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Developmental origins of early antisocial behavior

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Abstract

Early antisocial behavior has its origins in childhood behavior problems, particularly those characterized by aggressive and destructive behavior. Deficits in self-regulation across multiple domains of functioning, from the physiological to the cognitive, are associated with early behavior problems, and may place children at greater risk for the development of later antisocial behavior. Data are presented from a longitudinal study of early self-regulation and behavior problems, the RIGHT Track Research Project, demonstrating that children at greatest risk for early and persistent problem behavior display patterns of physiological and emotional regulation deficits early in life. Parenting behavior and functioning have also been examined as predictors of trajectories of early problem behavior, and some data support the interaction of parenting and self-regulation as significant predictors of patterns of problematic behavior and ongoing problems with the regulation of affect. Peer relationships also affect and are affected by early self-regulation skills, and both may play a role in academic performance and subsequent school success. These data provide evidence that the social contexts of early family and peer relationships are important moderators of the more proximal mechanism of self-regulation, and both types of processes, social and biobehavioral, are likely implicated in early antisocial tendencies. Implications of these findings on self-regulation and early behavior problems are discussed in terms of future research and treatment approaches.

Antisocial behavior is generally defined as behavior that violates the basic rights of others. In adults, antisocial behavior is often associated with criminal behaviors such as stealing or physical assault, but it also includes other more insidious behaviors such as lying, duplicity, and manipulating others for personal gain. These antisocial behaviors comprise the criteria necessary to meet the diagnosis of antisocial personality disorder (ASPD). In addition, a hallmark feature of this disorder is marked indifference to the victim (American Psychiatric Association, 2000). In adolescents, antisocial behavior typically manifests itself as delinquency. Chronic antisocial behavior in adolescence and ASPD in adulthood are serious societal problems with financial (e.g., arrest, adjudication, and incarceration) and personal (medical expenses, lost wages, loss of property, loss of life) costs (Foster & Jones, 2006), making an understanding of these conditions, and their development, an important research question.

Recent research has begun to illuminate our understanding of the development of antisocial behavior. We know that ASPD in adults and antisocial behavior in adolescents share a common antecedent of early aggressive and disruptive behavior in childhood (Dishion & Patterson, 2006). In fact, a history of conduct disorder before the age of 15 is a requisite criterion for the diagnosis of ASPD. For some individuals, conduct disorder bespeaks the beginning of a persistent pattern of antisocial behavior. However, for others, these behaviors desist or continue at subclinical levels, as only about 25% of children with conduct disorder are later diagnosed with ASPD (American Psychiatric Association, 2000). The heterogeneity of these problems

with respect to symptomatology, age of onset, and risk factors suggests that there may be more than one pathway to later significant antisocial problems (Dodge & Pettit, 2003; Moffitt, 2003; Willoughby, Kupersmidt, & Bryant, 2001). One compelling explanation of these divergent outcomes is the environment to which the aggressive, disruptive child is exposed. Lahey and colleagues (Lahey, Waldman, & McBurnett, 1999), in fact, propose that the different manifestations of antisocial behavior result from successive transactional processes that a child experiences within his/her social environment.

Although there have been a number of different conceptual and empirical approaches to the study of early conduct problems and antisocial behavior, such work is often conducted from within a developmental psychopathology framework (e.g., Campbell, Shaw, & Gilliom, 2000). Such a perspective suggests that there are multiple contributors to maladaptive and adaptive outcomes, that these contributors may interact in various ways within different individuals, and that the consequences for development are multiple pathways to disordered behavior and/or multiple variants of outcome from individual causative factors (Cicchetti, 1984, 1993; Cicchetti & Rogosch, 1996; Sroufe & Rutter, 1984). Cicchetti and others (Cicchetti & Rogosch, 1996; Richters, 1997) have described these perspectives as multifinality and equifinality. This perspective also emphasizes the importance of conducting longitudinal investigations of the multiple forces that may both influence and be influenced by early contextual, familial, or individual difference factors. Finally, a developmental psychopathology perspective advocates an organizational view of development; thus, multiple factors, or levels of a given factor, are considered in the context of one another, rather than in isolation (Cicchetti & Dawson, 2002; Cicchetti & Rogosch, 1996; Cicchetti & Schneider-Rosen, 1986).

A developmental psychopathology perspective highlights the need to consider that antisocial behavior represents one outcome of a developmental progression from earlier child behavioral characteristics and/or difficulties that, in the context of other moderational processes or risk factors, increase the likelihood of serious problems in later childhood and adolescence. These “early starter” models have attempted to identify child and environmental factors that place a child on an early and stable trajectory of problem behavior that, in some cases, lead to serious antisocial behavior. For example, much of the work on antecedents of antisocial behavior has focused on difficult temperament, autonomic underarousal, and neuropsychological deficits as factors that predispose children to develop chronic problem behavior (Dodge & Pettit, 2003). The challenge to this work has been the observation that difficult temperament and underarousal are not often co-occurring (Calkins, 2009), perhaps because of the fact that difficult temperament may not be differentiated early in development and may lead to very different outcomes depending on its primary manifestation (Calkins & Fox, 2002).

A second approach to the study of early antecedents of antisocial behavior has been to conduct a downward extension of psychopathy and examine traits or behaviors that forecast future callous–unemotional behavior (Frick & White, 2008), considered a hallmark of some antisocial behaviors. This work has examined whether children who do not display empathy or guilt and who engage in proactive versus reactive aggression are more likely to display antisocial behavior later in adolescence. The findings from this work suggest that some children do, in fact, display such a profile, and continue along a pathway to more serious antisocial behavior (Frick et al., 2003). These children also tend to display greater fearlessness and may, in fact, have deficits in the processing of emotional stimuli that make them less responsive to both cues of danger and the emotional distress of others (Frick & White, 2008).

The data from studies examining early problem behaviors like aggression and negativity as precursors to antisocial behaviors and those examining callous–unemotional traits have been difficult to reconcile. However, one possible explanation is that there may be more than one

subgroup of “early starters” who are characterized by different emotional and behavioral traits and respond differently to environmental moderators. Frick has proposed that at least two subgroups, characterized by overarousal versus underarousal, may be identified, and that these profiles interact with differential dimensions of parenting to make children more or less vulnerable to conduct problems and later antisocial behavior (Frick, 2006; Frick & White, 2008). Moreover, the group of children at risk because of overarousal may also display deficits in the regulation of that arousal, which places them at greater risk for reactive, rather than proactive aggression.

The notion that the regulation of arousal may be a marker for a subtype of antisocial behavior is consistent with a third and somewhat overlapping approach to the study of antecedents of conduct problems and precursors to antisocial behavior. This approach has focused on the emotional skills that the child brings to interactions with others, and that may underlie problematic behavioral responding and lead to disruptive behavior. This work places a particular emphasis on emotion regulation and the way in which specific manifestations of very early problem behaviors are characterized by poor or maladaptive regulatory skills (Cole, Hall, & Radzich, 2009; Keenan & Shaw, 2003). From a developmental perspective, success or failure at important developmental tasks, like the acquisition of emotion regulation skills during toddlerhood and preschool, likely plays some role in the trajectory of more serious problem behavior as children enter the peer and school contexts (Hill, Degnan, Calkins, & Keane, 2006; Keane & Calkins, 2004). Moreover, from this standpoint, early childhood behavior problems are considered a risk factor for later antisocial behavior and suggest that the mechanism(s) responsible for ongoing behavioral difficulties are to be found in the interactions between very early child functioning, particularly with respect to the regulation of arousal, and the contexts in which the development of regulation is occurring: family and peer relationships.

Antecedents of Antisocial Behavior: Childhood Behavior Problems

The study of childhood behavior problems has focused on two broad sets of difficulties: those characterized by aggression and acting-out behaviors (externalizing problems), and those characterized by anxiety, withdrawal, and depression (internalizing problems; Achenbach, 1991a, 1991b, 1992; Achenbach & Edelbrock, 1983). Externalizing spectrum problems have likely received more focus because they are presumed to be more easily observed and cause greater disruptions in the family, peer, and school contexts. Moreover, such problems are of interest to clinicians and researchers alike because of their influence on concurrent psychological and social functioning (Campbell, 2002), their role in influencing later behavior across peer and school contexts (Keane & Calkins, 2004), and their potential to constrain the development of a range of emotional, cognitive, and social skills (Calkins & Fox, 2002; Nigg & Huang-Pollock, 2003).

Disruptive behaviors such as aggression, defiance, and temper tantrums are some of the most common behavioral problems seen in children (Beauchaine, Strassberg, Kees, & Drabick, 2002). Traditionally, it was thought that as young children acquire more cognitive, linguistic, and regulatory skills, they are better able to cope with developmental challenges and outgrow these types of problem behaviors (Campbell, 2002; Kopp, 1982). Indeed, much research has shown a normative developmental pathway of externalizing spectrum behavior problems that peaks during the third year, and shows a distinct decline with age (Hartup, 1974; Tremblay, 2000). However, considerable research has also demonstrated that early aggressive and oppositional behaviors are risk factors for the development of later, more serious problems such as conduct disorder, attention-deficit/hyperactivity disorder, and juvenile delinquency (for reviews, see Campbell, 2002; Campbell et al., 2000). Clearly, although it may be the case that most children acquire adaptive skills that help them manage challenging situations in

appropriate and constructive ways (e.g., Coie & Dodge, 1998; Hartup, 1996; Tremblay, 2000), for some children, early onset externalizing problems remain stable and lead to more serious mal-adaptive outcomes (Campbell, 2002; Cummings, Ianotti, & Zahn-Waxler, 1989). Of importance, chronic disruptive behavior problems are often resistant to treatment and may result in significant costs to children, families, and society over time (Shaw et al., 1998). Thus, understanding the differential pathways from early to later problematic behavior is of both theoretical and practical significance.

Consistent with a developmental psychopathology framework, theories of externalizing behavior suggest that there are individual differences in developmental patterns of disruptive behavior. Recent research on trajectories of problem behaviors, including our own work, finds that there are multiple trajectories of antisocial behaviors that start early in life (Broidy et al., 2003; Hill, Degnan, Calkins, & Keane, 2008; Nagin & Tremblay, 1999; Shaw, Gilliom, Ingoldsby, & Nagin, 2003). These patterns include a normative decline pattern consistent with the findings of longitudinal studies of toddler and early childhood functioning (cf. NICHD Early Child Care Research Network, 2004); an early onset pattern, which accounts for the stability of problem behavior across early childhood (Broidy et al., 2003); and an adolescent-limited pattern, which appears to be more transient and less predictive of ongoing difficulties (Moffitt, 2003).

Although the existence of multiple patterns of disruptive behavior has been supported empirically, the array of factors that might distinguish among these trajectories is less clear. Prior research has focused on several child and environmental factors, including, but not limited to, genes, neural, and physiological processes, temperament, family functioning, and interaction, and peer relationships and social skills (cf. Lahey, Moffitt, & Caspi, 2003; Olson & Sameroff, 2009). It is important to note that much of the work on antecedents of early behavior problems has been framed largely in terms of risk factors for problematic behaviors and outcomes, with less emphasis on understanding the mechanisms and processes that link risk factors to outcomes (Rutter, 2003). Frameworks that focus on developmental process rather than correlates will likely lead to further elucidation of how risk factors are implicated in the continuity or discontinuity of problem behavior.

In our work on the trajectories of early problem behavior from toddlerhood through early childhood, we have tried to identify the dimensions of child functioning that appear to be compromised and that may underlie the tendency to engage in difficult and disruptive behavior. We have focused on the proximal mechanism of *self-regulation*, with a particular emphasis on measuring specific regulatory processes operating at different levels of analysis and across different domains of functioning. We have used this approach to try to understand both the trajectories of problem behavior as well as the way in which various risk factors operate to alter those trajectories. It is important that we and others who have focused on the role of self-regulation in early behavior problems (cf. Olson & Sameroff, 2009) place this development within the context of family and peer relationships, highlighting the transactional role of such relationships in shaping and being shaped by the child's functioning.

A Self-Regulatory Framework for Understanding Early Childhood Behavior Problems

In our work, we developed a conceptual model of the development of childhood disruptive behaviors that focused on mechanisms and moderating factors, highlighting variations in developmental patterns of problem behaviors for boys and girls (Calkins, 1994, 2004, 2009; Calkins & Keane, 2004; Degnan, Calkins, Keane, & Hill-Soderlund, 2008; Hill et al., 2006). This model hypothesizes that self-regulation is a key set of processes that are directly and interactively linked with the development of behavioral difficulties. Self-regulation allows an

organism to control biological, emotional, behavioral, and cognitive responses (Vohs & Baumeister, 2004). Because of its dependence on the maturation of prefrontal-limbic connections, the development of self-regulatory skills is relatively protracted (Beauregard, Levesque, & Paquette, 2004), from the emergence of basic and automatic regulation of biological processes in early childhood to the more self-conscious and intentional regulation of behavior and cognition emerging in middle childhood and adolescence, that require and are supported by, biological processes (Ochsner & Gross, 2004). Our model also hypothesizes that contextual factors, including relationships with parents and peers, moderate the links between self-regulation and developmental patterns of problem behaviors.

Our focus on specific self-regulatory process, such as the ability to control physiological arousal or the capacity to manage negative affect, provides us with more proximal mechanisms, and perhaps, targets of interventions, that may help to elucidate how and why some children are at greater risk than others for chronic disruptive behavior problems. That is, a self-regulatory perspective on the stability of problem behavior from toddlerhood to early childhood may begin to answer the question of *how* known risk factors such as compromised parent functioning work in conjunction with child characteristics in defining the trajectories of problem behavior or normative functioning. In our work, we have attempted to examine the child's behavior in contexts and situations that may provide insight into the proximal mechanisms whereby children engage in aggressive, impulsive, disruptive, or oppositional behavior versus adaptive behavior. Using this approach, we have identified several core self-regulatory processes that are observable across different levels of child functioning and that influence the child's adaptive functioning and capacity to learn from experiences.

Using this multilevel process-oriented approach, we have observed that the early processes of physiological, attentional, emotional, and cognitive control are integral to the emergence of child competence (Calkins, 2009). When these processes are not functional, the child's success at managing the challenges of early development is compromised. Moreover, failures of these basic regulatory processes have cascading consequences. First, they contribute directly to behaviors that are disruptive to the child's functioning in the situations in which they occur. Second, because the child is unable to control affect and behavior, these failures limit opportunities to learn adaptive skills in social interactional contexts with parents and peers. From this perspective, then, understanding the contribution of self-regulation to early behavior problems versus adaptive behavior of childhood is enhanced by an examination of the component processes of self-regulation that emerge over this developmental period. Thus, a central focus of our recent research has been to examine the role of these early foundational processes in subsequent behavioral adaptation.

Biological foundations of self-regulation reflect dynamic processes of both physiological and neural activity. The autonomic nervous system provides a physiological window on regulatory skills; it functions as a complex system of afferent and efferent feedback pathways that are integrated with other neurophysiological and neuroanatomical processes, reciprocally linking *cardiac activity* with central nervous system processes (Chambers & Allen, 2007). Pathways of the parasympathetic nervous system in particular are implicated in these feedback processes and, consequently, play a key role in the regulation of state, motor activity, attention, emotion, and cognition (Porges, 2003). Specifically, the myelinated vagus nerve, originating in the brainstem nucleus ambiguus, provides input to the sinoatrial node of the heart, producing dynamic changes in cardiac activity that allow the organism to transition between sustaining metabolic processes and generating more complex responses to environmental events (Porges, 2007). This central-peripheral neural feedback loop is functional relatively early in development (Porges, 2007).

Of particular interest to researchers studying emotional and cognitive control has been measurement of vagal regulation of the heart (indexed by *vagal withdrawal* or decreases in respiratory sinus arrhythmia [RSA]) when the organism is challenged. *vagal withdrawal* is linked to behavioral processes that are regulatory in nature. Greater vagal withdrawal during challenging situations is related to better state regulation, greater self-soothing, and more attentional control in infancy (DeGangi, DiPietro, Greenspan, & Porges, 1991; Huffman et al., 1998), fewer behavior problems and more appropriate emotion regulation in preschool (Calkins, Blandon, Williford, & Keane, 2007; Calkins & Dedmon, 2000; Calkins & Keane, 2004), and sustained attention and effortful control in school-age children (Calkins et al., 2007). Excessive vagal regulation may index overcontrol of emotion and arousal, and has been linked to internalizing symptoms (Beauchaine, 2001; Calkins et al., 2007).

Emotion regulation is defined as those behaviors, whether automatic or effortful, conscious or unconscious, that are elicited during an affectively arousing situation (Buss & Goldsmith, 1998; Calkins & Hill, 2007). Emotion regulation helps individuals modulate their arousal and facilitates positive social interaction and effective social problem solving (Eisenberg et al., 1996; Eisenberg, Fabes, Murphy, & Maszk, 1995; Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003). The ability to regulate one's emotions is a critical achievement attained during childhood, and has implications for many dimensions of adolescent development, including behavioral adjustment, social relationships, and school achievement (Calkins & Howse, 2004). By adolescence, the pattern of emotion regulation may be entrenched and difficult to alter. For example, among older children, inhibition and suppression of negative emotion has been associated with greater internalizing problems (Suveg & Zeman, 2004), whereas under controlled negative emotion has been linked to greater externalizing problems (Eisenberg et al., 2001).

Cognitive control processes include attentional and inhibitory/effortful control skills and working memory (Blair, Peters, & Granger, 2004; Carlson, Moses, & Claxton, 2004). These skills develop interdependently (Bjorklund & Harnishfeger, 1995) and enhance an individual's ability to engage in effective planning and goal-directed behavior during adolescence, when demands for management of academic and social challenges are increasingly important. In work with young children, the focus has been primarily on the ability to use working memory and inhibitory control. Young children's abilities to attend to salient aspects of a task, inhibit prepotent responses, and follow rules are often the indicators of early executive function skills. Moreover, these basic cognitive skills are considered foundational to later academic functioning. For example, executive function skills have been linked to literacy and mathematical reasoning in young children (Espy et al., 2004; Gathercole, Brown, & Pickering, 2003). The development of executive functioning in children has been linked to the development of the frontal lobes and associated neural connections. Consequently, dramatic changes in executive functioning during childhood have been reported, especially between 3 and 5 years of age (e.g., Carlson, Davis, & Leach, 2005; Zelazo, Müller, Frye, & Marcovitch, 2003).

This brief review of the development of the components of self-regulation suggests that there are expected trajectories of skills in these subdomains, and that patterns of regulatory deficits are related to patterns of behavioral adjustment versus maladjustment. For example, there is good evidence that young children with behavior problems display a range of regulatory deficits (cf. Olson & Sameroff, 2009). However, regulatory skills have been shown to be particularly important in the development of antisocial behavior. Lower levels of effortful control have been linked with less empathy (Rothbart, Ahadi, & Hershey, 1994) and the lags in the development of conscience (Kochanska, 1995), two factors that are reliably linked to adolescent antisocial behavior. Not surprisingly, low levels of effortful control are also linked with externalizing problems and conduct disorder in preadolescents (Oldehinkel, Hartman, De

Winter, Veenstra, & Ormel, 2004). Other forms of self-regulation including behavioral self-control (Henry, Caspi, Moffitt, & Silva, 1996) and delay of gratification (Krueger, Caspi, Moffitt, White, & Stouthamer-Loeber, 1996) have also been shown to directly affect the development and expression of antisocial behavior across childhood and adolescence (Melnick & Hinshaw, 2000).

Although our model of self-regulation focuses on the way in which failures of basic regulatory processes underlie early behavioral maladjustment, it is also clear that trajectories of both self-regulation and behavioral adjustment are subject to the environmental effects associated with early relationships. For example, a great deal of recent conceptual work and empirical research suggest that caregiver behavior may affect the development of behavioral self-regulation skills (Calkins, 2004; Cole, Martin, & Dennis, 2004), as well as the functioning of numerous biological regulatory and stress systems (Calkins & Hill, 2007; Gunnar, 2006).

Caregiver effects at the behavioral level have long been hypothesized to play a key role in the emergence of early regulatory skills (Kopp, 1982). During infancy, successful regulation largely depends on caregiver support and flexible responding (Calkins & Fox, 2002; Kopp, 1982; Sroufe, 2000). To the extent that a caregiver can appropriately read infant signals and respond in ways that minimize distress, or alternatively, motivate positive interaction, the infant will integrate such experiences into the emerging behavioral repertoire of self-regulatory skills. In addition, deviations from supportive care giving may contribute to patterns of self-regulation that undermine the development of appropriate skills and abilities needed for later developmental challenges (Cassidy, 1994). During toddlerhood, the range of self-regulatory skills of the child is expected to increase, and the caregiver's supportive versus nonsupportive role in this process is also an important predictor of positive outcomes (Calkins, 2009). By early childhood, when children begin to engage in a range of self-help behaviors and expectations for well-regulated behavior increase, parenting behavior and child self-regulation interact to create multiple pathways to adjustment and maladjustment (Bandon, Calkins, Keane, & O'Brien, 2008).

Parenting behavior has also been implicated specifically in the emergence and maintenance of early childhood behavior problems; this work has focused on a number of indices of the parent-child relationship as predictors and risk factors in predicting early externalizing spectrum problems in particular. For example, a number of studies have shown that insecure infant attachment is predictive of later behavior problems in children (cf. Shaw et al., 1998). In addition, a considerable body of evidence indicates that preschool children are more likely to show overactive, noncompliant, aggressive, and impulsive behavior when their parents are displaying negative control and are uninvolved, rejecting, and harsh (Campbell, 1995; Pettit, Bates, & Dodge, 1993).

Children displaying child behavior problems also have been found to have less harmonious mother-child interactions (Gardner, 1994), relationships that are often characterized as low on affection, positive involvement, and warmth (McFadyen-Ketchum, Bates, Dodge, & Pettit, 1996). In other studies, mother-child relationships where the children are displaying behavior problems have been characterized by high conflict and coercion. Patterson has identified a pattern of coercive interaction between mothers and children, where both the mothers' and children's aversive behaviors are reinforced and escalate as a result of this reinforcement (Patterson, 1982; Patterson, DeBaryshe, & Ramsey, 1989). Finally, mothers of children displaying behavior problems have been found to be more adult focused by controlling and dominating activities with their children instead of being child focused and encouraging actions initiated by the children (Gardner, 1994; Rubin, Booth, Rose-Krasnor, and Mills, 1995). Thus, considerable evidence suggests that more conflict, less synchrony, and lower shared positive affect may be important elements of the child's relationship with the caregiver and may lead

to increases in the kinds of difficult behavior that may evolve into more serious and entrenched behavior problems in later childhood.

Although there has been less focus on peers and the development of self-regulation, it is clear that by the time children enter school, peers, like parents, help with the development of these important self-regulatory skills. Peers serve as sources of emotional support during times of stress (Hartup, 1996) but also provide feedback about the appropriateness of emotional displays. Anger expression, bossiness, aggression, and impulsivity are all negatively related to peer status (Eisenberg, Fabes, Bernzweig, & Karbon, 1993; Keane & Calkins, 2004); rejected children are also more effusive in their display of emotion (i.e., happiness) to positive events (Hubbard, 2001). Taken together, these studies suggest that both positive and negative high-intensity emotional behavior play a role in determining concurrent peer status. The peer group may also attempt to socialize children's emotion regulation through specific negative treatment, such as peer victimization or exclusion (Salisch, 2001).

Peers have been shown to influence antisocial behavior development as well. Early peer rejection is related to later aggressive behavior, even when early aggression is taken into account (Dodge, Bates, & Petit, 1990), and it is clear that these types of peer interactions are related to higher levels of delinquency and maladjustment (Deater-Deckard, 2001; Rubin, Bukowski, & Parker, 1998). Children who associate with deviant peers are more likely to engage in delinquent behaviors (Dishion & Piehler, 2007), and adolescents who develop friendships with delinquent peers may also contribute to increased levels of maladaptive behaviors through deviancy training. Despite consistent findings demonstrating that peers can influence the development of antisocial behavior, many youth who associate with deviant peer contacts do not go on to display similar patterns of antisocial behavior. One explanation for these differential outcomes is individual differences in regulatory skills such as self-control (Hirschi, 2004). Gardner, Dishion, and Connell (2008) found that the interaction between adolescents' emotion regulation and association with deviant peers predicted antisocial behavior at age 19, controlling for early antisocial behaviors. Specifically, peer deviance was not related to antisocial behavior for high regulating adolescents; however, high peer deviance was particularly detrimental for adolescents with low self-regulation. Thus, contexts of low peer deviance served as a protective factor for low regulators.

Smaller social networks and dyadic friendships also attenuate the association between self-regulation difficulties and later delinquent and antisocial behaviors in children and adolescents. Poulin, Dishion, and Haas (1999) found that highly delinquent boys had persistent high delinquency scores 1 year later only in the context of friendships with low levels of positive features. Similarly, Berndt and Keefe (1995) demonstrated that disruptive behaviors decrease in the context of high-quality friendships, even when the friend is initially disruptive. Although these studies do not address the role of emotion regulation, it is plausible that through these positive and high-quality friendships children are learning more effective social and emotional strategies, which lead, in part, to less delinquency.

Poor self-regulation places children at risk for negative peer treatment, which can further exacerbate behavior problems. However, peer contexts can change the trajectories of these children. Exposure to more normative peer groups may encourage the development of adaptive emotion regulation skills, and may decrease the likelihood that poor regulation will lead to serious delinquent behaviors. Although poor self-regulation decreases the likelihood of successful friendship interactions, some delinquent children *are* able to establish stable and high-quality friendships. These high-quality friendships then lead to fewer delinquent and antisocial behaviors over time.

Clearly, it is difficult to describe the complex ways that trajectories of self-regulation affect the trajectories of behavior problems and the differential pathways to specific behavioral subtypes. Further complexity is added by the consideration of the ways in which these trajectories are moderated by environmental factors, including, but not limited to family and peer relationships. It is possible, however, to make some general statements about the unfolding of these core self-regulatory processes. Thus, the hierarchical organization of this model suggests that if early difficulties in self-regulation, for example, at the physiological and attentional level, are not moderated by positive environmental effects, behavioral difficulties may be more entrenched and resistant to intervention. Data from recent research suggests that early, severe, and chronic problems often characterize stable trajectories of problem behavior that are observed in adolescence (NICHD SECCRN, 2005), and that the deficits associated with a lack of appropriate and adaptive emotion regulation persist and affect early peer relationships (Keane & Calkins, 2004). Second, moderators such as parents and peers must also be conceptualized in terms of the variants of poor adjustment that are possible as a consequence of these moderational effects. Thus, distinctions between patterns of problems characterized by attention deficits without disruptive behaviors versus those with associated disruptive behaviors may be a function of poor regulation at the attentional level in combination with some supportive versus nonsupportive environmental dimension that either facilitates or disrupts subsequent emotional and behavioral regulation. Similarly, early externalizing problems may evolve into more severe conduct problems, or perhaps anxiety and depression, as a consequence of some specific type of negative peer environment (e.g., rejection vs. neglect by peers). Third, the nature of co-occurring problems, which are an ongoing challenge to the study of early behavior problems, may be facilitated by a consideration of the nature of their specific underlying self-regulatory deficit. This implies that studying the self-regulatory characteristics of particular behavioral subtypes may help us to identify the differential developmental processes that produce such subtypes.

In sum, our model of the emergence of early disruptive behavior focuses on the multiple self-regulatory deficits that may characterize particular patterns of problem behavior. Although the complexities inherent in such a model are numerous, particularly when one considers the proximal and distal moderators that have been identified in prior research, some foundational questions must be addressed first. Thus, an important step in verifying this conceptual framework is to specify the role that different levels of self-regulation may play in constraining subsequent development, and to study the role of the most proximal moderators (parents and peers) on indicators of child functioning. We have been addressing these important developmental issues in an ongoing longitudinal study of early self-regulation and behavior problems.

Longitudinal Data on Self-Regulation and Behavior Problems: The RIGHT Track Research Project

The RIGHT Track Research Project focuses on the development of self-regulation and disruptive behavior problems in a group of 450 2-year-olds and their mothers recruited into the study beginning in 1996 (Calkins, Bandon, et al., 2007; Calkins & Keane, 2004; Smith, Calkins, Keane, Shelton, & Anastopoulos, 2004; Williford, Calkins, & Keane, 2007). Children were recruited from the community using a behavior problems questionnaire that emphasized *externalizing* or *acting-out* problems (Achenbach, 1991a, 1991b, 1992) that assessed a broad array of behaviors seen in toddlers and that was completed by the mothers of several hundred toddlers. We over-sampled for children who were behaviorally at risk, with 30% of these toddlers identified by their mothers as being particularly difficult to manage (had more temper tantrums, were more difficult to soothe, became more easily frustrated, cried more frequently, compared to the typical 2-year-old). When the children were 2, mothers and toddlers

participated in laboratory assessments that measured the different domains of self-regulation. Mothers were asked to report on their child's, their own, and their family's functioning. We conducted similar assessments at ages 4, 5, 7, and 10 years, broadening our assessment to include the home environment. In addition to laboratory and home context, we also assessed children's functioning in the classroom when children entered preschool and formal schooling (Keane & Calkins, 2004). We asked teachers to report on children's behavioral, emotional, and academic functioning and, beginning in kindergarten, we added a peer assessment to measure how successful children were in their social relationships.

We have used a multimethod, multi-informant approach to gather information about children's ability to control themselves in individual tasks and in the school and peer settings. The data collected to this point have been used to address the question of whether and how self-regulation skills affect children's development across many areas of functioning, and in particular, of the relevance of these skills to the persistence and desistance of disruptive behaviors. Here we summarize some of our findings that lend support to our model of the physiological self-regulatory component of disruptive behavior and the role of important contextual factors, namely, parents and peers, in influencing pathways to behavioral adjustment and maladjustment.

One of the primary goals of our research has been to understand the way in which children's self-regulatory behaviors are supported by fundamental physiological processes. The paradigm we use to examine this issue is to measure cardiac vagal tone, or RSA, at rest and in situations in which the child is challenged to utilize self-regulatory skills such as attentional, emotional, and cognitive control. We have been especially interested in whether children with poorer self-regulation display more symptoms of disruptive behavior at home. In an initial analysis comparing the 2-year-old children at highest risk for disruptive behavior problems to those at lowest risk, we observed that high risk children displayed significantly lower vagal withdrawal (lower baseline to task changes in RSA) across all challenge tasks than did children at low risk for behavior problems. Moreover, these children displayed a pattern of poorer attentional and emotional regulation to the challenging tasks than did lower risk children (Calkins & Dedmon, 2000). Thus, early evidence from our study indicated that children with greater levels of problematic behavior during toddler-hood, behavior that fell reasonably outside the level considered normative even at this age, displayed a profile of lower levels of physiological, attentional, and emotional regulation.

In a follow-up of these same children at age 4, continued behavioral difficulties, including social problems and difficulties with emotion regulation, were characteristic of the children who displayed, across the preschool period, a stable pattern of physiological dysregulation, in the form of lower vagal withdrawal to challenge (Calkins & Keane, 2004). Of interest, children who displayed a pattern of lower vagal withdrawal at age 2, but who displayed a decrease in RSA at age 4, that is, a pattern of physiological regulation characteristics of children with fewer behavior problems, showed continued difficulties, suggesting that the early pattern of cardiac vagal regulation may have constrained the acquisition of regulatory skills that affected behavior later in the preschool period.

These early findings suggest that there may be a physiological profile of poorer vagal regulation of heart rate activity that may be characteristic of children with early externalizing problems. However, one challenge to the study of physiological regulation among children with behavior problems characterized by aggression is that these problems often present with co-occurring internalizing symptoms (anxiety, withdrawal; Achenbach, Howell, Quay & Connors, 1991; Gilliom & Shaw, 2004). These co-occurring problems are often ignored, either because they are thought to be a consequence of single-reporter bias, or because the sample sizes in most studies of children's behavior problems are too small to allow for separate consideration of

pure versus co-occurring problems (Calkins & Dedmon, 2000). However, in a recent large-scale study of early externalizing behavior problems, researchers identified differential behavioral and environmental correlates and predictors of pure versus mixed patterns of externalizing behavior problems (Keiley, Lofthouse, Bates, Dodge, & Pettit, 2003). Clearly, it is important to examine whether these different behavioral patterns may be distinguished by cardiac vagal regulation in the form of RSA suppression to emotional and behavioral challenges. One hypothesis is that the co-occurring anxiety symptoms, which are often associated with overcontrol of emotion, may indicate less severe behavior problems (Lilienfeld, 2003) and may reflect greater cardiac vagal regulation compared to children with pure externalizing problems. A second possibility is that co-occurring problems may be considered more severe than pure problems (Hinshaw, Lahey, & Hart, 1993), and may result in significantly poorer cardiac vagal regulation compared to children with pure externalizing problems.

We explored these questions in our follow-up study of the children at age 5, some of whom were at high risk for externalizing problems, others of whom displayed early externalizing problems with co-occurring internalizing problems, and a third group of children with no behavioral problems (Calkins, Graziano, et al., 2007). The children were assessed again in a battery of tasks that were emotionally and behaviorally challenging. We found that children displaying a mixed profile of externalizing and internalizing behavior problems displayed the greatest cardiac vagal regulation, whereas children with a pure externalizing profile displayed the least cardiac vagal regulation. These data suggest that either the pattern of greater vagal regulation leads to anxiety symptoms or that children with emergent anxiety become more regulated physiologically. Alternatively, these children may, in fact, be over regulated physiologically, which may explain the high level of co-occurring internalizing symptoms. Follow-up analyses of these two groups of children indicated that the pure externalizing group displayed more symptoms of reactive versus proactive aggression, as reported by their teachers. These data provide evidence that the pattern of early problem behavior and poor physiological regulation may lead to ongoing problems with control of emotion and social interactions.

Although much of our work with this sample has emphasized the physiological basis for children's emerging regulatory skills and behavior problems, we have also examined the role of parents and peers in facilitating and disrupting these pathways. We have extensively examined, for example, longitudinal trajectories of both behavior problems and self-regulation skills. So, for example, we found that children with high and stable trajectories of externalizing problems across toddlerhood and preschool were characterized by poor physiological regulation and low maternal control during toddlerhood (Degnan et al., 2008). Similarly, although on average children display a pattern of increase in emotion regulation skills over the preschool period, we have observed that early child and environmental factors affect this growth: maternal depression was predictive of less steep increases, whereas greater physiological regulation was predictive of steeper increases (Bandon et al., 2008). In a recent analysis of our data on the growth in attentional and behavioral control across this same period, we found that emotion control and maternal behavior were both predictive of trajectories of inhibitory control and attentional control (Graziano, Calkins, & Keane, 2009). Thus, trajectories of self-regulatory development are moderated by both family and child factors.

The data from our longitudinal study suggest that there is a foundational role for early biological self-regulatory processes in terms of supporting the skills necessary to negotiate early developmental challenges, but these skills emerge as a consequence of interactions with caregivers. However, we have also studied the important role of self-regulation for interactions with peers and are investigating the effects of peer relationships on emerging self-regulation skills. We have found that children's abilities to self-regulate are linked to peer relationships as well as to academic success. For example, we observed that in kindergarten, children with

better physiological regulation had higher peer status and this relation was mediated through better social skills for girls and better social skills and fewer behavior problems for boys (Graziano, Keane, & Calkins, 2007). In addition, after accounting for children's behavior problems, quality of the student-teacher relationship, and IQ, emotion regulation was positively associated with teacher report of children's productivity and academic skills in the classroom (Graziano, Reavis, Keane, & Calkins, 2007).

We also examined the role of social preference and perceived acceptance as moderators of the relation between prekindergarten child temperament and kindergarten externalizing behavior. The question of interest here was whether the temperamental dimension of extra-version, which is sometimes associated with acting-out behavior early in development, is moderated by the social skills and peer relationships that children develop. We found that, in fact, girls characterized by high-temperamental surgency/extraversion, high perceived acceptance, and low social preference were at risk for higher levels of teacher-reported and peer-nominated externalizing. In contrast, accurately high perceived acceptance served as a protective factor for high-temperamental surgency/extraversion (Berdan, Keane, & Calkins, 2008). Taken together, our findings on early child regulation and peer relationships illustrate that children bring to their early peer relationships and to the academic setting, patterns of emotional, and behavioral functioning that influence both their emerging social skills and their propensity to engage in behaviors that may disrupt those relationships and academic achievement. Self-regulation skills are foundational to successful relationships, but the role those relationships play in later child functioning is complexly influenced by existing skills and environmental demands and feedback.

Implications of a Self-Regulation Framework for the Study of Antisocial Behavior

In this paper, we have outlined a theoretical framework for addressing questions about the processes and mechanisms that may be implicated in the development, maintenance, and amelioration of childhood behavior problems, problems that may become stable and evolve into more serious antisocial behaviors for some children. We focused on the central role of physiological regulation of arousal in constraining the development of more sophisticated regulatory achievements of childhood, achievements that are critical for successful school, family, and peer functioning. Finally, we highlighted findings from our study of young children's developmental trajectories of self-regulation and early behavior problems, which may presage, for some children at least, future conduct problems and antisocial behavior. Regulatory explanations of antisocial and criminal behavior have focused on low arousal as an indicator of lack of fear (e.g., Raine, 1996) or as a physiological state signaling antisocial individuals to seek stimulation to raise arousal to a more optimal level. Our work extends these conceptualizations and focuses on how arousal regulation in early childhood sets into motion a cascade of other regulatory mechanisms that can help explain some of the child outcomes that are precursors to later, entrenched antisocial behavior.

Future directions of the empirical work investigating this conceptual model will focus on the specification of the processes whereby children with deficits in particular subdomains of self-regulation, when exposed to specific environments, within both peer and family domains, embark on trajectories to very different behavioral outcomes. In addition, there are clearly important questions to be addressed about the relations among the subdomains themselves. Questions about coherence and interaction across domains will help us to understand the degree to which early regulatory developments constrain later achievements. Researchers studying the developments of emotional and behavioral regulation, which may depend on more basic physiological and attentional processes, may need to consider the degree to which these earlier levels of functioning place limits on what can later be achieved in the regulatory domain.

Finally, it is important to consider the implications of a self-regulatory approach to disruptive behavior problems from the perspective of treatment and intervention efforts. For example, psychologists and clinicians interested in designing interventions to address deficits in specific regulatory functions may need to consider the more foundational processes as well as the behaviors of interest. Such an approach has been advocated with respect to the development of early school curricula designed to enhance children's social and academic skills (Calkins & Williford, in press; Diamond, Barnett, Thomas, & Munro, 2007). Targeting foundational skills very early in development may decrease the likelihood that more significant deficits may emerge later in development and may improve the child's chances of outgrowing more normative, though challenging, early behavior problems.

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References

- Achenbach, T.M. Integrative guide for the 1991 CBCL/4–18, YSR and TRF profiles. Burlington, VT: University of Vermont, Department of Psychiatry; 1991a.
- Achenbach, T.M. Manual for the Child Behavior Checklist/4–18 and 1991 profile. Burlington, VT: University of Vermont, Department of Psychiatry; 1991b.
- Achenbach, T.M. Manual for the Child Behavior Checklist/2–3 and 1992 profile. Burlington, VT: University of Vermont, Department of Psychiatry; 1992.
- Achenbach, T.M.; Edelbrock, C. Manual for the Child Behavior Checklist and revised Child Behavior Profile. Burlington, VT: University of Vermont, Department of Psychiatry; 1983.
- Achenbach T.M., Howell C.T., Quay H.C., Conners C.K. National survey of problems and competencies among four- to sixteen-year-olds: Parents' reports for normative and clinical samples. *Monographs of the Society for Research in Child Development* 1991;56:v–120.
- American Psychiatric Association. *Diagnostic and statistical manual of mental disorders*. Vol. 4. Washington, DC: Author; 2000. text revision
- Beauchaine T.P. Vagal tone, development, and Gray's motivational theory: Toward an integrated model of autonomic nervous system functioning in psychopathology. *Development and Psychopathology* 2001;13:183–214. [PubMed: 11393643]
- Beauchaine T.P., Strassberg Z., Kees M.R., Drabick D.A.G. Cognitive response repertoires to child noncompliance by mothers of aggressive boys. *Journal of Abnormal Child Psychology* 2002;30:89–101. [PubMed: 11930975]
- Beauregard, M.; Lévesque, J.; Paquette, V. Neural basis of conscious and voluntary self-regulation of emotion. In: Beauregard, M., editor. *Consciousness, emotional self-regulation and the brain*. Amsterdam: John Benjamins; 2004. p. 163-194.
- Berdan L.E., Keane S.P., Calkins S.D. Temperament and externalizing behavior: Social preference and perceived acceptance as protective factors. *Developmental Psychology* 2008;44:957–968. [PubMed: 18605827]
- Berndt T., Keefe K. Friends' influence on adolescents' adjustment to school. *Child Development* 1995;66:1312–1329. [PubMed: 7555218]
- Bjorklund, D.F.; Harnishfeger, K.K. The evolution of inhibition mechanisms and their role in human cognition and behavior. In: Dempster, F.; Brainerd, C., editors. *Interference and inhibition in cognition*. San Diego, CA: Academic Press; 1995. p. 141-173.
- Blair C., Peters R., Granger D. Physiological and neuropsychological correlates of approach/withdrawal tendencies in preschool: Further examination of the behavioral inhibition system/behavioral

activation system scales for young children. *Developmental Psychobiology* 2004;45:113–124. [PubMed: 15505800]

- Blandon AY, Calkins SD, Keane SP, O'Brien M. Individual differences in trajectories of emotion regulation processes: The effects of maternal depressive symptomatology and children's physiological regulation. *Developmental Psychology* 2008;44:1110–1123. [PubMed: 18605838]
- Broidy LM, Nagin DS, Tremblay RE, Bates JE, Brame B, Dodge KA. Developmental trajectories of childhood disruptive behaviors and adolescent delinquency: A six site, cross-sectional study. *Developmental Psychology* 2003;39:222–245. [PubMed: 12661883]
- Buss KA, Goldsmith HH. Fear and anger regulation in infancy: Effects on the temporal dynamics of affective expression. *Child Development* 1998;69:359–374. [PubMed: 9586212]
- Calkins SD. Origins and outcomes of individual differences in emotional regulation. *Monographs of the Society for Research in Child Development* 1994;59(Nos 2–3):53–72. [PubMed: 7984167]Serial No. 240
- Calkins, SD. Early attachment processes and the development of emotional self-regulation. In: Baumeister, R.; Vohs, K., editors. *Handbook of self-regulation: Research, theory, and applications*. New York: Guilford Press; 2004. p. 324-339.
- Calkins, SD. Regulatory competence and early disruptive behavior problems: The role of physiological regulation. In: Olson, SL.; Sameroff, AJ., editors. *Bio-psychosocial regulatory processes in the development of behavior problems: Biological, behavioral, and social-ecological interactions*. New York: Cambridge University Press; 2009. p. 86-115.
- Calkins SD, Blandon AY, Williford AP, Keane SP. Biological, behavioral, and relational levels of resilience in the context of risk for early childhood behavior problems. *Development and Psychopathology* 2007;19:675–700. [PubMed: 17705898]
- Calkins SD, Dedmon SE. Physiological and behavioral regulation in two-year-old children with aggressive/destructive behavior problems. *Journal of Abnormal Child Psychology* 2000;28:103–118. [PubMed: 10834764]
- Calkins SD, Fox NA. Self-regulatory processes in early personality development: A multilevel approach to the study of childhood social withdrawal and aggression. *Development and Psychopathology* 2002;14:477–498. [PubMed: 12349870]
- Calkins SD, Graziano PA, Keane SP. Cardiac vagal regulation differentiates among children at risk for behavior problems. *Biological Psychology* 2007;74:144–153. [PubMed: 17055141]
- Calkins, SD.; Hill, AL. Caregiver influences on emerging emotion regulation: Biological and environmental transactions in early development. In: Gross, J., editor. *Handbook of emotion regulation*. New York: Guilford Press; 2007. p. 229-248.
- Calkins, SD.; Howse, R. Individual differences in self-regulation: Implications for childhood adjustment. In: Philippot, P., editor. *The regulation of emotion*. Mahwah, NJ: Erlbaum; 2004. p. 307-332.
- Calkins SD, Keane SP. Cardiac vagal regulation across the preschool period: Stability, continuity, and implications for childhood adjustment. *Developmental Psychobiology* 2004;45:101–112. [PubMed: 15505799]
- Calkins, SD.; Williford, AP. Taming the terrible twos: Self-regulation and school readiness. In: Barbarin, O.; Wasik, B., editors. *Handbook of child development and early education*. New York: Guilford Press; in press
- Campbell SB. Behavior problems in preschool children: A review of recent research. *Journal of Child Psychology and Psychiatry* 1995;36:113–149. [PubMed: 7714027]
- Campbell, SB. Behavior problems in preschool children: Clinical and developmental issues. Vol. 2. New York: Guilford Press; 2002.
- Campbell SB, Shaw DS, Gilliom M. Early externalizing behavior problems: Toddlers and pre-schoolers at risk for later maladjustment. *Development and Psychopathology* 2000;12:467–488. [PubMed: 11014748]
- Carlson SM, Davis AC, Leach JG. Less is more: Executive function and symbolic representation in preschool children. *Psychological Science* 2005;16:609–616. [PubMed: 16102063]
- Carlson SM, Moses LJ, Claxton LJ. Individual differences in executive functioning and theory of mind: An investigation of inhibitory control and planning ability. *Journal of Experimental Child Psychology* 2004;87:299–319. [PubMed: 15050456]

- Cassidy J. Emotion regulation: Influences of attachment relationships. *Monographs of the Society of Research in Child Development* 1994;59:228–249.
- Chambers A, Allen J. Cardiac vagal control, emotion, psychopathology, and health. *Biological Psychology* 2007;74:113–115. [PubMed: 17055143]
- Cicchetti D. The emergence of developmental psychopathology. *Child Development* 1984;55:1–7. [PubMed: 6705613]
- Cicchetti D. Developmental psychopathology: Reactions, reflections, projections. *Developmental Review* 1993;13:471–502.
- Cicchetti D, Dawson G. Editorial: Multiple levels of analysis. *Development and Psychopathology* 2002;14:417–420. [PubMed: 12349866]
- Cicchetti D, Rogosch FA. Equifinality and multifinality in developmental psychopathology. *Development and Psychopathology* 1996;8:597–600.
- Cicchetti, D.; Schneider-Rosen, K. An organizational approach to childhood depression. In: Rutter, M.; Izard, CE.; Read, PB., editors. *Depression in young people: Developmental and clinical perspectives*. New York: Guilford Press; 1986. p. 71-134.
- Coie, JD.; Dodge, KA. Aggression and antisocial behavior. In: Damon, W.; Eisenberg, N., editors. *Handbook of child psychology: Vol. 3. Social, emotional, and personality development. Vol. 5*. New York: Wiley; 1998. p. 779-840.
- Cole, PM.; Hall, SE.; Radzioch, AM. Emotional dysregulation and the development of serious misconduct. In: Olson, SL.; Sameroff, AJ., editors. *Biopsychosocial regulatory processes in the development of childhood behavioral problems*. New York: Cambridge University Press; 2009. p. 186-211.
- Cole PM, Martin SE, Dennis TA. Emotion regulation as a scientific construct: Methodological challenges and directions for child development research. *Child Development* 2004;75:317–333. [PubMed: 15056186]
- Cummings M, Ianotti RJ, Zahn-Waxler C. Aggression between peers in early childhood: Individual continuity and developmental change. *Child Development* 1989;60:887–895. [PubMed: 2758884]
- Deater-Deckard K. Annotation: Recent research examining the role of peer relationships in the development of psychopathology. *Journal of Child Psychology and Psychiatry* 2001;42:565–579. [PubMed: 11464962]
- DeGangi G, DiPietro J, Greenspan S, Porges SW. Psychophysiological characteristics of the regulatory disordered infant. *Infant Behavior and Development* 1991;14:37–50.
- Degnan KA, Calkins SD, Keane SP, Hill-Soderlund AL. Profiles of disruptive behavior across early childhood: Contributions of frustrations reactivities, physiological regulation, and maternal behavior. *Child Development* 2008;79:1357–1376. [PubMed: 18826530]
- Diamond A, Barnett SW, Thomas J, Munro S. Preschool program improves cognitive control. *Science* 2007;30:1387–1388. [PubMed: 18048670]
- Dishion, T.; Patterson, G. The development and ecology of antisocial behavior in children and adolescents. In: Cicchetti, D.; Cohen, DJ., editors. *Developmental psychopathology: Vol. 3. Risk, disorder, and adaptation. Vol. 2*. Hoboken, NJ: Wiley; 2006. p. 503-541.
- Dishion, T.; Piehler, T. Peer dynamics in the development and child change of child and adolescent problem behavior. In: Masten, A., editor. *Multilevel dynamics in developmental psychopathology: Pathways to the future*. New York: Taylor & Francis/Erlbaum; 2007. p. 151-180.
- Dodge K, Bates J, Pettit G. Mechanisms in the cycle of violence. *Science* 1990;250:1678–1689. [PubMed: 2270481]
- Dodge KA, Pettit GS. A biopsychosocial model of the development of chronic conduct problems in adolescence. *Developmental Psychology* 2003;39:349–371. [PubMed: 12661890]
- Eisenberg N, Cumberlund A, Spinrad TL, Fabes RA, Shepard SA, Reiser M, et al. The relations of regulation and emotionality to children's externalizing and internalizing problem behavior. *Child Development* 2001;72:1112–1134. [PubMed: 11480937]
- Eisenberg N, Fabes R, Bernzweig J, Karbon M. The relations of emotionality and regulation to preschoolers' social skills and sociometric status. *Child Development* 1993;64:1418–1438. [PubMed: 8222881]

- Eisenberg N, Fabes RA, Guthrie IK, Murphy BC, Maszk P, Holmgren R, et al. The relations of regulation and emotionality to problem behavior in elementary school children. *Development and Psychopathology* 1996;8:141–162.
- Eisenberg N, Fabes RA, Murphy B, Maszk P. The role of emotionality and regulation in children's social functioning: A longitudinal study. *Child Development* 1995;66:1360–1384. [PubMed: 7555221]
- Espy KA, McDiarmid MM, Cwik MF, Stalets MM, Hamby A, Senn TE. The contribution of executive functions to emergent mathematic skills in preschool children. *Developmental Neuropsychology* 2004;26:465–486. [PubMed: 15276905]
- Foster EM, Jones D. Conduct problems prevention research group. Can a costly intervention be cost effective. *Archives of General Psychiatry* 2006;63:1284–1291. [PubMed: 17088509]
- Frick PJ. Developmental pathways to conduct disorder. *Child and Adolescent Psychiatric Clinics in North America* 2006;15:311–331.
- Frick PJ, Cornell AH, Bodin SD, Dane HA, Barry CT, Loney BR. Callous–unemotional traits and developmental pathways to severe conduct problems. *Developmental Psychology* 2003;39:246–260. [PubMed: 12661884]
- Frick PJ, White SF. Research review: The importance of callous–unemotional traits for developmental models of aggressive and antisocial behavior. *Journal of Child Psychology and Psychiatry* 2008;49:359–375. [PubMed: 18221345]
- Gardner FE. The quality of joint activity between mothers and their children with behavior problems. *Journal of Child Psychology and Psychiatry* 1994;35:935–948. [PubMed: 7962249]
- Gardner T, Dishion T, Connell A. Adolescent self-regulation as resilience: Resistance to antisocial behavior within the deviant peer context. *Journal of Abnormal Child Psychology* 2008;36:273–284. [PubMed: 17899361]
- Gathercole SE, Brown L, Pickering SJ. Working memory assessments at school entry as longitudinal predictors of National Curriculum attainments levels. *Educational and Child Psychology* 2003;20:109–122.
- Gilliom M, Shaw DS. Codevelopment of externalizing and internalizing problems in early childhood. *Development and Psychopathology* 2004;16:313–333. [PubMed: 15487598]
- Graziano PA, Calkins SD, Keane SP. Caregiver behavior and child temperament differentially predict children's behavioral inhibition and cognitive inhibition development. 2009Manuscript submitted for publication
- Graziano PA, Keane SP, Calkins SD. Cardiac vagal regulation and early peer status. *Child Development* 2007;78:264–278. [PubMed: 17328704]
- Graziano PA, Reavis RD, Keane SP, Calkins SD. The role of emotion regulation in children's early academic success. *Journal of School Psychology* 2007;45:3–19.
- Gunnar, MR. Social regulation of stress in early child development. In: McCartney, K.; Phillips, D., editors. *Blackwell handbook of early childhood development*. New York: Blackwell; 2006. p. 106-125.
- Hartup WW. Aggression in childhood: Developmental perspectives. *American Psychologist* 1974;29:337–341.
- Hartup WW. The company they keep: Friendships and their developmental significance. *Child Development* 1996;67:1–13. [PubMed: 8605821]
- Henry B, Caspi A, Moffitt T, Silva P. Temperamental and familial predictors of violent and non-violent criminal convictions: Age 3 to 18. *Developmental Psychology* 1996;32:614–623.
- Hill AL, Degnan KA, Calkins SD, Keane SP. Profiles of externalizing behavior problems for boys and girls across preschool: The roles of emotion regulation and inattention. *Developmental Psychology* 2006;42:913–928. [PubMed: 16953696]
- Hill-Soderlund AL, Mills-Koonce WR, Propper C, Calkins SD, Granger DA, Moore GA, et al. Parasympathetic and sympathetic responses to the strange situation in infants and mothers from avoidant and securely attached dyads. *Developmental Psychobiology* 2008;50:361–376. [PubMed: 18393278]
- Hinshaw SP, Lahey BB, Hart EL. Issues of taxonomy and comorbidity in the development of conduct disorder. *Development and Psychopathology* 1993;5:31–49.

- Hirschi, T. Self-control and crime. In: Baumeister, RF.; Vohs, KD., editors. *Handbook of self-regulation: Research, theory, and applications*. New York: Guilford Press; 2004. p. 537-552.
- Howse RB, Calkins SD, Anastopoulos AD, Keane SP, Shelton TL. Regulatory contributors to children's kindergarten achievement. *Early Education and Development* 2003;14:101-119.
- Hubbard JA. Emotion expression processes in children's peer interaction: The role of peer rejection, aggression, and gender. *Child Development* 2001;72:1426-1438. [PubMed: 11699679]
- Huffman LC, Bryan Y, del Carmen R, Pederson F, Doussard-Roosevelt J, Porges S. Infant temperament and cardiac vagal tone: Assessments at twelve weeks of age. *Child Development* 1998;69:624-635. [PubMed: 9680676]
- Keane SP, Calkins SD. Predicting kindergarten peer social status from toddler and preschool problem behavior. *Journal of Abnormal Child Psychology* 2004;32:409-423. [PubMed: 15305546]
- Keenan, K.; Shaw, DS. Exploring the etiology of antisocial behavior in the first years of life. In: Lahey, BB.; Moffitt, TE.; Caspi, A., editors. *Causes of conduct disorder and juvenile delinquency*. New York: Guilford Press; 2003. p. 153-181.
- Keiley MK, Lofthouse N, Bates JE, Dodge KA, Pettit GS. Differential risks of covarying and pure components in mother and teacher reports of externalizing and internalizing behavior across ages 5 to 14. *Journal of Abnormal Child Psychology* 2003;31:267-283. [PubMed: 12774860]
- Kochanska G. Children's temperament, mother's discipline, and security of attachment: Multiple pathways to emerging internalization. *Child Development* 1995;66:597-615.
- Kopp C. Antecedents of self-regulation: A developmental perspective. *Developmental Psychology* 1982;18:199-214.
- Krueger R, Caspi A, Moffitt T, White J, Stouthamer-Loeber M. Delay of gratification, psychopathology, and personality: Is low self-control specific to externalizing problems. *Journal of Personality* 1996;64:107-129. [PubMed: 8656312]
- Lahey, BB.; Moffitt, TE.; Caspi, A. *Causes of conduct disorder and juvenile delinquency*. New York: Guilford Press; 2003. *Causes of conduct disorder and juvenile delinquency*.
- Lahey BB, Waldman I, McBurnett K. The development of antisocial behavior: An integrative causal model. *Journal of Child Psychology and Psychiatry* 1999;40:669-682. [PubMed: 10433402]
- Lilienfield SO. Comorbidity between and within childhood externalizing and internalizing disorders: Reflections and directions. *Journal of Abnormal Child Psychology* 2003;31:285-291. [PubMed: 12774861]
- McFayden-Ketchum SA, Bates JE, Dodge KA, Pettit GS. Patterns of change in early childhood aggressive-disruptive behavior: Gender differences in predictions from early coercive and affectionate mother-child interactions. *Child Development* 1996;67:2417-2433. [PubMed: 9022248]
- Melnick S, Hinshaw S. Emotion regulation and parenting in AD/HD and comparison boys: Linkages with social behavior and peer preference. *Journal of Abnormal Child Psychology* 2000;28:73-86. [PubMed: 10772351]
- Moffitt, TE. Life-course persistent and adolescence-limited antisocial behavior: A 10-year research review and a research agenda. In: Lahey, BB.; Moffitt, TE.; Caspi, A., editors. *Causes of conduct disorder and juvenile delinquency*. New York: Guilford Press; 2003. p. 49-75.
- Nagin D, Tremblay R. Trajectories of boys' physical aggression, opposition, and hyperactivity on the path to physically violent and nonviolent juvenile delinquency. *Child Development* 1999;70:1181-1197. [PubMed: 10546339]
- NICHD Early Child Care Research Network. Trajectories of physical aggression from toddlerhood to middle childhood. *Monographs of the Society for Research in Child Development* 2004;69:vii-129.
- Nigg, J.; Huang-Pollock, C. An early-onset model of the role of executive functions and intelligence in conduct disorder/delinquency. In: Lahey, BB.; Moffitt, TE.; Caspi, A., editors. *Causes of conduct disorder and juvenile delinquency*. New York: Guilford Press; 2003. p. 227-253.
- Ochsner, K.; Gross, J. Thinking makes it so: A social cognitive neuroscience approach to emotion regulation. In: Baumeister, RF.; Vohs, KD., editors. *Handbook of self-regulation: Research, theory, and applications*. New York: Guilford Press; 2004. p. 229-255.

- Oldehinkel A, Hartman C, De Winter A, Veenstra R, Ormel J. Temperament profiles associated with internalizing and externalizing profiles in preadolescence. *Development and Psychopathology* 2004;16:421–440. [PubMed: 15487604]
- Olson, S.; Sameroff, A. *Biopsychosocial regulatory processes in the development of childhood behavioral problems*. New York: Cambridge University Press; 2009.
- Patterson, GR. *Coercive family processes*. Eugene, OR: Castalia; 1982.
- Patterson GR, DeBaryshe BD, Ramsey E. A developmental perspective on antisocial behavior. *American Psychologist* 1989;44:329–335. [PubMed: 2653143]
- Petitt GS, Bates JE, Dodge KA. Family interaction patterns and children's conduct problems at home and school: A longitudinal perspective. *School Psychology Review* 1993;22:403–420.
- Porges SW. The polyvagal theory: Phylogenetic contributions to social behavior. *Physiology and Behavior* 2003;79:503–513. [PubMed: 12954445]
- Porges SW. The polyvagal perspective. *Biological Psychology* 2007;74:116–143. [PubMed: 17049418]
- Poulin F, Dishion TJ, Haas E. The peer influence paradox: Friendship quality and deviancy training within male adolescent friendships. *Merrill–Palmer Quarterly* 1999;45:42–61.
- Raine, A. Autonomic nervous system activity and violence. In: Stoff, DM.; Cairns, RB., editors. *Aggression and violence*. Hillsdale, NJ: Erlbaum; 1996. p. 145-168.
- Richters JE. The Hubble hypothesis and the developmentalist's dilemma. *Development and Psychopathology* 1997;9:193–229. [PubMed: 9201442]
- Rothbart M, Ahadi S, Hershey KL. Temperament and social behavior in childhood. *Merrill–Palmer Quarterly* 1994;40:21–39.
- Rubin, KH.; Booth, C.; Rose-Krasnor, L.; Mills, RSL. Social relationships and social skills: A conceptual and empirical analysis. In: Shulman, S., editor. *Close relationships and socioemotional development*. Norwood, NJ: Ablex; 1995. p. 63-94.
- Rubin, K.; Bukowski, W.; Parker, J. Peer interactions, relationships and groups. In: William, D.; Eisenberg, N., editors. *Handbook of child psychology: Vol. 3. Social, emotional, and personality development*. Vol. 5. Hoboken, NJ: Wiley; 1998. p. 619-700.
- Rutter M. Commentary: Causal processes leading to antisocial behavior. *Developmental Psychology* 2003;39:372–378. [PubMed: 12661891]
- Salisch M. Children's emotional development: Challenges in their relationships to parents, peers and friends. *International Journal of Behavioral Development* 2001;25:310–319.
- Shaw DS, Gilliom M, Ingoldsby EM, Nagin D. Trajectories leading to school-age conduct problems. *Developmental Psychology* 2003;39:189–200. [PubMed: 12661881]
- Shaw DS, Winslow EB, Owens EB, Vondra JI, Cohn JF, Bell RQ. The development of early externalizing problems among children from low-income families: A transformational perspective. *Journal of Abnormal Child Psychology* 1998;26:95–107. [PubMed: 9634132]
- Smith CL, Calkins SD, Keane SP, Shelton TL, Anastopoulos AD. Predicting stability and change in toddler behavior: Contributions of maternal behavior and child gender. *Developmental Psychology* 2004;40:29–42. [PubMed: 14700462]
- Sroufe LA. Early relationships and the development of children. *Infant Mental Health Journal* 2000;21:67–74.
- Sroufe LA, Rutter M. The domain of developmental psychopathology. *Child Development* 1984;55:17–29. [PubMed: 6705619]
- Suveg C, Zeman J. Emotion regulation in children with anxiety disorders. *Journal of Clinical Child and Adolescent Psychology* 2004;33:750–759. [PubMed: 15498742]
- Tremblay RE. The development of aggressive behavior during childhood: What have we learned in the past century? *International Journal of Behavioral Development* 2000;24:129–141.
- Vohs, K.; Baumeister, R. Ego depletion, self-control, and choice. In: Greenberg, J.; Koole, SL.; Pyszczynski, T., editors. *Handbook of experimental existential psychology*. New York: Guilford Press; 2004. p. 398-410.
- Williford AP, Calkins S, Keane S. Predicting change in parenting stress across early childhood: Child and maternal factors. *Journal of Abnormal Child Psychology* 2007;35:251–263. [PubMed: 17186365]

- Willoughby M, Kupersmidt J, Bryant D. Overt and covert dimensions of antisocial behavior in early childhood. *Journal of Abnormal Child Psychology* 2001;29:177–187. [PubMed: 11411781]
- Zelazo PD, Müller U, Frye D, Marcovitch S. The development of executive function in early childhood. *Monographs of the Society for Research in Child Development* 2003;68(3)Serial No. 274