometimes six, years during childhood (especially for attention focusing and inhibitory control; less so for attention shifting; Eisenberg et al. 2005b, Murphy et al. 1999, Valiente et al. 2006). According to Kochanska et al. (2000), the robust stability findings in their work indicate a trait-like quality of effortful control and support Rothbart & Bates' (2006) view of effortful control as a temperamental characteristic.

RELATIONS BETWEEN EMOTION REGULATION/EFFORTFUL CONTROL AND ADJUSTMENT PROBLEMS

Emotion self-regulation frequently has been examined as a correlate of both externalizing and internalizing problems.

Emotion Regulation and Externalizing Problems

Because of the role of effortful control and related skills in the regulation of emotion and behavior, effortful control has been linked conceptually to the development and maintenance of children's externalizing problems (e.g., aggression, defiance, delinquency). Effortful control is believed to affect maladjustment by contributing to the processing of information relevant to adaptive functioning, as well as to the modulation of emotional experience and behavior.

Conceptual arguments—There likely are multiple pathways to externalizing problems, and deficits in self-regulation are hypothesized to play a major role in some pathways and not (or to a lesser degree) in others. For example, Nigg (2006) argued that conduct disorder involves at least two different temperamental pathways. One is based on a low fear response and low affiliation (resulting in low empathy and sympathy), often accompanied by impulsivity (low reactive control), and sometimes emanating from psychopathy. Physiological arousability to potential punishment in these individuals is weak, which makes efforts to socialize the child difficult. The second pathway leading to impulsive conduct problems involves extreme levels of approach (e.g., to incentives), especially if combined with average to high negative emotionality and average or lower levels of reactive and effortful control. Nigg (2006) further suggested that ADHD also has at least two temperament pathways, one involving very low levels of effortful control (often co-occurring with high emotionality) and another involving strong approach.

Frick & Morris (2004), in a review of the relevant literature, argued that deficits in self-regulation are associated with reactive, emotionally driven conduct problems (e.g., reactive aggression) but are unlikely to be involved in covert externalizing problems (e.g., stealing) and proactive externalizing problems (e.g., unprovoked, unemotional aggression that is used for personal gain or to influence and coerce others). Children in the former group are prone to negative emotion and difficulties in regulating such emotion and in inhibiting their behavior when emotionally aroused. Their emotion dysregulation can impair the development and use of social cognition involved in information processing (Frick & Morris 2004) and undermine the quality of socializing interactions with parents and peers. In contrast to children prone to emotionally driven externalizing problems, Frick & Morris (2004) argued that children prone to proactive aggression, including those with callous-unemotional (psychopathic) traits, are low in their fearful inhibition, which undermines the development of conscience, but do not exhibit consistent problems with self-regulatory processes.

Consistent with the arguments of Frick & Morris (2004), research supports the prediction that reactive aggression is associated with higher cortisol reactivity than is proactive aggression (or low aggression; Lopez-Duran et al. 2009) and that reactive aggression but not proactive aggression is associated with anger (e.g., de Castro et al. 2005, Hubbard et al. 2002, Marsee & Frick 2007). In contrast, findings regarding the relations of self-regulation to proactive and reactive aggression are not as consistent with the predictions of Frick and Morris. Marsee & Frick (2007) found that reactive aggression was uniquely associated with poor emotion regulation when controlling for proactive aggression but not in the zero-order correlation. In addition, Xu et al. (2009) and de Castro et al. (2005) found that reactive and proactive aggressions were similarly negatively related to effortful control. Perhaps different aspects of self-regulation (e.g., regulation of emotional experience versus behavior) are associated with the two types of aggression, but the measures of regulation have not been sufficiently differentiated.

Empirical relations with reported or behavioral measures of self-regulation— More generally, measures of self-regulation (including effortful control) have been fairly consistently negatively related to externalizing problems, even in studies using multiple reporters and/or methods of assessing self-regulation and/or externalizing problems. This association is evident even in the toddler and preschool years (Eiden et al. 2009, Hill et al. 2006, Kochanska et al. 2008, Olson et al. 2005, Raaijmakers et al. 2008, Rydell et al. 2003, Spinrad et al. 2007), albeit sometimes for some types of externalizing problems but not others (e.g., Murray & Kochanska 2002, Olson et al. 2005). Similarly, low levels of executive functioning have been linked to preschoolers' externalizing problems (e.g., Hughes & Ensor 2008).

A more stringent test of the potential causal role of self-regulation in externalizing problems involves examining the relation across time while controlling for initial levels of the constructs. Eiden et al. (2007) found that self-regulation at age 3 predicted concurrent problem behaviors and externalizing problems in kindergarten, even when controlling for stability in problem behaviors. However, although Eisenberg et al. (2009c) found that effortful control and externalizing problem behaviors were consistently inversely related at 18, 30, and 42 months of age, they found no evidence that effortful control had a causal relation with later externalizing once stability of the constructs was controlled in a panel structural equation model. In that panel design, externalizing problems at 30 months predicted lower effortful control at 42 months, suggesting that externalizing problems might lead to declines (or less improvement) in self-regulation.

Consistent with the bulk of the research with very young children, the inverse relation of self-regulation/effortful control with externalizing problems (including ADHD) also has been found in numerous studies of school-aged children and adolescents (e.g., Eisenberg et al. 2004b, 2009b; Gardner et al. 2008; Lengua 2008; Martel et al. 2009; see Eisenberg et al. 2000 for a review of earlier studies). Borderline and clinical levels of externalizing problems have been consistently related with low levels of effortful control when investigators have examined both externalizing problems that co-occur with internalizing problems and those that do not (Eisenberg et al. 2009e). Of note, relations of behavioral tasks of self-regulation, especially those that tap components of executive functioning, tend to be less consistently related to externalizing problems than are self- or other-report indices of self-regulation/ effortful control (e.g., Eisenberg et al. 2005a, Lengua 2003, Muris et al. 2008), albeit such relations sometimes have been significant (e.g., Eisenberg et al. 2001a, Lengua 2008, Olson et al. 2005), especially in the early years (Belsky et al. 2007, Kochanska & Knaack 2003).

Unlike Eisenberg et al.'s (2009c) findings for toddlers/preschoolers, this inverse relation has been found across time in studies of children aged 54 months or older in which the stability

of relations over time were taken into account; these findings suggest that change in self-regulation is associated with change in the level of children's externalizing problems (e.g., Eisenberg et al. 2005b, Kim & Brody 2005, Valiente et al. 2006; also see Lengua 2008, who controlled for stability of externalizing problems). For example, using the large National Institute of Child Health and Development child care study sample and a panel structural equation model (including paths for across-time stability of constructs), Belsky et al. (2007) found consistent evidence that children's attentional regulation at 54 months, grade 1, and grade 5 predicted externalizing problems at the next assessment.

Moreover, externalizing problems have been associated with various aspects of self-regulation. Specifically, attentional regulation and inhibitory control have been inversely related to externalizing problems both in the toddler and preschool years (Hill et al. 2006, Lemery et al. 2002, Lengua 2003, Spinrad et al. 2007) and the elementary and junior high school years (Belsky et al. 2007; Eisenberg et al. 2005a, 2009e; also see Martel & Nigg 2006). The relation of attentional control with externalizing problems appears to emerge very early in life; Crockenberg et al. (2008) found that 6-month-olds' attention to frustrating events was positively related to aggression at age 2.5 years, whereas looking away from frustrating events was associated with less aggression for girls.

In addition, the ability to explicitly modulate emotion has been negatively related to externalizing problems, both early in life (Hill et al. 2006) and in the early school years (Rydell et al. 2003). Oosterlaan et al. (2005) found that planning, considered an aspect of effortful control, also was inversely related to elementary school children's ADHD [independent of oppositional defiant disorder/conduct disorder (ODD/CD)]; ODD/CD was not related to planning or other deficits in executive functioning. Although Oosterlaan et al. (2005) argued that their findings support the conclusion that comorbid ADHD accounts for the deficits in executive functioning in ODD/CD children, they did not examine deficits in response inhibition, which are more likely to relate to ODD/CD.

Although many of the aforementioned studies on the relation of self-regulation/effortful control and externalizing problems have been conducted in the United States, inverse relations between self-regulation and externalizing problems have been obtained in numerous countries, including Western Europe (e.g., Hofer et al. 2009, Muris 2006, Oldehinkel et al. 2007, Rydell et al. 2003), New Zealand (e.g., Caspi 1998), China (Eisenberg et al. 2007b, Xu et al. 2009, Zhou et al. 2008), Turkey (Batum & Yagmurlu 2007), and Indonesia (Eisenberg et al. 2001c, 2004a). In one study that compared the degree of relation, Zhou et al. (2009) found that effortful control was negatively related to externalizing problems in both the United States and in China, but the relation was stronger in China.

Supporting the distinction between reactive and effortful control, both constructs provide some unique prediction of younger children's externalizing problems (Eisenberg et al. 2005a, Valiente et al. 2003). However, Eisenberg et al. (2004b) found that by mid to late childhood, the relation of reactive control dropped to marginal significance or was nonsignificant when children's effortful control was also used to predict externalizing problems (also see Valiente et al. 2003). In contrast, in a larger sample including more high-risk youths, Martel et al. (2007) found that early reactive undercontrol and poor response inhibition provided unique prediction of externalizing problems in adolescence.

Children's negative emotionality has been found to moderate the degree of relation between self-regulation/effortful control and children's externalizing problems. In general, school-age children and adolescents appear to be more at risk if they are prone to negative emotion intensity (Degnan et al. 2008, Valiente et al. 2003; see Eisenberg et al. 2000) or neuroticism

(Muris 2006), and especially anger or frustration (rather than sadness or fear; Diener & Kim 2004; Eisenberg et al. 2004b, 2007b; Oldehinkel et al. 2007), and are also low in effortful control (contrast with Eisenberg et al. 2001a and Martel & Nigg 2006, in a study of ADHD); put differently, self-regulation is more strongly related to externalizing for children high in negative emotionality. However, this sort of interaction has not been found in studies of infants (Belsky et al. 2001) or 3-year-olds (Olson et al. 2005), suggesting that it may emerge with the development of self-regulation or more severe externalizing problems.

Empirical relations with physiological measures of self-regulation—Research with measures believed to tap neurological/physiological self-regulation also support the role of self-regulation in at least some forms of externalizing problems. For example, Crowe & Blair (2008) argued, based on functional neuroimaging findings, that a dysfunction in the frontal cortex regulatory system is associated with reactive (i.e., unplanned, emotionally driven) aggression and the co-occurrence of CD with ODD.

Cardiac vagal regulation, often assessed with measures of respiratory sinus arrhythmia (RSA) and RSA reactivity (RSA or vagal suppression—the decline from baseline in RSA during challenging/stressful situations), is viewed as a marker of parasympathetic-based physiological regulation (especially for suppression; see Beauchaine 2001, 2009; Beauchaine et al. 2007). Consistent with this view, Blandon et al. (2008) found an association of vagal suppression with an increase in emotion regulation over time. Some researchers have found that externalizing problems are associated with low levels of vagal suppression (Beauchaine et al. 2007, Calkins & Keane 2004, Degnan et al. 2008, for children high in observed reactivity or with mothers high in strictness/punativeness). However, others have found that externalizing problems are positively related to RSA (Dietrich et al. 2007), that there is little direct, linear relation (El-Sheikh et al. 2009), or that the findings vary depending upon the comorbidity of externalizing problems with internalizing problems (Calkins et al. 2007).

The complex pattern between RSA measures and externalizing problems is likely due to several factors. First, high vagal suppression interacts with stressful family environments when predicting children's adjustment or maladjustment. For example, El-Sheikh (2001) found that parental problem drinking was associated with internalizing, externalizing, and social problems for children with low, but not high, vagal suppression (also see El-Sheikh et al. 2009). In addition, Beauchaine (2009) noted that the pattern of findings appears to differ for children who are in relatively representative samples and children who are at risk. Moreover, Beauchaine (2001, 2009) argued that moderate levels of RSA suppression during attention-demanding tasks are adaptive, whereas large reductions in RSA are a marker of emotion dysregulation. He proposed that excessive vagal withdrawal is a marker of emotional lability and a flight/fight response for children prone to anxiety (Beauchaine 2001). Furthermore, relations between RSA responding and externalizing problems may vary with age. For example, Beauchaine et al. (2007) found that the association between inadequate vagal modulation and externalizing problems held for school children and adolescents but not preschoolers.

Recent findings suggest that the coordination of the sympathetic and parasympathetic nervous system functioning is predictive of maladjustment. Across three studies, El-Sheikh et al. (2009) examined whether RSA [reflecting primarily parasympathetic responding (PNS)] and skin conductance [a marker of sympathetic nervous system (SNS) responding] moderated the relation of exposure to marital conflict to externalizing problem behaviors. In general, they found that children with high RSA (baseline and/or suppression) and low SNS responding, or high SNS and low PNS (vagal) regulation, seemed to be somewhat protected from the effects of marital conflict. El-Sheikh et al. (2009) argued that opposing action of

the PNS and SNS systems (both being high or both being low) conferred greater vulnerability for externalizing problems, whereas reciprocal action operated as a protective factor (see El-Sheikh et al. 2009 as well as Beauchaine 2009 for more discussion of the possible reasons for the pattern of relations). Given the apparent role of RSA/vagal responding in self-regulation, these findings indicate that self-regulation moderates the relation of stressors to externalizing problems, but that effective vagal modulation must be considered in the context of individual differences in SNS responding as well as the social context.

Emotion Regulation and Internalizing Problems

Internalizing is a class of emotion/behavior problems such as anxiety, depression, withdrawal, and somatic complaints. Aspects of self-regulation have been theoretically related to internalizing. Indeed, children with internalizing problems have been referred to as overcontrolled, but the relation between control and internalizing is not straightforward. Children with internalizing problems may appear to be overcontrolled in that their overt behavior is inhibited or rigid. However, we have argued that this type of overcontrol is not volitional but instead is reactive (see Eisenberg et al. 2002).

Conceptual arguments—Researchers have hypothesized that there is an inverse relation between internalizing problems and effortful control or emotion regulation capabilities. Internalizing problems involve difficulty controlling attention, cognition, and emotion, for example, rumination (e.g., Garnefski et al. 2005) and, when severe, may be associated with an attentional bias toward negative stimuli (e.g., Waters et al. 2008). Regulation of affect seems particularly important for children with internalizing problems because negative affect is highly associated with these problems (e.g., Carver et al. 2008; see Yap et al. 2007). Attentional control may reduce bias toward negative/threatening stimuli for children prone to negative affectivity (e.g., Derryberry & Rothbart 1997) and may facilitate moving attention from negative to neutral or positive thoughts. Furthermore, attentional control may contribute to the quality of social interactions, which is especially relevant to internalizing problems involving withdrawal (e.g., Eisenberg et al. 1998b, 2001a). Carver et al. (2008) also suggested that low effortful control could be detrimental for people vulnerable to depression because they might have difficulty overcoming their lack of approach motivation.

Inhibitory control may be less conceptually related to internalizing than are other components of effortful control, particularly when assessed as inhibition of motor behavior. Nonetheless, children with internalizing problems may have difficulty inhibiting thoughts (e.g., rumination). In addition, children with comorbid internalizing/externalizing problems may demonstrate lower inhibitory control because lack of inhibitory control has been associated with externalizing problems. Indeed, in many studies in which relations between effortful control and internalizing problems have been assessed, co-occurring externalizing problems may artificially inflate the inverse relations with effortful control. Eisenberg and colleagues have found a greater number of relations between aspects of effortful control and internalizing when children with comorbid externalizing problems were included versus differentiated from children with pure internalizing problems (compare findings for Eisenberg et al. 2004b, 2005a).

Empirical relations—Children's self-regulation often has been negatively related with concurrent and/or later internalizing problems in at-risk and typical samples. For example, premature children's neonatal vagal tone (a physiological measure thought to support regulation), observed emotion regulation during the first year of life, and observed attentional control during the second year of life negatively predicted mother-reported

behavior problems (internalizing and externalizing) at 5 years of age (Feldman 2009). Dennis et al. (2007) found that effortful control (observed suppressing/initiating behavior) was negatively related to internalizing for at-risk 4-year-olds but not 5- and 6-year-olds (also see Silk et al. 2006a). In addition, Buckner et al. (2009) reported that low-income 8- to 18-year-olds with high (rather than low) self-regulation had fewer concurrent depressive and anxiety symptoms. Internalizing also has been negatively correlated with parent-reported effortful control and observed attentional control during middle childhood (Lemery-Chalfant et al. 2008). In addition, Lengua (2006) reported that growth over two years in effortful control (assessed at 8–12 years, 9–13 years, 10–14 years) was negatively related to internalizing when children were 10–14 years old.

Scholars have suggested that item-content overlap in questionnaires assessing aspects of temperament and psychopathology may increase associations and have used approaches such as removing problematic items to remedy the issue of measurement confounding (e.g., Eisenberg et al. 2005a, Lemery et al. 2002, Lengua et al. 1998). For example, Lemery et al. (2002) used expert raters in one study and a factor analysis method in another study to identify problematic items on temperament and problem-behavior questionnaires. The two methods yielded different solutions in terms of which items were confounded. Nonetheless, correlations with purified measures suggested that attention focus and inhibitory control (averaged across age 3.5 and 4.5 years) were negatively related to internalizing at 5.5 years (see also Lengua et al. 1998). Thus, even when overlapping items were removed, aspects of effortful control were negatively related to internalizing problems.

Eisenberg, Spinrad, and colleagues have found numerous relations between effortful control and internalizing, especially when examining measures of internalizing that do not take into account co-occurring externalizing. For example, Spinrad et al. (2007) found that effortful control was negatively related to separation distress at both 18 and 30 months. However, 18-month effortful control did not relate to 30-month separation distress when controlling for stability in separation distress. In a study involving three time points—T2 (6.5–10 years), T3 (two years after T2), and T4 (four years after T2)—Valiente et al. (2006) found that T2 effortful control did not predict T3 internalizing after controlling for T2 internalizing. However, T3 effortful control negatively predicted T4 teacher-reported but not mother-reported internalizing when controlling for earlier effortful control and internalizing (data from the earlier time point are discussed below; see also Lengua 2008).

Positive relations between effortful control and internalizing problems also have been found, mostly early in life. Murray & Kochanska (2002) found that preschoolers with high as opposed to moderate observed effortful control scores (average of toddler, preschool age, and early school age scores) had higher mother-reported internalizing. The authors noted that severe internalizing problems were infrequent in that sample (two children had clinical-range scores). Moderate internalizing symptoms may relate differently to effortful control than do higher levels; moreover, it is possible that internalizing relates differently to effortful control early in life. Thus, the literature contains varying reports of relations between self-regulation and internalizing; however, significant relations obtained between effortful control and internalizing most often have been negative and appear to vary with age.

Effortful control abilities may allow for flexible, adaptive behavior when faced with challenging situations and, thus, prevent internalizing problems. Indeed, Eisenberg and colleagues have found that ego resiliency mediates the relation between effortful control and internalizing. Using the same sample as Valiente et al. (2006), ego resiliency mediated negative relations between effortful control and internalizing (better effortful control → resiliency → low internalizing problems) at 4.5 to 8 years (T1) and two years later (T2; even

when controlling for stability in variables from T1 to T2; Eisenberg et al. 2004b). In a French sample, the relation between adolescents' effortful control and internalizing also was mediated by ego resiliency (Hofer et al. 2009).

Effortful control may be particularly important for regulating internalizing problems for children who are prone to negative emotion. In some cases, effortful control has been found to moderate relations between negative emotionality and internalizing (but see Eisenberg et al. 2004b). For example, the relation between preadolescents' fear and later internalizing has been found to be weaker for preadolescents with higher effortful control (Oldehinkel et al. 2007). In a study of Chinese elementary school children, anger sometimes interacted with children's inhibitory control: Inhibitory control was associated with nondisordered (versus pure internalizing) status regardless of the level of children's anger, but this relation was stronger when children were lower in anger (Eisenberg et al. 2007b).

As discussed above, components of effortful control may relate in differing ways to internalizing problems. The expected negative relations between attentional control and internalizing sometimes have been found (e.g., Derryberry & Reed 2002; see Carver et al. 2008 for a review). For example, Eisenberg et al. (2001a) found that children with pure internalizing had lower attention shifting and focusing than did control nondisordered children at 55 to 97 months but not two or four years later (Eisenberg et al. 2005a, 2009e). Negative relations also have been found between parent-rated attention focusing and pure internalizing in Chinese first-and second-graders (Eisenberg et al. 2007b).

Attentional control appears to be negatively related to specific aspects of internalizing, including withdrawal and anxiety/depression. Using the same sample as Eisenberg et al. (2001a) and using adults' reports, Eggum et al. (2009) found that attentional control predicted different trajectories of withdrawal over time. Among other findings, low attentional control was related to withdrawal that was high at 55 to 97 months and declined over the next six years (as opposed to withdrawal that was initially low and either declining or stable). Furthermore, early adolescents' low attentional control has been related to anxiety/depression using self-reports (Muris et al. 2006, 2007). The relation may be more robust when reported rather than observed measures of attentional control are used (Muris et al. 2008).

In contrast to attentional control, inhibitory control is conceptually less related to internalizing, and empirical relations have been inconsistent across studies. Some researchers have found negative relations between inhibitory control and internalizing. For example, inhibitory control has been negatively related to first- and second-graders' internalizing two years later (Riggs et al. 2003; also see Lengua 2003). Similarly, Chinese first- and second-graders with pure (noncomorbid) internalizing problems were lower than control children in inhibitory control (Eisenberg et al. 2007b). In contrast, Spinrad et al. (2007) found that toddlers' inhibitory control (but not attentional control) sometimes was positively related to inhibition to novelty. Aksan & Kochanska (2004) argued that reactive inhibition to novelty, which often is viewed as an early internalizing problem, decreases the speed of approach responses during the early course of life, which in turn facilitates the emerging capacity for effortful inhibitory control. In correlations, they found that fearfulness in novel contexts, but not inhibition, was related to higher effortful inhibitory control in toddlerhood. Other researchers have found that internalizing and control children do not differ in inhibitory control or that inhibitory control accounts for little variance in internalizing problems. For instance, children with pure internalizing were similar to control children in inhibitory control at 55 to 97 months (Eisenberg et al. 2001a) and also two and four years later (Eisenberg et al. 2005a, 2009e). Furthermore, Martel et al. (2007), with a high-risk sample, found low observed response inhibition during adolescence accounted for

little variance in internalizing beyond that accounted for by resiliency and reactive control (during adolescence) when controlling for childhood internalizing problems.

In summary, results from many studies in which relations between self-regulation and internalizing have been examined suggest that they are negatively related. In some cases, relations have not held when controlling for stability in internalizing and/or regulation. When attentional control and inhibitory control have been examined separately (not combined), attentional control and internalizing generally have been negatively related. In contrast, inhibitory control and internalizing are inconsistently related, and relations may vary with age. Furthermore, resiliency has been found to mediate relations between effortful control and internalizing.

THE GENETIC BASES OF SELF-REGULATORY CAPACITIES

Both behavioral genetics research and molecular genetics research support the assertion that effortful control and self-regulation more generally have a hereditary basis. On the basis of eight twin studies, Goldsmith et al. (2008) concluded, “individual differences in childhood effortful control are at least moderately heritable” (Goldsmith et al. 2008, p. 133; also see Young et al. 2009). They further concluded that individual differences in emotion regulation on parent-report questionnaires were clearly heritable, and laboratory and observer-based measures appear to be heritable; nonetheless, the data were viewed as “fully compatible with developmental plasticity of ER [emotion regulation] systems” (p. 133).

Of particular relevance to this review, Lemery-Chalfant et al. (2008) found that shared additive genetic influence accounted for the covariation between self-regulation (effortful control) and symptoms of psychopathology. Similarly, with a twin study, Young et al. (2009) found that the association between response inhibition [on executive functioning tasks that likely tapped both response inhibition (stop-go task) and attentional control on tasks (Stroop and antisaccade tasks)] and 12- and 17-year-olds’ behavioral disinhibition (defined as substance use, conduct disorder, ADHD, and novelty seeking) was primarily genetic in origin (the correlation between the genetic influence on behavioral disinhibition and on response inhibition was approximately −0.60 at both ages). Lemery-Chalfant et al. (2008) argued that their results suggest that environmental factors might moderate, but are unlikely to mediate, the relations of effortful control to psychopathology.

Consistent with the behavioral genetic studies, effortful control and executive functioning have been associated with variation in specific candidate genes that affect synaptic availability of neurotransmitters (serotonin or dopamine; see Posner et al. 2007). Among the genes implicated are monoamine oxidase A (MAOA) and dopamine receptor genes (e.g., DRD2 and DRD4; Fossella et al. 2002, Propper et al. 2008), as well as catechol-o-methyltransferase (COMT) in some studies (Blasi et al. 2005, Heinz & Smolka 2006). In a small sample of 2-year-olds, a COMT haplotype, but not the simple genotype, had a direct relation with anticipatory attention, with Valine relating to better performance (Voelker et al. 2009), although it was unrelated to parent-reported orienting and effortful control in the first or second year of life, respectively (Sheese et al. 2009). DAT1 (a dopamine transporter) and DRD4 (a dopamine receptor) also have been linked to ADHD (Brookes et al. 2006). 5-HT (involved in serotonergic activity) has been implicated in cognitive attentional control (Canli et al. 2005, Oades et al. 2008, albeit labeled impulsivity). Moreover, Sheese et al. (2009) found that a polymorphism of the CHRNA4 gene that indirectly modulates dopamine neurotransmission was associated with effortful control in the second year of life in a small sample (although this relation was only marginally significant for attention focusing and attention shifting and was significant for cuddliness, which loaded on the effortful control composite used in some analyses). Although the data are sometimes inconsistent or

complicated and effects usually are small, these findings support the role of heredity in self-regulation. Part of the reason for small effects may be that these relations change with age and there are gene × gene (G × G) interactions when predicting regulation and problem behaviors (Voelker et al. 2009).

Initial research indicates that self-regulation also is predicted by gene × environment (G × E) interactions. Researchers examining G × E interactions sometimes have targeted a polymorphism in the serotonin (5-HT) transporter gene-regulatory region (5-HTTLPR). (Serotonin is an inhibitory neurotransmitter.) Individuals with one or two short (*s*) rather than long (*l*) alleles develop problems if they also experience suboptimal and/or stressful environments. Suomi and collaborators have repeatedly found that monkeys with a *s* allele exhibit a variety of problems indicative of deficits in self-regulation and/or reactive control (e.g., impulsivity, inappropriate aggression, orienting problems, alcohol consumption), but only if they had experienced a separation from their mothers. For monkeys raised in more normal, supportive relationships with their mothers, there was no effect of the *s* genotype (Suomi 2009). For example, Champoux et al. (2002) found that infant monkeys with the *ls* allele who were being reared in the laboratory neonatal nursery exhibited deficits in attention, activity, and motor maturity relative to nursery-reared infants possessing the *ll* allele, whereas both *ls* and *ll* infants being reared by competent mothers were normal on these aspects of functioning. Similarly, Kochanska et al. (2009) found that among children with a short 5-HTTLPR allele (*ss*/*sl*), those who were insecurely attached developed poor regulatory capacities (aggregated across behavioral assessments at 25, 38, and 52 months), whereas those who were securely attached did not differ in regulatory capacities from children homozygotic for the long allele (*ll*) (and there was no effect of attachment security for *ll* homozygotes).

Voelker et al. (2009) examined the interaction of COMT genotypes and haplotypes with the general quality of observed parenting. They found that a commonly examined genotype of COMT (Valine present) was associated with an advantage in anticipatory looking (viewed as involving effortful control) when parenting quality was high. A similar pattern of findings was also found for a COMT haplotype. Sheese et al. (2007) examined G × E interactions when predicting effortful control and high approach tendencies (a composite of impulsivity, activity level, and high-intensity pleasure) from a common allelic variation in the dopamine receptor D4 (DRD4) gene and caregiver quality in interactions at 18–21 months of age. For children with the 7-repeat DRD4 allele, lower-quality parenting was associated with higher levels of sensation seeking; for children without the 7-repeat allele, temperament was not related to parenting quality. Differences between alleles were not related to the children's effortful control. Thus, this allele seemed more closely associated with impulsivity than effortful control.

In summary, it appears that self-regulatory capacities have a substantial heritable component and that some specific genes likely are involved in individual differences in these abilities and responses. In addition, it is likely that environmental factors may moderate the effects of these genes, although research on this topic is in its infancy.

SOCIALIZATION AND EMOTION REGULATION

Although effortful control is considered a construct of temperament, the environment also plays a role in the development of emotion regulation/effortful control (Rothbart & Bates 2006). Thus, given the important role of the family in children's lives, parental socialization of emotion regulation/effortful control has been a topic of considerable research. Eisenberg et al. (1998a) proposed that socialization of emotion regulation can occur in at least three

ways: (*a*) socializers' reactions to children's emotions, (*b*) socializers' expression of emotion in the family or toward the child, and (*c*) socializers' discussion of emotion.

Parental Reactions to Children's Emotions

Socializers' reactions to children's emotions are likely to provide important opportunities for emotion socialization. Researchers examining emotion socialization in early life often focus on maternal sensitive caregiving, a measure that involves mothers' responsivity to their infants' cues and emotional reactions. Researchers have found that sensitive, responsive parenting has been linked with lower negativity and more regulatory behavior (Kochanska et al. 2000, Li-Grining 2007, Propper & Moore 2006, Rodriguez et al. 2005, Spinrad et al. 2007), as well as lower cortisol response to emotional arousal (Blair et al. 2008). Belsky and colleagues (2007) found that maternal sensitivity at 54 months and in first grade predicted better inhibition of attention in first grade and third grade, respectively. These findings are noteworthy because this study is one of the few to involve more than two assessments.

Similar to maternal responsivity or sensitivity, maternal interactions characterized by warmth and support are also thought to foster emotion-regulation skills. Indeed, maternal warmth or positivity has been associated with greater self-regulation/effortful control (Eiden et al. 2007, Eisenberg et al. 2005b, Gaertner et al. 2008, Gilliom et al. 2002, Valiente et al. 2006). Maternal scaffolding, reflecting parents' responsiveness to the child's need and respect for autonomy, as well as maternal limit setting, has also been related to higher effortful control in children (Lengua et al. 2007) and low dysregulation (Hoffman et al. 2006).

Similarly, parenting style, which reflects general parenting attitudes and behaviors toward children, appears to be related to children's emotion regulation (Morris et al. 2007). Specifically, authoritarian, negative, and punitive parenting, as well as parental negative expressivity, has been associated with lower levels of effortful control (e.g., Gartstein & Fagot 2003, Hofer et al. 2009, Kochanska & Knaack 2003, Xu et al. 2009). Authoritarian parenting (high on strict control and low on warmth) also has been negatively related to Chinese children's effortful control (Zhou et al. 2004) and coping efficacy (Zhou et al. 2008). On the other hand, authoritative parenting has been associated with higher levels of effortful control (Hofer et al. 2009; Morris et al. 2007; Zhou et al. 2004, 2008). In a recent study using a Chinese sample, Eisenberg et al. (2009a) found that reported authoritative parenting style (including warmth/acceptance, inductive discipline, democratic parenting, and responsiveness) was positively related to children's effortful control, whereas their use of corporal punishment was negatively related to effortful control.

Researchers have also examined the quality of socializers' reactions to children's expression of emotion, especially negative emotion. Investigators have suggested that parental reactions to children's negative emotions provide children with valuable information about the experience and expression of emotions. Supportive responses and emotion coaching may help children to reduce their negative emotions, contribute to children's abilities to understand emotions, or directly teach ways to deal with emotions in the future. On the other hand, nonsupportive reactions may induce more negative emotion and dysregulation. Mothers' supportive practices in response to children's expression of emotion have been related to higher emotion regulation/effortful control, whereas nonsupportive or punitive responses have been related to lower levels (Davidov & Grusec 2006; Lengua 2008; Spinrad et al. 2007; Valiente et al. 2007; Yap et al. 2007, 2008a). Similarly, parents who are aware and supportive of their children's emotions, validate and label their emotions, and help their child deal with emotions in a constructive way (known as emotion coaching) tend to have children with relatively high levels of regulatory skills (Gottman et al. 1997, Hannesdottir & Ollendick 2007, Lunkenheimer et al. 2007, Morris et al. 2007, Shipman et al. 2007; contrast

with Yap et al. 2008b). Thus, there is some evidence that warmth, sensitivity, and supportive parental responses to children's emotions may foster children's emotion regulation.

There is also a body of work focused on relations between the quality of the mother-child attachment relationship and children's effortful control/regulation. Secure attachment relationships are often characterized by mothers who are emotionally available and responsive to their infants' needs. Cassidy (1994) argued that emotion regulation strategies are influenced by the quality of attachment relationships—that securely attached children have mothers who are accepting of their displays of emotion and, consequently, these infants are likely to feel free to express their emotions and seek out assistance from their caregivers when stressed (resulting in better self-regulation). In contrast, infants classified as insecure-avoidant, in comparison to securely attached infants, may learn to rely less on the mother as a source of support given their history of maternal rejection (Cassidy 1994). Empirical findings have supported this view (Contreras et al. 2000, Gilliom et al. 2002, Muris & Dietvorst 2006). In addition, as discussed above, attachment security has been found to moderate the effect of genotype (i.e., 5-HTTLPR polymorphism) on self-regulation skills (Kochanska et al. 2009).

Expression of Emotion

Parents' expression of emotion has also been related to children's abilities to regulate their emotion and behavior. General positive or negative emotionality in the home may induce emotions in children by emotional contagion (see Morris et al. 2007) and may also teach children through imitation about where and when to express emotion. For example, Sallquist et al. (2009) found positive relations between mothers' and children's observed positive emotions within time (but not across time). Children of parents who are emotionally expressive in the family tend to be emotionally expressive themselves for both positive and negative expressivity (Halberstadt et al. 1999). In addition, there is evidence that mothers' expressivity (positive minus negative dominant emotion) predicted higher effortful control two years later (Valiente et al. 2006).

It is noteworthy, however, that most of the research on parental expressivity has been conducted in the United States. The research may not generalize to non-Western cultures because norms regarding emotional expressivity vary (Eisenberg et al. 1998a). For example, in Indonesia, parental negative expressivity was negatively related to children's regulation, but, unlike in the United States, parental positive expressivity was unrelated to children's regulation. This result may be because the expression of strong emotion, even positive emotion, is devalued in Indonesia and is viewed as disrupting social relationships (Eisenberg et al. 2001b).

Related to the findings on general expressivity in the home, maternal depression, characterized by relatively high levels of negative affect in the home (Propper & Moore 2006, Rogosch et al. 2004), may disrupt children's emotion regulation/effortful control. There is evidence to suggest that children of depressed mothers have problems with regulation (Blandon et al. 2008, Cicchetti & Toth 2006, Feng et al. 2008, Gartstein & Fagot 2003). For example, preschool children of depressed mothers (particularly girls) are more likely to use ineffective regulation strategies during a delay-of-gratification task than are children of non-depressed mothers (Silk et al. 2006b). Thus, parental expressivity in the home has been demonstrated to be an important correlate of the development of children's regulation skills.

Discussion of Emotion

The third aspect of parental socialization highlighted by Eisenberg et al. (1998a) is parental discussion of emotion. Most of the studies in this area have been conducted with young children. Parents who discuss emotions with their children likely teach them about the meanings of emotions, the circumstances in which they should and should not be expressed, and the consequences of expressing or not expressing them (Dunn & Brown 1994, Gottman et al. 1997). Indeed, children whose parents discuss emotion with them tend to have relatively high emotional understanding (Dunn & Brown 1994; see Thompson 2006).

Parental discussion of emotion also has been associated with children's emotional reactivity and regulation (Gottman et al. 1997, Laible 2004). In a recent study, Eisenberg and colleagues (2008) found a negative relation between mothers' discussion of emotions and young adolescents' negative conflict reactions during a parent-child conflict discussion. Thus, parents who discuss emotions with their children tend to be better regulated; however, future work should focus on the type of emotion discussions (i.e., positive versus negative or hostile emotions) and the context because focusing on negative emotions may have detrimental effects on children's ability to regulate in a hostile family environment (see Dunn & Brown 1994).

Effortful Control as a Mediator Between Socialization and Children's Outcomes

Eisenberg and colleagues (1998a) proposed that some of the relations between parenting and children's outcomes are mediated by children's regulation/effortful control (also see Gottman et al. 1997 and Yap et al. 2007). Thus, parents who are sensitive and warm and/or express appropriate emotions in the home are likely to rear better-regulated children, who in turn are less likely to develop problem behaviors and are more likely to be socially competent. A number of investigators have tested this notion and found support for the meditational process (Belsky et al. 2007, Eiden et al. 2007, Eisenberg et al. 2005b). For example, in a three-assessment panel model in which the stability of constructs was taken into consideration, Valiente et al. (2006) found that effortful control mediated relations between earlier maternal expressivity and externalizing and internalizing problems four years later (see Eisenberg et al. 2005b for similar findings for externalizing in another sample of school children). Similarly, in a study of young children, effortful control mediated the relation of maternal supportive parenting with low externalizing problems and separation distress and high social competence at 18 and 30 months of age, albeit not across time (Spinrad et al. 2007). In addition, Yap et al. (2008a) found that mothers' observed dampening responses to their children's positive interpersonal behavior were positively related to their adolescents' depressive symptoms, and this relation was mediated (albeit in concurrent data) by children's maladaptive emotion-regulation strategies. For girls, similar mediation was found involving mothers' self-reported invalidation of positive affect (invalidating responses to positive affect → maladaptive emotion regulation strategies → depressive symptoms). Thus, parents' influence on adjustment may be operating through effects on children's self-regulation capabilities.

It is possible that this mediated relation occurs at some stages of development and not at others. Using a longitudinal panel model with assessments at 18, 30, and 42 months of age, Eisenberg et al. (2009c) found that unsupportive parenting at 18 months predicted low levels of children's effortful control at 30 months, even when controlling for stability of the constructs. However, effortful control did not predict problem behaviors across time, after controlling for stability, suggesting that the causal relations among parenting, effortful control, and problem behaviors may only occur in the school years and not during early childhood.

In addition, physiological measures associated with self-regulation have been found to moderate or mediate relations between socialization and adjustment. Hastings & De (2008) found that relations between maternal or paternal responses to negative emotions and 2- to 5-year-olds' internalizing (controlling for externalizing) were strongest for children with low baseline RSA (low baseline RSA was thought to indicate a more aroused and less regulated autonomic state); for instance, mothers' lack of response to children's fear and sadness was related to higher internalizing for less-regulated children. Researchers also have found associations involving RSA suppression. For instance, marital conflict and concurrent internalizing have been found to be positively related for school-aged and young adolescent boys and girls with lower RSA suppression. The relation held only for girls when predicting internalizing two years later; however, lower RSA suppression was predictive of internalizing problems for boys when controlling for marital conflict (El-Sheikh & Whitson 2006). Hastings et al. (2008b) found that higher paternal support was negatively related to preschoolers' internalizing for children with weaker vagal suppression during a difficult task. Hastings et al. (2008a) also found that vagal regulation during a socially challenging context partially mediated the relation between maternal negative control and preschoolers' internalizing problems (negative control → less vagal regulation → higher internalizing). However, RSA reactivity and recovery are not always found to be related to internalizing or to moderate/mediate the relations between parenting and internalizing (e.g., Willemen et al. 2009), perhaps because, as is discussed below, the level of autonomic nervous system functioning also moderates the relation between marital conflict and children's problem behavior (El-Sheikh et al. 2009).

Bidirectional Effects

It is important to recognize that children can evoke certain parenting reactions and that the process of influence between parenting and children's self-regulation is likely bidirectional. That is, children who are unregulated, in comparison to those who are more regulated, may elicit different responses from their social environment, such as hostility from peers and adults and lower-quality social interactions (Belsky et al. 2007, Bridgett et al. 2009, Crockenberg & Leerkes 2003, Eisenberg et al. 2008). In one recent study, for example, initial levels of temperament and parenting predicted growth in each other when children were transitioning from middle childhood to adolescence. Specifically, effortful control predicted decreases in parental rejection, suggesting that regulation may serve to improve the quality of parent-child interactions over time (Lengua 2006). Moreover, there is evidence that even within parent-child interactions, there is reciprocal regulation of emotion (Crockenberg & Leerkes 2004). Specifically, Cole and colleagues (2003) found that during a delay task, mothers' positive emotion tended to be reciprocated by preschoolers, and in turn, preschoolers' emotion tended to elicit positive responses from mothers (see Sallquist et al. 2009 for a similar correspondence between mothers' and young children's positive emotion during interactions). Such findings suggest that the quality of the parent's and the child's behavior affect one another during interactions and likely across time.

PROMOTING CHILDREN'S EMOTION REGULATION THROUGH INTERVENTION

There are many reasons that scholars, educators, and parents would want to foster self-regulation, particularly for children at risk for maladjustment. In addition to associations between self-regulation and fewer adjustment problems, self-regulation is associated with school readiness and overall social competence (for reviews, see Blair & Diamond 2008, Eisenberg et al. 2009d).

Although the research is limited, there is evidence that interventions can promote self-regulation. For example, researchers have examined effects of the Promoting Alternative Thinking Strategies (PATHS) Curriculum, which is aimed at fostering social competence and adjustment. The teacher-administered curriculum involves classroom lessons and students' practice of inhibitory control and emotion identification. Riggs et al. (2006) found that students (second- and third-graders at pretest) participating in PATHS performed better than control children on measures of executive function (inhibitory control and verbal fluency). Furthermore, posttest inhibitory control significantly mediated the effect of PATHS on teacher-reported externalizing, as well as internalizing, at the one-year follow up.

PATHS has been used with school-aged children as well as preschoolers. Domitrovich et al. (2007) evaluated the Preschool PATHS Curriculum in which emotion-awareness and self-regulation strategies were taught by Head Start teachers to preschoolers. Children in classrooms receiving PATHS exhibited better emotion knowledge and were rated by teachers as less socially withdrawn and more socially competent relative to students in waitlist-control classrooms; however, significant intervention effects were not found for children's performance on tasks assessing inhibitory control or sustained attention.

In a similar study with young children, Bierman and colleagues (2008) examined the effects of the Head Start Research-Based Developmentally Informed intervention, which was delivered by Head Start teachers over the school year (parents also received take-home materials) and was designed to promote language, literacy, and social-emotional skills (through use of the Preschool PATHS Curriculum). Prekindergarteners' cognitive performance on a task likely requiring inhibitory control, working memory, and attention shifting as well as children's task orientation (sustained focus) were better if in a classroom receiving, rather than not receiving, the intervention; however, effect sizes were small and the former finding was marginally significant. Furthermore, task orientation mediated the effects of the intervention for some of the literacy and social-emotional outcomes (Bierman et al. 2008).

Izard et al. (2008) examined treatment effects for the teacher-administered Emotion-Based Prevention Program (EBP) in Head Start children in two studies: (*a*) in a rural/small-town area and (*b*) a modified version of EBP administered in an inner-city area. The program included lessons regarding emotion understanding and regulation strategies and involved parents through messages summarizing each lesson and requesting the parents to do a lesson-relevant activity with their children. In the first study, emotion knowledge was significantly predicted by the EBP intervention for children who were at least 4 years old but not 3 years old at the pretest. Preschoolers' teacher-reported lower lability/negative emotionality, teacher-reported lower aggressive and anxious/depressed behavior, and lower observed negative behaviors and emotion also were predicted by EBP; however, treatment effects were not found for teacher-rated or observed measures of positive behavior. In the second study, EBP was assessed relative to a social-cognitive intervention program, I Can Problem Solve (ICPS). Children receiving EBP relative to ICPS demonstrated significant gains in emotion knowledge, teacher-rated emotion regulation skills, and positive behavioral outcomes. No differences were found for teacher-rated lability/negative emotionality, negative emotion expression, externalizing problems, or internalizing problems. In study 2, evidence also was found for mediation of the EBP treatment effect on change in emotion regulation by emotion understanding.

Diamond et al. (2007) reported promotion of preschoolers' cognitive control through use of the teacher-administered Tools of the Mind (Tools) curriculum in low-income classrooms. The curriculum focuses on challenge, training, and support of executive functions. Children

receiving the Tools curriculum for 1–2 years were more accurate on tasks assessing aspects of executive function relative to children receiving their school district's curriculum.

In summary, interventions for preschoolers and school-aged children appear to foster at least some gains in executive function, emotion identification/regulation, and/or adjustment. In several of the studies, however, improvements were not observed in all areas targeted by the intervention or effect sizes were small. In the future, it will be important to identify factors that moderate the effectiveness of the interventions and establish if gains are maintained over an extended period of time.

CONCLUSIONS

The topic of children's regulation of emotion and emotionally driven behavior has received extensive attention in recent years, and for good reason. Individual differences in children's emotion regulation are clearly related to their maladjustment as well as to numerous other aspects of their socioemotional functioning. For example, children's self-regulation (measured as a dispositional variable such as effortful control or with behavior measures in specific contexts) has fairly consistently been inversely related to a range of externalizing problems and frequently has been inversely associated with children's internalizing problems. Nonetheless, there is much to clarify and learn.

One issue is how to think about, and perhaps differentiate between, emotion regulation that can be effortfully controlled (be it usually highly conscious or usually automatic) and less voluntarily controlled aspects of functioning that might reflect reactivity more than effortful control. We probably will never be able to cleanly separate the two at an empirical level because of the complex interplay between top-down, effortful control processes and bottom-up, subcortically driven neural processes (Thompson et al. 2008) and because behavior is likely affected by both types of processes simultaneously. Perhaps work on the neural bases of behavior is the most promising for both identifying differences in the neural bases of effortful control, impulsivity, reactive overcontrol, and related constructs and identifying their complex interrelations and interactions. In the meanwhile, it is important to conceptually differentiate, regardless of the specific terminology, among these constructs so that thinking about regulatory/controlling processes can be sharpened.

Similarly, differentiation between reactive and effortful forms of inhibition of behavior may be helpful in clarifying the inconsistent associations between inhibitory control and internalizing problems. It may be difficult to accurately assess pure effortful inhibitory control (inhibitory control that does not reflect reactive control as well), particularly in people whose dominant response is avoidance or withdrawal.

Compared to inhibitory and attentional control, relatively little is known about the development of activational control—the ability to make oneself approach rather than avoid stimuli or activities. Activational control likely is related to adjustment problems, perhaps particularly for children with internalizing problems. For example, withdrawn children might have difficulty overriding their prepotent response of avoiding people so as to approach an unfamiliar person.

Although self-regulatory capacities are clearly associated with low levels of externalizing problems, the role of regulation in different types of externalizing problems and in different developmental pathways is not sufficiently delineated. Researchers such as Frick (e.g., Frick & Morris 2004) and Nigg (2006) have delineated promising pathways, yet the results of research (e.g., on reactive versus proactive aggression) are not always consistent with expectations. Moreover, different aspects of emotion regulation may relate to different types of externalizing problems, and these relations may vary with age.

Additionally, researchers have obtained different findings when examining the relation between self-regulation and adjustment problems when taking into account or when ignoring co-morbidity of adjustment problems. In the future, it is important for researchers to assess co-occurring problems to avoid obtaining spurious relations between self-regulation and internalizing or externalizing problems due to comorbidity.

Despite the abundant relations between maladjustment and children's emotion regulation, it is difficult to identify and verify causal relations and processes. Both genetics and socialization are associated with regulation and also with maladjustment. Genetic factors appear to account for substantial overlapping variance in both regulation and maladjustment (Lemery-Chalfant et al. 2008). In addition, the relation of genes to regulation may change with age and genes, and environmental factors appear to interact in their prediction of regulation. When predicting regulation, genes related to regulation may also interact with other genes related not only to regulation but also to emotionality or reactive control. Thus, to better identify factors that predict regulation and to clarify its relation to maladjustment, additional research on the role of various genes and environmental influences on regulation is necessary, as is research on how these factors might account for the covariation between regulation and adjustment. Moreover, the combination of factors that predict regulation and its relation to maladjustment likely varies with age as well as with type of maladjustment or regulation and degree of maladjustment.

We also need to remember that genes are often not destiny. It is important to keep in mind that both genetic and the environmental factors, as well as their interactions, often predict regulation (and account for its relations with maladjustment). Although heredity may bias a child toward certain kinds of behaviors or emotional reactions that tend to cause maladjustment, environmental factors that mediate or moderate that relation could be changed. For example, children prone to low effortful control (or negative emotionality or impulsivity) might evoke negative responses from socializers that tend to promote maladjustment (an evocative gene effect). However, consistent with some of the research on interventions reviewed in this article, children's behavior, and that of their parents, can often be modified. Interventions will be optimized to the degree that we understand environmental factors such as low-quality parenting, family/residential stressors, and sociodemographic risk (see Li-Grining 2007) that appear to compromise children's development of self-regulation. More generally, a better understanding of interventions that promote children's regulation (directly or indirectly through socializers), and the degree to which such interventions are effective and for whom, in what contexts, and at what age, are important topics to address in the future.

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Glossary

Emotion-related self-regulation	processes used to manage and change if, when, and how (e.g., how intensely) one experiences emotions and emotion-related motivational and physiological states, as well as how emotions are expressed behaviorally
ADHD	attention deficit/hyperactivity disorder
ODD	oppositional defiant disorder

CD conduct disorder

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