Biopsychosocial Regulatory Processes in the Development of Childhood Behavioral Problems

Edited by

Sheryl L. Olson and Arnold J. Sameroff

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BIOPSYCHOSOCIAL REGULATORY PROCESSES IN THE DEVELOPMENT OF CHILDHOOD BEHAVIORAL PROBLEMS

In this timely volume, leading behavioral scientists describe recent advances in our understanding of the multiple biopsychosocial regulatory processes underlying the development of children's behavior disorders. A full spectrum of regulatory influences is addressed, ranging from genes to cultural factors. Individual chapters highlight the importance of developing research paradigms that synthesize biological, behavioral, and social-ecological influences and of viewing self-regulation as a complex system that reorganizes across development. The regulatory foundations of a diverse range of childhood behavior problems are examined, including anxiety, social withdrawal, depression, conduct problems, inattention and impulsivity, and sleep problems.

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PREFACE

The theme of regulatory disturbances in development is an exciting and timely topic. In recent years, there has been an explosion of research on regulatory processes governing the development and expression of child psychopathology. A diverse range of biological, behavioral, and social-ecological processes have been shown to play integral roles in the development of childhood behavior disorders. Conceptualizing the nature of these influences and "capturing" them in research paradigms remain strong challenges for developmental scientists. For example, when we refer to a child's functioning as *dysregulated*, we could be describing atypical patterns of psychophysiological responding, extreme fluctuations of activity or attention, loss of control over behavioral impulses, or variations in the expression, intensity, duration, or patterning of emotional responding. Moreover, without knowing the specific developmental or social contexts of the child's behavior, we cannot assign meaning to any of the pieces of this puzzle. Current theoretical models of psychopathology and self-regulation underscore the importance of developing research paradigms that synthesize biological, behavioral, and social influences. However, most prior research on the regulatory bases of child behavior disorders has been domain-specific. Thus, our first goal was to provide a series of "state of the art" chapters presenting a full spectrum of regulatory processes. In this spirit, each of our contributing authors has examined interactions among regulatory influences that range from genes to cultural factors. We hope that our volume will help stimulate a new phase of thinking about regulatory disturbances in development, one that is marked by thoughtful integrations across different domains, levels, and paradigms.

Including the term "regulatory *processes*" in our title signals our second goal: to address issues in the conceptualization of self-regulation as a dynamic system process. Concepts of regulation are inherently active, including both in-the-moment responses to environmental challenges and complex changes in the organization of regulatory behaviors across development. Not surprisingly, however, theory has outpaced empirical research on dynamic processes in development. We hope that our volume will inspire further thinking and research into the nature of self-regulation as a complex system that reorganizes across time in response to changes in the child and in his or her social experiences.

The structure of our volume follows a hierarchical pathway, moving from biological to behavioral and then to social contextual processes thought to influence the development of children's behavior disorders. This organizational structure offers a somewhat artificial guideline, in light of our goal of integrating across various domains and levels of regulatory processes while identifying top-down as well as bidirectional influences.

When navigating challenging terrain, it helps to have a good map. In our introductory chapter, Sameroff provides a set of conceptual guideposts for understanding self-regulation as a complex system of multilevel processes that change dynamically across development. The next four chapters (Chapters 2–5) primarily address the biological foundations of emotion regulation. Suomi conceptualizes emotion regulation as an "emergent property" of early socialization in rhesus monkeys, showing how genetic risk for two patterns of regulatory disorders, excessive fearfulness and impulsive aggression, can be significantly altered by the quality of socialization that infant monkeys experience. Keenan, Jacob, Grace, and Gunthorpe discuss challenges inherent in understanding the nature of poorly regulated responses to stress in human neonates and in linking these responses to individual differences in neuroendocrine function. They illustrate how our definitions of "atypical" responding must be understood as a complex *pattern* of behavior with time-sensitive parameters, such as intensity, duration, rapidity of buildup, and lability, that vary across different contexts of environmental stress, even within the same child. Similarly, Lopez-Duran, Olson, Felt, and Vazquez define emotion regulation as a chain of neurocognitive processes that moderate the activation, intensity, duration, quality, and expression of emotional experience. Focusing on the neuroendocrine foundations of behavioral inhibition in young children, they show how individual differences in stress regulation must be understood in light of co-occurring bio-behavioral processes, specific contextual influences, and development. Calkins also highlights the central role played by physiological arousal in the development of early regulatory competence. Conceptualizing self-regulation as a multilevel construct, she describes how failures in the early regulation of arousal have cascading consequences for understanding the later development of attentional, emotional, and behavioral regulatory vulnerabilities that underlie early disruptive behavior problems.

The next three chapters (Chapters 6–8) highlight individual differences in the development of behavior regulation. First, Bates, Goodnight, Fite, and Staples conceptualize behavioral adjustment as the product of an interaction between the child's temperament traits and salient aspects of family and peer socialization. Following "goodness of fit" models, they show how biologically rooted behavioral traits that propel a child toward extremes of regulatory difficulties, such as impulsive aggression, are amplified by the quality of the child's relationships with parents and with peers. Next, Olson, Sameroff, Lunkenheimer, and Kerr outline a conceptual model for understanding how early regulatory failures become "translated" into enduring patterns of disruptive behavior. They argue that, to understand the nature of this complex process, we must attend to early failures in self-regulation that place children at elevated risk for psychopathology, how these vulnerabilities transact with qualities of the child's social experiences, and how child and parent gender moderate these processes. Cole, Hall, and Radzioch then discuss the nature of emotion dysregulation in development, tracing pathways from early emotion dysregulation to severe conduct problems in later life. They argue that severe conduct problems reflect the operation of failures in multiple emotion systems that transact with family-level risks over the course of development.

Social contextual factors that play critical roles in the development of regulatory competence are illuminated in Chapters 9 to 12. Cummings, Papp, and Kouros outline complex transactional processes that lead to emotional distress and behavioral dysregulation in children who experience a potent form of social risk – destructive marital conflict. They show how children's emotional responses to interpersonal conflict function as regulatory processes that activate maladaptive coping responses, a common pathway to diverse behavior problems. Volling, Kolak, and Blandon argue that the quality of children's early self-regulation reflects complex family system dynamics that have been ignored in prior research. For example, they illustrate how a toddler's early regulatory competence is an emergent property of complex family subsystem dynamics, such as the quality of co-parenting or a parent's differential treatment of siblings. At a broader level of contextual influence, Tardif, Wang, and Olson examine the nature of cultural influences on early emotion regulation. Comparing the development of young children growing up in China and the United States, they show how differing cultural preferences of self-regulation can be examined from the consideration of biological, behavioral, and social differences in the expression and regulation of emotion.

Finally, Dahl and Conway discuss common themes that were presented in individual chapters, thereby extending the focus on the regulation of negative emotions to include positive ones as well. Beginning with the many biopsychosocial regulatory challenges that characterize early child development, they go on to describe how analogous integrative challenges occur in other developmental epochs, using adolescence as an example.

This volume grew out of a symposium on regulatory processes in development that was held at the University of Michigan in May 2003. We are indebted to the University of Michigan Office of the Vice President for Research and to the Horace H. Rackham School of Graduate Studies for providing major financial backing of our symposium through their Distinguished Faculty and Graduate Student Seminar program. We are indebted to the National Institute of Mental Health for sharing the cost of this seminar through the mechanism of Arnold Sameroff's Center for Development and Mental Health. We also thank the University of Michigan School of Social Work, Center for Human Growth and Development (CHGD), Department of Psychology, and Committee for Children for their generous assistance. Among the individuals whose assistance has been invaluable, we especially want to acknowledge Linda Anderson, Evelyn Craft-Robinson, and Cindy Overmyer. Last but not least, we thank our authors for their excellent contributions.

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Conceptual Issues in Studying the Development of Self-Regulation

ARNOLD J. SAMEROFF

> The romantic myth of literary genius which has long promoted an effortless and unfathomable Shakespeare, cannot easily accommodate a model of a Shakespeare whose greatness was a product of labor as much as talent. The humbler portrait of Shakespeare . . . is of a writer who knew himself, knew his audience, and knew what worked.
>
> (Shapiro, 2005, p. 303)

The capacity for self-regulation is a hallmark of successful development. People engage in a variety of interactions with the physical, cognitive, and social world that require responsiveness to the actions of others while at the same time making a variety of choices. The agentic aspect of this engagement is understood as self-regulation. Although the construct of self-regulation originated in general systems theories whose concern was the complexity of bidirectional part-whole relationships in biology and physics, the adoption of the construct by developmental psychologists has tended to isolate the part from the whole, so that regulation is seen as a trait of the individual, rather than the result of the individual's experience with the context of development. Understanding self-regulation as intertwined with experiences in the social context will produce more accurate scientific predictions as well as more efficient intervention programs to improve children's behavioral problems.

Human self-regulation ultimately means knowing one's self, knowing one's context, and knowing how to interact with that context to achieve individual goals. Therefore, study of the development of self-regulation must encompass four issues: how individuals come to know themselves, understand the world in which they live, develop a set of goals, and understand how their actions can lead toward those goals. An important empirical question is whether this knowledge grows through interactions with other agentic beings or whether it arises as a "romantic myth" of inherent capacities.

Calkins and Fox (2002) proposed three different approaches to the study of self-regulation as an aspect of personality. The first considers the multiple influences on individual development, which include individuals, groups, and cultures, considered separately or in reciprocal interaction. The second adds a developmental dimension and considers these social interactions in a hierarchical cascade in which early face-to-face interactions set the stage for attachment relations that become the basis for later social interactions. The third gives equal considerations to physiological, emotional, behavioral, and social processes within the individual that differentiate and interact over time to produce self-regulation. To these, I would add a fourth approach that bridges individual factors and social factors and defines behavioral self-regulation as an emergent of social regulation.

During early development, human regulation moves from the primarily biological to the psychological and social. What begins as a process for regulating temperature, hunger, and arousal soon turns to the regulation of attention, behavior, and social interactions. These achievements in "self"-regulation are heavily influenced by "other"-regulation. Parents are the ones who keep children warm, feed them, and cuddle them when they cry; peers provide children with knowledge about the range and limits of their social behavior; and teachers socialize children into group behavior, as well as regulate cognition into socially constructed domains of knowledge. Although these other-regulators can be considered background to the emergence of inherent individual differences in regulatory capacities, there has been much evidence from longitudinal research among humans and cross-fostering studies in other animals that "self"-regulatory capacities are heavily influenced by the experience of regulation provided by caregivers. The "other"-regulation position is that the capacity for self-regulation arises through the actions of others.

Sleep is an interesting example of a process in which biological regulation becomes psychological regulation through social regulation. As wakefulness begins to emerge as a distinct state, it is expanded and contracted by interactions with caregivers who stimulate alertness and facilitate sleepiness. Although it remains an essential biological process, eventually sleep takes on a large degree of self-regulation as the child and then adult make active decisions about waking time and sleeping time. But this agentic decision making remains intimately connected with other-regulation in terms of the demands of school and work for specific periods of wakefulness.

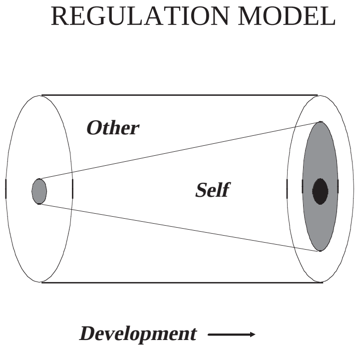

Figure 1.1. Changing balance between other-regulation and self-regulation as the child develops into an adult.

This volume is devoted to presenting the empirical evidence for the development of self-regulation. In what follows, we deal with the definition of self-regulation as it makes the transition from explaining biological to explaining psychological functioning. We will be concerned with delineating and differentiating what the child and the socializing environment contribute to the process. Generally, research on self-regulation has focused on part-processes, such as emotion or attention, separately from each other. This process of isolation obscures the larger picture in which many interacting systems are playing a role. For example, without regulation provided by the social context, the young child would not survive to engage in emotional or attentional processes. The other-regulation of nutrition and temperature provides clear examples of survival necessities.

Sameroff and Emde (1989), in a discussion of infant mental health diagnoses, argued for a position that infant diagnoses cannot be separated from relationship diagnoses. Their point is that, in early development, life is a "we-ness," rather than an "I-ness." The developmental and clinical question in this case is when does diagnosis become individualized; in other words, when can we say that a child has a self-regulation problem. Their proposal was to examine the point in development at which areas of self-regulation become independent of specific contexts and are carried into new relationships. This issue of the developmental expansion of self-regulation is captured by the *ice-cream cone-in-a-can* model of development (Sameroff & Fiese, 2000). In Figure 1.1, the developmental changes in this relationship between individual and context are represented as an expanding cone within a cylinder. The balance between other-regulation and self-regulation shifts as the child is able to take on more and more responsibility for his or her own well-being. The infant, who at birth could not survive without the caregiving environment, eventually reaches adulthood and can become part of the other-regulation of a new infant, thereby beginning the next generation.

REGULATION AS A SYSTEMS PROPERTY

There are several ways of thinking about the history of regulation as a developmental construct. One approach is to count the growth in the number of times that the terms "regulation," "self-regulation," or "emotional regulation" occur in indexes of child development meeting programs or the number of times these constructs are mentioned in developmental textbooks (Eisenberg, Champion, & Ma, 2004). This is akin to describing the growth of the child by measuring his or her weight across time. Both measures show an increase. The more interesting question is the source of this increase. Did the increase occur because researchers discovered a new area of development that had gone unnoticed? Did it occur because researchers did not discover a new area, but simply renamed an old one? Or did the increase occur because researchers were using a new theory for examining existing areas of research? The answer is probably a mix of all three. The core change in research orientation came with a shift from static trait models of behavior to dynamic process models (Sameroff, 1983). Frequent attributions are made to the work of Rothbart (Rothbart & Derryberry, 1981) and her redefinition of temperamental traits as process variables – reactivity and self-regulation. Then, in collaboration with Posner, she presented an integrated view emphasizing the emotional aspects of reactivity and the cognitive aspects of self-regulation conceptualized as executive functioning (Posner & Rothbart, 2000).

However, this empirical change in orientation is embedded in a much larger theoretical and empirical context. The theoretical context is reflected in the history of systems thinking (von Bertalanffy, 1968) and considerations of the organismic metaphor (Overton & Reese, 1973). The empirical context is reflected in the explosive growth of molecular biology and its extension into cognitive and affective neuroscience. From the theoretical perspective, there is always a disconnect between the complexity of reality and the necessarily simpler empirical constructs. The belief of bottom-up scientists has been that, by understanding the basic units of life (either physical, biological, or psychological), the more complex forms will be understood. The belief of top-down scientists is that basic units participate in larger wholes that give meaning to the activity of the units – what is usually described as emergent properties.

A wonderful example of the bottom-up approach is the recently completed human genome project that was touted as offering an explanation for all illnesses of humankind (Collins, 1998). However, on completion of this mapping of all human genes, no such explanation was forthcoming. Because of the large number of such genes (∼25,000, fewer than expected), predicting the particular combinations that would produce proteins is essentially impossible. Similar to language use but of a different magnitude, the smaller number of 25,000 genes (letters) can produce a much larger set of one to two million proteins (words). Using gene mapping to understand all human illness would be akin to the classic question of whether monkeys at a typewriter could come up with Shakespeare. Recent attempts to answer this question with simulations have been able to get virtual monkeys to type a string of only 19 characters that appear in any of Shakespeare's work, and this minor accomplishment took 42,162,500,000 billion billion monkey years (Wershler-Henry, 2007).

As a consequence of this bottom-up disconnect, molecular biologists interested in the biological contributions to disease have shifted their interest to the more complex biological structure of proteins in the relatively new field of proteomics. And proteins and their combinations are still near the beginning of a bottom-up explanation of human biological functioning. The top-down approach, in which researchers study the disease process and try to identify the genes that contribute to it, has proven to be much more fruitful in understanding disorder.

The primary reason that there is a gap between studying regulatory processes (the parts) and understanding human development (the whole) is that they have evolved together: there has always been a context in which to organize the parts into a viable and replicable system. Species and their environments have evolved together in a coactive and transactional relationship. In Gottlieb's (1992) coaction model for explaining developmental causality, development requires a relationship not only between two components, usually an organism and its context, but also between components of the same organism. Neither the internal expression of genes nor external stimulation can explain development, but their relationship can – what is typically called experience.

Biological development and evolution are fertile models for understanding the psychological analogs. The activity of single-cell bacteria in the primordial soup from which they evolved produced oxygen that changed the atmosphere and permitted the evolution of newer oxygen-utilizing bacteria with more efficient metabolic processes. The transactional consequence, however, was that the prior oxygen-producing cells could not survive in the new environment. In addition, species not only transact with the environment but also with each other. Nutritional sources that had been restricted to simple compounds for the original single-cell life-forms became more complex as life became more complex. For example, the evolution of jaws expanded the possible food supplies for a new set of predators. The colonization of land by plants provided a food source for animals to follow. Fish and then amphibians had been limited to the water for reproduction, but reptiles developed the hard-shelled egg that gave them the capacity to live completely on land. Mammals, who developed placental reproduction and could thus provide a highly stable, insulated, internal early environment for their offspring, were even more independent of their environment. Each step in the evolutionary sequence provided new opportunities for adaptation. Whenever the environment changed, either as new species emerged or through geological changes (e.g., the volcanic Galapagos Islands), new adaptations were possible so that new selective advantages could be achieved for one species or another.

The implications for the study of human behavioral regulatory processes are that these processes evolved in a context where such regulations were needed. The study of emotions from a functional perspective (Campos, Frankel, & Camras, 2004) focuses on the organizing and adaptive role of emotions. Functionality implies a relation between individuals and their contexts. However, it can also reflect relations among different aspects of the individual. Much of the recent discussions of temperament describe it as a relationship between arousal and attentional processes, both described in regulation terminology. Moreover, these regulation processes are embedded not only in the relation between child and context but also in the additional relations between the family and its cultural and economic situations (Raver, 2004).

When we turn our attention to the development of behavioral regulation, many additional dynamics become salient. Over time, the brain changes, the body changes, the mind changes, and the environment changes along courses that may be somewhat independent of each other and somewhat a consequence of experience with each other. Discussions of behavioral regulation presented in the chapters in this book primarily focus on short-term processes in the relation between biological measures and child behavior or between child and parent behavior. These micro-regulations gain significance when they are understood in reference to what are described later as mini- and macro-regulations that operate on a larger timescale and incorporate these shorter term processes into a developmental agenda for the child. In the rest of this chapter, I outline a theoretical view of these regulatory systems within an evolutionary, intergenerational framework.

THE ENVIRONTYPE

The study of self-regulation and of other-regulation is highly contextualized. To adequately interpret these constructs, the general scope of developmental psychology needs to be augmented by two relatively recent major approaches, the orientations of life span (Baltes, 1979) and life course theories (Elder, 1979), in addition to the more traditional evolutionary approach. Life span approaches place development within a much larger time frame by redefining adulthood as a period of continuing individual change, but one that is in much more intimate contact with life experiences in the family and the workplace. Life course theory emphasizes the linking of lives – that each individual's development is influenced by and influences the development of other close individuals, especially other family members. For example, the development of the offspring of teenage mothers may take a different course from that of the offspring of mothers in their thirties and forties. Younger mothers may have more energy, whereas older mothers may have more resources. This theory also emphasizes that the life course occurs in history and that major social events have cohort effects on these linked lives. Historical events that stress parents, such as wars and economic downturns, will affect their child-rearing interactions and may have different consequences for younger children than for older ones (Elder, 1979).

The evolutionary approach is more than an acknowledgment that humans have evolved; it also incorporates the realization that communities continue to behave in accordance with evolutionary principles emphasizing reproductive fitness, measured by the number of offspring who will continue to reproduce the species, in general, and their society specifically. The prolonged development of human offspring relative to that of other animals has required an evolution in the complexity of the social organization that supports that development from birth to adulthood and beyond. This entire period that is repeated generation after generation is based on the interactions among a host of regulatory systems. These regulatory systems range from the here-and-now experiences of mother-infant interactions to governmental concern with the burden of national debt that will be passed on to the next generation and to conservationists' concerns with the fate of the planet as a viable environment for future generations of humans. Despite the immense complexity of cataloging all such regulation processes, I attempt to provide here a simple conceptual framework.

Just as there is a biological organization, the genotype, that regulates the physical development of each individual, there is a social organization that regulates the way human beings fit into and reproduce their society. This organization operates through socialization patterns of societal

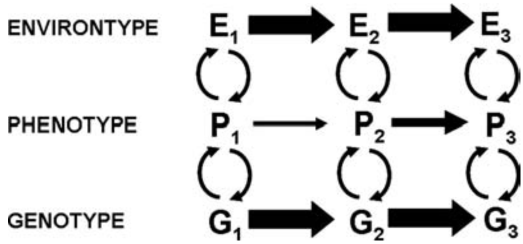

Figure 1.2. Regulation model of development with transactions among genotype, phenotype, and environtype.

institutions such as the family, the school, and the community and has been postulated to compose an *environtype* analogous to the biological *genotype* (Sameroff, 1989). In both cases there is a code, either genetic or environmental, that is preserved and transmitted from one generation to another. The genotype is preserved in a biological set of molecules contained within a genome, whereas the environtype is preserved through psychological meaning systems. Many of the chapters in this book are devoted to specifying the interactions between biological and behavioral systems that are the proximal manifestations of these more distal regulatory systems and that deserve attention especially when these regulations are dysfunctional. The use of developmental psychopathology as a framework in these studies seeks examples of maladaptation in these interactions to illuminate the complexity of adaptive regulations in human development.

The child's behavior at any point in time is a product of the transactions among the phenotype (i.e., the child), the environtype (i.e., the source of external experience), and the genotype (i.e., the source of biological organization; see Figure 1.2). This regulatory system is reciprocally determined at each point in development. On the biological side, the genotype in each cell is identical, but the particular set of genes active at any point in time is regulated by the state of the phenotype. Depending on the current chemical environment, certain genes are activated that alter the phenotype. The altered phenotype may then act reciprocally to deactivate the original genes and activate another set that will produce further developmental changes in the phenotype. On the environmental side, the environtype contains a range of possible reactions to the child, but the particular regulating experiences that are active at any point in time are in response to the behavioral status of the child's phenotype. Once the child changes as a consequence of one set of experiences, that set of experiences may be inhibited and another set activated in response to the changed status of the child. An early example would be the change in human parent feeding behavior as the milk provided by breast or bottle leads to growth and changes in the child's digestive capacities that permit solid feeding and the reduction in nipple feeding.

Traditional research on child development has emphasized the child's utilization of biological capacities to gain experience and the role of experience in shaping child competencies, but has paid far less attention to how that experience is organized. Indeed, the organization of experience is explicit in the great amount of attention given to curriculum development in educational programs, but far less attention is given to the implicit organization of experience found in the family and social contexts that comprise the environtype. The environtype is composed of subsystems that transact not only with the child but also with each other. Bronfenbrenner (1977) provides the most detailed descriptions of environmental organizations that influence developmental processes within these categories: microsystems, mesosystems, exosystems, and macrosystems.

For our present purposes, we restrict the discussion to levels of environmental factors contained within the culture, family, and the individual parent, although other social settings, such as schools, have their own encoded traditions. Developmental regulations at each of these levels can be conceptualized as codes: a cultural code, a family code, and a code of the individual parent. These codes regulate cognitive and social-emotional development so that the child ultimately will be able to fill a role defined by society. They are hierarchically related in their evolution and in their current influence on the child. The experience of the developing child is partially determined by the beliefs, values, and personality of the parents; partially by the family's interaction patterns and transgenerational history; and partially by the socialization beliefs, controls, and supports of the culture.

We should recognize a distinction here between codes and behaviors. The environtype is no more a description of a specific experiential context than the genotype is a description of a specific biological phenotype. In each case, the code must be actualized through behavior. The environtype and genotype represent a range of responses. The environtype codes have an organizational and regulatory influence on parent behavior, for example, but any specific behavior is only one of a number of possible behavioral or biological manifestations.

Although the environtype can be conceptualized independently of the child, changes in the abilities of the developing child are major triggers for regulatory changes and in most likelihood were major contributors to the evolution of a developmental agenda (Sameroff, 1987); that is, each environtype's timetable for developmental milestones. Although developmental milestones have always been thought to be a property of the child, their significance is much reduced unless there is a triggered regulation from the environtype. Different parents, different families, and different cultures may be sensitive to different behaviors of the infant as a regulatory trigger (deVries & Sameroff, 1984).

There is increasing variability in regulations as one moves from the cultural level through the family to the behavior of the individual parent, but typically the result is adaptive toward the future development of the child. When these regulations are either missing or outside the range of typical social experiences, the resulting maladaptations become the concern of developmental psychopathology.

Cultural Code

Culture is often defined by anthropologists as a shared meaning system that is transmitted across time. The ingredients of the cultural code are the complex of characteristics that organize a society's child-rearing system and that incorporate elements of socialization and education. These processes are embedded in sets of social controls and social supports. They are based on beliefs that differ in the degree of community consensus, ranging from mores and norms to fads and fashions, and can systematically vary among subpopulations within a culture. They can be encoded in written documents such as constitutions and laws or transmitted through the daily activities of social groups.

Many common biological characteristics of the human species have acted to produce similar developmental agendas in most cultures. In most cultures, formal education begins between the ages of 6 and 8 when most children have attained the cognitive ability to learn from structured experiences (Rogoff, 1981). However, historical and cross-cultural differences can emphasize or ignore changes in child behavior. Informal education can begin at many different ages depending on the culture's attributions to the child. For example, some middle-class parents have been convinced that prenatal experiences will enhance the cognitive development of their children and consequently begin stimulation programs during pregnancy, whereas others believe it best to wait until the first grade before beginning formal learning experiences. Such examples demonstrate the variability of human developmental contexts and the openness of the environtype to modification.

Family Code

Just as cultural codes regulate the fit between individuals and the social system, family codes organize individuals within the family system. Family codes provide a source of regulation that allow a group of individuals to form a collective unit in relation to society as a whole. As the cultural code regulates development so that an individual may fill a role in society, family codes regulate development to produce members who fulfill a role within the family and who ultimately are able to introduce new members into the shared system. Traditionally, new members are incorporated through birth and marriage, although more recently cohabitation and remarriage have taken on a more frequent role in providing new family members.

The family regulates the child's development through a variety of processes that vary in their degree of explicit representation and conduct. For example, families have *rituals* that prescribe roles and dictate conduct within family settings, *stories* that transmit orientations and accounts to each family member as well as to whomever will listen, shared *myths* that influence individual interactions and exaggerate aspects of family stories, and *paradigms* that change individual behavior when in the presence of other family members (Sameroff & Fiese, 1990). As with culture, the operation of the code can take the form of articulated rules and procedures as well as group behavior. Family research has demonstrated that the other-regulation provided by family members to each other is often unrecognized. Reiss (1989), for example, contrasts the degree to which family processes are articulated and readily recounted by individual members with the degree to which each family member's behavior is regulated by a common practice evident to an observer only when the family members are together.

Individual Code of the Parent

There is clear evidence that parental behavior is influenced and embedded within the family context. When a member is operating as part of a family, his or her behavior is altered, frequently without awareness of the behavioral change (Volling, McElwain, & Miller, 2002). However, there is also no doubt that individuals bring their own contribution to family interactions. The contribution of parents is determined much more complexly than that of young children, given the multiple levels that contribute to their behavior. The socializing regulations embodied in the cultural and family codes may be interpreted differently by each parent. To a large extent, these interpretations are conditioned by each parent's past participation in his or her own family's coded interactions, but they are captured uniquely by each member of the family. These individual influences further condition each parent's responses to his or her own child. For example, through interviews with parents and other adults, Main and Goldwyn (1984) identify adult attachment categories that are based on the encoding of each individual's interpretation of the attachment to his or her own parents. What is compelling about these adult attachment categories is that, although they operate outside awareness, they have influence across generations and are predictive of the attachment categories of the individual's offspring.

It is important to recognize the parent as a major regulating agent, but it is equally important to recognize that parenting behavior is itself embedded in hierarchical regulatory contexts such as the family and culture at the same time as it is affected by the child to whom it is directed, constraining or amplifying specific practices.

REGULATIONS

The description of the contexts of developmental regulation is a necessary prologue to the understanding of the origin and maintenance of behavioral regulatory problems. The core concerns of developmental psychopathology are regulatory disorders, and the chapters in this book provide evidence of the success of research in revealing the processes that lead to these regulation problems in the interfaces among the child, family, and cultural systems described earlier as codes.

To complete the picture, we must elaborate on the complexity of regulatory processes reflected in their time span, purposiveness, level of representation, and the nature of the child's contribution. Developmental regulations can be divided into three categories based on these considerations – macro-regulations, mini-regulations, and micro-regulations (Sameroff, 1987; Sameroff & Fiese, 1990). Macro-regulations are predominantly purposive major changes in experience that take place after intervals of months or years, such as weaning or school entry, that vary from culture to culture. Mini-regulations are predominantly caregiving activities that occur on a daily basis, such as dressing, feeding, or disciplining, that vary by parent, family, and culture. Micro-regulations are momentary interactions between individuals and contexts, such as the physiological, psychological, and social aspects of crying behavior, that may vary from second to second within a situation.

Macro-Regulations

The most extensive cycle of regulations are macro-regulations that are part of a culture's developmental agendas, including those of the family, school, and community. These agendas are a series of points in time when the environment is restructured to provide different experiences to the child. For example, toilet training and schooling may be initiated at different times in the child's course of development based on different cultural codes. The Digo and Kikuyu are two East African distinct cultures that provide different experiences to infants according to their cultural beliefs (deVries & Sameroff, 1984). The Digo view the infant as capable of learning within a few months after birth, and so they begin socialization early on. The Kikuyu do not hold such beliefs and wait until the second year of life before educating their children. Similar cultural contrasts are found between American and Chinese families described by Tardif, Wang, and Olson in Chapter 11. Because these macro-regulations have evolved, they are open to further change as cultures encounter technological advances or other cultures with different agendas.

Macro-regulatory codes provide a basis for socialization in each culture. They are responses to behaviors from the child that are easily identifiable as distinct events and are expected of all members of a culture. Temporally, macro-regulations are epochal in nature, reflecting changes that mark major milestones and a restructuring of the child's activities; for example, the move into a school setting. After the child's behavior triggers a restructuring of the environment, shorter term regulatory systems shift and restabilize until another macro-regulation occurs, triggered by further changes in the child's behavior. The validity of cultural developmental agendas lies not in their particular details, but in the fact that the culture is successful in reproducing generation after generation of offspring. Macro-regulations are the most highly articulated of the regulatory functions, are known to socialized members of each culture, and may be openly discussed or written down in the form of laws; for example, all children age 6 and older must be registered for school. In Western culture, the recording of a set of developmental milestones is an institutionalized practice of health personnel and family members.

Mini-Regulations

The second level is characterized by mini-regulations that operate within a shorter time span. They include the daily caretaking activities of a family.

Temporally, they operate on a daily basis, reflecting repeated demands within the family. Such activities include feeding children when they are hungry, changing their diapers when they are wet, and disciplining them when they misbehave. Mini-regulations are susceptible to a wide range of individual variability while still conforming to cultural codes. The family provides the arena for most of the early developmental mini-regulations and throughout much of the child's growth and development. Families may develop their own codes that are then transmitted to other members of the family (Sameroff & Fiese, 1990). Families may carry out caregiving practices such as disciplining in a variety of ways while still conforming to the cultural code. Deviances such as coercive parenting can have a detrimental effect on the child's behavior, but can be maintained as a form of regulation within the family (Patterson, 1986). Most family members can agree on their mini-regulations, although they may not be able to articulate them spontaneously (Reiss, 1989).

The child's contribution to mini-regulations may be seen in instances where the caretaking behaviors of the family are restructured to meet the unique demands of the child. A child with cerebral palsy, for example, may present difficulties for established routine caretaking. However, adjustments are made to incorporate the child into daily routines through alterations in mini-regulations. These adaptive regulations may be the result of a macro-regulation where a diagnosis is made and organized therapeutic procedures are called into play. However, in the absence of a diagnosis or service delivery systems, parents may need to fend for themselves to find more successful regulation strategies.

Micro-Regulations

The third level of regulation consists of micro-regulations that operate on the shortest time base. Micro-regulations are momentary interactions between child and caregiver that others have referred to as "behavioral synchrony" or "attunement" (Field, 1979; Stern, 1977). Micro-regulations are a blend of social and biological codes because, although they may be brought to awareness, many of these activities appear naturally and with seeming automaticity. Toward the biological end is the caregiver's smile in response to an infant's smile, and toward the socialized end are "micro-social" patterns of interaction that increase or decrease antisocial behavior in the child (Patterson, 1986). The child's contribution to micro-regulations may be seen in the effects of infant temperament on maternal responsivity. Many of the chapters in this book describe variations in parental response to temperamental variability and in the child's response to parental variability.

Premature infants or infants who have experienced multiple prenatal complications may exhibit a lower activity level overall and require less active stimulation from their mother than that required by a healthy, full-term newborn. Conversely, malnourished infants may not have the energy to elicit caregiving regulations from parents who are probably also malnourished, so mini- and macro-regulations may come into play to encourage the parent to change routines and be more attentive and responsive.

Interactions among Regulation Systems

The three sources of regulation outlined in this section are typically organized at different levels of the environtype. Macro-regulations are the modal form of regulation within the cultural code. Many cultural codes are written down or memorized and may be passed on to individual members of society through customs, beliefs, and mythologies, in addition to actual laws that are aimed at regulating child health and education. Mini-regulations are modal within the family code where less formal interactions condition the caregiving behavior of family members. Micro-regulations come into play at the individual level where differences in personality and temperament interact with commonalities in human species-specific caregiving behavior to produce a variety of adaptive and maladaptive parent-child relationships.

Although these levels of regulation have been described independently, they are in constant interaction and transaction. The family develops its caretaking routines influenced by the transactions between the cultural and family codes; that is, between social norms and family traditions. As children develop within the family, they increasingly influence these transactions that serve as a foundation for continuing social interaction. Families highlight the role defined for each child, which further regulates the child's development. The style of each family member contributes to the way in which the regulations will be carried out in relation to the individuality of each child. However, it has been frequently demonstrated that static characteristics like gender and birth order or even physical appearance trigger differences in routines and even different culturally sanctioned developmental agendas.

The operation of the family code is characterized by a series of regulated transactions. The parents may hold particular concepts of development that influence their caretaking practices. As children are exposed to different role expectations and listen to family stories, they make their own contribution through their particular personalities. By becoming an active transactor with the family code, the child ultimately may affect the daily child-rearing mini-regulations of the parents and thereby influence the regulatory practices to be passed down to the next sibling or even the next generation.

SUMMARY

The major thrust of this volume is to illuminate the development of behavior regulation in children, especially when it becomes problematic to the child, the parents, or other care or education providers. Chapters that focus on the child and the biological correlates of behavioral regulation are augmented by chapters on family processes, describing the variations of self-regulation and other-regulation not only between child and parent but also among parents and siblings. Variations in cultural practices are also demonstrated as influencing child behavioral regulation.

This chapter presents a model for understanding the impact of contextual influences on development. Through an ecological analysis, it highlights some aspects of the environtype as providing the regulatory framework for healthy child development. These factors include cultural, family, and individual caregiver codes. The environment as the source of other-regulation is an active force in shaping the capacity for self-regulation. However, the quality and degree of shaping are constrained by the state and potentialities of the individual child.

Within this regulatory framework, transactions are ubiquitous. Whenever parents change their way of thinking about or behaving toward the child as a result of something the child does, a transaction occurs. Most of these transactions are normative within the existing cultural code and facilitate development. Intervention may become necessary when these transactions are non-normative. A breakthrough in our progress toward understanding child regulation problems is the recognition that social experience is a critical component of all behavioral developments, both normal and abnormal. The work described in the chapters of this book has increased the level of sophistication in theory and research that connect childhood behavioral regulation problems with problems in biological regulatory systems, providing evidence for effects in both directions. Problems in biological regulation produce problems in behavioral regulation that produce problems in family interactions. Conversely, there is evidence that dysregulation in family interactions produces dysregulation in child behavior that produces problems in child biological regulation.

The complex model that characterizes our modern understanding of the regulation of development seems an appropriate one for analyzing the etiology of developmental disorders. It helps us understand why initial conditions do not determine outcomes, either positively or negatively. There are many points in development at which regulations can facilitate or retard the child's progress. The hopeful part of this model is that these many points in time represent opportunities for changing the course of development.

In sum, explanatory models need to focus on multiple factors at multiple levels for either the study or manipulation of developmental outcomes. The evolution of humans and their cultural systems has provided a regulatory model that incorporates feedback mechanisms between the individual and regulatory codes conceptualized as a genotype *and* an environtype. These cultural and genetic codes are the context of development. By appreciating the workings of this regulatory system, we can obtain a better grasp of the processes of development and, eventually, how to change it.

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2

How Gene-Environment Interactions Can Influence the Development of Emotion Regulation in Rhesus Monkeys

STEPHEN J. SUOMI

INTRODUCTION

Humans do not have a monopoly on emotionality. More than a century ago, Charles Darwin (1872) provided compelling arguments that some animals, especially mammals, are capable of expressing human-like emotions. Today, an increasing body of research convincingly demonstrates that most nonhuman primates possess the same basic neural circuitry and exhibit the same general patterns of neurochemical change that have been implicated in human emotional expression (cf. Panksepp, 1998). Monkeys and apes routinely display characteristic patterns of emotional expression that seem strikingly similar to, if not homologous with, those routinely exhibited by infants and young children in virtually every human culture studied to date. To be sure, some complex emotions such as shame are most likely exclusively human, but they apparently require cognitive capabilities well beyond those of human infants and nonhuman primates of any age (cf. Lewis, 1992). The more basic emotions, such as fear, interest, surprise, and rage, are clearly expressed soon after birth by human and nonhuman primate infants alike, and their expression is usually obvious to all around; that is, they serve as highly visible and salient social signals (cf. Suomi, 1997b).

Ethologists have long argued that these basic emotions, having been largely conserved over mammalian evolutionary history, serve important adaptive functions (i.e., they are thought to enhance the immediate survival and long-term fitness of the individuals expressing them). Consider the case of fear: in a world full of latently dangerous stimuli – predators and competitors – that have the potential to produce serious injury or even death, any individual completely without fear is unlikely to survive very long. Conversely, excessive or inappropriate fear could effectively paralyze any individual, basically limiting those very interactions with the environment needed to obtain the physical and social sustenance necessary for survival. Thus, although every human and every nonhuman primate is born with the capacity to be fearful, each must learn which stimuli merit fearful responses, as well as how to inhibit the expression of fear in nonthreatening situations, in order to survive within his or her own complex social environment (Suomi & Harlow, 1976).

Similarly, the capacity for aggressive attack and/or defense in the service of protecting self, family, and friends from predators and competitors in the long run would almost certainly be crucial for the survival of the individual and the maintenance of any social group of long-term standing. Yet, excessive and/or inappropriate aggression by any individual has the potential to destroy the very social fabric that binds the group together. Therefore, the expression of aggression must be regulated: individual group members must come to know which social stimuli merit an aggressive response and which do not and, for those that do, to what degree and for how long, if the group is to maintain its basic integrity over time and across generations. Indeed, learning how and when to avoid aggressive encounters and when and how to end those once begun may be at least as important as learning how and when to start or respond to such an encounter (Suomi, 2000a).

The development of proficiency in emotional regulation seems to be especially important for advanced primate species whose members live in large social groups that are well defined in terms of both kinship relationships and social dominance hierarchies. Among the most complex are those of rhesus monkeys (*Macaca mulatta*), a highly successful species of macaque monkeys that live throughout most of the Indian subcontinent and parts of Afghanistan, China Myanmar, Nepal, and Tibet (Fooden, 2000). In their natural habitats, rhesus monkeys typically reside in large, distinctive social groups ("troops") that can range in size from two dozen to two hundred or more individuals. Every troop is composed of several female-headed families, each spanning three or more generations of kin, plus numerous immigrant adult males. This form of social group organization derives from the fact that all rhesus monkey females spend their entire life in the troop in which they were born, whereas virtually all males emigrate from their natal troop around the time of puberty and eventually join other troops (Lindburg, 1971). Rhesus monkey troops are also characterized by multiple social dominance relationships, including distinctive hierarchies both between and within families, as well as a hierarchy among the immigrant adult males (Sade, 1967).

The complex familial and dominance relationships seen in rhesus monkey troops seemingly require that any well-functioning troop member not only be able to regulate its expressions of fear and aggression but also to become familiar with the specific kinship and dominance status of other monkeys toward whom those emotions might be expressed. How might such knowledge be acquired, maintained, and used in generation after generation of monkeys born into the troop? An impressive body of both laboratory and field data strongly suggests that it represents an emergent property of the species-normative pattern of socialization that rhesus monkey infants experience as they are growing up (Sameroff & Suomi, 1996).

DEVELOPMENT OF EMOTIONAL REGULATION IN RHESUS MONKEYS

A rhesus monkey infant begins life highly dependent on its biological mother for essentially all of its immediate biological and psychological needs (in this species, fathers are not active participants in early child care activities). An infant typically spends its first month of life in almost continuous physical contact with its mother, who is usually able to shield it from most potentially fear-provoking stimuli. During this time, a strong and enduring social bond between mother and infant emerges naturally (Harlow, 1958). This bond, largely homologous with Bowlby's (1969) characterization of human mother-infant *attachment*, is unique in terms of its exclusivity, constituent behavioral features, and ultimate duration – it is unlike any other social relationship that the infant will ever experience again in its lifetime, except for females (in reciprocal form) when they grow up to have infants of their own (Suomi, 1999).

Rhesus monkey infants are inherently curious (Harlow, 1953), and once an infant has become securely attached to its mother, it can use her as an established base from which to make exploratory ventures toward stimuli that have attracted its curiosity. Most infant monkeys soon learn that, if they become frightened or otherwise threatened, they can always run back to their mother for immediate safety and comfort via mutual ventral contact. Several studies have documented that initiation of ventral contact with the mother promotes rapid decreases in hypothalamic-pituitary-adrenal (HPA) activity, as indexed by lowered plasma cortisol concentrations (e.g., Gunnar et al., 1981; Mendoza et al., 1978), and in sympathetic nervous system arousal, as indexed by reductions in heart rate (e.g., Reite et al., 1981), along with behavioral changes commonly associated with soothing. Secure attachment relationships thus help infants learn to manage the fears they will inevitably experience in the course of exploring their ever-expanding world. Conversely, if a rhesus monkey infant develops an insecure attachment relationship with its mother, both its ability to regulate fear and its willingness to explore may be compromised, consistent with Bowlby's observations regarding human attachment relationships (Bowlby, 1988; Suomi, 1999).

In their second and third month, rhesus infants begin to interact with monkeys other than their mother, and they soon develop distinctive social relationships with specific individuals outside their immediate family. Increasingly, these interactions come to involve *peers* – other infants of like age and comparable physical, cognitive, and social capabilities. After weaning (usually in the fourth and fifth months), play with peers emerges as a predominant social activity for young monkeys and essentially remains so until puberty (Ruppenthal et al., 1974). During this time, the play interactions become increasingly gender specific and sex segregated (i.e., males tend to play more with males, and females with females; Harlow & Lauersdorf, 1974). Peer play also becomes more and more complex, behaviorally and socially, and by the third year the play bouts typically involve patterns of behavior that appear to simulate the full range of adult social activity. By the time they reach puberty, most rhesus monkey juveniles have had ample opportunity to develop, practice, and perfect behavioral routines that will be crucial for functioning as a normal adult, especially those involving dominance interactions and aggressive exchanges.

Aggression first appears in a rhesus monkey's behavioral repertoire around the time of weaning. Virtually all infants at this age may try to bite their mother when their efforts to obtain nipple contact are rebuffed; such biting often results in immediate physical punishment by the mother, usually in the form of a cuff, swat, or even a reciprocal nip. An infant's attempts to hit or bite other adults in the troop may lead to even harsher retaliation, especially if the adult is socially dominant over that infant's mother. Most young monkeys soon learn to inhibit such behavior and even to avoid most other direct interactions with adults outside their immediate family.

In contrast, biting, hair pulling, wrestling, and other forms of physical contact are basic components of rough-and-tumble play directed toward peers. Rough-and-tumble play increases in frequency among males during the second half of their first year of life and, in fact, becomes their predominant form of play behavior throughout the juvenile years. Although some form of virtually all of the basic physical components of adult aggressive exchanges can be seen in these rough-and-tumble play bouts, the intensity of such interactions is usually quite controlled and seldom escalates to the point of actual physical injury – if it does, the play bout is almost always terminated immediately, either via adult intervention or by one or more of the participants backing away themselves (Symons, 1978). The importance of these play bouts with peers for the socialization of aggression seems obvious, given the finding that rhesus monkey infants reared in laboratory environments that deny them regular access to peers during their initial months consistently develop patterns of excessive and socially inappropriate aggression later in life (cf. Suomi & Harlow, 1975).

The onset of puberty is associated with major life transitions for both male and female rhesus monkeys. Adolescence involves not only major hormonal alterations, pronounced growth spurts, and other obvious physical changes but also major social changes for both sexes. Males experience the most dramatic and serious social disruptions: when they leave home, they sever all social contact not only with their mother and other kin but also with all others in their natal social troop. Virtually all of these adolescent males soon join all-male "gangs," and after several months to a year, most of them then attempt to join a different troop, usually composed entirely of individuals largely unfamiliar to the immigrant males (Berard, 1989). The process of natal troop emigration represents an exceedingly dangerous transition period – the mortality rate for these young males from the time they leave their natal troop until they become successfully integrated into another troop can approach 50%, depending on local circumstances (e.g., Dittus, 1979). Recent field studies have identified and characterized striking variability in both the timing of male emigration and the basic strategies followed in attempting to join other established social groups: this variability is seemingly associated with individual differences in emotional regulation, as discussed later in the chapter.

Females, by contrast, never leave their maternal family or natal troop. Puberty for them is instead associated with increases in social activities directed toward maternal kin, usually at the expense of interactions with unrelated peers. Family interactions are heightened even more when these young females begin to have offspring of their own. Rhesus monkey females remain actively involved in family social affairs for the rest of their lives, even after they cease having infants of their own. Adult females' ties to both family and troop are facilitated by the appropriate regulation of fear and aggression; conversely, these ties can become strained whenever such emotional regulation goes awry (Suomi, 1998).

INDIVIDUAL DIFFERENCES IN THE REGULATION OF FEAR AND AGGRESSION

Although the basic developmental sequences described here characterize rhesus monkeys growing up both in the wild and in captivity, nevertheless individuals differ substantially in the precise timing and relative ease with which they adjust to major developmental transitions, as well as how they manage the day-to-day challenges and stresses that are an inevitable consequence of complex social group life. In particular, recent research has identified two subgroups of monkeys that exhibit specific deficits in emotional regulation that can result in increased long-term risk for behavioral pathology and even mortality: those that are fearful and those that have difficulty regulating aggression.

Members of one subgroup, comprising approximately 15 to 20% of both wild and captive populations, seem excessively fearful. These monkeys consistently respond to novel or mildly challenging situations with extreme behavioral disruption and pronounced physiological arousal. Whereas most other monkeys typically find novel stimuli interesting and readily explore them, usually with minimal physiological arousal, excessively fearful individuals tend to avoid such stimuli, and if that is not possible, they predictably react with obvious behavioral expressions of fear and anxiety and with significant and often prolonged activation of the HPA axis, sympathetic nervous system arousal, and increased noradrenergic turnover (Suomi, 1986).

These fearful or "uptight" monkeys can usually be readily identified during their first few months of life. Most begin to leave their mothers later chronologically and explore their physical and social environment less frequently and for shorter periods than do the other infants in their birth cohort. Highly fearful youngsters also tend to be shy and withdrawn in their initial encounters with peers: laboratory studies have shown that they exhibit significantly higher and more stable heart rates and greater secretion of cortisol in such interactions than do their less reactive age-mates. However, when these monkeys are in familiar and stable social settings, they are virtually indistinguishable, both behaviorally and biologically, from others in their peer group. In contrast, when fearful monkeys encounter extreme and/or prolonged stress, the differences in their behavioral and biological reactions relative to those of others in their social group usually become exaggerated (Suomi, 1991a).

For example, young rhesus monkeys growing up in the wild typically experience functional maternal separations during the 2-month-long annual breeding season when their mothers repeatedly leave the troop for brief periods to consort with selected males (Berman, Rasmussen, & Suomi, 1994). The sudden loss of access to its mother is a major social stressor for any young primate, and not surprisingly, virtually all of these monkeys initially react to their mother's departure with obvious protest, characterized by short-term behavioral agitation and physiological arousal, much as Bowlby (1973) described for human infants experiencing involuntary maternal separation. However, whereas most youngsters soon begin to adapt to the separation and begin to seek out the company of others in their social group until their mother returns, highly fearful individuals typically lapse into a behavioral depression characterized by increasing lethargy, lack of apparent interest in social stimuli, eating and sleeping difficulties, and a characteristic hunched-over, fetal-like posture (Suomi, 1991b).

Laboratory studies simulating these natural maternal separations have shown that, relative to their like-reared peers, highly fearful monkeys not only are more likely to exhibit depressive-like behavioral reactions to short-term social separation but also tend to show greater and more prolonged HPA activation, more rapid central noradrenergic turnover, and greater immunosuppression (Suomi, 1991a). These differential patterns of biological and behavioral responses to separation remain remarkably stable throughout prepubertal development and are usually maintained during adolescence and even into adulthood (Davenport et al., 2003; Suomi, 1995). Moreover, individual differences in infant biological and behavioral responses to separation are predictive of differential responses to other situations experienced later in life. For example, Fahlke et al. (2000) showed that monkey infants who exhibited high levels of plasma cortisol after brief separations at 6 months of age subsequently consumed significantly more alcohol in a “happy hour” situation as young adults than did monkeys whose 6-month cortisol responses were more moderate. An increasing body of evidence has demonstrated significant heritability for at least some components of these differential responses to stress (e.g., Higley et al., 1993; Williamson et al., 2003). In naturalistic settings, fearful rhesus juveniles show greater adrenocortical activity, higher parasite loads, and lower antibody titers following tetanus vaccination than do others in their birth cohort (Laudenslager et al., 1993, 1999). When they reach adolescence, fearful males usually emigrate from their natal troop at significantly older ages than the rest of their male cohort, and when they do finally leave, they typically employ much more conservative strategies for entering a new troop than do their less-reactive peers. Such an emigration strategy may actually be adaptive, in that the larger physically and heavier a male is at the time he emigrates from his natal troop, the greater the likelihood that he will survive and successfully join another troop (Rasmussen, Fellows, & Suomi, 1990). Therefore, if a male is able to postpone emigration until he has largely finished his adolescent growth spurt, he appears to be better able to make the transition to adult male life than if he leaves home before or during the growth spurt. Because fearful adolescent males pose little apparent threat to adult females and their offspring, they tend to be tolerated by other troop members at ages when the rest of their birth cohort have either left voluntarily or been forcibly driven away. Thus, even though excessive fearfulness apparently puts an individual male at increased risk for adverse biological and behavioral reactions to stress throughout development, there are some circumstances where this characteristic may actually be adaptive (Suomi, 2000b).

A similar situation exists for females: highly fearful young mothers in the wild tend to reject and punish their infants at higher rates around the time of weaning than do other mothers in their troop (Rasmussen, Timme, & Suomi, 1997). In captive settings, they are at increased risk for infant neglect and/or abuse when social support is limited (Suomi & Ripp, 1983). Yet, under stable and supportive social circumstances, these fearful females may not only turn out to be highly competent mothers but also often achieve relatively high positions of social dominance (Rasmussen et al., 1997). In sum, excessive fearfulness in infancy appears to be associated with increased risk for developing anxious- and depressive-like behavioral and biological symptoms, excessive alcohol consumption, and potential problems in parenting in response to stressful circumstances later in life – but such long-term outcomes are far from inevitable.

Another subgroup of monkeys appear to have problems regulating aggression. These monkeys, comprising approximately 5 to 10% of the population, seem unusually impulsive, insensitive, and overly aggressive in their interactions with other troop members. Impulsive young monkeys, especially males, seem to be unable to moderate their behavioral responses to rough-and-tumble play initiations from peers, and they often escalate initially benign play bouts into full-blown, tissue-damaging aggressive exchanges (Higley et al., 1992). Not surprisingly, most of these individuals tend to be avoided by peers, and as their childhood progresses, they become increasingly isolated socially. In addition, many of these juvenile males often appear unwilling (or unable) to follow the "rules" inherent in rhesus monkey social dominance hierarchies. For example, they may directly challenge a dominant adult male, a foolhardy act that can result in serious injury, especially when the juvenile refuses to back away or exhibit submissive behavior once defeat becomes obvious. Impulsive juvenile males also show a propensity for making dangerous leaps from treetop to treetop, sometimes with painful outcomes (Mehlman et al., 1994).

Overly impulsive monkeys, male and female alike, consistently exhibit chronic deficits in central serotonin metabolism, as reflected in unusually low cerebrospinal fluid (CSF) concentrations of the primary central serotonin metabolite, 5-hydroxyindoleacetic acid (5-HIAA). Laboratory studies have shown that these deficits in serotonin metabolism appear early in life and tend to persist throughout development (Higley, Suomi, & Linnoila, 1992; Shannon et al., 2005), as was the case for HPA responsiveness among highly fearful monkeys. Monkeys who exhibit such deficits are also likely to show poor state control and visual orienting capabilities during early infancy (Champoux, Suomi, & Schneider, 1994), poor performance on delay-of-gratification tasks during childhood (Bennett et al., 1999), and excessive alcohol consumption as young adults (Higley, Suomi, & Linnoila, 1996). Importantly, individual differences in 5-HIAA concentrations are highly heritable among monkeys of similar age and comparable rearing background (Higley et al., 1993).

The process of natal troop emigration typically experienced by impulsive males is seemingly the opposite of that shown by fearful males, with a long-term prognosis that is not particularly promising. Ostracized by their peers and frequently attacked by adults of both sexes, most of these excessively aggressive young males are physically driven out of their natal troop prior to 3 years of age, well before the onset of puberty and long before the rest of their male birth cohort begins the emigration process (Mehlman et al., 1995). These males tend to be grossly incompetent socially and typically lack the requisite social skills necessary for successful entrance into another troop or even to join an all-male gang. Most become solitary after they have been driven out of their natal troop, and most of those typically perish within a year (Higley et al., 1996b).

Young females with chronically low CSF levels of 5-HIAA also tend to be impulsive, aggressive, and generally rather incompetent socially. However, unlike the males, they are not expelled from their natal troop, but instead remain with their family for the rest of their lives. Studies of captive rhesus monkey groups have reported that these females are usually at the bottom of their respective dominance hierarchies (Higley et al., 1996a). Although most become mothers, in many cases their maternal behavior leaves much to be desired (Maestripieri et al., 2006; Suomi, 2000a). In sum, rhesus monkeys who exhibit poor regulation of impulsive and aggressive behavior and who exhibit low central serotonin turnover early in life often follow developmental trajectories that result in premature death for males and chronically low social dominance and poor parenting for females.

EFFECTS OF EARLY PEER REARING ON THE REGULATION OF FEAR AND AGGRESSION

Although the findings from both the field and laboratory studies cited in the previous section consistently show that differences among rhesus monkeys in their expressions of fearfulness and impulsive aggression tend to be quite stable from infancy to adulthood and are at least in part heritable, this does not mean that they are necessarily fixed at birth or not subject to subsequent environmental influence. To the contrary, an increasing body of evidence from laboratory studies demonstrates that patterns of emotional expression can be modified substantially by certain early social experiences, especially those involving early attachment relationships.

Compelling evidence comes from studies of rhesus monkey infants raised with peers instead of their biological mothers. In these studies, infants typically are separated from their biological mothers at birth, hand reared in a neonatal nursery for their first month of life, housed with same-aged, like-reared peers for the rest of their first 6 months, and then moved into larger social groups containing both peer-reared and mother-reared age-mates. During their initial months, these infants readily establish strong social bonds with each other, much as mother-reared infants develop attachments to their own mothers (Harlow, 1969). However, because peers are not nearly as effective as typical monkey mothers in reducing fear in the face of novelty or in providing a "secure base" for exploration, the attachment relationships that these peer-reared infants develop are basically dysfunctional or even nonfunctional (in attachment theory parlance, "anxious" or "disorganized") in nature (Suomi, 1995). As a result, although peer-reared monkeys exhibit normal physical and motor development, most appear to be excessively fearful – their early exploratory behavior is clearly restricted, they seem reluctant to approach novel objects, and they tend to be shy in initial encounters with unfamiliar peers (Suomi, 1997a).

Even when peer-reared youngsters interact with their same-age rearing partners in familiar settings, their play behavior is usually limited in both frequency and complexity. One explanation for their relatively poor play development is that their peer partners have to serve both as attachment figures and playmates, a dual role that neither mothers nor mother-reared peers have to fulfill. Another obstacle to developing sophisticated play repertoires faced by peer-reared monkeys is that all of their early play bouts involve partners who are basically as incompetent socially as themselves.

Several prospective longitudinal studies have found that peer-reared monkeys consistently exhibit more extreme behavioral, adrenocortical, and noradrenergic reactions to social separations than do their mother-reared cohorts, even after they have been living in the same social groups for extended periods (e.g., Higley & Suomi, 1989; Higley, Suomi, & Linnoila, 1992). Interestingly, the general nature of the separation reactions exhibited by peer-reared monkeys seems to mirror that shown by "naturally occurring" highly fearful mother-reared subjects. In this sense, early rearing with peers appears to have the effect of making rhesus monkey infants generally more fearful than they might have been if reared by their biological mothers (Suomi, 1997a).

At the same time, early peer rearing also has the effect of making rhesus monkeys more impulsive and aggressive throughout development, especially if they are males. Like the previously described impulsive monkeys growing up in the wild, peer-reared males initially are overly aggressive in the context of juvenile play; as they approach puberty, the frequency and severity of their aggressive episodes consistently exceed those of mother-reared group members of similar age. Peer-reared females tend to groom (and be groomed by) others in their social group less frequently and for shorter durations than their mother-reared counterparts, and they usually stay at the bottom of their respective dominance hierarchies (Higley, King, et al., 1996). These differences between peer-reared and mother-reared age-mates in aggression, grooming, and dominance remain relatively robust throughout the juvenile and adolescent years (Higley, Suomi, & Linnoila, 1996). Peer-reared monkeys also consistently show lower CSF concentrations of 5-HIAA than their mother-reared counterparts. These group differences in 5-HIAA concentrations appear in the first few weeks of life, and they remain stable at least throughout adolescence and into early adulthood (Higley & Suomi, 1996; Shannon et al., 2005). Thus, peer-reared monkeys exhibit the same general tendencies that characterize excessively impulsive wild-living (and mother-reared) rhesus monkeys, not only behaviorally but also in terms of decreased serotonergic functioning.

Other laboratory studies have disclosed additional differences between peer-reared (PR) monkeys and their mother-reared (MR) counterparts. For example, peer-reared adolescent and adult males exhibit significantly higher rates of whole-brain glucose metabolism under mild isoflurane anesthesia, as determined by positron emission tomography (PET) imaging, than mother-reared controls (Doudet et al., 1995). Significant differences between MR and PR juveniles in serotonin transporter ligand binding potential and in cerebral blood flow, as determined by PET, have been detected in raphe, thalamus, striatum, frontal, and parietal brain regions, with PR subjects exhibiting significantly lower levels for both measures in each region (Ichise et al., 2006). Finally, peer-reared adolescent monkeys as a group consume larger amounts of alcohol under comparable ad libitum conditions than their mother-reared age mates (Higley, Hasert, Suomi, & Linnoila, 1991), and they also rapidly develop a greater tolerance for alcohol, which appears to be associated with differences in serotonin turnover rates (Heinz et al., 2003) and in serotonin transporter availability

(Heinz et al., 1998). All in all, early rearing with peers seems to make rhesus monkey infants both more fearful and more impulsive, and their resulting developmental trajectories not only resemble those of naturally occurring subgroups of rhesus monkeys growing up in the wild but also persist long after their period of exclusive exposure to peers has been completed and they have been living in more diverse social groups.

GENE-ENVIRONMENT (G × E) INTERACTIONS

Studies examining the effects of peer rearing and other variations in early rearing history (e.g., Harlow & Harlow, 1969), along with the previously cited heritability findings, clearly provide compelling evidence that *both* genetic and early experiential factors can affect a monkey's capacity to regulate the expression of fear and aggression. Do these factors operate independently, or do they interact in some fashion in shaping individual developmental trajectories? Ongoing research capitalizing on the discovery of a polymorphism in one specific gene – the serotonin transporter (5-HTT) gene – suggests that gene-environment (G × E) interactions not only occur but also can be expressed in multiple forms and at different points during development.

The 5-HTT gene is a candidate gene for impaired serotonergic function (Lesch et al., 1996). Length variation in its promoter region results in allelic variation in 5-HTT expression: the "short" allele (s) confers low transcriptional efficiency to the 5-HTT promoter relative to the long allele (l), raising the possibility that low 5-HTT expression may result in decreased serotonergic function (Heils et al., 1996); however, evidence in support of this hypothesis in humans has been decidedly mixed to date (cf. Rutter, 2007). The 5-HTT polymorphism was first characterized in humans, but it also appears in largely homologous form in rhesus monkeys, but not in most other primates (Lesch et al., 1997; Wendland et al., 2006).

We recently characterized the genotypic status of most of the monkeys in the studies comparing peer-reared monkeys with mother-reared controls described earlier with respect to their 5-HTT polymorphic status. This analysis has made it possible to examine a wide range of behavioral and physiological measures for potential 5-HTT polymorphism main effects and interactions with early rearing history. Analyses completed to date suggest that such interactions are widespread and diverse.

For example, Bennett et al. (2002) found that CSF 5-HIAA concentrations did not differ as a function of 5-HTT status for mother-reared subjects, whereas among peer-reared monkeys, individuals with the "short" allele (ls) had significantly lower CSF 5-HIAA concentrations than those with the "long" (ll) allele. One interpretation of this interaction is that mother rearing appears to "buffer" any potentially deleterious effects of the ls allele on serotonin metabolism. A similar pattern appeared with respect to aggression: high levels of aggression were shown by peer-reared monkeys with the ls allele, whereas mother-reared ll monkeys exhibited low levels that were comparable to those of both mother-reared and peer-reared ll monkeys, again suggesting a buffering effect of maternal rearing (Barr et al., 2003).

Champoux et al. (2002) examined the relationship between early rearing history and serotonin transporter gene polymorphic status and its effect on measures of neonatal neurobehavioral development during the first month of life and found further evidence of maternal buffering. Specifically, infants possessing the ls allele who were being reared in the laboratory neonatal nursery showed significant deficits in measures of attention, activity, and motor maturity relative to nursery-reared infants possessing the ll allele, whereas both ls and ll infants who were being reared by competent mothers exhibited normal values for each of these measures.

A somewhat more dramatic pattern of G $\times$ E interaction was revealed by an analysis of alcohol consumption data: whereas peer-reared monkeys with the ls allele consumed more alcohol than peer-reared monkeys with the ll allele, the reverse was true for mother-reared subjects, with individuals possessing the ls allele actually consuming *less* alcohol than their ll counterparts (Bennett et al., 1998). The same pattern was found for relative levels of alcohol intoxication (Barr et al., 2003). In other words, the ls allele appeared to represent a significant risk factor for excessive alcohol consumption among peer-reared monkeys, but perhaps instead was a protective factor for mother-reared subjects.

In sum, peer-reared monkeys with the ls allele display deficits in measures of neurobehavioral development during their initial weeks of life and reduced serotonin metabolism and excessive alcohol consumption as adolescents compared with those possessing the ll allele. In contrast, mother-reared subjects with the ls allele are characterized by normal early neurobehavioral development and serotonin metabolism, as well as reduced risk for excessive alcohol consumption later in life compared with their mother-reared counterparts with the ll allele. It could be argued on the basis of these findings that having the ls allele of the 5-HTT gene may well lead to psychopathology among monkeys with poor early rearing histories, but might actually be adaptive for monkeys who develop secure early attachment relationships with their mothers.

IMPLICATIONS FOR UNDERSTANDING HUMAN SOCIOEMOTIONAL REGULATION

The introduction to this chapter argued that emotion regulation represents a process that is not limited to humans. To what extent can studies of its development and possible biological correlates in rhesus monkeys enhance our understanding of emotion regulation in children, particularly those who display extreme fearfulness or excessive physical aggression as they are growing up? To be sure, rhesus monkeys are clearly *not* furry little humans with tails, but rather members of another (albeit closely related) species. One should be especially cautious when making comparisons between humans and other primate species regarding fearful and aggressive behavior, given that there exist obvious age, gender, and cultural differences in what is considered excessive or abnormal across different human populations. Nevertheless, there appear to be some general principles emerging from research with rhesus monkeys that are likely to be relevant for the human case.

First, expressions of both fearful and aggressive behavior per se are neither abnormal nor necessarily undesirable, but rather represent behavioral capacities present in every individual that usually follow an orderly pattern of developmental change. However, to be adaptive, expressions of these emotions must be effectively socialized during the childhood years. Indeed, problems in the socialization process may result in alterations of the species-typical developmental trajectories for fear and aggression that can have adverse consequences with respect to long-term morbidity and possibly even mortality. Yet, such adverse long-term outcomes are not necessarily inevitable for all individuals who display difficulties in emotion regulation early in life, especially if those individuals are able to grow up in stable, supportive social environments (cf. Suomi, 1999).

Second, both excessive fearfulness and excessive physical aggression appear to be associated with specific patterns of biological functioning. This is *not* to say that dysregulation of the HPA axis actually causes excessive fearfulness or that deficits in serotonin metabolism directly lead to excessive physical aggression (or vice versa), but rather that each of these behavioral propensities seems to be closely linked to non-normative patterns of biological activity for both males and females throughout development. In particular, the inverse relationship between CSF 5-HIAA concentrations and excessive physical aggression is exceedingly robust, such that factors that can alter the expression of physical aggression also typically alter CSF 5-HIAA concentrations. Moreover, individual differences in CSF 5-HIAA concentrations appear to be relatively stable throughout development, despite major normative ontogenic changes in the concentrations, and they also tend to be stable across situations. These trait-like characteristics make it possible to predict individual differences in physical aggression throughout development on the basis of CSF 5-HIAA values obtained early in life. The same general principles also seem to apply to the relationship between HPA axis hyperresponsiveness and excessive fearfulness, albeit to a somewhat less robust degree.

A third basic principle is that deficits in physiological functioning and abnormalities in emotional regulation at the behavioral level are the exclusive product of neither nature nor nurture but rather reflect the interaction of both. For example, it is possible to demonstrate significant heritability for individual differences in 5-HIAA concentrations, and it is also clear that certain rearing experiences often result in deficits in serotonin metabolism. However, the recent findings that specific polymorphisms in the serotonin transporter gene are associated with different behavioral and biological outcomes for rhesus monkeys as a function of their early social rearing histories suggest that more complex G × E interactions actually are responsible for these phenomena. It is hard to imagine that the situation would be any less complex for humans.

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3

Context Matters: Exploring Definitions of a Poorly Modulated Stress Response

KATE KEENAN, SUMA JACOB, DESIA GRACE, AND DANA GUNTHORPE

There are an increasing number of studies assessing the early development of physiological and emotion self-regulation and the risk for psychopathology (Calkins & Dedmon, 2000; Calkins & Fox, 2002; Keenan, 2000; Shaw et al., 1997). The capacity to regulate emotion and behavior in early childhood has been shown to be extremely important in the development of adaptive and appropriate social behaviors in the preschool and school years (Calkins, 1994; Eisenberg et al., 1995, 1996). Children of parents with psychopathology are at greater risk for psychopathology and even in their infancy can exhibit behavioral differences from other children (Cohn & Tronick, 1983; Field, 1995).

Developmental psychopathology is a discipline that is organized around the incorporation of developmental principles into the study of the etiology of psychopathology. The program of research described in this chapter is informed by this framework and as a result is focused on this question: How early can we tell that a child is on a pathway toward deficient behavioral and emotional functioning? We propose that poorly modulated responses to stimuli in the first months of life may indicate risk for the development of later behavioral and emotional problems. In this chapter we present an overview of the theoretical underpinnings of this program of research, descriptive data on individual differences in the neonate's cortisol response to two different stressors, and an examination of the relations between behavior and cortisol response, with the goal of exploring how to operationally define suboptimal patterns of stress reactivity in human infants.

PRENATAL CONTEXT

There is growing evidence that the prenatal environment influences early brain development, mostly within the context of maternal exposure to stress during pregnancy (Huizink et al., 2004; Maccari et al., 2003; Wadhwa, 2004). In nonhuman primates, prenatal maternal stress is related to offspring exhibiting lower cognitive-motor functioning and inhibited behavior or delayed object permanence with mild stress (Schneider, 1992; Schneider & Coe, 1993). More specifically, poor attention during the first year is associated with chronic prenatal stress or two weeks of adrenocorticotropic hormone (ACTH) administration at midgestation (Schneider & Coe, 1993; Schneider, Coe, & Lubach, 1992).

In humans, moderate to severe life events during pregnancy are associated with obstetric complications, including preterm delivery and low birthweight (Lou et al., 1994; Wadhwa et al., 1993). More than a dozen independent studies link prenatal maternal stress and anxiety to differences in later child development, even when controlling for confounders such as postnatal mood (Van den Bergh et al., 2005). Negative child outcomes associated with prenatal stress include infant regulation problems (crying, sleeping, feeding), decreased attention, more impulsivity, negative affect or temperament, and lower cognitive test scores or language abilities. Although there is growing evidence of long-term effects, we are far from understanding the mechanisms by which maternal mental state may influence the mother's own physiology and in turn the prenatal environment, which may affect early child development within an epigenetic framework of genetic vulnerability and environmental interactions.

More work is needed to clarify the impact of maternal psychological state and stress on a developing nervous system and to explore if maternal health is important during specific periods of fetal development or if the risks were conferred before conception. The mechanism of programming or regulating the offspring's hypothalamic-pituitary-adrenal (HPA) axis may be related to the level of early exposure to stress hormones in utero or to impaired uterine blood flow (Van den Bergh et al., 2005). The onset, chronicity, timing, and intensity of maternal stress may influence the development and functioning of the placenta and other structures affecting the fetal environment. Alternatively, maternal stress may be linked to critical periods of neurobehavioral development, such as periods of limbic or frontal cortical neuron differentiation. In addition, genetic risk factors for mood and anxiety disorders may be greater in these babies and these may influence different outcomes.

It is possible, however, that what appears to be an association between prenatal factors and infant emotion and behavioral regulation is actually better understood as a genetic predisposition for deficits in regulation that are expressed in the mother within the context of a high life stress and in the infants as poor modulation of neuroendocrine functioning or difficulty being soothed. Animal studies have generated some evidence for the direct association between altered stress reactivity in neonates and the prenatal environment. Less optimal responses to stress, defined as heightened behavioral reactivity, were found in rat pups whose mothers were exposed to stress during the first trimester of pregnancy (Weinstock, 1997). In primates, infants who were exposed to stress prenatally showed poorer neurobehavioral functioning at birth and poorer behavioral response to novelty later in life (Schneider & Moore, 2000). Prenatal cocaine exposure in the rodent was associated with delays in attaining developmental milestones (Tonkiss et al., 1995) and the longer duration of aggression responses in males (Johns & Noonan, 1995).

Because the increasing capacity for self-regulation is part of a normal maturation process, it is expected that factors affecting the normal development of the fetus or neonate may also interrupt or impede other maturational processes. With regard to the regulation of emotion and behavior, there is evidence that medically high-risk neonates have deficits in their self-regulatory capacities. When arousal was measured by behavioral state (alert or crying), affect (negative, positive, or neutral), and attention in cocaine-exposed and non-cocaine-exposed 3-month-old infants, there were no significant differences between the two groups on baseline measures of these three indices of arousal (Mayes et al., 1996). In response to a novel stimulus, however, cocaine-exposed infants displayed more negative affect and cried more often and longer than non-cocaine-exposed infants. In summary, teratological and maternal psychological factors appear to be associated with differences in infant emotion regulation. In the human, there is still debate over whether this association reflects the importance of insults during fetal development or the inherited predisposition for deficits in emotion and behavior regulation.

EARLY DEVELOPMENTAL CONTEXT

There is evidence to suggest that parenting behavior during infancy and the early toddler period explains more variance in later emotional and behavioral functioning than pre- and perinatal factors, including prenatal drug exposure (Beeghly & Tronick, 1994; Shaw, Bell, & Gilliom, 2000; Wakschlag & Hans, 1999). Animal models have shown that maternal

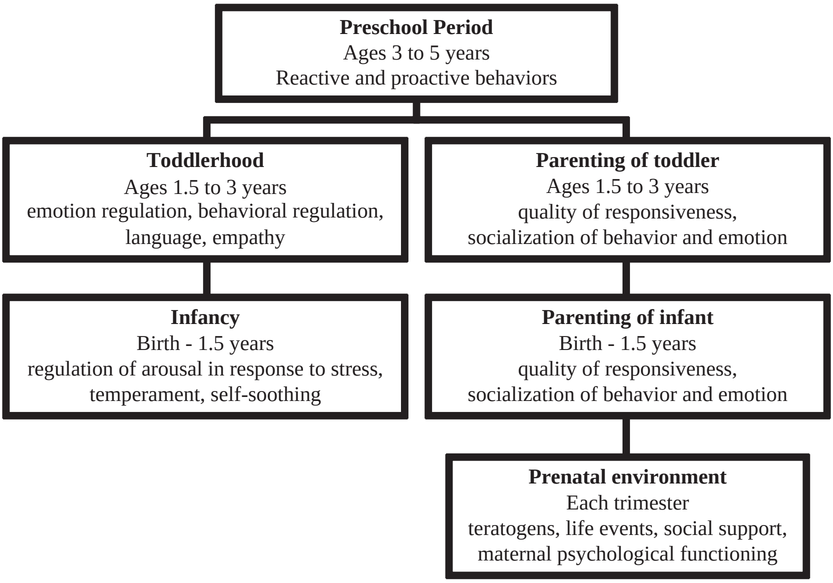

Figure 3.1. Developmentally based domains of assessment from the prenatal environment to the preschool period.

behavioral differences with newborn pups can produce lasting changes of genetic expression in regions of the brain associated with stress responses (Weaver et al., 2004). Although details of brain development time courses vary among species, the first few months to years of life are a dynamic period during which input and context may significantly influence developmental trajectories (see Figure 3.1).

Different brain mechanisms are involved in the activation of stress responses and the homeostatic feedback control of those responses. For example, research on the role of the HPA axis on the stress response has demonstrated that the hypothalamic paraventricular nucleus (PVN) is critical for HPA activation, whereas structures outside the hypothalamus, such as the hippocampus and prefrontal cortex, provide controlling homeostatic feedback (Sapolsky, Krey, & McEwen,1984; Sullivan & Gratton, 2002). Further, there is evidence that caregiving behaviors during the early part of development influence the efficacy of the feedback loop but not the activation of the HPA system (Liu et al., 1997). Therefore, it is important to investigate what aspects of biobehavioral systems are stable during early development and what aspects change or are influenced by varying environmental inputs or caregiving approaches.

Early interventions with mothers and infants at sociodemographic risk have shown effects on children's later behavior and intellectual functioning

(Olds et al., 2004). Therefore, it is reasonable to hope that identifying newborns who are most vulnerable for potential psychopathology through the use of biological or behavioral correlates will make possible early intervention and prevention of mental health problems.

INDIVIDUAL DIFFERENCES DURING DEVELOPMENT

Given that individual differences in emotion and behavior regulation exist at birth, a longitudinal study beginning at birth and continuing for several years would yield up to four groups of children: those who continue to show deficits, those who continue to show competency, those who initially showed deficits but develop competency, and those who initially showed competency but develop deficits. These naturally occurring groups could provide the opportunity for exploring several key etiologic questions that are aimed at both the individual level and the level of the caregiving environment. The first question is whether dysregulation that is present at birth places children at a higher risk for developing behavioral and emotional problems than children without such problems at birth. The second question is whether risk and protective factors can be identified that affect a child's developmental trajectory early in life.

However, even if individual differences can be reliably identified at birth and are found to be associated with later behavioral and emotional problems, the predictive utility of a single construct (i.e., infant self-regulation) to later psychopathology is likely to be relatively low. To significantly improve the ability to detect infants at risk, we need to generate a more comprehensive profile of how both the infant and the caregiver respond to deficits in self-regulation. This second step should lead to the elucidation of both risk and protective factors. For example, despite a deficit in self-regulation, an infant may develop strategies for reducing physical or emotional tension. Some infants avert their gaze or begin to suck their thumbs when presented with visual stimuli. Such infants may be experiencing a level of arousal that is uncomfortable (e.g., an increased heart rate), but are able to return to a more optimal level of arousal by engaging in such behaviors. The ability to better control their physiological response to stimuli may lead to greater tolerance and less distress. By examining the relation between such behavioral and biological responses to stimuli longitudinally, it may be possible to identify behavioral strategies that allow infants to effectively manage deficits in their biological responses to stimuli.

Individual differences in the capacity to regulate arousal in response to stimuli are present at birth. In many studies, these individual differences have been operationalized as the intensity of behavioral and biological responses to stimuli and the latency to return to baseline behavioral and biological functioning after the stressor (Gunnar, Connors, & Isenjee, 1988; Spangler & Grossmann, 1993). Two important areas of research relevant to the regulation of arousal in infancy are research on temperamental differences and studies of biological (e.g., cortisol) and behavioral responses to known stressors (e.g., inoculation). Many studies of typical and atypical development define emotion regulation via measures of temperament. Most developmental psychopathology research has focused on a "proneness to distress" or a "difficultness" factor that reflects both negative affect and difficulty with the self-regulation of that affect (Rothbart, Derryberry, & Posner, 1994). Although the methods of assessment of these dimensions vary across studies, the construct appears to be relatively robust and stable over the first few months and even into later infancy. For example, Bates defined temperamental difficultness via factor analysis, the result of which included items representing frequency and intensity of negative emotion and difficulty being soothed (Bates, 1992). This factor remained distinct from other temperamental dimensions from 6 to 24 months.

In typically developing infants, regulation of behavior, as demonstrated by more stable periods of sleep and wakefulness and less frequent crying and irritability, proceeds at a fairly rapid rate in the first year of life (St. James-Roberts & Plewis, 1996). The increase in regulatory skills is concurrent with other developmental gains, including increases in social communication and motor skills, which provide infants with opportunities to signal to their caregivers that they want to be held or to crawl toward a desired object, thereby engaging in regulatory strategies (Kopp, 1989). Research on the role of neuroendocrine functioning has generated similar results. In normal development, habituation to a negative stimulus such as separation from a caregiver or inoculation is associated with a decreased cortisol response over time (Gunnar, Connors, & Isenjee, 1989; Gunnar, Larson et al., 1992; Lewis & Ramsay, 1995b; Ramsay, & Lewis, 1994).

Inconsistency in research findings regarding the stability of individual differences in the regulation of arousal in infancy is partly caused by the difficulty in developing reliable and valid definitions of infant emotion regulation and dysregulation, given the number of systems involved, the variability in how quickly various systems react to stressors, the impact of the pre- and postnatal environment, and the absence of a consensus on what constitutes "maladaptive" infant behavior. Emotion dysregulation has been defined as an inability to respond to stimuli with well-maintained control (Keenan, 2000). In a well-regulated infant, modulated changes in emotions, behavior, and neuroendocrine functioning allow optimal responding to stimuli. In an emotionally dysregulated infant, transitions to states or responses to stimuli are accompanied by unmodulated changes in behavior, emotions, or neuroendocrine functioning. A lack of modulation could be manifest in many ways, including a response that is too weak, a response that is too intense, or one that is too long in duration. Thus, although there appear to be reliable and meaningful differences in regulatory abilities in infancy, how well those individual differences map onto later problems with emotional and behavioral functioning has not been adequately explored.

CORTISOL AS A DEVELOPMENTAL BIOBEHAVIORAL MARKER

Over the past 10 years, much research has aimed to elucidate the association between certain types of psychopathology and individual differences in cortisol, both resting levels and reactivity (Delamater & Lahey, 1983; Granger et al., 1998; McBurnett et al., 1991, 2000). There is still a fair amount of inconsistency across studies, but sufficient data exist to explore this link more fully. During this same period, several groups of researchers have examined the development of normative patterns of cortisol reactivity to a variety of stimuli, including painful stimuli (e.g., circumcision, inoculation) and social stimuli (e.g., separation, entry into day care) (Gunnar et al., 1996; Lewis & Ramsay, 1995a).

One point of interface between these two areas of research is the predictive utility of individual differences in cortisol response very early in life to the development of behavioral and emotional problems. Deficits in the regulation of behavior and emotion are at the foundation of psychopathology, and patterns of cortisol response may be indicative of such deficits. Thus, by examining individual differences in patterns of cortisol reactivity very early in life, we may reveal a mechanism for identifying children at risk for later psychopathology.

The first major challenge to such a program of research, however, is the fact that defining a poorly modulated response to stimuli is not simple. Glucocorticoids are often used as indices of stress reactivity, but there is no consensus on how to operationalize a well or poorly modulated glucocorticoid response in the human. Increases in glucocorticoids are not always bad and can lead to enhanced performing in some contexts, such as threat (Sapolsky et al., 2000) or cognitive demand (Ferry, Roozendaal, & McGaugh, 1999). A lack of increase may in fact represent a system that is unable to successfully meet challenges (Gunnar et al., 1995). Thus, simply mounting or not mounting a response is inadequate with regard to identifying maladaptive patterns. In response to these issues, we decided to study the quality of both cortisol and behavioral response to two different types of stimuli so that we may compare and contrast the utility of each stimulus context in eliciting suboptimal patterns of stress reactivity in infants.

Stress Reactivity in Infants from an Urban, Low Socioeconomic Context

We chose to focus on African American neonates born to families living in urban, low-income environments for two reasons. First, the majority of research on neonates who represent ethnic minorities is drawn from studies of mothers who abuse substances. Thus, normative data on healthy African American neonates are needed. Second, although children living in inner-city, low-income environments are at higher risk for developing later behavioral and emotional problems, the vast majority of these children do not have mental health problems. Thus, the mechanisms by which high-risk environments confer risk for later emotional and behavioral problems have yet to be elucidated. Moreover, much of the research in this area has often confounded socioeconomic status (SES) with ethnicity. By focusing on healthy African American neonates who are homogeneous with respect to SES, we are able to make meaningful comparisons between children with positive versus negative developmental outcomes without confounding ethnicity and income. Our long-term goal is to identify individual characteristics that are present very early in life that may serve to increase a child's susceptibility to the potential negative impact of environmental factors that are relatively common in low-income environments.

In this longitudinal study from birth to age 2 years, we recruited healthy African American neonates and their mothers from the general care nursery after careful screening (Keenan, Gunthorpe, & Young, 2002). We excluded infants who had obvious congenital and chromosomal abnormalities or who tested positive for cocaine or opioid exposure because they were likely to have serious deficits in neurobiological functioning. On average, the mothers in the present study were in their early twenties, were generally healthy during pregnancy, had graduated from high school, were single, had family incomes of about $600 per month, and were receiving some sort of public aid. Almost half of the neonate sample (47%) was male, and all but four (8.5%) of the males were circumcised. We tested the hypothesis that relations between behavioral and biological measures of stress reactivity will vary depending on the type of stressor and the method with which individual differences in stress reactivity are assessed. We used two different stressors to examine individual differences in stress reactivity, both of which were administered within 48 hours of birth: a heel stick and the Neonatal Behavioral Assessment Scale (NBAS; Brazelton & Nugent, 1995).

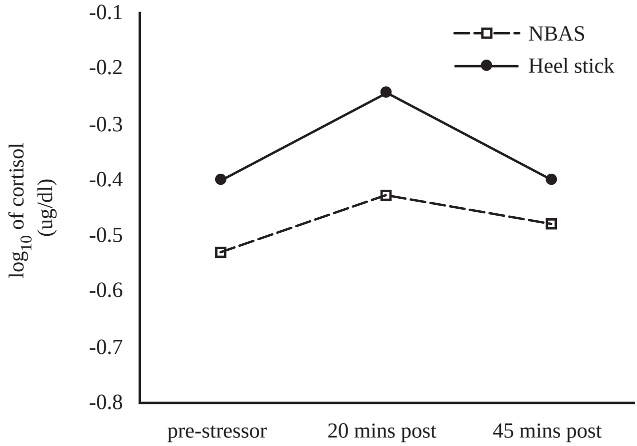

Figure 3.2. Change in cortisol in response to the NBAS and the heel stick.

The NBAS samples a broad range of behaviors, including reflexes, state changes, attention, arousal, and regulatory capacities. We collected saliva pre-stressor, at 20 minutes to represent the peak stress response, and at 45 minutes to assess the recovery response. Thus, we were able to compare and contrast the relations between behavioral and biological measures of stress reactivity within individuals across the two paradigms by examining patterns of cortisol responses.

Cortisol Response Patterns in Neonates with Different Stressors

Pre-stressor cortisol values were not normally distributed in the neonates in our study, as is typically the case. Therefore, we computed $\log_{10}$ transformations of all cortisol values and examined baseline, peak, and recovery cortisol values (Keenan et al., 2002). Cortisol concentrations changed significantly across the three time points. The magnitude of change during the recovery period differed across stressors. Pre-stressor cortisol values were associated with cortisol reactivity. Both pre-stressor cortisol concentrations and pattern of cortisol response were significantly associated within individuals (Figure 3.2).

For most infants, we captured a significant increase in cortisol in response to both the heel stick and the NBAS by sampling 20 minutes post-stressor. Similarly, the 45-minute post-stressor sample captured a phase of recovery from the stressors for most infants. Although the examination of average changes in cortisol across neonates demonstrated that an increase in cortisol was typically observed in response to the two stressors, our goal of exploring atypical patterns of change in cortisol led us to examine individual patterns

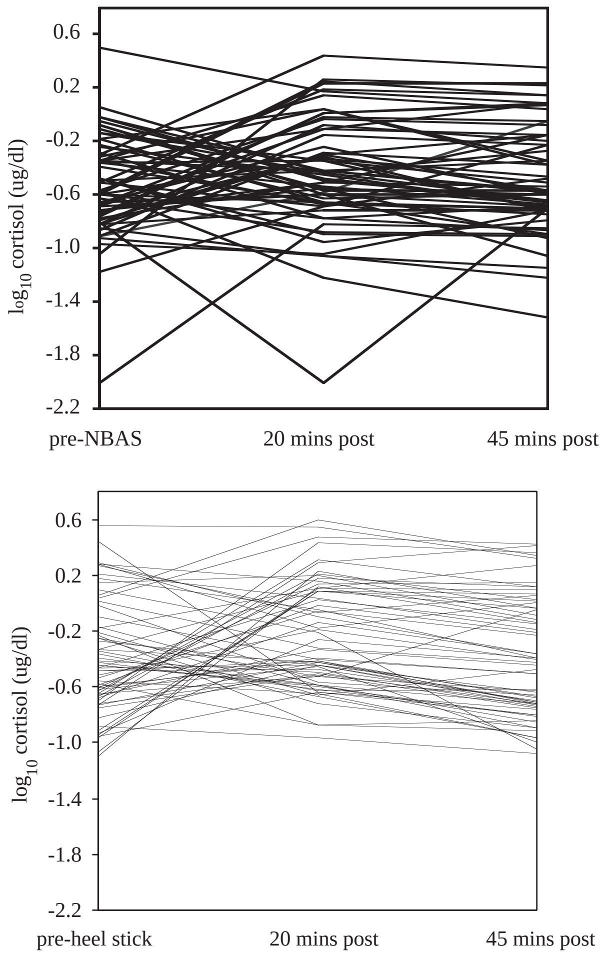

Figure 3.3. Individual patterns of cortisol response to the NBAS and heel stick.

of cortisol reactivity to the two stressors. We plotted each infant's cortisol level at pre-, 20 minutes post-stressor, and 45 minutes post-stressor for the two stressors. As seen in Figure 3.3, there is quite a bit of variation around the average scores. For example, 14.5% of infants continued to show an increase in cortisol 45 minutes post-NBAS. Thus, the recovery period for a substantial group of infants appears to be longer than 45 minutes. Capturing the peak and recovery phases in cortisol reactivity is likely to be an important aim of studies designed to identify markers for psychopathology. The ability to identify the magnitude of the initial response and the point at which levels start to decline may be particularly useful for identifying infants at risk for problems with emotion regulation. Thus, multiple samples may be needed to capture important individual differences, especially atypical or maladaptive patterns of stress response.

There is some evidence of individual stability in both baseline cortisol levels and the magnitude of recovery from 20- to 45-minutes post-stressor. There appear to be three patterns of cortisol responsiveness: neonates who respond to a stressor with an increase in cortisol, those who have a minimal or no response, and those who respond with a decrease in cortisol. Whether an infant responded with a cortisol increase or decrease was also relatively stable across stressors. Slightly more than half of the infants demonstrated the same pattern of initial response across both paradigms. Given that the stressors were quite different in terms of the demands on the infant, the level of discomfort, and the duration, one might hypothesize that there would be more variability than stability in the quality of the cortisol response. Yet, baseline cortisol values have a significant impact on the direction of the initial response. For many infants, the effect of baseline values appears strong enough to be maintained even in the context of qualitatively different stressors.

Defining a Poorly Modulated Stress Response

Our initial step was to test the association between cortisol and behavior, with the goal of identifying patterns of cortisol reactivity that occur in the context of poorly modulated behavior. For example, behavioral data on the intensity of crying or the ability to self-soothe may be used in conjunction with changes in cortisol to indicate whether an increase (or decrease) is associated with poor emotional and behavioral functioning. Starting with an operational definition of maladaptive behavioral responses to stress makes sense for two reasons. First, extreme variations in later infant behavior and emotion regulation, including the intensity and ease of eliciting negative emotions and the ability to recover from distress, are associated with early psychopathology. Whether or not such individual variations in neonatal behavior and emotion regulation are meaningful with respect to later psychopathology has not been tested, but it seems reasonable to explore such a relationship. Second, impairment resulting from the behavioral response can be directly measured in infancy by using indices such as insufficient sleep or food intake or caregiver distress.

Based on the work of Gunnar, we hypothesized that the ability to identify atypical patterns of stress reactivity would be dependent on the context of the stressor (Gunnar, Hertsgaard et al., 1992). Specifically, we expected that a highly intense response would be easier to detect in the context of a less acute stressor, during which the majority of infants would have a

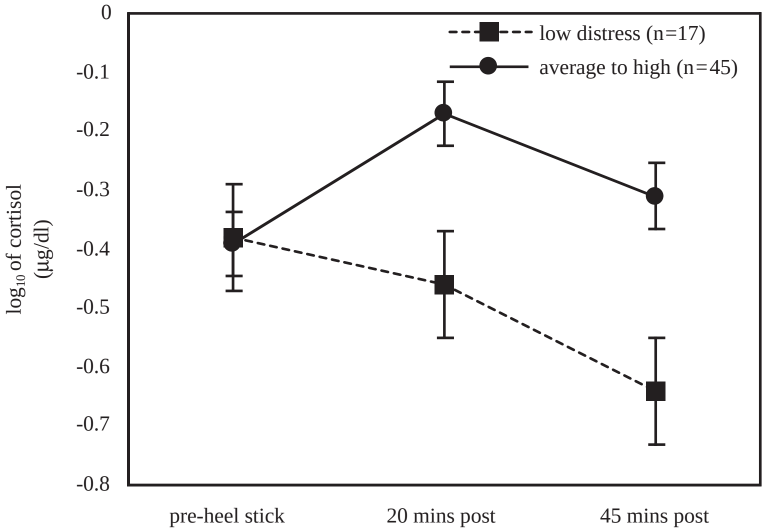

Figure 3.4. Interaction of time and behavior on cortisol level in response to the heel stick.

more modulated response. Our own work in identifying atypical patterns of aggressive behavior in toddlers supported this hypothesis. In an earlier study, aggression that occurred in low-stress contexts (e.g., free play) showed greater stability than aggression that occurred in high-stress contexts (e.g., separation from mother; Keenan & Shaw, 1994).

We used the examiner ratings from the NBAS and coded behavior from the videotapes of the heel stick to establish atypical behavioral responses to the two stressors. The Kaye criterion, which was developed to classify infants as irritable or not irritable in response to the NBAS (Kaye, 1978), averages three items from the NBAS: rapidity of buildup, irritability, and lability of states. Infants with a score of 6 or above are classified as irritable (n = 23). We used a similar metric for the response to the heel stick by standardizing and combining scores for intensity of distress, duration of distress, and self-soothing in response to the heel stick. We dichotomized the distribution of the summed scores into scores falling at or above 0.5 SD above the mean for the sample (high distress, n = 22) and those below (average to low distress). Thus, we now had two paradigms within which to capture atypical levels of behavioral distress.

As shown in Figure 3.4, neonates in the low behavioral distress group demonstrated a significantly different pattern of cortisol reactivity from neonates in the average to high behavioral distress group. Whereas neonates in the average to high distress group demonstrated an increase at 20 minutes post-stressor and a decrease in cortisol at 45 minutes post-stressor, neonates in the low distress group had cortisol levels that decreased over the three time points. Similar results were generated using the within-subject groupings of increasers, stable, and decreasers in each of the two stimulus contexts. In response to the NBAS, the neonates who manifested high levels of behavioral distress were distributed differently across the three patterns of cortisol response from the rest of the sample, with greater representation in the increasing and stable groups (Figure 3.5a). In response to the heel stick, the neonates who manifested lower than average behavioral distress were distributed differently from the remaining neonates, with greater representation in the decreasing and stable groups (Figure 3.5b).

SUMMARY OF PROGRESS AND FUTURE DIRECTIONS

We have made some progress toward operationally defining atypical patterns of cortisol response in human newborns. Behavior and cortisol levels are associated, depending on the definition of atypical behavior. Moreover, the definition of atypical behavior needs to be conceptualized within a specific context and is likely to vary across contexts. Significant relations between *high* levels of behavioral distress and cortisol were found in response to the NBAS, but not to the heel stick. In this set of analyses, our goal was to examine whether patterns of cortisol response associated with poor behavior regulation differed from those in neonates demonstrating better behavior regulation. On average, neonates whose behavior was coded as reflecting low to average levels of distress had very minimal change in cortisol over time. Neonates, whose behavior was coded as irritable or highly distressed, demonstrated a significant change in cortisol over time. This finding was maintained when we classified within-individual change in cortisol into one of three groups: increasers, stable, and decreasers. The same pattern of association between behavior regulation and cortisol was found in the context of the heel stick. In this context, however, atypical behavior needed to be conceptualized as lower than average distress for an association between behavior and cortisol to emerge.

The idea that context is important for evaluating the quality of behavior and emotion regulation early in life is intuitively appealing with regard to identifying precursors to psychopathology. Part of what helps differentiate typical from atypical patterns of behavior is the nature of the challenge that the child faces. For example, it may be common for a preschooler to be defiant when asked to clean up, but defiance in the context of a free-play

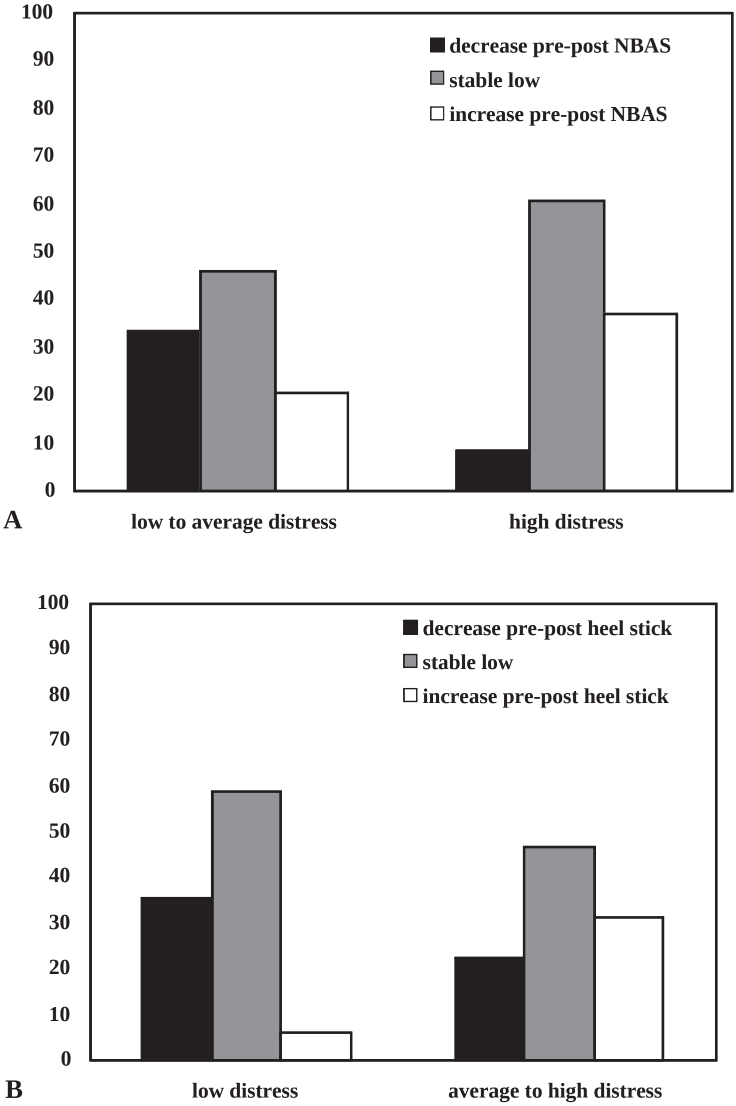

Figure 3.5. Patterns of cortisol response among behavioral groups.

situation would be atypical. Similarly, it is not unusual for an infant to become distressed when a caregiver leaves the house, but it would be uncommon for distress to occur when a caregiver leaves the room. Conversely, it would be atypical for an infant *not* to evidence distress on separation. Deviations from the typical response therefore may include both overarousal, such as higher than average stress reactivity, and underarousal, such as lower than average stress reactivity. The ability to detect such deviations may depend on whether the stressor is one that typically elicits a low or high response.

In this chapter, we describe our exploration of the importance of the context of the stimulus for understanding typical and atypical cortisol responses. There are many other contexts, however, that ultimately will need to be incorporated into a model of developmental psychopathology. First, there is the genetic context. Individual differences in the genes that regulate cortisol will affect the observed stress response. Thus far, the evidence for an association between glucocorticoid receptor polymorphisms and altered stress reactivity, as in the form of posttraumatic stress disorder, is mixed (Bachmann et al., 2005). A stronger link may be apparent earlier in life, however, when gene expression is less influenced by environmental factors.

Second is the prenatal context. There is substantial evidence from the animal literature and emerging evidence from the human literature that psychological and physical experiences during pregnancy result in altered stress reactivity in the offspring. In rodent and nonhuman primate models, prenatal stress has been associated with increases in behavioral reactivity to stimuli (Weinstock, 1997), less organized behavioral responding to novel stimuli (Schneider & Moore, 2000), and reduced hippocampal volume and higher cortisol values after a dexamethasone suppression test (Coe et al., 2003) in the offspring. O'Conner and colleagues reported that prenatal anxiety was associated with cortisol levels in adolescent offspring, even after accounting for maternal anxiety postnatally and throughout the child's development (O'Connor et al., 2005). These data support the hypothesis that psychopathology may be transmitted from one generation to another via fetal programming of biological systems such as the HPA axis.

Third is the context of the organism's resources. Although we attempted to recruit a sample of healthy neonates, a number of factors can affect the impact of a stimulus and the functioning of the neuroendocrine system, such as temperature, glucose level, and immune functioning (Plagemann, 2005). Moreover, neurotransmitter systems such as the serotonergic system and autonomic functioning are all linked to the HPA system. Environmental resources may also play a key role. Later in development, family context appears to be related to cortisol reactivity in older children (Flinn & England, 1995; Granger et al., 1998). Similarly, maternal responsiveness is related to cortisol reactivity in older infants (Spangler et al., 1994), and temperamental difficultness may explain some of the variance in cortisol response to different caregiving contexts (Gunnar, Larson et al., 1992).

The utility of research aimed at one piece of the puzzle, such as that described in this chapter, will be influenced by how well the results can be incorporated into the understanding of a more complex system. To that end, we aim to examine the associations among behavior, cortisol, and heart rate variability in our own research and to explore whether specific profiles of infant behavioral, neuroendocrine, and autonomic reactivity to specific stimuli are predictive of later behavioral and emotion problems in toddlers.

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4

An Integrative Approach to the Neurophysiology of Emotion Regulation: The Case of Social Withdrawal

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The concept of emotion regulation as a psychological construct has become an issue of significant scientific debate during the last decade (see Cole, Martin, & Dennis, 2004). Recent conceptualizations of emotion regulation have ranged from "changes associated with activated emotions" (Cole et al., 2004. p. 320) to emotion regulation as embedded in emotion or as an integrated component of emotional processes, including the generation, manifestation, and termination of the emotional experience (Campos, Frankel, & Camras, 2004). Because of the integrative nature of the physiological processes involved in the perception, processing, and reaction to emotional stimuli,we agree with Campos et al.'s (2004) working definition of emotion regulation. We view emotion regulation as a chain of neurocognitive *processes* that modulate the activation, intensity, duration, quality, and expression of emotional experience. At their most basic form, these processes are in charge of the processing of emotional stimuli and the subsequent regulation of arousal (Bradley, 2000).

Although theorists have called for a "process" model of emotion regulation (Campos et al., 2004), empirical validation of this model has been limited. One barrier to progress has been the lack of well-articulated processes involved in emotion regulation and of cohesive theoretical formulations that account for the highly interconnected nature of these processes. One example of this process model can be observed in children's reactions to fear-inducing stimuli. In our laboratory, we perform a brief fear-inducing task during which children are exposed to a realistic rubber snake. The reaction to such stimuli varies significantly. Some children barely flinch; they

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smile, lean forward, and ask, "Can I hold it?" Others hesitate, approach the cage slowly, their eyes wide open; a nervous smile may form on their faces. Yet, other children jump back and may refuse to approach the snake even after many reassurances that it is fake. What biological processes may be involved in the regulation of emotions during fear-inducing situations such as this one? To answer this question, we must examine the entire emotional process from the initial reaction to the stimuli to the eventual regulation of the child's physiological arousal.

First, when exposed to an emotion-eliciting situation, the child initiates a chain of activating/arousing events, for which quality, intensity, and duration are determined both by the nature of the stimulus and by a series of internal physiological processes and set points. Individual differences in these physiological processes are responsible for the wide diversity of sensations that people may experience when exposed to the same emotion-eliciting situation. In our laboratory for example, we argue that the process of emotion regulation begins *before* the child is exposed to the fake snake. Specifically, the fear and arousal modulating systems, controlled by the amygdala and the limbic-hypothalamic-pituitary adrenal (LHPA) axis, respectively, are at work at all times and prime the child's bodies for action if and when a fear-inducing stimulus is encountered. The child reacts to the fear stimuli when such stimuli elicit a specific level of arousal (set point) that initiates a cascade of cortical and subcortical events resulting in the subjective experience and expression of fear. Individual variations in such biological priming play an important role in the experience and expression of emotion and thus should be viewed as a key component of the human emotion regulation system.

Second, emotion regulation also occurs *during* the elicitation of such arousal and is governed by established biological set points and neurocognitive processes active during the exposure to the stimuli. That is, the child's arousal level depends both on his or her biological predisposition to respond to specific situations (temperament) and on the active interpretation of the event (neurocognitive functioning). Once the stress response system reaches an arousal threshold, the regulation of this arousal continues. Various cortical and subcortical structures will then modulate the intensity and duration of the experience, as well as the behavioral expression of such experience. For example, specific neurocognitive processes, mostly modulated by the frontal cortex, can alter the child's internal working models that in turn alter self-perception, sense of efficacy, and insight, all of which are important in affecting the child's perception and interpretation of emotional stimuli and the subsequent subjective experience of the emotion (Bradley, 2000).

Third, emotion regulation *during* the elicitation of arousal also is affected by the ability to inhibit emotional expression through behavioral inhibitory mechanisms controlled by the prefrontal cortex. Children may react with extreme fear after being exposed to the fake snake. However, for many reasons, they may "regulate" their reaction, thereby preventing them from displaying their true emotional state. The concept of "display rules" – our ability to understand and apply social rules governing our expression of emotion – has been studied for decades and can also be seen as a self-initiated attempt to regulate emotional expression.

Finally, *after* the initial elicitation of arousal, a child's subjective experience of emotion and underlying arousal are regulated by a series of autonomic regulatory systems, such as the mineracorticoid and glucocorticoid receptor negative feedback mechanisms of the LHPA axis. These regulatory mechanisms help modulate levels of arousal by facilitating the body's return to a homeostatic level. Therefore, from a neurophysiological perspective, the process of emotion regulation is intrinsically multifaceted. Biological processes are involved in regulating our temperament (initial predisposition), the activation of our arousal systems, the experience and expression of our emotions, and the regulation of the system back to a homeostatic level.

To illustrate these processes, we examine how three unique physiological systems interact among themselves and with the environment to affect the regulation of emotions in children who experience high levels of social withdrawal. We review the *LHPA axis* as a central component of the human stress response system, which affects the cognitive and subjective experience of emotionally charged situations and has motivational properties by directly influencing the behavioral responses to stress. We then describe the neurophysiology of the *amygdala* and its relation with the LHPA, particularly as they relate to two components of emotion regulation: the processing and behavioral reaction to fearful stimuli and the consolidation of emotion-dependent memories. Finally, we present a summary of the functioning of the *prefrontal lobes* in the processing of positive and negative emotions as it relates to the subjective experience of negative emotionality.

We define social withdrawal as a pattern of behavioral inhibition *during social situations*, an extension of Jerome Kagan's concept of inhibition. Kagan and his collaborators (Kagan, 1989; Kagan, Reznick, & Snidman, 1988; Kagan, Reznick, Snidman, & Gibbons, 1988) studied behavioral inhibition in relation to children's responses to unfamiliar stimuli and viewed it as a stable trait. Inhibited children, when exposed to novel situations, "show a pattern of restraint and avoidance, together with signs of wariness or fear of unfamiliar people, objects, and events." Conversely, uninhibited children "display a relatively rapid and fearless approach to unfamiliar people, places, and objects" during similar situations (Robinson, Kagan, Reznick, & Corley, 1992, p. 1030).

However, from an emotion regulation perspective, social withdrawal refers to a pattern of avoidant behaviors resulting from increased levels of social anxiety. When we discuss emotion regulation in the context of social withdrawal, we focus on the regulation of socially induced anxiety and related behavioral manifestations. This distinction is key, because as we explore later in this chapter, the behavioral inhibition associated with social withdrawal can be conceptualized as a consequence of variations in a person's emotion regulation process or as a emotion-regulating act intended to regulate the experience of social anxiety.

LIMBIC-HYPOTHALAMIC-PITUITARY-ADRENAL (LHPA) AXIS

The LHPA axis is the major regulatory system for stress in humans and most mammals and is a central component of the emotion regulation system. The LHPA is activated during stress to produce a series of hormones and leads to the release of corticoids. Cortisol, the end product of this activation, is the major stress steroid in humans; it modulates several neurophysiological processes, such as termination of digestive activity, increase in heart rate, and mobilization of glucose as an energy source for utilization under "flight or fight" type of events (de Kloet, 1991; Johnson, Kamilaris, Chrousos, & Gold, 1992). These processes have a survival function, priming the individual for action. The role of the LHPA in emotion regulation is at least twofold. First, tonic LHPA functioning is believed to affect the activation threshold of the LHPA system, possibly affecting the intensity and speed of emotional experience. Second, the LHPA axis serves as its own regulator, facilitating the termination of the stress response and associated emotional experience.

The LHPA process begins when the paraventricular nucleus (PVN) of the hypothalamus produces and secretes corticotrophin-releasing hormone (CRH), which in turns activates the anterior pituitary gland's corticotrophic cells to secrete andrenocorticotropic hormone (ACTH; see Vazquez, 1998, for an extensive review of the functioning and development of this system). ACTH in turn activates the release of cortisol by the adrenal glands (adrenocortical stress response). This cascade of hormonal activating events is triggered by stress signals received by multiple brain circuits specific for different types of stress that converge in the PVN hypothalamic area. However, in addition to acting as an alarm system, the LHPA axis also has intrinsic

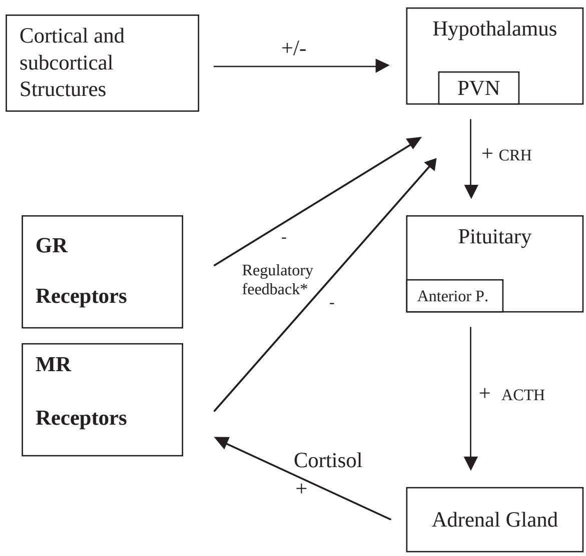

Figure 4.1. Basic model of the activation and regulation of the LHPA axis.

activity, maintaining an underlying 24-hour cortisol rhythm that is independent of stress responses and linked to activity level. As such, during this circadian rhythm in humans, high cortisol levels are observed during the start of the wake cycle (morning), decrease through the afternoon, and are lowest at nighttime at the start of the sleep cycle. These circadian levels of cortisol are believed to reflect a person's basal cortisol levels, which also have an important role in emotion regulation processes by affecting tonic functioning and stress-induced activation patterns. See Figure 4.1 for a basic model of the LHPA system.

In addition, cortisol also is its own regulator, activating feedback mechanisms and making the LHPA shut down the release of activating hormones and consequently cortisol's own release. Variations in the efficiency of these feedback mechanisms can be linked to individual variations in the regulation of emotional experience after stressful situations.The LHPA inhibitory system is controlled by two types of corticoid receptors: mineralocorticoid receptors (MRs) and glucocorticoid receptors (GRs). MRs are mostly located in limbic structures, particularly the hippocampus. Hippocampal effect on LHPA functioning is mostly inhibitory and is mediated by MR activation. In the brain, MRs have a high affinity for corticoids and therefore are activated to inhibit hormonal secretion by very low levels of corticoids (de Kloet, 1991). Because of MRs' high affinity to corticosteroids, these receptors are believed to control tonic basal activity of cortisol by inhibiting CRH release.

Conversely, GRs are localized throughout the brain and are activated by high levels of stress-induced corticoids (Heuser, Deuschle, Weber, Stalla, & Holsboer, 2000; Oitzl, van Haarst, & de Kloet, 1997). During emotional stress, high levels of cortisol saturate brain MRs first and then begin to bind to GRs (Oitzl et al., 1997). Although GRs are generally believed to have an inhibitory function, recent data suggest that they may first help maintain the elevated levels of cortisol that may be necessary during dangerous situations (Oitzl et al., 1997). Thus, GR antagonists (that block GR activation) can result in blunted cortisol secretion, perhaps by increasing MR activation (see Figure 4.2).

Therefore, individual variations in cortisol can influence emotion regulation at several levels. The speed, intensity, and duration of activation of emotional processes can be influenced by several factors, including individual variations in patterns of tonic LHPA functioning, the degree of LHPA activation during stress caused by varying activation of brain cortical and/or subcortical signaling, individual differences in sensitivity to CRH and ACTH, and MR-GR dependent regulatory functions controlling the sensitivity to cortisol feedback inhibition.

LHPA, Emotional Dysregulation, and Psychopathology

Because cortisol secretion is the end product of the activation of the LHPA system, the study of cortisol in a variety of contexts provides important information about various aspects of a person's stress response system and related emotion regulation processes. First, extremely high or low levels of cortisol, whether at rest (basal) or stress induced, can be viewed as reflecting a dysregulation of the LHPA system (Heim, Ehlert, & Hellhammer, 2000) and have been associated with distinct emotion regulation problems (Checkley, 1996; Gunnar, 2001; Tobin, 2001; ver Ellen & Van Kammen, 1990). Second, individual differences in normative cortisol levels have also been linked to specific affect-related behaviors. Both normative and dysregulated LHPA function may have direct links with behavior and personality traits directly related to emotional regulation (Guerra, Nucci, & Huesmann, 1994; Gunnar, 1994).

For example, LHPA dysregulation, both in terms of resting (basal) hormonal activity and abnormalities of the activation or inhibition of hormonal levels after a stressor (reactive), has been linked to a variety of affective psychiatric disorders. Major depressive disorder (MDD) and posttraumatic

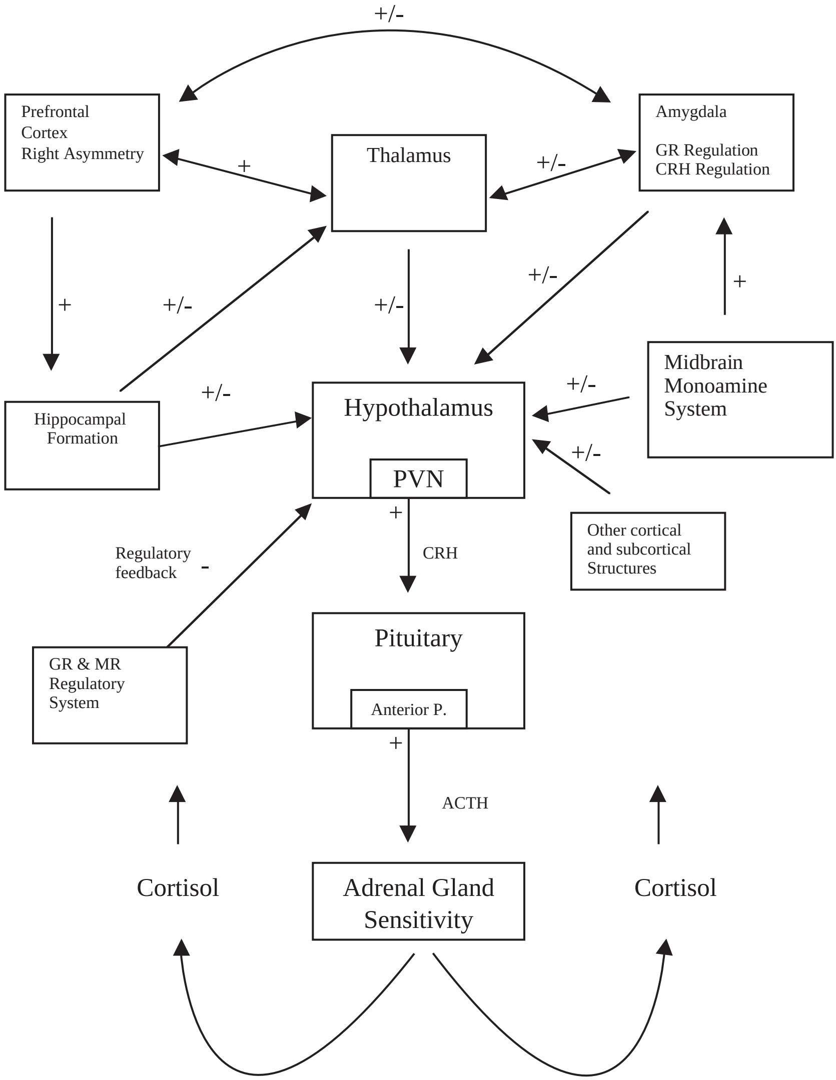

Figure 4.2. Expanded model of the activation and regulation of the LHPA axis.

stress disorder (PTSD) are among the psychopathological disorders associated with LHPA abnormalities (Checkley, 1996; Gunnar, 2001; Tobin, 2001; ver Ellen & Van Kammen, 1990). A common interpretation of these findings is that dysfunctional tonic LHPA functioning may result in extreme physiological activation during stressful situations or elevated activation during day-to-day activities. This elevated propensity to activate the stress response may create problems with the emotional reaction to daily events, ultimately producing atypical levels of negative emotionality.

The literature linking dysregulation of the LHPA axis to affective disorders is extensive and continues to grow rapidly. It underscores the importance of LHPA axis functioning for the regulation of emotional experience and expression. However, we are mostly interested in examining the evidence linking normal variations of LHPA functioning to individual differences in patterns of emotion regulation and their effect in the phenomenology of social withdrawal. Thus, we present evidence suggesting that normal LHPA circadian activity and normal activation and autonomic regulation of the system during stress are important components of the phenomenology of social withdrawal because they affect several emotion regulation processes.

LHPA and Social Withdrawal

The development of social anxiety and related avoidant behaviors has been linked to a number of neurophysiological processes, including the functioning of the LHPA system. Schmidt and colleagues (Schmidt, Fox, Rubin, & Sternberg, 1997) found that 4-year-old children with high morning salivary cortisol engaged in more wary behavior during peer play and were reported as shy by their mothers. In another study of LHPA functioning throughout the day, Dettling and colleagues (1999) also found that shyness was a predictor of high basal cortisol levels during the day among 6- to 8-year-old children. Furthermore, conduct-disordered children with high basal levels of cortisol also reported high levels of anxiety (McBurnett et al., 1991). The association between cortisol and anxious behaviors appears to be present during infancy, suggesting a relatively stable developmental trajectory. For example, studies by Kagan and colleagues (Kagan, Reznick, & Snidman, 1988; Kagan, Reznick, Snidman, & Gibbons, 1988) showed that infants who displayed high levels of negative affect to sensory stimulation were later identified as withdrawn in a variety of contexts when they were 4 years old. These children also presented higher basal cortisol levels than more highly sociable children. Consistent with these results, high levels of cortisol were also found among withdrawn anxious infants after the acute stressful challenge of a mother-infant separation (Tennes, Downey, & Vernadakis, 1997). The implications of these findings are considered in a later section, but it is possible that for shy children their overactive basal LHPA functioning (high basal cortisol levels) serves as a behavioral motivator by creating subtle but consistent levels of social anxiety. These children may attempt to regulate this stress by avoiding social situations and therefore increasing their socially withdrawn behaviors.

The studies described in the previous paragraph suggest that high basal cortisol levels may be a biological marker that differentiates shy from uninhibited children throughout many stages of development from infancy to adolescence and beyond. However, other studies provided opposite results, suggesting that specific biosocial contexts may significantly alter the relationship between cortisol and stress, at least during the school-age period. For example, Gunnar and colleagues presented a series of studies showing that behavioral inhibition may actually blunt LHPA activation during specific social situations, resulting in an apparent relative elevation of cortisol secretion among extroverted children. They repeatedly found that extroverted children display higher levels of cortisol during the early stages of a school year when compared to shy and inhibited children (Gunnar, 1994; Gunnar, Tout, de Haan, & Pierce, 1997). Davis, Donzella, Krueger, and Gunnar (1999) also examined the cortisol levels of 7- to 12-year-old children during the first week of a new school year. They found that highly assertive and social children had higher levels of cortisol than shy children, but this trend was reversed after the formation of peer groups. Similarly, de Haan and colleagues (de Haan, Gunnar, Tout, Hart, & Stansbury, 1998) found that cortisol measures taken during a similar school period were positively correlated with assertive behavior in children. Likewise, high levels of cortisol were found among extroverted children after engaging in a competitive task (Donzella, Gunnar, Krueger, & Alwin, 2000).

How can understanding the complexity of the LHPA axis help us clarify the findings linking high levels of cortisol to both inhibited and uninhibited children? First, most studies linking high levels of cortisol with shy and withdrawn behaviors used basal resting levels of cortisol (Gunnar, 1994; Gunnar et al., 1997; Kalin, Larson, Shelton, & Davidson, 1998; McBurnett et al., 1991; Schmidt et al., 1997). Conversely, studies linking high levels of cortisol to outgoing and assertive behavior measured cortisol after or during prolonged stressful situations (Davis et al., 1999; de Haan et al., 1998; Donzella et al., 2000; Gunnar, 1994; Gunnar et al., 1997). It is possible that inhibited children may have an overactive basal LHPA system (low basal inhibitory tone), facilitating the rapid activation of the stress system and creating consistent levels of anxiety and withdrawn and avoidant behaviors. When placed in social situations that may result in increased arousal (such as during the initial stages of group formation), these children may regulate negative arousal by avoiding social interactions. This avoidance may contribute to reduced activation of their LHPA system. In addition, it is possible that any activation of the LHPA system may be difficult to observe because these children already present high basal levels of cortisol and the activation of LHPA to a stressor should be measured in the context of each child's pre-stress cortisol levels. Therefore, under this view, social withdrawal can be conceptualized not as a consequence of variations in emotion regulation processes, but instead as a regulatory action intended to avoid the activation of the stress system and the experience of even higher levels of social stress.

In contrast, uninhibited children may have a readily active tonic inhibition of their LHPA system that results in low basal cortisol levels. This inhibition may lead to a high stress threshold that allows the child to engage in more stress-inducing behaviors, which in turn maximally elevates their cortisol levels (as they are already starting from a low cortisol level under the resting condition). Thus, it is possible that the individual differences in cortisol activation found in various contexts among children with different levels of social withdrawal may be in part related to MR functioning that leads to different patterns of basal cortisol secretion and behavioral correlates.

These different response profiles may be related to the regulation activity of the MRs and GRs. Several animal models provide more insight into the role of GRs and MRs in the manifestation of inhibited and uninhibited behaviors (Kabbaj, Devine, Savage, & Akil, 2000). When rats are exposed to novel environments, they can be categorized based on their exploratory behavior. High responders engage in high levels of exploratory behavior in a novel environment, whereas low responders engage in limited exploration (Kabbaj et al., 2000). These behaviors resemble the sensation-seeking styles that have been identified in humans (Gerra, Zaimovic, Avanzini et al., 1997; Gerra et al., 1999; Gerra, Zaimovic, Timpano et al., 2000). MRs and GRs are thought to be involved in the generation of exploratory behavior among rats because high responders and low responders differ in the density of GR expression in the hippocampus and because artificial manipulation of GR and MR activity results in a reversal of these behavioral characteristics.

In an influential study of the physiological makeup of high- and low-responder rats, Kabbaj and colleagues (Kabbaj et al., 2000) found that, in a basal nonstressed state, compared to low-responder rats, high responders have increased levels of CRH in the PVN, but lower CRH levels in the central nucleus of the amygdala. High-responder animals also have lower basal GR expression in the hippocampus when compared to low-responder animals. In contrast, both high- and low-responder animals have equal levels of MR expression in the hippocampus. We find it interesting that high- and low-responder animals were found to have equal levels of basal corticosterone. However, they differ in the magnitude of the corticoid response to novelty stress. Although intuitively we may think that high levels of exploration would be associated with low corticosterone stress response in high-responder rats, these animals have a high corticosterone response to novelty, whereas low-responder animals have a blunted response. On further scrutiny of the biological markers described earlier, this finding is not entirely unexpected. The profile described in high-responder animals is consistent with increased responsiveness to stress (high CRH in PVN), coupled with decreased anxiety behavior (low CRH levels in the amygdala, a structure associated with fear and anxiety, in which CRH is not directly related to LHPA activity). In addition, a low GR hippocampal expression also suggests a diminution of the inhibitory capacity observed as a sustained corticosterone release after novelty, which some investigators have reported in high-responder animals (Kabbaj, Piazza, Le Moal, & Maccari, 1996; Piazza, Deroche, Deminiere, Maccari, Le Moal, & Simon, 1993).

Glucocorticoid receptors appear to be key in modulating the novelty stress-induced corticosterone response. Direct antagonism of hippocampal GRs (blocking GR action) changes the behavior of a low-responder rat that has high GR expression in the hippocampus into behavior consistent with that displayed by a high-responder rat. This effect is evidenced by changes in exploratory behavior and corticosterone response in a novel environment (Kabbaj et al., 2000; Maccari, Piazza, Deminiere, & Angelucci, 1991; Strohle, Poettig, Barden, Holsboer, & Montkowski, 1998). This result suggests that high-responder rats engage in exploratory behaviors despite experiencing high levels of stress during exploration. It is possible that high responders engage in exploratory behaviors precisely because such a physiological reaction drives risk-taking behavior. Favoring this possibility is vast evidence suggesting that corticoids are reinforcing among rats, leading them to engage in self-administration of psychostimulants or to substitute stress for psychostimulant administration (Piazza et al., 1993). Finally, given the high level of distribution of GRs in the brain, including the limbic system, activation of GRs may have an impact on multiple neuronal pathways, which may result in avoidant or escape behaviors. Thus, blocking of GR activation or a reduced number of GR receptors may prevent an organism from activating avoidant or escape behaviors, resulting in more exploratory and risk-taking activity.

These animal models may provide insight into the underlying neural mechanisms that modulate inhibited and uninhibited human behavior. First, although we must be careful in translating the significance of novelty as a stressor in rodents to its equivalent in human children, we could extrapolate based on the high-low responder animal model that perhaps extroverted children should not have an underactive LHPA response to stress when exposed to unfamiliar surroundings or novel social interactions. As with the high-responder rats, these children may experience a physiological stress reaction when engaging in assertive social behaviors. However, their high levels of assertive social behaviors cannot be explained by an "underactive" LHPA response to stressful situations. Instead, their behavior could be explained by a sensitive LHPA system, perhaps characterized by high levels of CRH in the PVN just waiting to be released on demand, decreased levels of CRH in fear-related centers (amygdala), and reduced GR expression in the hippocampus limiting the occurrence of avoidant behaviors. As in the high-responder animals, this combination would result in increased or normal responsiveness to stress, but a decrease in anxiety-like behaviors when exposed or prior to novel social environments. Likewise, it is plausible that inhibited children have high levels of CRH in the amygdala and high numbers of GR receptors in the hippocampus; both could explain their nonexploratory freezing behavior displayed during stressful situations and the low levels of cortisol secreted during these situations because their *actual* exposure to the novel situation is self-regulated through avoidant behaviors.

The application of animal models to human data appears adequate because the interpretation of these results is consistent with the work by Gunnar and colleagues, who have shown that children with different temperamental characteristics have different LHPA activation when placed in specific environmental contexts. In contexts that may lead to stressful situations, such as the start of a school year, inhibited children display very low levels of cortisol, whereas uninhibited children display high levels of cortisol (Davis et al., 1999; Donzella et al., 2000; Gunnar, 1994; Gunnar et al., 1997). They postulate that inhibited children engage in nonsocial behaviors in an effort to avoid possible stressful situations, and such avoidant behaviors result in decreased levels of cortisol. Conversely, uninhibited children actively seek social interactions despite their normal LHPA response to stress, which in novel contexts may explain their high LHPA activation during these encounters. Considering the multiple functions that cortisol subserves, it is possible that elevations of cortisol *before* these encounters lead inhibited children to engage in socially avoidant behaviors. Instead, uninhibited children seek these social interactions, which activate their LHPA axis.

In addition, facilitation of cognitive function and association, consolidation, and memory processes is linked to elevated (but optimal) levels of corticoids in plasma during learning tasks (de Kloet, 1991). It is possible that, during their social encounters, uninhibited children are consolidating and processing information about social situations that would allow them to be much more adept in future social interactions and be able to reduce anticipatory anxiety related to these situations. Indeed, this may very well explain the lower cortisol levels detected in uninhibited children later in the school year once peer groups are established. We explore this hypothesis further as we review the role of the prefrontal cortex and the amygdala in the phenomenology of social withdrawal.

AMYGDALA

Several structures within the LHPA system have direct and indirect connections to the amygdala (Afifi & Bergman, 1998). The amygdala has also been associated with emotion regulation, mostly through its role in modulating fear-induced behaviors. The study of the amygdala and its relation to emotion, memory, social behaviors such as reproduction and aggression, and the modulation of autonomic and neuroendocrine systems follows three lines of research: case studies of patients with anterior temporal lobe damage, lesion studies using rodents and nonhuman primates, and more recent imaging studies using clinical and nonclinical human populations. Based on these findings, the amygdala is viewed as a key component in the circuitry of emotion regulation and experience (see Davidson, Jackson, & Kalin, 2000, for a review). We now present a brief review of this literature, paying special attention to research linking the amygdala to the activation and regulation of the LHPA axis.

The amygdala appears to play a key role in the processing of emotional sensory information. For example, clinical neuropsychological studies examining the cognitive effects of bilateral damage to the amygdala indicate impaired processing of facial emotions. Specifically, bilateral lesions to the amygdala can result in an inability to recognize negative emotions and difficulty in learning procedures that involve emotional components (Adolphs et al., 1999; Boucsein, Weniger, Mursch, Steinhoff, & Irle, 2001; Calder, Young, Rowland, Perrett, Hodges, & Etcoff, 1996; Hamann & Adolphs, 1999).

In the largest study of humans with amygdala damage, Adolphs and his colleagues (1999) found that subjects with bilateral amygdala damage were significantly impaired in recognizing negative facial emotions, particularly fear. However, the subjects were not impaired in recognizing neutral or positive emotions such as happiness. Adolphs suggested that the amygdala is a component of a complex neural system that recognizes facial cues that signal the presence of danger. He argued that this finding is consistent with animal studies indicating that damage to the amygdala results in an inability to recognize potentially dangerous stimuli. However, he also noted that individual performances on the facial recognition task varied from complete impairment to normal performance. It is not clearly understood why some patients with complete bilateral amygdala lesions did not have problems recognizing all facial expressions including fear. However, it is possible that, given the length of time between the time of the injury and the time of assessment, some patients had already developed compensatory strategies or new neural pathways to help them identify negative facial emotions. Interestingly, Hamann and Adolphs (1999) examined the ability of two subjects with complete bilateral amygdala damage to recognize similarities among similar emotions. These patients were able to correctly identify the similarities among all emotions. Thus, the inability to recognize negative emotional expressions found in people with bilateral damage to the amygdala may reflect an inability to provide meaning to specific emotions, rather than an inability to recognize the *features* of an emotional expression. Furthermore, there also is evidence that the amygdala's role in the recognition of negative emotions goes beyond facial expressions, because bilateral damage to the amygdala also appears to affect recognition of auditory stimuli that represent danger or anger (Scott et al., 1997). More recent functional magnetic resonance imaging (fMRI) studies provide similar results, indicating that when clinical and nonclinical subjects are exposed to stimuli that are associated with fear or anxiety, there is significant activation of the amygdala (Morris, Frith et al., 1996; Phillips et al., 1997; Rauch, van der Kolk, Fisler, & Alpert, 1996). In particular, exposure to faces showing expressions of fear has been found to consistently activate the amygdala (Morris, Frith et al., 1996; Phillips et al., 1997).

The amygdala not only is associated with the perception of emotional stimuli but also may serve an important role in regulating fear-related behaviors. Specifically, studies of nonhuman primates suggest that the amygdala can also modulate the behavioral response to fearful stimuli. Early studies reported that lesions to the amygdala resulted in drastic behavioral and personality changes usually known as the Kluver-Bucy syndrome (reduced fear responses, hypersexuality, and hyperorality; Aggleton & Passingham, 1981). However, more recent studies indicate that lesions to the amygdala reduce behavioral responses to some unconditioned fear responses (such as the exposure to a snake), yet fear responses to some social human interactions remain intact (Kalin, Shelton, Davidson, & Kelley, 2001). For example, Kalin and colleagues (2001) were able to create lesions in the amygdala of several sexually mature rhesus monkeys while sparing adjacent areas as well as fibers passing through the amygdala. In adult male monkeys, these lesions reduced fear responses after exposure to a snake. However, lesioned monkeys did not reduce their freezing behavior during a human intruder paradigm and had levels of frontal lobe asymmetry similar to those of nonlesioned monkeys. Kalin suggested that the amygdala mediates behavioral responses to acute fear, but does not affect behaviors that reflect more stable behavioral traits such as social anxiety. These findings have important implications about the role of the amygdala in influencing the behavioral responses to fear and its relationship to social behaviors such as withdrawal and aggression.

The point in development at which neuronal pathways are interrupted also appears to be important. Amaral and colleagues (2003) are currently following a group of macaque monkeys that endured bilateral amygdalectomy shortly after birth. In contrast to monkeys that had amygdala lesions as adults, these monkeys do not show a blunted behavioral response to a social stressor. Instead, they appear *extremely fearful* when exposed to an unfamiliar animal. This finding indicates that there are discrete temporal windows during which the amygdala is developing its connections to other brain structures and cortical associative areas that are important for the development and modulation of fear-related behaviors. Thus, the time that an insult is created during development, be it anatomical, toxic, or "experiential," may lead to very different behavioral and perhaps neuroendocrine manifestations later in life.

If we considered social avoidant behaviors to be specifically affected by the presence of socially induced anxiety or fear, then the amygdala could be related to social withdrawal in at least two specific ways. First, as the amygdala plays a role in the activation of the LHPA, dysregulation of the amygdala may affect LHPA functioning. Although there are few direct amygdala connections to the PVN in the hypothalamus, a number of researchers have argued that social inhibition may be the result of an overstimulated amygdala (much like the "freezing" response to fear in monkeys). Freezing behavior or social inhibition may underlie the observed elevated basal levels of cortisol found among inhibited-shy children in particular contexts (Kagan, 1994; Kagan, Reznick, & Snidman, 1988; Kagan, Reznick, Snidman, & Gibbons, 1988; Schmidt et al., 1997). Thus, the amygdala may indirectly affect LHPA functioning, thereby creating high levels of social anxiety and affecting the phenomenology of behavioral inhibition during social situations.

There are some conflicting reports regarding the effect of the amygdala on LHPA functioning, which may again be related to the extent of the lesion performed by the investigator and/or the age of the animal at the time of the intervention. Nevertheless, stimulation of the amygdala results in increased corticoid production (Feldman, Conforti, & Siegel, 1982), whereas damage to this structure (specifically, the central nucleus of the amygdala) results in blunted LHPA activity (ACTH release) in response to physical stress (Van de Kar, Piechowski, Rittenhouse, & Gray, 1991). Despite the blunted ACTH response, the adrenocortical response to stress (cortisol response) is unaffected by bilateral amygdala lesion in adult rhesus monkeys (Kalin et al., 2001), suggesting that the adrenal response is sensitized to low ACTH levels after amygdala damage. Furthermore, basal tonic cortisol levels are likewise unaffected (Kalin et al., 2001). Consequently, although the amygdala may be related to LHPA functioning, it is neither necessary nor sufficient for the regulation of tonic LHPA function or the adrenocortical response to stress.

The amygdala may play a more direct role in emotion regulation by facilitating fear-induced learning and the expression of fear-related behavior. In particular, animal and human studies suggest that the amygdala facilitates the learning of both emotional information and stimuli-response contingencies related to fear (Goldstein, Rasmusson, Bunney, & Roth, 1996; Rosen, Hamerman, Sitcoske, Glowa, & Schulkin, 1996). For example, Goldstein and his colleagues (1996) found that amygdala lesions in rats prevented the learning of simple stimuli-response (S-R) contingencies and blocked previously learned responses. Damage to the amygdala, therefore, may prevent the animal's anticipation of the possible consequences of behavior.

Proper functioning of the amygdala would be necessary to extinguish fear-induced behaviors. Failure to extinguish these behaviors would lead to the maintenance or increase of avoidant behaviors that paradoxically would prevent the necessary exposure to fear stimuli (social situation) that would facilitate such extinction. Socially withdrawn children, therefore, may have specific patterns of amygdala functioning that interfere with learning simple S-R contingencies in social situations. From a developmental standpoint, such emotional learning is a key to the acquisition of emotion regulation strategies during childhood. Recent advances in fMRI technology could help delineate the relation of amygdala functioning to S-R learning. It would be revealing to observe the pattern of amygdala activation during S-R learning paradigms among normal children and those with internalizing or externalizing behavior problems. Unfortunately, most of the research on amygdala functioning has been based on animals or humans with a severely damaged amygdala, and studies focusing on normal variations of amygdala functioning and the developmental trajectory of this structure are noticeably absent.

PREFRONTAL LOBE ASYMMETRY

The amygdala and other limbic structures have unilateral and reciprocal connections with the forebrain, particularly with the prefrontal cortical regions (Afifi & Bergman, 1998). It is therefore relevant that a number of studies of the neurophysiology of emotional expression have implicated several areas of the prefrontal cortex (PFC) in the processing and expression of both negative and positive emotions. Specifically, activation of left prefrontal areas is associated with the experience and processing of positive emotions, whereas activation of right prefrontal areas is associated with negative emotions (Gainotti, 1972; Gladue, 1991; Morris, Robinson, Raphael, & Hopwood, 1996). Extensive reviews of this relation have already been presented (Davidson et al., 2000). Thus, in this section we only provide a brief summary of the literature and focus instead on discussing how understanding the neural projections between the PFC and several limbic structures can help us clarify the relationship between cerebral asymmetry and emotional regulation as it pertains to social withdrawal.

The role of cerebral asymmetry in the regulation of emotional expression has been reported in the clinical neuropsychology literature since the early 1970s. These studies showed that patients with damage to the left side of their brain tended to report more depressive symptoms than did patients with right hemisphere injuries (Gainotti, 1972). It has been argued that the disruption of specific circuitry within the left cortex may preclude the expression of positive affect, which in turn may result in depressive symptomatology. In addition, damage to the left hemisphere results in a marked cerebral asymmetry favoring activation of the *right* hemisphere, which controls the regulation of negative affect (Davidson, 1993; Gainotti, 1972; Morris et al., 1996). However, most projections from the frontal cortex to ipsilateral limbic structures are inhibitory in nature. This suggests that damage to the left PFC may disrupt inhibitory signals to left limbic structures, which may facilitate the subjective experience of negative emotionality. That is, damage to the left frontal cortex may affect the regulation of a left "depressive" limbic system.

Consistent with this theory, a number of studies using EEG recordings of cerebral activation have implicated the right frontal lobe in the activation of negative affect and related behavioral responses. Nathan Fox and colleagues (Fox, 1994; Fox, Bell, & Jones, 1992; Fox, Calkins, & Bell, 1994; Fox et al., 1995; Fox et al., 1996) have shown evidence linking frontal asymmetry to the regulation of emotions. For example, 7- to 22-month-old infants showed marked right frontal activation during a mother-infant separation paradigm (Fox et al., 1992). Conversely, socially outgoing toddlers showed increased left frontal activation during social situations (Fox et al., 1996; Rubin, Coplan, Fox, & Calkins, 1995). This group of investigators also found that relative right frontal asymmetry is associated with later behavioral problems among both socially inhibited and uninhibited toddlers, suggesting that right frontal asymmetry is related to negative emotionality (Fox et al., 1996). It is possible, therefore, that right frontal activation projects to equilateral limbic structures, which may control the subjective experience of positive emotions. Therefore, increased inhibitory signals to this "happy" right limbic system may result in an apparent cerebral asymmetry during the experience of negative emotions consisting of right frontal lobe activation and blunted activation of the right limbic structures.

However, there is significant evidence that suggests that prefrontal functioning serves a more intricate role in the processing of emotional stimuli and regulation of emotional experiences than the simple transmission of inhibitory signals to limbic structures. For example, Davidson, Ekman, Saron, Senulis, and Friesen (1990) found a marked activation of the right PFC and right temporal lobe after the presentation of an aversive film, and a contralateral activation of the same regions after the presentation of a film designed to elicit positive affect. By presenting aversive films to subjects targeting specific hemispheres, Wittling and Genzel (1995) expanded on the findings of Davidson and colleagues. After presenting an aversive or neutral film to either the left or the right visual field of a subject, they found that a physiological reaction to the aversive film occurred only after it was presented to the left visual field (processed by the right hemisphere). This finding suggested that the right hemisphere is the predominant processing and regulatory site for negative emotions. There is also evidence linking basal patterns of cerebral asymmetry to specific temperaments and social behaviors. In particular, relative right prefrontal asymmetry has been found among infants with more difficult temperaments and in socially inhibited children (Davidson & Fox, 1989; Schmidt et al., 1997; Schmidt, Fox, Schulkin, & Gold, 1999; Schmidt, Fox, Sternberg et al., 1999).

To further understand how PFC asymmetry relates to emotion regulation and social withdrawal, we must explore the relationship between the PFC and other subcortical structures previously identified as major regulators of emotional experience and expression. Given the role of the amygdala and LHPA axis in the regulation of emotional experience, we can expect the PFC to be functionally and anatomically related to these two systems. In fact, a number of investigators recently proposed ways to explain the possible circuitry between the PFC and these subcortical structures (Davidson &

Irwin, 1999; Feldman, Conforti, & Weidenfeld, 1995). Specifically, reciprocal neural projections between the PFC and the amygdala can explain the role of the PFC in regulating amygdala function, as well as the role of these two systems in the processing and integration of aversive stimulus-response contingencies. Furthermore, specific neural projections from the PFC to several subcortical structures related to the LHPA axis (e.g., the hippocampus, subiculum) may explain how PFC may influence the regulation of the LHPA system (Feldman et al., 1995).

The PFC has direct neural projections from a variety of limbic structures that are directly linked to the amygdala (Afifi & Bergman, 1998). There are input projections from the thalamus to the PFC, and these connections contain information arising from the temporal cortex and the amygdala. Direct reciprocal connections from the PFC to the amygdala have also been identified (Afifi & Bergman, 1998). Output projections to the amygdala are both excitatory and inhibitory in nature. However, damage to the PFC results in an overactivation of the amygdala, suggesting that the effect of the PFC on the amygdala is of a predominantly inhibitory type (Gewirtz, Falls, & Davis, 1997; Morgan, Romanski, & LeDoux, 1993).

How does this translate to the functional domain? Lesions to the PFC in rats reduce the PFC inhibitory action on the amygdala, resulting in a reduced ability to extinguish aversive responses (Morgan et al., 1993). In humans, damage to the PFC impairs the ability to anticipate future negative consequences (Bechara, Tranel, Damasio, & Damasio, 1996). Therefore, it appears that the PFC plays an important role in regulating the acquisition of aversive contingencies, and, most importantly, the extinction of aversive conditioned responses.

The role of the PFC in the acquisition and extinction of aversive conditioned behaviors may help us understand the relationship between cerebral asymmetry and emotion regulation. First, right frontal lobe asymmetry has been associated with withdrawal-related behaviors, such as those activated to escape or avoid aversive stimuli (see Davidson & Irwin, 1999, for a recent review). These behaviors resemble aversive S-R responses, whose extinction may be modulated by the PFC. Thus, it is possible that right prefrontal asymmetry results in reduced inhibitory signals toward the amygdala, which would then maintain aversive-related responses. This hypothesis can explain the relatively high rates of avoidant behaviors displayed by socially inhibited children. New social interactions are intrinsically stressful, explaining the findings showing that *socially uninhibited* children experience high levels of stress (as measured by cortisol secretion) during the early weeks of the school year when social groups are being formed (Davis et al., 1999; de Haan et al., 1998). The stress perceived by these children eventually subsides after repeated exposures to the same social situations, a form of extinction or habituation. That is, with repeated social interactions, the events (or expectations of these events) that previously elicited stress (such as rejection and ridicule by unknown peers) are no longer present or expected, resulting in the extinction of the stress response. Children with right cerebral asymmetry may have difficulty habituating and reducing such stress response, possibly resulting in increased rates of avoidant behaviors.

The PFC also appears to be involved in the regulation of LHPA activation. In a series of studies with nonhuman primates, Kalin and colleagues (1998) found an association between extreme right frontal asymmetry and elevated basal levels of cortisol. Although these findings do not provide concrete evidence explaining how these two processes may be related, data from Wittling and Genzel's study (1995) suggested that right hemisphere activation is involved in the activation of the LHPA axis in humans. In this study, presentation of an aversive film to the right hemisphere (left visual field) resulted in increased cortisol levels. Presentation of the same film to the left hemisphere resulted in reduced cortisol levels, comparable to those produced by the presentation of a neutral film to each hemisphere. It appears that the processing of the aversive component of the film and the physiological reaction to the aversive film are in part under the control of the right hemisphere. Although there are direct connections between the PFC and the hypothalamus through the medial forebrain bundle (Afifi & Bergman, 1998), it is not clear if the excitatory effect of the right hemisphere on the LHPA axis occurs directly through PFC activation.

In conclusion, right prefrontal asymmetry has been linked to the processing and expression of negative emotions. Right prefrontal activation has also been associated with LHPA axis activation during the regulation of negative emotion. Most important, however, Fox and colleagues (Fox et al., 1996) found that although right frontal asymmetry is more commonly seen in socially inhibited children, such a pattern of activation predicts future behavioral problems for both socially inhibited and uninhibited children. These findings underscore the role of right frontal activation in the regulation, processing, and expression of negative emotions.

CONCLUSIONS AND INTEGRATION

Social inhibition during social situations can be viewed as a consequence of specific emotion processes affecting the regulation of social anxiety. However, social inhibition can also be viewed as a regulatory influence on the experience of social anxiety. In addressing the physiological underpinnings of emotion regulation and its relationship to social withdrawal, we must consider the systems that affect the regulation of social anxiety as well as the phenomenology of socially avoidant behaviors. Emotion regulation (or dysregulation) begins before the child is exposed to a social situation. Specific neurophysiological profiles, such as tonic LHPA functioning or PFC activation patterns, may affect a person's stress threshold and thus affect the propensity to experience social anxiety during specific situations. The study of the neurophysiology of emotion regulation processes should also focus on systems that facilitate the acquisition of behavioral emotion regulation strategies and the progression of normative regulatory systems, such as behavioral extinction of conditioned responses. Finally, once the individual is exposed to the situation and the emotion is activated, several neurophysiological systems, such as the LHPA negative feedback mechanism, interact to facilitate the deactivation of the stress system and thus the regulation of emotional experience.

We argue that social anxiety and related behaviors are strongly mediated by prefrontal lobe functioning, specifically by right frontal lobe asymmetry and reduced prefrontal lobe activation. Prefrontal lobe functioning has been associated with amygdala activation, in that damage to the PFC affects inhibitory signals to the amygdala (Gewirtz et al., 1997; Morgan et al., 1993), which in turn may increase the frequency of avoidant behaviors. In addition, frontal lobe damage hampers the extinction of responses to aversive stimuli and therefore fear-induced behaviors (Morgan et al., 1993), which can have a reciprocal influence on socially avoidant behaviors. Failure to extinguish fear-induced behaviors could lead to increased avoidance, which in turn prevents the necessary exposure to fear stimuli (social situation) that would facilitate extinction and the subsequent reduction of social anxiety. Right frontal lobe asymmetry has been related to increased LHPA activation (Wittling & Genzel, 1995), which could also lead to increased social anxiety and avoidant behaviors by affecting activation of a person's tonic LHPA tone and LHPA activation threshold. Finally, the LHPA MR and GR negative feedback system and the density of MRs and GRs throughout the brain may facilitate the regulation of emotional experience by influencing specific temperamental characteristics as well as by determining the pattern of deactivation of the stress system once negative emotions are activated (see Figure 4.3 for a summary of the model).

FINAL DEVELOPMENTAL CONSIDERATIONS

Research on the biological underpinnings of social anxiety and avoidant behaviors has generally neglected to look at these factors from a true developmental perspective. We know little about how these biological variables

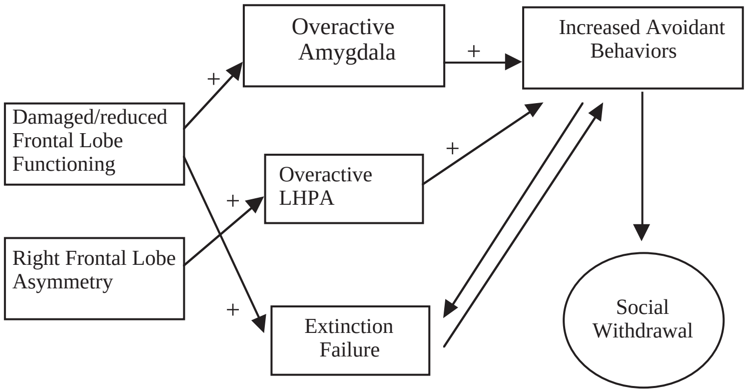

Figure 4.3. Expanded model of the neurophysiological profile of social withdrawal.

interrelate and affect behavior, and we know even less about how development affects these relationships. Evidence from at least three research areas underscores the need to approach biosocial research from a developmental perspective.

First, animal and human research suggests that specific early aversive experiences, particularly acute stress, can lead to significant neuroanatomical changes that can permanently affect future behavior. For example, Meaney and colleagues extensively documented that early experiences affect the functioning of the LHPA system as well as other neurocircuitry such as the GABA and the benzodiazepine receptor system (Anisman, Zaharia, Meaney, & Merali, 1998; Caldji, Francis, Sharma, Plotsky, & Meaney, 2000; Huot, Thrivikraman, Meaney, & Plotsky, 2001; Meaney, 1985a, 1985b; Meaney & Stewart, 1981). Human studies provide similar results. Children who were maltreated during infancy and early childhood have altered LHPA functioning marked by increased morning and afternoon cortisol levels and reduced daily variations of cortisol (Cicchetti & Rogosch, 2001a, 2001b). Evidence is also accumulating suggesting that the LHPA changes produced by early aversive experiences remain stable throughout development and can be observed during adulthood (Heim, Newport, Bonsall, Miller, & Nemeroff, 2001; Heim et al., 2000). Little research is available indicating how the functioning of these biobehavioral systems is affected when they are exposed to both severe and normative levels of stress during different developmental stages throughout the life span.

Second, both animal lesion studies and human neuropsychological evidence indicate that the behavioral consequences of brain insults may drastically differ as a function of the time of the insult. As described earlier, Amaral and colleagues (Amaral, 2002; Amaral, 2003) are currently following a group of macaque monkeys that endured bilateral amygdalectomy shortly after birth (2 weeks of age) and were subsequently returned to and raised by their mothers. Amygdala lesions normally result in reduced fear responses to novel inanimate objects as well as during social interactions. Surprisingly, however, their findings indicate that when the lesion occurs in early infancy it does not preclude the fear response to social interactions. Although no data are currently available about the developmental progression of these monkeys, Amaral indicates that other brain areas may be able to elicit social fear responses in early infancy (Amaral, 2002). Human neuropsychology studies also indicate that the time of insult has differential behavioral and cognitive consequences (see Kolb, Gibb, & Gorny, 2001, for a recent review).

Finally, developmental research has consistently shown that biobehavioral relationships are not stable throughout development. Both basic neurophysiological functioning and the behavior associated with one's specific biological profile change throughout development. For example, Jerome Kagan and colleagues have presented extensive descriptive research showing how specific biological variables associated in infancy and early childhood with specific behavioral profiles did not remain stable throughout childhood (Kagan, Reznick, & Snidman, 1988; Kagan, Reznick, Snidman, & Gibbons, 1988; Schmidt et al., 1997). That is, some children who displayed an anxious and fearful temperament in early childhood were no longer anxious and fearful in middle childhood, but kept the biological profile of anxious and fearful children. Although an extensive analysis of these findings is beyond the scope of this chapter, it is clear that the relationship between biological variables and behavior can be drastically altered throughout development, underscoring the plasticity of biobehavioral systems.

In conclusion, the biosocial processes that explain the stability and changes in the relationship between biological systems and behavior are not understood and should be an important factor in future longitudinal studies. In particular, there is little information about the natural developmental changes in LHPA functioning and how these changes interact with other variables to affect normal and abnormal development. Furthermore, future research needs to examine how individual developmental differences in the pattern of functioning of various physiological systems (LHPA, amygdala, PFC, etc.) throughout development are associated with specific emotion regulation processes and related behaviors. Finally, we must determine how the timing of exposure to both aversive and positive environmental experiences affects the development and functioning of physiological systems, and how changes in these systems affect emotional experience and behavioral expression throughout the life span.

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5

Regulatory Competence and Early Disruptive Behavior Problems: The Role of Physiological Regulation

SUSAN D. CALKINS

OVERVIEW

Childhood externalizing behavior problems, including aggression, inattention, and defiance, have been the focus of considerable recent theoretical and empirical work (Broidy, Nagin, Tremblay, Bates, Brame, & Dodge, 2003; Campbell, 2002; Dodge & Pettit, 2003; Hinshaw, 2002; Moffit, 1993). This emphasis is due largely to the observation that such problems are moderately stable and predictive of other, more serious kinds of disorders in middle childhood (Olson, Bates, Sandy, & Schilling, 2002) and adolescence (Moffit, Caspi, Dickson, Silva, & Stanton, 1996). Risk factors for early behavior problems include child dispositional characteristics, such as temperament and biology (Bates, Pettit, Dodge, & Ridge, 1998; Hill, Degnan, Calkins, & Keane, 2006; Shaw, Gilliom, Ingoldsby, & Nagin, 2003); family factors, such as stress, psychopathology, and negative coercive behavior (Cummings, Davies, & Campbell, 2000); and contextual factors, such as social class, peers, school experiences, and neighborhoods (Coie, Terry, Lenox, Lochman, & Hyman, 1998; Dodge et al., 2003). Despite recent efforts to understand the trajectory of early disruptive behavior problems, much remains to be known about the *mechanisms* that maintain, ameliorate, or exacerbate such problems very early in development (Hinshaw, 2002).

Based on data from several longitudinal studies of infant and child socioemotional development, I have developed a conceptual model of the trajectories of early disruptive behavior problems that focuses on one key process, *self-regulation*, as a critical mechanism through which early child and family factors become translated into entrenched behavioral difficulties characterized by disruptive, aggressive, oppositional behavior (Calkins, 1994, 1997, 2002, 2004a, 2004b; Calkins & Fox, 2002; Calkins & Howse, 2004; Calkins & Keane, 2004; Hill et al., 2006; Keane & Calkins, 2004;

Smith, Calkins, Keane, Anastopoulos, & Shelton, 2004). In this chapter, I argue that recent research on infant and childhood development suggests that important regulatory developments are occurring on multiple levels and that these developments are likely to be hierarchically organized, with basic physiological processes contributing to early developments in attention and emotional functioning (Calkins, Graziano, & Keane, 2007). Individual differences in these processes are likely to be implicated in both personality and behavioral adjustment during the early childhood years when the self-regulation of emotion and behavior become core indices of successful adaptation. I highlight the central role played by control of physiological arousal, which is achieved during very early infancy and eventually becomes integrated into the processes of attentional control (Porges, 1996; Richards, 1985, 1987); emotion regulation; and the behavior regulation and executive control processes characteristic of middle childhood (Belsky, Friedman, & Hsieh, 2001; Rothbart, Posner, & Boylan, 1990; Sethi, Mischel, Aber, Shoda, & Rodriquez, 2000). Data from ongoing research with a sample of toddlers displaying early behavioral difficulties illustrate the foundational role of physiological regulation in early development. Finally, I offer some suggestions on how measures of physiological regulation may be usefully studied in a developmental psychopathology framework that emphasizes multiple pathways to adaptation and maladaptation.

A SELF-REGULATION PERSPECTIVE ON EARLY DISRUPTIVE BEHAVIOR

Disruptive behavior problems in early childhood have been the focus of considerable developmental and clinical research largely because of the repeated observation that these problems are highly stable across childhood (Campbell, Pierce, Moore, & Marakovitz, 1996; Cohen & Bromet, 1992; Heller, Baker, Henker, & Hinshaw, 1996), predictive of other more serious kinds of behavior problems (Campbell, 1991; Loeber, 1982), and implicated in disruptions in other domains like social competence and academic functioning (Campbell, 2002; Moffitt, 1993). Although behavior problems can be highly stable throughout development, increases in language development, cognitive abilities, and self-regulation during toddlerhood should allow children to learn to control early normative noncompliant, aggressive, and impulsive tendencies, leading to a decline in problem behavior (Campbell, 2002). In fact, the majority of studies on childhood aggression have demonstrated that aggressive behavior decreases across toddlerhood and preschool (e.g., Cummings, Ianotti, & Zahn-Waxler, 1989; Parke &

Slaby, 1983; Rubin, Burgess, Dwyer, & Hastings, 2003). Nevertheless, there is clearly a subset of children for whom continuing difficulties in managing emotion and behavior contribute to stable and increasing trajectories of problem behavior (NICHD SECC, 2005).

Why does difficult toddler behavior persist and worsen for some children? Researchers have identified a number of biological and environmental risk factors that are linked with persistent problem behavior (Rutter, 2003). However, an unanswered question is *how* risk factors function in conjunction with mechanisms in the trajectories of problem behavior or normative functioning. In my work, I 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. In early work (Calkins, 1994, 1997; Calkins, Gill, Johnson, & Smith, 1999), I hypothesized that the regulation of affect was a proximal mechanism for such behavior, in that failure to regulate affect could lead directly to aggressive behavior. In more recent work (Calkins & Dedmon, 2000; Calkins & Fox, 2002; Calkins & Howse, 2004), I argue that emotion regulation is one component process of self-regulation and that the capacity to self-regulate across a number of levels influences the child's adaptive functioning and capacity to learn from experiences (Hill et al., 2006).

The central role given to self-regulatory processes in my work is based largely on prior research and theorizing in the area of disruptive behavior disorders (Barkley, 1997; Melnick & Hinshaw, 2000) and developmental psychopathology (Calkins & Fox, 2002; Keenan, 2000; Olson et al., 2002; Posner & Rothbart, 2000). Much of this recent focus on child self-regulation and behavior problems has its roots, in part, in work that focuses on child characteristics, broadly construed (Moffitt, 1993). Recent reviews of the behavior problem literature note that a comprehensive model of childhood disruptive problems must include the notion of biological risk (Dodge & Pettit, 2003) and that biological risk interacts with socialization factors to initiate an early-onset pattern of disruptive behavior problems that is highly stable across time (Moffitt, 1993). The child biological factor that has received the most attention by far is early temperament. This body of work has been conducted in several different countries, with both boys and girls, using different measurement tools. These studies are consistent in finding only modest direct effects of early temperament dimensions, such as negativity, on the display of externalizing or acting-out behavior problems at later ages (Calkins & Dedmon, 2000; Caspi, Henry, McGee, Moffitt, & Silva, 1995; Prior, Smart, Sanson, & Oberklaid, 1993; Shaw, Owens, Giovannelli, & Winslow, 2001).

One hypothesis generated as a result of this body of work is that the temperamental characteristic of negative reactivity in particular plays a role in at least the display, if not the development, of emotion regulation skills that are integral to appropriate functioning (Calkins, 1994; Keenan & Shaw, 2003). The absence of these skills is seen as contributing to behavior problems (Calkins, 1994; Gilliom, Shaw, Beck, Schonberg, & Lukon, 2002; Keenan, 2000; Mangelsdorf, Shapiro, & Marzolf, 1995; Stifter & Braungart, 1995). From this perspective, it is assumed that the inborn personality characteristic of temperamental distress that differentiates infants and children from one another influences, either directly or indirectly, the kinds of emotion regulatory skills and strategies that children develop.

There are several possible ways that temperamental distress may affect the display and development of emotion regulation and, consequently, the development of behavior problems (Calkins, 1994, 2004b). One hypothesis that we and others have examined is that distress might be mediated by other processes, such as attention or physiology (Calkins & Dedmon, 2000; Harman, Rothbart, & Posner, 1997; Hill et al., 2006; Shipman, Schneider, & Brown, 2004), that then affect the development of emotional regulation in context. 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 negative affect, these failures limit opportunities to learn adaptive skills in social-interactional contexts with parents and peers.

Because I view emotion regulation skills as linked to more basic physiological and attentional processes, I embed these skills in a larger construct of self-regulation. Thus, these emotion regulation skills emerge during infancy and toddlerhood, as a function of more basic regulatory processes, and they assume a central role in the development of the more complex self-regulation of behavior and cognition characteristic of early and middle childhood (Calkins & Fox, 2002; Calkins & Howse, 2004). From this perspective, then, understanding the contribution of self-regulation to behavior problems versus adaptive behavior of childhood requires an examination of the *component processes* of self-regulation that emerge over this developmental period. Such an examination reveals mechanisms and processes in the development of adaptive behavior and failures of adaptive behavior that take multiple forms.

Within this approach, then, self-regulatory processes refer to control mechanisms that allow an organism to manage processes that occur at the level of biology, attention, emotion, behavior, and cognition (Vohs & Baumeister, 2004). Moreover, this system of regulation emerges and becomes integrated over time. My rationale for examining the differentiation, development, and integration of these regulatory processes emanates from recent work in the area of developmental neuroscience that has identified specific brain regions that may play a functional role in the deployment of attention and in the processing and regulation of emotion, cognition, and behavior (Posner & Rothbart, 1994, 1998). This work has identified areas of the prefrontal cortex as central to the effortful regulation of behavior via the anterior attention system. This system is guided by the anterior cingulate cortex (ACC), which includes two major subdivisions. One subdivision governs cognitive and attentional processes and has connections to the prefrontal cortex. A second subdivision governs emotional processes and has connections with the limbic system and peripheral autonomic, visceromotor, and endocrine systems (Lane & McRae, 2004; Luu & Tucker, 2004). Recent research suggests that these subdivisions have a reciprocal relation (Davidson, Putnam, & Larson, 2000; Davis, Bruce, & Gunnar, 2002). Moreover, the functional relation between these two areas of the cortex provides a biological mechanism for the developmental integration of self-regulatory processes in childhood.

Recent developmental neuroscience work suggests that, because of its dependence on the maturation of prefrontal-limbic connections, the development of self-regulatory processes is relatively protracted (Beauregard, Levesque, & Paquette, 2004) – from the development of basic and automatic regulation of physiology in infancy and toddlerhood to the more self-conscious and intentional regulation of cognition emerging in middle childhood (Ochsner & Gross, 2004). From a developmental psychopathology perspective, then, opportunities for success and failure of self-regulation are numerous over the course of childhood, particularly given the potential of environmental factors such as parenting to facilitate or disrupt development in these domains (Calkins, Smith, Gill, & Johnson, 1998). Next, I describe normative developments in each of these domains, as well as the consequences of failures in each for individual behavioral functioning.

Physiological Regulation

Recent developmental psychophysiological work emphasizes that certain underlying physiological processes and functioning may play an important role in the etiology of early regulatory behaviors (Fox, 1994; Fox & Card, 1999; Porges, 1991, 1996). Porges (1996; Porges, Doussard-Roosevelt, & Maita, 1994) argues that maturation of the parasympathetic nervous system plays a key role in the regulation of state, motor activity, and emotion and that these regulatory functions support social engagement (Porges, 2003). One index of parasympathetic functioning is heart rate (HR) variability, which has been linked specifically to deficits in self-regulation across multiple levels of functioning (Calkins, 1997; Calkins & Dedmon, 2000). HR variability is reduced in children with conduct disorder (Pine, Wasserman, Coplan, et al., 1996; Pine, Wasserman, Miller, et al., 1998). Eisenberg (Eisenberg, Fabes, Murphy, Maszk, Smith, & Karbon, 1995) found that greater HR variability was also related to better social competence. Such relationships may occur because of parasympathetic links to regulatory abilities involving attentional and behavioral control and may provide a window on how early characteristics affect the development of later skills (Calkins & Fox, 2002). For example, control of physiological arousal eventually becomes integrated into the processes of attention engagement and disengagement (Porges, 1996, 2003; Richards, 1985, 1987). That is, parasympathetic processes implicated in the process of increasing or decreasing HR, referred to as the vagal brake, enable the individual to respond to environmental stimuli rapidly, and this neural mechanism supports appropriate behavioral adjustments to environmental events (Porges, 2003). I return to this process and its implications for behavioral adjustment later in the chapter.

Attentional Regulation

The capacity for attentional self-regulation begins to emerge and mature toward the end of the first year and continues throughout the preschool and school years (Rothbart, 1989). Moreover, individual differences in the ability to voluntarily sustain focus, shift attention, and initiate and inhibit actions are believed to be early behavioral manifestations of an emerging system of emotional and behavioral control (Ahadi & Rothbart, 1994). For example, the ability to shift attention away from a negative event (such as something frightening) to a positive distracter may lead to decreases in the experience of negative affect. Importantly, there are clear individual differences in the ability to use attention to successfully control emotion and behavior. For example, Rothbart (1981, 1986) found increases in positive affect and decreases in distress in infants from 3 to 6 months of age during episodes of focused attention, suggesting that attentional control is tied to affective experience and regulation. Moreover, dysregulated negative affectivity is believed to interfere with the child's ability to explore and learn about the environment (Rueda, Posner, & Rothbart, 2004; Ruff & Rothbart, 1996), suggesting a mechanism whereby later self-regulation and cognitive functioning become compromised. In addition, the vulnerabilities in attention control implicated in attention deficit hyperactivity disorder (ADHD), in combination with less-than-optimal parenting, may lead to problems with emotion and behavior regulation (Nigg & Huang-Pollock, 2003; Sethi, Mischel, Aber, Shoda, & Rodriguez, 2000). In this way, ADHD, which may be caused initially by deficits in attentional control, may act to perturb the normal development of more sophisticated self-regulation (Barkley, 2004). Finally, early attentional capacities, particularly the effortful redirection of attention, is believed to be a precursor to later executive control.

Emotion Regulation

Emotion regulatory processes refer to processes that serve to manage arousal and support adaptive social and nonsocial responses (Calkins, 1994; Thompson, 1994). Importantly, recent research on the self-regulation of emotion demonstrates quite convincingly that the display of affect and affect regulation are powerful mediators of interpersonal relationships and socio-emotional adjustment, including behavioral self-control, in the first few years of life (Calkins, 1994; Cicchetti, Ganiban, & Barnett, 1991; Malatesta, Culver, Tesman, & Shepard, 1989; Rothbart, 1989; Thompson, 1994). Stifter, Spinrad, and Braungart-Rieker (1999) found that emotional regulation in response to frustration in infancy was related to compliance in toddlerhood. Eisenberg, Fabes, and colleagues (Eisenberg, Fabes, Bernzweig, Karbon, Poulin, & Hanish, 1993; Eisenberg, Fabes, Richard, Nyman, Bernzweig, & Pinuelas, 1994; Fabes & Eisenberg, 1992) found that individuals who are highly emotional in response to anger-inducing events and low in regulation are likely to be aggressive. Shipman and colleagues hypothesize that, whereas problems with emotion regulation may be broadly related to externalizing behavior problems characterized by aggression (Calkins, Gill, & Williford, 1999), they may differentially predict children who are prone to oppositional defiant disorder (Shipman et al., 2004).

Thus, early deficits in attention that manifest in deficits in emotion regulation as well may create a vulnerability for a behavioral disorder that is likely influenced by parent-child interactions and has implications for peer relationships (Melnick & Hinshaw, 2000). Such a process may enable a developmental distinction to be drawn between children with attention problems that are also accompanied by more serious disorders versus those with attention problems only (Barkley, 2004; Melnick & Hinshaw, 2000). Moreover, problems with emotion regulation may distinguish children who display reactive aggression from those who display proactive aggression, which may differentiate behavioral outcomes characterized by oppositional defiant disorder (ODD) from those with early indicators of conduct disorder (CD; Keenan & Shaw, 2003). Although no studies have addressed these distinctions in a comprehensive way, it is clear that children whose behavior is characterized by poorly regulated anger do display patterns of behavior marked by aggression and noncompliance that may be characteristic of oppositional behavior (Calkins & Dedmon, 2000; Calkins et al., 1999; Melnick & Hinshaw, 2000).

Behavior Regulation

During toddlerhood, the ability to use self-regulating behaviors becomes critical as the child is gaining independence, control, and an identity separate from the caregiver (Kochanska, Coy, & Murray, 2001). In the second and third years of life, children begin to gain control over their impulses and actions that are mostly activated in response to external events. Examples of behavior management or control include compliance with maternal directives and the ability to control impulsive responses (Kopp, 1982; Kuczynski & Kochanska, 1995). Increasingly, these kinds of demands are placed on children during early childhood; the child's task then is to overcome impulsive reactions or to suspend the desired activity to meet external demands. Self-control is demonstrated when a child is able to comply with demands, delay specific activities, and monitor his or her own behavior. Importantly, each of these skills will support the emergence of the kind of independent and adaptive behavioral functioning that is necessary for the child to make a successful transition to the school and peer environment. Evidence exists for a negative relation between the child's success at behavior regulation (compliance, control of impulsivity, and delay of gratification ability) and externalizing problem behavior (Eisenberg, Fabes, Shepard, Murphy, Gutherie, Jones, et al., 1997). Effortful control, a construct that Kochanska has identified as incorporating both attentional and behavioral demands, has also been implicated in the development of conscience and the internalization of standards of conduct (Kochanska, Murray, & Coy, 1997; Kochanska, Murray, & Harlan, 2000), suggesting that the absence of such skills may be implicated in behavioral outcomes characterized by a lack of empathy and conscience, such as CD.

Executive or Cognitive Control

Executive functioning encompasses a number of cognitive factors including working memory and inhibitory control; executive functions enable the child to "maintain behavior on a goal and calibrate behavior to context" (Pennington & Ozonoff, 1996). Paris and Newman (1990) define this type of self-regulation as involving planfulness, control, reflection, competence, and independence. Importantly, this more sophisticated level of self-regulation is likely supported by earlier forms of self-regulation. In fact, Kuhl and Kraska (1993) argued that children's school performance is influenced not only by behavior self-regulation but also by attention control, motivation control, and emotion control. Immature executive functioning is common in children with attention problems (Hinshaw, 1994; Nigg, Hinshaw, Carte, & Treuting, 1998), but executive function deficits have also been linked to conduct problems and learning style differences (Moffitt, 1993; Pennington & Ozonoff, 1996). Moreover, the reported association between executive function and disruptive behavior is independent of IQ (Moffitt, 1993). Although the causal role of executive functioning deficits has not been examined in longitudinal studies (Nigg et al., 1998), Rutter (1987) proposed that executive functions mediate the development of psychopathology in children. However, the majority of research highlighting the relation between executive functioning and behavioral difficulties has been cross-sectional or conducted with clinical versus normative between-group designs where the effects of executive functioning, independent of behavioral functioning, are difficult to identify.

Summary and Implications

This brief review of the development of the components of self-regulation suggests that there are expected trajectories of skills in the five subdomains, that patterns of regulatory deficits are related to patterns of behavioral adjustment versus maladjustment, and that trajectories of both self-regulation and behavioral adjustment are subject to the environmental effects associated with early relationships. Such a framework has implications for an understanding of both normative and compromised development and clearly contributes to the identification of *mechanisms* of development that have largely been neglected in the behavior problem literature.

Figure 5.1 depicts a model of the trajectories of both self-regulation and behavior problems, incorporating the proximal moderators of parenting

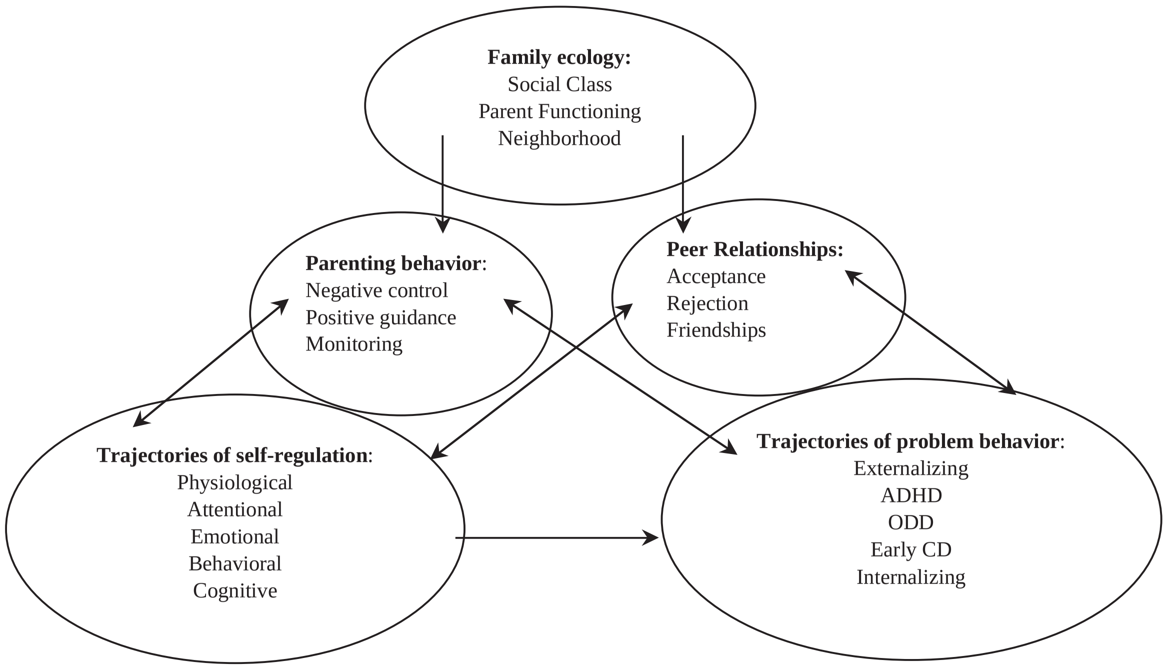

Figure 5.1. Conceptual model of the proximal and distal factors that affect the developmental trajectories of early behavior problems.

and peers and the distal moderators of parent functioning, social class, and neighborhood quality. This model currently guides an investigation of the processes that may be implicated in the developmental trajectories of early behavior problems that my colleagues and I are conducting (Calkins et al., 2007; Calkins & Keane, 2004; Hill et al., 2006; Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003; Keane & Calkins, 2004; Smith et al., 2004).

Clearly, it is difficult to depict the complex ways in which trajectories of self-regulation affect the trajectories of behavior problems and the differential pathways to specific behavioral subtypes. Further complexity is added by the ways in which both proximal and distal environmental factors moderate these trajectories. It is possible, however, to make some general statements about the unfolding of these core self-regulatory processes. First, the hierarchical organization of this model suggests that, if early difficulties in self-regulation at, for example, 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 suggest that early, severe, and chronic problems often characterize stable trajectories of problem behavior that are observed in adolescence (NICHD SECC, 2005) and that the deficits associated with a lack of appropriate and adaptive emotion regulation persist (Hill et al., 2006) and affect early peer relationships (Keane & Calkins, 2004). Second, moderational factors 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 emotion and behavior 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 (rejection versus neglect by peers, for example). Third, determining 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 identify the differential developmental processes that produce such subtypes.

In sum, this 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 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. To illustrate, we examine the foundational role of physiological regulation in supporting the regulation of attention, emotion, and behavior. In the next section, we explore in depth one measure of physiological regulation, cardiac vagal tone, and the research supporting its role in emerging self-regulation across multiple levels.

PHYSIOLOGICAL REGULATION AND DISRUPTIVE BEHAVIOR PROBLEMS

This description of the multiple levels of self-regulation points to the central role played by the control of physiological arousal, which begins to emerge during very early infancy and underlies mastery of state regulation and control of sleep-wake cycles during this period. Indeed, most current approaches to developmental psychophysiological work emphasize that certain underlying physiological processes and functioning may play an important role in the etiology of early regulatory behaviors (Fox, 1994; Fox & Card, 1999) and are believed to underlie functioning in many domains of infant and child behavior (Bornstein & Suess, 2000; Fox, 1994; Porges, 1991, 1996). Three primary types of measures have been used to study relations between physiology and self-regulatory behavior to a variety of elicitors: measures of heart rate (HR), brain electrical activity, and adrenocortical activity (Fox, Schmidt, & Henderson, 2000; Gunnar, 1990; Porges, 1991; Stansbury & Gunnar, 1994). HR measures are of particular interest to researchers studying self-regulation because of their potential to index arousal and control of arousal. In addition, behavioral and physiological research with infants and young children clearly demonstrates that control of physiological arousal eventually becomes integrated into the processes of attention engagement and disengagement (Porges, 1996; Richards, 1985, 1987), which is central to both emotion regulation, and behavior regulation (Belsky et al., 2001; Rothbart et al., 1990; Sethi et al., 2000).

Researchers have also been drawn to physiological measures of regulation because of the growing interest in the critical role of emotion regulation in child functioning. Theories of emotion regulation that focus on underlying biological components of regulation assume that maturation of different biological support systems lays the foundation for increasingly sophisticated emotion and behavior regulation observed across childhood.

Fox (1989, 1994), for example, noted that the frontal lobes of the brain are differentially specialized for approach versus avoidance and that these tendencies influence the behaviors that children engage in when emotionally and behaviorally aroused. He further noted that maturation of the frontal cortex provides a mechanism for the more sophisticated and planful regulatory behaviors of older children versus infants.

Porges' polyvagal theory (Porges, 1996; Porges, Doussard-Roosevelt, & Maita, 1994) also describes an important role for biological maturation, specifically maturation of the parasympathetic nervous system that plays a key role in the regulation of state, motor activity, and emotion. Moreover, Porges noted that individual differences in nervous system functioning might mediate the expression and regulation of emotion (Porges et al., 1994). Porges and others found that parasympathetic nervous system functioning, as reflected in high-frequency HR variability, is related to the control of attention, emotion, and behavior (Calkins, 1997; Calkins & Dedmon, 2000; DeGangi, DiPietro, Greenspan, & Porges, 1991; Huffman, Bryan, del Carmen, Pederson, Doussard-Roosevelt, & Porges, 1998; Porges, Doussard-Roosevelt, Portales, & Greenspan, 1996).

Vagal Tone as a Measure of Reactivity and Regulation

There are multiple ways to measure HR variability; Porges (1985, 1991, 1996) and colleagues developed one such method that measures the amplitude and period of the oscillations associated with inhalation and exhalation. This method measures the variability in HR that occurs with variations in the frequency of breathing (respiratory sinus arrhythmia [RSA]) and is thought to reflect the parasympathetic influence on HR variability via the vagus nerve. Thus, efficient neural control of the heart is manifest as rhythmic physiological variability that can be quantified. Porges called this measure of HR variability *vagal tone* (Vna; Porges, 1996; Porges & Byrne, 1992).

Although there are other components of HR variability, the RSA measure has been identified as suitable for the study of physiological links to multiple dimensions of behavioral functioning in young children (Huffman et al., 1998; Richards, 1985, 1987). For example, high resting RSA is one index of autonomic functioning that has been associated with appropriate emotional reactivity (Stifter & Fox, 1990) and good attentional ability (Richards, 1985, 1987; Suess, Porges, & Plude, 1994). Several studies link high RSA in newborns with good developmental outcomes, suggesting that it may be an important physiological component of appropriate engagement with the environment (Hofheimer, Wood, Porges, Pearson, & Lawson, 1995; Richards & Cameron, 1989). In short, high resting RSA, or greater HR variability under conditions of little environmental challenge, supports a greater physiological and behavioral response, or reactivity, when a response to an environmental event is needed.

Porges' theory further suggests that one particular measure of cardiac activity that may be more directly related to the kinds of regulatory behaviors children begin to display in toddlerhood and early childhood is vagal regulation of the heart as indexed by a decrease (suppression) in RSA during situations where coping or emotion and behavior regulation are required. Vagal regulation in the form of suppression of RSA during demanding tasks may reflect physiological processes that allow the child to shift focus from internal homeostatic demands to demands that require internal processing or the generation of coping strategies to control affective or behavioral arousal. Thus, suppression of RSA is thought to be a physiological strategy that permits sustained attention and behaviors indicative of active coping that are mediated by the parasympathetic nervous system (Porges, 1991, 1996; Wilson & Gottman, 1996) and that results in greater cardiac output in the form of HR acceleration.

What can studies of physiological regulation in children tell us? Several fundamental predictions and hypotheses regarding stability, continuity, context effects, and links to behavioral functioning may be usefully examined with RSA measures, and these findings shed light on the role of physiological regulation in emerging adaptive behavioral functioning and behavior problems. In the next sections, I examine these questions and hypotheses using data from a series of cross-sectional and longitudinal studies in which both physiological and behavioral measures of reactivity and regulation were collected.

Vagal Regulation and Child Functioning Across Development

One question being investigated is whether developmental shifts in RSA contribute to observed developments in behavioral and physiological reactivity and regulation. That is, based on Porges' polyvagal theory, as the parasympathetic nervous system matures and RSA increases over the course of early development, one should observe increases in the capacity of the infant to react to environmental stimuli and to regulate that stimuli. Numerous studies document shifts in RSA over the course of infancy and childhood (e.g., Bar-Haim, Marshall, & Fox, 2000; Fracasso, Porges, Lamb, & Rosenberg, 1994). However, very few studies have examined parallel changes in reactivity and regulation. In one study conducted in our laboratory with a large sample of infants, we observed increases in resting measures of RSA across the first year of life that paralleled measures of both reactivity to novelty and to frustration and soothability (Wilkinson & Howse, 2003), all of which also increased over the first year. We also observed that this resting measure of RSA was correlated with both HR increases and RSA suppression in response to a stressor at 6 and 12 months of age, but not at 3 months of age. Thus, there are clear developments in both the magnitude of RSA and in its role in the facilitation of cardiac output under conditions that stress or challenge the organism.

Although early research and theorizing on the role of vagal regulation in emotional regulation focused on resting measures of RSA, more recent work has explored the characteristics and development of RSA responses under conditions of challenge, which presumably facilitate active coping. Numerous studies document that RSA does change under conditions in which the individual must generate a response to emotional, cognitive, and behavioral challenges. The specific demands of the challenge and whether these different demands elicit different RSA responses have been less well explored. That is, is RSA suppression a sensitive measure of the degree of challenge faced by the individual? We have explored this question in several samples of infants and children (Calkins, 1997; Calkins & Dedmon, 2000; Calkins & Keane, 2004; Calkins et al., 2007; Calkins et al., 1998; Calkins, Dedmon, Gill, Lomax, & Johnson, 2002). Our results have been remarkably consistent across several studies of infants, toddlers, preschoolers, and school-age children. First, tasks that elicit negative affect typically yield a greater RSA suppression response than do tasks that elicit positive affect. Second, tasks that elicit negative affect elicit a greater RSA response than those that have attentional but not affective domains. Third, infants and children engaged in a challenge task with a caregiver typically display a greater magnitude of RSA suppression than when they are engaged in a task alone. Thus, the RSA suppression measure does seem to be an indicator of both the degree of challenge the task imposes on the child's regulatory ability and the extent to which the child can generate a coping response independently versus with environmental support.

A third question that we have begun to address concerns the stability of vagal regulation across infancy and early childhood. Prior work has demonstrated that the resting measure of RSA is moderately stable across infancy and childhood (Bar-Haim et al., 2000; Fracasso et al., 1994), although little research has explored the stability of the vagal response under challenge. Resting measures of RSA may be good indicators of temperamental reactivity or the capacity of the individual to respond to an external stimulus. Such a capacity may be more stable because it is more biologically based (Calkins, 1997). However, the regulatory dimension of RSA may be in part determined by stable biologically based factors and environmentally influenced factors (Calkins et al., 1998). That is, self-regulation, whether it occurs at the behavioral or the physiological level, has both biological and environmental components to its development (Calkins, 1994). In our studies examining stability in RSA suppression across both infancy and the preschool period, we found little evidence that the RSA suppression measure is stable across infancy (Wilkinson & Howse, 2003). However, one difficulty in studying the stability of the RSA response under conditions of challenge is the equivalence of task demands at different ages. In a second study of stability across the preschool period (Calkins & Keane, 2004), we found evidence of modest stability in attention and problem-solving tasks, but not in affect-eliciting tasks. Affective tasks may be more subject to contextual influences and therefore less stable over time. In contrast, attention and problem-solving tasks may index more basic cognitive processes that are stable over time.

These longitudinal data demonstrate the need for careful consideration of the tasks that are used to elicit both behavior and physiological regulation. However, they do suggest that some characteristics of the child that are relevant to their behavioral function across time may be indexed by measures of physiological regulation. Although the ability to suppress RSA may be related to complex responses involving the regulation of attention and behavior, a deficiency in this ability may be related to early behavior problems, particularly problems characterized by a lack of behavioral and emotional control (Calkins & Dedmon, 2000; Porges, 1996; Wilson & Gottman, 1996). In the next section, we discuss data more directly relevant to the question of whether deficits in the regulation of physiological arousal underlie the behavioral characteristics of children with early disruptive behavior problems.

Vagal Regulation and Disruptive Behavior Problems

Lack of behavioral and emotional control is considered a core deficit for children with externalizing-type behavior problems (Gilliom & Shaw, 2004; Keenan & Shaw, 2003). Moreover, children with externalizing problems display patterns of aggressive, destructive, and undercontrolled behavior that remain stable from preschool to middle childhood (Gilliom & Shaw, 2004) and that often result in more severe conduct problems in adolescence and young adulthood (Olweus, 1979). Given that such problems are believed to have both biological and socialization origins (Moffitt, 1993), one question that may be asked is whether these children display a pattern of physiological dysregulation that impairs their ability to generate and engage appropriate regulatory strategies in situations that are emotionally or behaviorally challenging. A small number of studies have addressed this question. Pine and colleagues (Pine et al., 1998) reported that 11-year-old boys with externalizing symptoms had lower heart period variability. Mezzacappa and colleagues (Mezzacappa, Tremblay, Kindlon, Saul, Arseneault, Seguin et al., 1997) reported similar findings among adolescent males. Both researchers concluded that such relations may occur because of parasympathetic links to regulatory abilities involving attentional and behavioral control.

These early seminal studies of RSA and externalizing problems are limited because of their focus on adolescent male samples. More recent work addresses whether such findings may be observed in samples of younger girls and boys. In one study, children at high risk for the development of aggressive behavior problems were identified at age 2 and assessed in a number of challenging tasks (Calkins & Dedmon, 2000). These children displayed significantly lower RSA suppression across these tasks than did children at low risk for behavior problems. In a follow-up of these same children, 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 RSA suppression to challenge (Calkins & Keane, 2004). An interesting finding is that children who displayed a pattern of lower suppression at age 2, but who were observed to suppress RSA at age 4, 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 limited findings suggest that a physiological profile of poorer vagal regulation of HR activity 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 different 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 behavior patterns may be distinguished by cardiac vagal regulation in the form of RSA suppression to emotional and behavioral challenges. One hypothesis is that co-occurring anxiety symptoms, which are often associated with overcontrol of emotion, may indicate less severe behavior problems (Lilienfield, 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 a large sample of 5-year-old children divided into three groups: those who were at high risk for externalizing problems, those who displayed early externalizing problems with co-occurring internalizing problems, and those with no behavior problems (Calkins et al., 2007). We assessed the children's performance on 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 overregulated physiologically, which may explain the high level of internalizing symptoms. Recent research in the study of emotion regulation suggests that both underregulation and overregulation of emotion may be characteristic of children with very different patterns of behavioral difficulties (Eisenberg, Smith, Sadovsky, & Spinrad, 2004). Studies of physiological regulation have yet to address the question of whether greater vagal regulation may, in some instances, be an indicator of overregulation.

The question as to why these children also display externalizing problem behaviors remains unanswered. It would be important for future research to identify which type of behavior problems emerged first. Perhaps the child's initial internalizing symptoms affect his or her ability to effectively communicate with parents and/or peers, which may lead to more frustration during social interactions and, eventually, to aggressive or impulsive behavior. Or, the child's initial externalizing symptoms may influence the ability to communicate effectively with parents and/or peers, which may lead that child to being rejected at school and to subsequent internalizing symptoms. The cross-sectional nature of this data set precludes answering these questions.

The data from this study and our prior work suggest that children with different patterns of behavior problems, patterns that may reflect the lack of control of emotion and aggression versus overcontrol of emotion and aggression, also display a distinct pattern of parasympathetic nervous system functioning that has been linked in past research to the regulation of attention, affect, and behavior (Calkins, 1997; Calkins & Dedmon, 2000; Calkins & Keane, 2004). Differentiating among subtypes at both the behavioral and physiological levels is critical, as it may suggest sources of these behavioral differences as well as factors that influence the outcomes of these behavioral patterns. Future research with these kinds of populations must determine whether the parasympathetic processes precede the behavioral pattern or are a consequence of it. Moreover, future research should also examine whether the greater cardiac vagal regulation of the anxious/aggressive group might serve as a protective factor against later and more severe conduct problems or whether it is a risk factor for more severe internalizing spectrum problems.

SUMMARY AND IMPLICATIONS

In this chapter, I 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. I argued that the recent narrow focus on emotion regulation deficits as the core of problematic behavioral functioning in childhood disruptive behavior disorders overlooks important regulatory functions that may be observed in different behavioral and biological domains. I 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, I highlighted findings from several studies with infants and young children demonstrating the associations between behavior and one measure of physiological regulation, vagal regulation of cardiac output, that we have found differentiates children with different behavior problem profiles.

Although physiological regulation may be foundational to adaptive functioning across a number of subdomains of regulation, clearly many more issues need to be addressed before we can fully appreciate the role this type of regulation plays in the development of childhood disruptive behavior problems. First, this review of the development of self-regulation suggests that there are expected trajectories of skills in the five subdomains and that patterns of regulatory deficits are related to specific and, presumably, identifiable patterns of behavioral adjustment versus maladjustment. The added complexity of studying environmental moderators of emerging self-regulatory processes makes empirical examination of these emergent processes not only quite challenging but also a promising direction for research. And, although I have generated some hypotheses about the different trajectories of early self-regulation and the implications of such trajectories for development, to date, there has not been a comprehensive examination of these processes in representative samples of children that would allow differentiation of patterns of adjustment in girls and boys. Such an examination has implications for an understanding of both normative and compromised development and would clearly contribute to the identification of mechanisms of development that have largely been neglected in the behavior problem literature. Thus, future empirical work investigating this conceptual model should 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.

Second, 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 understand the degree to which early regulatory developments constrain later achievements. Researchers studying the development of emotion and behavior regulation, which may depend on more basic physiological and attentional processes, may need to consider the degree to which earlier levels of functioning place limits on what can later be achieved in the regulatory domain. Or, 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.

Third, this model hypothesizes that the developments that take place in the domains of self-regulation, and the relations between self-regulation and the trajectories of problem behavior, will be moderated by numerous environmental factors. So, for example, I have described the important role played by the attachment relationship in emerging self-regulatory abilities (Calkins, 2004a). One important direction for future research is the study of *how* early caregiving experiences influence the development of physiological regulation, a question that has been addressed primarily in the animal literature, but not with humans. For example, Hofer (1994; Polan & Hofer, 1999) addressed the multiple psychobiological roles that the caregiver plays in regulating infant's behavior and physiology early in life. Based on his research with infant rat pups, he described these "hidden regulators" as operating at multiple sensory levels (olfactory, tactile, and oral, for example) and influencing multiple levels of behavioral and physiological functioning in the infant. So, for example, maternal tactile stimulation may have the effect of lowering the infant's heart rate during a stressful situation, which may in turn, support a more adaptive behavioral response. Moreover, removal of these regulators, during separation, for example, disrupts the infant's functioning at multiple levels as well. Clearly, then, opportunities for individual differences in the development of emotion self-regulation may emerge from differential rearing conditions that provide more or less psychobiological regulation. Clearly, then, a more comprehensive study is needed of the effects of the environment on the development of infant and child self-regulation.

Finally, it is important to continue to address the question of self-regulation and its role in both normative and non-normative psychological functioning from a developmental psychopathology perspective. Such a perspective suggests that (a) there are multiple contributors to maladaptive and adaptive outcomes, (b) that these contributors may interact in various ways within different individuals, and that (c) the consequences for development are multiple pathways to disordered behavior and/or multiple variants of outcomes from individual causative factors (Cicchetti, 1984, 1993; Cicchetti & Rogosch, 1996; Sroufe & Rutter, 1984). A developmental psychopathology perspective on the differentiated self-regulatory processes described here may illuminate the mechanisms implicated in the different pathways and outcomes that have been observed among children with disruptive behavior disorders.

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6

Behavior Regulation as a Product of Temperament and Environment

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The field of developmental psychopathology (Achenbach, 1974; Sroufe & Rutter, 1984) identifies risk factors and models the processes by which risks relate to behavior problems. One type of model posits that risks add in a linear way to increase the chances that a child will develop problems. This type of model has been well supported. Research to date has established that adverse rearing conditions, such as excessively hostile parenting or poverty (e.g., Rothbaum & Weisz, 1994), and adverse personal qualities of children, such as neurological dysfunctions or difficult temperament (Moffitt, 1993; Rothbart & Bates, 2006), are correlated with behavior problem outcomes. The more such adversities are present, the stronger the prediction of later behavior problems (Appleyard, Egeland, van Dulmen, & Sroufe, 2005; Deater-Deckard, Dodge, Bates, & Pettit, 1998). Some additive risk models postulate mediating factors and thus provide a more satisfying account of developmental process; for example, the experience of physical abuse leads to deviant social cognition, which, in turn, leads to aggressive behavior (Dodge, Bates, & Pettit, 1990; Dodge, Pettit, Bates, & Valente, 1995).

However, linear combinations of even relatively large numbers of predictors tend to account for less than half of the variance in behavioral adjustment (e.g., Deater-Deckard et al., 1998). Part of this shortcoming may be due to failure to specify enough of the many possible risk factors. Another part may be that risk factors that are conceptually distinct may, in fact, correlate with one another and overlap to a considerable degree in their relation with adjustment outcomes. A third part could be imprecise measurement of the relevant constructs. These three barriers to more complete accounts of development could, in theory, be overcome by massively large, psychometrically optimal assessment batteries in massively large samples of participants. However, as we wait for such studies to be completed, we can consider another possible reason why additive models account for limited amounts of variance: the additive model itself could be insufficient.

Another kind of model that has been widely mentioned involves nonlinear combinations of risk factors, such as the multiplicative influence of ineffectual parenting and adverse child temperament (Wachs, 2000). Why, however, should we invest in such complex models? We were initially inclined to prefer linear models because of their mathematical and conceptual simplicity, as well as their demonstrated efficiency (Wiggins, 1973). However, although additive models are certainly attractive in developmental psychopathology, there would be a reason to consider nonlinear models even if they did not produce substantially more accurate predictions: the prediction task that the field of developmental psychopathology has set for itself differs from the clinical prediction studies reviewed in Wiggins' (1973) classic text. Developmental psychopathology seeks models of process, not merely efficient models of prediction. More than 30 years after what could be considered the birth of the field of developmental psychopathology (Achenbach, 1974), it is difficult to imagine a viable theory in which additive models are viewed as giving a sufficient account of developmental process (Wachs, 2000). Indeed, one of the key points of this chapter is that empirical findings have very recently, within the past 10 years or so, begun to catch up to the nonlinear, theoretical models.

We have been particularly interested in possible processes in which basic characteristics of an individual child interact with characteristics of the child's socializing environment to produce socially significant developmental outcomes, particularly conduct problems. Temperament is frequently used as a way of considering characteristics of the individual child. Chess and Thomas's (1984) concept of "goodness of fit" is useful: the same child temperament means different things for development in different kinds of families. For example, when an active child is in a family that values vigorous and noisy physical activity, the fit may be better than when a similar child is in a family that values quiet activity. With better fit come fewer social conflicts and less likelihood of development of behavior problems. One can also consider the temperament-environment interaction from the complementary perspective of "organismic specificity" (Wachs & Gruen, 1982). Children with different temperaments respond differently to a given environment characteristic; for example, in intellectually understimulating environments, an active child's intelligence develops better than that of an inactive child (Escalona, 1968). However, although theory in developmental psychopathology has tended to expect interaction effects, until recently, the literature has provided relatively few empirical examples, and the array of interaction effect findings has been relatively unsystematic.

Interaction effects geometrically increase the complexity of conceptual models. Social development research considers a very large number of concepts, and there is not a high degree of standardization in measurement approaches. This latter factor alone would make it unlikely that there would be a systematic array of interaction effect findings. However, in several ways, statistical power problems also impede the finding of interaction effects in the nonexperimental studies that are typical in developmental science (McClelland & Judd, 1993; Rutter, 1983; Stoolmiller, 2001; Wachs & Plomin, 1991). If one searches for interactions in a design that compares individuals classified into groups, the numbers of individuals in groups composed of the intersection of two or more dimensions can become small. Even if one analyzes interactions among continuous variables, which enhances power to detect an interaction, the predictor measures are often substantially correlated, which reduces the likelihood of detecting an interaction. The statistical reliability of interactions tends to be lower than the reliability of main effects. And finally, non-normal distributions, which are quite likely in measures of temperament, environment, and behavioral adjustment, might not substantially reduce power to detect main effects, such as finding whether children who receive ineffective parenting tend to have higher levels of aggressive behavior; however, they can reduce power drastically in tests of interaction effects, such as finding whether temperamentally difficult children are more likely to develop aggression in response to ineffective parenting than are temperamentally easy children.

One approach to dealing with the statistical challenges in demonstrating person-environment interaction effects involves careful statistical transformations of data and the use of complex statistical techniques (Stoolmiller, 2001). Another complementary approach is to search for theoretically interesting and empirically replicated patterns. Recent literature shows a rapid and encouraging growth in findings on temperament-environment interaction effects in child development, despite the statistical difficulties in finding such effects. As of about 10 years ago, there were very few notable patterns of convergent temperament-environment interaction effects in accounting for children's social development outcomes (Rothbart & Bates, 1998). Since then, it has become possible to write detailed reviews of the recent temperament-environment interaction findings (Bates & Pettit, 2007; Rothbart & Bates, 2006). In this chapter, we describe a small part of that burgeoning literature and relate it to concepts of self-regulation. In addition, we summarize several findings related to the development of self-regulation emerging from our own recent work.

SELF-REGULATION CONCEPTS

Current developmental psychopathology models rely heavily on concepts of self-regulation. Problem behavior can be convincingly described as a function of learning deviant response tendencies through processes of positive and negative reinforcement (e.g., Patterson, Reid, & Dishion, 1992) and other kinds of social learning processes (Coie & Dodge, 1998). However, most typically, even children with diagnosable behavior problems do learn skills for performing prosocial and avoiding antisocial actions. So, theory also seeks to explain how individuals manage and fail to manage their own behavior. Many problem emotions and behaviors can be seen as resulting from failures of self-regulation. For example, some antisocial behavior could reflect overattending to reward cues and failing to heed peripheral cues for inhibition (Newman & Wallace, 1993). Antisocial behavior could also result from a chain of events starting with the child's inability to redirect attention when frustrated, leading to poorly regulated negative affect and, ultimately, reinforcement of coercive behavior (Patterson et al., 1992).

Children's development of self-regulation shows normative patterns of development. In the latter part of the second year, children begin to be able to respond to prohibitions and directives from caregivers, but are not truly self-controlled (Kopp, 1982). Between 2 and 5 years of age, they develop more self-directed control. Children show major improvements in their ability to suppress a dominant, but incorrect response, in favor of a subdominant, but correct, response on laboratory measures of self-regulation (Gerardi-Caulton, 2000; Jones, Rothbart, & Posner, 2003). In addition, whereas most 2-year-olds can use a single rule to sort objects, most 5-year-olds can use complex, multistep rules (Zelazo & Frye, 1998). These developmental trends reflect improved abilities to control and flexibly redirect attention and motor control. They correspond in important ways to neural development, especially the development of frontal lobe structures and enhanced neural coordination among orienting, alerting, and arousal networks (Rueda, Posner, & Rothbart, 2004).

Development of self-regulatory traits, we assume, involves transactions between the child's initial dispositions, including potentials for the approach and inhibitory systems in the brain, based in both genetic and acquired constitution, and the rich array of cues and consequences available in the child's environment. Returning to our nonlinear model of development, we further assume that whether self-regulation development proceeds well or poorly would only in relatively extreme cases depend primarily on the child's initial dispositions or primarily on the qualities of the environment. In more typical, mid-range cases, development would in some way depend on the fit between the child and environment. For example, if the child is strongly disposed to seek rewards, lacks fear, and is not initially high in effortful control, successful socialization will require an environment that carefully monitors the child and channels the child's energy in socially positive directions. In contrast, if a child's disposition toward fearfulness dominates the child's disposition toward reward-seeking, his or her effortful control and parental positivity may be of less importance for socialization. Such processes seem quite plausible, but their empirical instantiation will take a lot of research. For the moment, however, we are pleased to see an accumulation of studies of environmental traits in interaction with even a single child temperament dimension, such as child social behavior outcomes as a function of harshness of parental control in interaction with a temperament dimension, such as child fearfulness (Bates & Pettit, 2007).

DEVELOPMENTAL ANTECEDENTS AND CONSEQUENCES OF EARLY SELF-REGULATION DIFFERENCES

Self-regulation abilities and traits are the product of development up to the time in development at which they are measured. This makes it impossible to be sure that a measure of a self-regulation trait reflects "pure" temperament. Nevertheless, just as any personality trait likely reflects in part a temperamental core (Zuckerman, 1991), self-regulation traits can be assumed to be partly based in temperament. And, even if one takes the contrary view that self-regulation has no roots in temperament, one can still be interested in the developmental antecedents and consequences of an early self-regulation trait and how it interacts with environmental characteristics.

Structure of Self-Regulation

Our interest in self-regulation and much of our perspective on its development began with our collaboration with Sheryl Olson in the context of the Bloomington Longitudinal Study. To study the influence of self-regulation on social development requires good measures of the construct of self-regulation. Self-regulation is now understood to be a multidimensional construct. One approach to capturing its complexity is to use a diverse battery of measures of self-regulation under diverse conditions. The work of Olson and her colleagues was pioneering in its use of multiple measures to capture the structure of self-regulation and to identify its connections to the early home environment and later adjustment.

Olson and her colleagues assessed self-regulation at ages 6 and 8 using measures of children's ability to exhibit gross and fine motor control, inhibit behavior in response to situational requirements, exhibit attentional engagement during play, and delay gratification (Olson, Bates, & Bayles, 1990; Olson, Bates, Sandy, & Schilling, 2002; Olson, Schilling, & Bates, 1999). Principal components analyses showed a structure of relations and nonrelations among the measures that was relatively consistent and stable from age 6 to age 8. For example, an inhibitory control factor captured the ability to inhibit behavior on command, as in tracing a star slowly on command, and to be meticulous when matching figures, as in performance on the Matching Familiar Figures Test (Kagan, Rosman, Albert, & Phillips, 1964). A second factor tapped individual differences in impulse control in academic-like tasks under nonincentive conditions, including refraining from playing with forbidden toys and engaging in repetitive, academic-like tasks in situations without the availability of an explicit reward for following our requests. Yet another factor tapped impulse control in following the same requests in situations with clear incentives. There were also some age-limited factors (e.g., fast motor control, which was only found at age 6).

It is reassuring to note that the three consistent factors mentioned here – inhibitory control, behavioral control under nonincentive conditions, and behavioral control under incentive conditions – are consistent with other, more recent divisions of self-regulation into motivational/emotional and executive/cognitive components (Kindlon, Mezzacappa, & Earls, 1995; Nigg, 2000; Rothbart, Derryberry, & Posner, 1994). Motivational components of regulation may operate relatively automatically via the activation of brain systems for acting on cues for potential punishment versus reward; effortful components may operate in a more consciously self-directed way. For example in the first instance cited in the previous paragraph, a child with a relatively sensitive behavioral inhibition system (BIS; Gray, 1993) avoids a misbehavior because of the presence of cues for punishment. And in the second instance a child, despite being strongly motivated to pursue a potential reward, pauses to attend to the mother's disapproving frown and then voluntarily suspends the disapproved pursuit, evidently not merely because of fear of punishment but also because of a desire to do what is correct or to maintain a positive connection with the mother (Kochanska, Coy, & Murray, 2001). It appears that the ability to respond flexibly to situational demands is based on both exerting control over attention and motor processes and responding optimally to reward and punishment cues. Although we do not believe that these factors are entirely distinct in operation, the factor-analytic results suggest that different situations may place different demands on different facets of the broader self-regulation. The approach to assessing self-regulation using a battery of diverse tasks has been used by other researchers with success (e.g., Kochanska et al., 2001). Nonetheless, measurement of self-regulation remains a difficult challenge, and task-based measures provide an imperfect account. Other types of measures, including naturalistic observations and caregiver report, provide important additional perspectives on self-regulation.

Developmental Antecedents of Self-Regulation

In addition to investigating the structure of the self-regulation construct, our work with Olson also considered early precursors and adjustment outcomes related to school-age self-regulation. Several aspects of caregiver-child interaction at 13 and 24 months predicted self-regulation at ages 6 and 8. High levels of maternal responsiveness and sensitive control explained variance in child self-regulation at age 6 beyond the variance explained by early child intellectual ability (Olson et al., 1990). In addition, maternal stimulation of the infant with objects, nonrestrictiveness, and verbal interaction were predictive of greater child inhibitory control and greater attentional engagement in tasks at age 8 (Olson et al., 2002). Difficult temperament as assessed by maternal reports at 13 and 24 months was not found to be related to school-age self-regulation (Olson et al., 1990, 2002). Fittingly, however, the temperamental trait of attentional disengagement, observed in home visits at 24 months, was negatively correlated with later inhibitory control (Olson et al., 2002). Finally, and also fittingly, early cognitive competence as measured with the Bayley Mental Development Index was related to greater inhibitory control and greater attentional engagement during lab procedures (Olson et al., 1990, 2002).

Self-Regulation and Behavioral Adjustment

A number of adjustment outcomes were also related to self-regulation at ages 6 and 8 (Olson et al., 1999). Three to five years later, child inhibitory control was negatively related to mother-reported hyperactivity, and behavioral control in a nonincentive condition was negatively related to teacher-reported attention problems. Furthermore, nearly 10 years after the assessments of self-regulation, behavioral control in an incentive condition was negatively related to self-reported delinquency, as was inhibitory control, and performance on the delay of gratification task was negatively related to self-reported aggression.

The Olson et al. findings in the Bloomington Longitudinal Study indicate diverse associations between different aspects of early maternal characteristics and different components of later self-regulation. More research is necessary to clearly identify the individual pathways. However, it appears that responsive and positively involved parenting, intellectual ability, and temperamental disengagement in the infancy to toddlerhood period contribute to individual differences in the development of self-regulation in the early elementary school years. Consistent with a developmental cascade model (e.g., Masten et al., 2005), school-age self-regulation, in turn, was found to buffer against the development of externalizing problems in adolescence. However, despite their theoretical value, the connections we have drawn – between early temperament or parent-child relationship experiences and later self-regulation, and between self-regulation and later adjustment – generally account for modest to moderate amounts of variance. Therefore, although we feel that this research in the Bloomington Longitudinal Study has taught us valuable things, it has left unresolved many questions about the developmental process. As indicated earlier, we think it likely that interactions between individual child characteristics and rearing experiences shape important developmental processes and outcomes. We next provide some hints as to what kinds of interactions might shape the development of self-regulation differences in children. First, we briefly review a few findings, already in the literature, that are influencing our current thinking about the development of self-regulation. Then, we review some findings that have been emerging in our current work on self-regulation.

PRIOR STUDIES ON SELF-REGULATION AND ADJUSTMENT AS THE INTERACTIVE PRODUCT OF CHILD AND PARENT CHARACTERISTICS

Fearful Temperament, Harsh Parenting, and Socialization Outcomes

Grazyna Kochanska (1991, 1995, 1997) has found one of our favorite patterns of results of the past 10 years. The pattern is satisfying because it has been replicated, although not perfectly (Bates & Pettit, 2007); because it has theoretical resonance, evoking the insights of Martin Hoffman (1983) about the alternative pathways to socialization; and because it has potential clinical implications for our work with oppositional children. The core temperament trait in this pattern is fearfulness, which is conceptually related to what Kagan (1998) calls behavioral inhibition – distress in the presence of novel situations. Kochanska (1991, 1995) found that gentler discipline was associated with higher levels of socialized behavior in children who were temperamentally fearful, but not in nonfearful children. She found this pattern with both younger and older children. Theoretically, a child temperamentally disposed to anxiety would respond to harsh discipline with excess anxiety, which would interfere with learning cognitive controls over behavior, whereas the same child would more easily extract useful socialization lessons with gentler discipline. In her study of younger children, Kochanska (1995) also found that another dimension of the mother-child relationship – a warm, fun, securely attached relationship –mattered differentially for fearless children. Theoretically, the second pathway to socialization is for the child to care about the parent and the positive aspects of the relationship. Inhibiting misbehavior and performing prosocial acts are part of a positively reciprocal relationship. Further replications of this pattern are needed (Bates & Pettit, 2007), but if it does hold, it suggests that prevention and treatment programs for oppositional behavior in young children should emphasize different blends of parenting techniques, depending on levels of children's temperamental fearfulness.

In the Kochanska example of how socialized self-regulation may result from the interaction of child temperament and environmental characteristics, temperament served as the moderator variable. The analysis evaluated the relation between two parent-child continuous variables, maternal discipline and an attachment Q-sort, and a continuous variable of child regulation outcome in high versus low fearful children. It is fairly common to establish an interaction effect in multiple regression analysis, in which the outcome variable is predicted by the individual predictor variables and there is also a significant interaction term composed of the product of the predictor variables. Kochanska (1997) did this as a preliminary analysis and then focused on the child temperament as the moderator variable. In the next example of a temperament-parenting moderator effect, the data were presented from the opposite perspective – with temperament as the main predictor of regulation-relevant outcome and the parenting variable as the moderator of that relation. In practice, the two perspectives can very occasionally differ in their results because of differences in distributions, but in theory and usual practice, they are quite complementary (Bates & Pettit, 2007). The choice of one perspective over another is usually based on the way the researcher prefers to ask the moderator question.

Temperamental Unmanageability, Maternal Control, and Externalizing Behavior Outcomes

Bates, Pettit, Dodge, and Ridge (1998) explored the temperamental antecedents of externalizing behavior problems in middle childhood as reported by teachers and as reported by mothers in two, separate longitudinal studies: the Bloomington Longitudinal Study and the Child Development Project. Data were preliminarily explored via multiple regression analyses, and ultimately by a combination of nested structural equations and visual analysis of scatterplots. The findings suggested that a child's temperament has different developmental implications in different kinds of rearing environments.

Overall, the more that children were temperamentally unmanageable – defined by mothers' reports that they were relatively unlikely in very early childhood to comply with prohibitions, such as "no-no" – the more likely they were to show aggressive, uncooperative, disruptive, and rule-violating behaviors in middle childhood. However, the strength of the prediction differed according to the kind of maternal control we observed. In both samples and for behavior outcomes in both school and home settings, the patterns were quite similar: Maternally rated resistant (unmanageable) temperament was more predictive of later externalizing problems when the child's mother had been observed to be low in reactive control. Reactive control was defined as the mother verbally or physically restraining or scolding the child in response to potentially troublesome behaviors, such as touching a forbidden object. Reactive control could be viewed as restrictiveness. However, in fact it was generally not reflective of harsh physical punishment. We observed essentially no spanking in our home visits.

This pattern requires further replication, but if it holds up, it suggests that high levels of control serve to protect against early unmanageable tendencies developing into entrenched patterns of misbehavior in the elementary school years. This was not true of every case in our samples, as shown by visual inspection of scatterplots (see Bates et al., 1998); however, there were enough cases illustrating the pattern to invite interpretation. One plausible interpretation is that the temperamentally unmanageable child with a mother who is high in control learns, through repeated encounters, that the mother has rules and that she will enforce them. In contrast, such a child with a mother who is observed to be low in control may be failing to learn to cooperate with social regulation, perhaps because the mother is avoiding, at least in the presence of an observer, the hassles of confronting a resistant child. It is possible that a resistant child with a mother low in reactive control may experience more irritable or hostile control at times when observers are not present. Either kind of transaction could perhaps exemplify Gerald Patterson's (1982) seminal model of training in coerciveness, which would ultimately become a dysfunctionally aggressive pattern of social behavior.

Visual inspection of the scatterplots suggested another facet of the interaction effect, accounting for the development of tractable children, those at the low end of the continuum of temperamental unmanageability: when such children had mothers observed to be low in control, they ended up with very low levels of behavior problems. However, when they had mothers who were observed to be high in control, a number of them later showed higher levels of externalizing behavior than would have been predicted by their temperament alone. In other words, the relatively low correlation between temperamental unmanageability and later externalizing behavior for children of high-control mothers was a function of cases falling away from the expected regression line at both ends of the temperament distribution. Perhaps the children who were temperamentally tractable were somewhat frustrated by high-control mothers, which encouraged them to become more aggressive. As in the field in general, many questions here about the developmental process are left for future research. The processes could be as we have speculated, or there could be other kinds of process. However, the study does support in a general way the notion that there may be developmental implications of fit versus misfit between child temperament and parenting characteristics.

Depending on further work done to replicate and specify processes mediating the interaction effect, one hypothesis for clinical experimentation might be the following. If a young child with externalizing behavior problems has a history of being low in resistance to control, perhaps the emphasis of parent behavioral training might be on reducing excessive parental control; whereas, if the child has a (probably more typical) history of having been high in resistance, then the emphasis might be on making parental control firmer and more steady in the face of child coercive countercontrol efforts. Both kinds of training are part of standard manuals (e.g., Fleischman, Horne, & Arthur, 1983), but hypothetically, given the limited time for treatment, it may be more effective to emphasize certain elements.

Negative Emotionality, Parenting, and Internalizing Behavior Outcomes

The literature generally implies that negative parenting, such as in the form of reactive control, is associated with child behavior problem outcomes. However, one of the useful implications of the Bates et al. (1998) pattern just described is that, for some kinds of children, parental behavior that is apparently negative can actually have positive developmental implications. The findings of Arcus (2001) support this implication in a different context. According to research by Kagan and colleagues (e.g., Kagan, 1998), negative emotional reactivity is a typical antecedent of behavioral inhibition in the face of novelty. Arcus found, however, that when parents were high in limit setting, highly reactive infants were less likely to become inhibited toddlers. Her interpretation was that experiencing optimal challenges helped fear-prone children gain regulatory control over their emotions. Belsky, Hsieh, and Crnic (1998) reported a similar finding. In addition, Bates (2003) presented some results, from the same longitudinal data as in Bates et al. (1998), also suggesting that higher levels of maternal control attenuated the relationship between early fearful temperament and later internalizing symptoms.

However, negative parenting can still have negative implications, as shown by Rubin, Burgess, and Hastings (2002), who operationalized negative parenting as intrusive affection and derisive comments, or psychological control, given to toddlers. When toddlers' mothers were high in psychological control, toddlers' reticence with a peer was predictive of their reticence with an unfamiliar peer when they were 4 years old. However, when the mothers were low in psychological control, the toddlers' early peer reticence was not predictive of later peer reticence.

In thinking about how to resolve the differences between the Rubin et al. (2002) findings and those of Arcus (2001), it might help to recall Richard Bell's (1968) distinction between two kinds of parental control: upper limit and lower limit control. Upper limit control, triggered by a child who is actively transgressing, has been the most salient construct to us as clinical psychologists. Parents most often bring in their children because their upper limit controls have been ineffective: the child is still resisting authority too much, fighting too much, whining too much. Parents are also occasionally concerned with children not doing enough, and this can elicit lower limit control, in which parents try to activate an inactive child. The parents in the studies of Kochanska (1997), Bates et al. (1998), Arcus (2001), and Bates (2003) could also be described as exercising upper limit control. However, it is possible that much of the control in the Rubin et al. (2002) work represented parents' attempts at lower limit control in dealing with a shy, constricted toddler. There is an interesting question about development in the contrasting findings in these studies. Does limit setting prevent the development of anxious behavior, and intrusive and derisive control promote it? Do some kinds of control succeed because they enhance children's abilities to regulate behavior and emotion, whereas other kinds diminish such abilities? Research that more richly accounts for this contrast will provide an important step in understanding the processes of social development.

RECENT FINDINGS, PART 1: IMPULSIVITY AS A MODERATOR OF SOCIALIZATION PRESSURES

A key aspect of self-regulation that has been important in our recent work is impulsivity. It is well established that the trait of impulsivity has direct associations with externalizing behavior problems. More impulsive youths tend to show an externalizing pattern of adjustment. They show more antisocial and risky behavior and less prosocial and achievement behavior (Barkley, 1997; Lahey & Waldman, 2003; Olson et al., 1999; Weithorn, Kagen, & Marcus, 1984). It is also well established that environmental pressures toward antisocial behavior are associated with the development of an externalizing pattern. For example, youths whose parents are hostile and ineffectual toward them develop antisocial behavior problems (Patterson et al., 1992; Rothbaum & Weisz, 1994). And as another example, youths whose friends engage in antisocial acts are more likely to behave in antisocial ways themselves (Deater-Deckard, 2001; Dishion, Spracklen, Andrews, & Patterson, 1996).

However, although the patterns hold even when impulsivity, socialization pressures, and behavioral adjustment outcomes are defined in many different ways, the associations are far from perfect. This leaves open the possibility that the behavioral adjustment outcomes are not simply an additive effect of impulsivity traits and socialization pressures. Rather, adjustment outcomes may be an interactive product of impulsivity traits and the particular socializing pressures experienced by a youth. Here we summarize three efforts to answer the question of how youths' impulsivity might moderate the effects of socialization experiences. The first concerns the effects of deviant peers, the second concerns the effects of parent-teen warmth, and the third concerns the effects of a theoretically pivotal by-product of children's social experience – their social-information-processing biases (Dodge, 2003).

Impulsivity as a Moderator of the Effects of Peers' Deviance

We often think of impulsive individuals as sensitive to rewards (i.e., having an approach system that is highly tuned relative to their inhibition or executive control systems). A key situation for seeking rewards, especially in adolescence, is with peers, and this is also a key situation for antisocial behavior. As part of a longitudinal study, Dishion and his colleagues (1996) observed youths interacting with friends and saw that antisocial friends responded positively (e.g., laughed) to rule-breaking talk and ignored normative and prosocial talk. In contrast, non-antisocial friends responded positively to normative and prosocial talk and ignored rule-breaking talk. Teens' antisocial and prosocial behaviors during the observed interactions were directly proportional to the ratio of their friends' positive responses for antisocial and prosocial behavior. These observations suggest that teens' behaviors with friends are organized around opportunities for social reinforcement. Furthermore, Dishion and colleagues found that friends' rates of positive response to rule-breaking talk, as observed during a 25-minute period in the lab, predicted teens' antisocial behavior 2 years later.

We wondered whether this main effect of peer deviance might be moderated by personal characteristics of the teen. Would teens who were more inclined to impulsivity be more susceptible to friends' influence than those who were less impulsive? We expected the answer to be "yes," because our assessments of impulsivity were designed to capture individual differences in teens' sensitivity to reward relative to sensitivity to punishment.

We tested this prediction using data from the Child Development Project (Goodnight, Bates, Newman, Dodge, & Pettit, 2006). Friend deviance and externalizing behavior were assessed by teen self-report. Impulsivity or reward sensitivity was assessed in the card-playing task (Newman, Patterson, & Kosson, 1987; Siegel, 1978) administered at age 16. The card-playing task was simple – all the player had to do was decide whether to "turn over" another card on the computer. If a face card turned up, the player received a quarter; if a number card turned up, the player had a quarter removed from the winnings pile. The challenge in the task was to determine the best time to stop playing. Chances of winning money decreased from 90% at the beginning of the game to 10% just before the forced termination of the game. Teens who played beyond the optimal stopping point, whose performance appeared to be more influenced by the reward than the punishment, were classified as reward sensitive in our analyses.

In fact, as expected, reward-sensitive teens showed the effects of friend deviance more strongly than less impulsive teens. A cross-lagged structural model controlling for stability in externalizing behavior from age 14 to age 16 indicated that the predictive association between age 14 friend deviance and age 16 externalizing behavior was significant only for reward-sensitive teens. This model had significantly better fit to the data than the alternative model, in which the association between age 14 friend deviance and age 16 externalizing behavior was constrained to be equal for reward-sensitive and non-reward-sensitive youths. It appears that teens' motivational self-regulation, specifically their differential responsiveness to reward versus punishment cues, helps determine the negative influence of deviant peer affiliation. Impulsive or reward-sensitive youths with well-behaved friends did not show a relative increase in externalizing problems, whereas those with more antisocial friends did. Among nonimpulsive youths, friend deviance did not have a bearing on future externalizing problems. We speculate that this pattern of findings occurs because reward-sensitive youths are more susceptible to the rewards that peers provide for prosocial or antisocial behavior.

Impulsivity as a Moderator of Parental Warmth

Is it possible that parents' rewards might influence the social behavior of youths in a way comparable to the influence of peers' rewards? Snyder and Patterson (1995) found that children were more likely to behave in ways that had produced positive parental responses during previous parent-child interactions than to behave in ways that had not produced positive responses during previous interactions. Using the same Child Development Project sample (Goodnight, Bates, Kuwabara, Newman, Pettit, & Dodge, 2006), we assessed maternal reward behavior via both teens' reports and observations of mothers' warmth, support, positive reinforcement, and listener responsiveness in structured interactions with their teens at age 16. We assessed teens' antisocial behavior at ages 15 and 17 with adolescent and mother reports of externalizing behaviors. Finally, we assessed impulsivity with the same card-playing measure described earlier.

Our analysis approach was slightly different from what we used to assess impulsivity as a moderator of peer effects, but the basic pattern of results was quite similar: teens who were more impulsive (reward sensitive) showed a stronger effect of maternal responsive warmth than those who were less impulsive. A latent difference score (LDS) structural equation model (McArdle, 2001) showed a sizable and inverse association between maternal warmth and growth in externalizing behavior (standardized coefficient of $^{-}.59$) for reward-sensitive boys, but a small and nonsignificant (average standardized coefficient of .02) association between maternal warmth and growth in externalizing behavior for reward-insensitive boys and girls (as well as for reward-sensitive girls). This model fit the data better than an alternative model in which the reward-sensitive and reward-insensitive groups' associations between positive parenting and externalizing behavior were constrained to be equal.

The results of the two Goodnight et al. (2006) studies suggest that impulsivity, which theoretically reflects a motivation to pursue reward and not to avoid punishment, alters the meaning of socialization experiences. Whether there are positive influences or not matters more for impulsive youths than for nonimpulsive ones. With further research, this kind of finding might offer implications for treatment and prevention practices, at least when dealing with boys, who tend to show higher levels of antisocial behavior (Broidy et al., 2003). For example, it may be more crucial to intervene to prevent deviant peer influences and to promote positive parenting for the more reward-sensitive boys than for the less reward-sensitive boys.

Impulsivity as a Moderator of Links between Social Cognition and Aggressive Behavior

Studies of social information processing have shown that children's social cognitive styles, as measured by responses to hypothetical vignettes, predict levels of aggressive behavior concurrently and over time (Dodge, 2003; Dodge, Bates, & Pettit, 1990; Dodge, Pettit, & Bates, 1994). How are such predictions obtained? Theoretically, children have acquired their cognitive biases as the result of social experiences (Crick & Dodge, 1994; Dodge et al., 1990, 1994), and then these biases probabilistically influence processing of the information present in everyday social conflict situations. If the biases are toward aggression (e.g., assuming hostile intent by another or belief that aggression will be efficacious), then the likelihood of aggressive behavior is greater than if the biases are away from aggression; that is, the person assumes benign intent or that aggression would not be effective.

However, in fact, the level of predictiveness of any given social-information-processing mechanism, such as hostile attribution bias, tends to be modest. In addition, although linear combinations of multiple mechanisms tend to account for more variance in aggressive behavioral adjustment than does a single mechanism, the level of prediction still remains moderate (Dodge, 2003). A factor limiting the linkage between a social-information-processing trait and behavioral adjustment may be that social-information-processing traits are assessed by verbal responses to hypothetical social conflicts. Such hypothetical social conflict vignettes are presented in a controlled environment. They place few immediate cognitive demands to process information, whereas an arousing social situation unfolding in real time requires fast processing of relevant information and behavioral enactment of a response.

Here is where we can bring our interest in impulsivity to bear. We assume that children differ in their tendency to thoroughly process information before acting, as well as in the relative amount of attention they give to rewards and punishments. Some children are prone to act without thinking, whereas others are more likely to pause and consider the unique elements of a social situation before acting. Similarly, some children are prone to focus on immediate rewards in a situation (e.g., regaining a ball that another child has taken), whereas others are more likely to focus on the possible negative consequences of aggressing (e.g., getting punished by a teacher). For children who regularly act without thinking or who are unable to attend to negative future consequences, their typical patterns of processing social information may be most influential in determining behavioral responses. Conversely, for children more prone to thinking before pursuing a goal, the unique elements of a social situation may be more influential than their typical information-processing pattern in determining behavioral responses.

We found support for the role of impulsivity as a moderator of the link between social information processing (SIP) and behavior in the Child Development Project (Fite et al., 2008). Impulsivity in early adolescence (age 11–13), as measured by teacher reports, moderated the association between adolescent (age 13) social information processing, specifically positive endorsement of aggressive responses, and subsequent aggressive behavior (age 14–17), even after controlling for earlier aggressive behavior. Although modest in size, the Impulsivity × SIP interaction indicated that positive endorsement of aggression was predictive of later behavior for high-impulsive but not for low-impulsive adolescents. This finding suggests that a teen's impulsivity enhances the likelihood that a cognitive default will be translated into real behavior.

We also found a similar result when considering a specific type of aggressive behavior, namely dating violence (Fite et al., 2005). However, this effect applied only to the boys in the sample. A further complication was that the effect of impulsivity also depended on the level of anxiety, which theoretically could affect self-regulation through a fear of punishment, but that also could influence the level of aversive responses to interpersonal conflicts. A significant SIP × Impulsivity × Anxiety interaction indicated that endorsement of aggression predicted subsequent young adult dating violence for boys with moderate to high levels of impulsivity, as measured by the Passive Avoidance Task (Newman & Schmitt, 1998) and anxiety, as measured by the Welsh Anxiety Scale (Welsh, 1956). Endorsement of aggression was not

Table 6.1. *Unstandardized regression coefficients among boys for SIP predicting dating violence, estimated at high, medium, and low levels of impulsivity and anxiety*

	Anxiety		
Impulsivity	−1 SD	0 SD	+1 SD
−1 SD	.25	.16	.07
0 SD	.11	.32**	.54**
+1 SD	.03	.48**	.99**

** $p < .001$

predictive of dating violence for boys with low levels of impulsivity or anxiety (see Table 6.1). These results suggest a threshold effect, whereby high levels of impulsivity coupled with high levels of anxiety increase the likelihood that a boy's aggressive SIP patterns will be played out in real behavior within the confines of the dating relationship. Romantic relationships provide a unique social context for exploring the effects of impulsivity and social cognition. Although we might normally expect that the intimacy of a romantic relationship would foster more positive interactions between the individual and his or her partner, the comfort and importance of romantic relationships may provide a unique opportunity for individuals to display aggression, particularly high-anxious, high-impulsive individuals.

RECENT FINDINGS, PART 2: SLEEP AND SELF-REGULATION

Some years ago, under the influence of infant-induced sleep deprivation, we began to attend to the role of children's sleep in their daily functioning. Clinically, we observed in some cases of young children with conduct problems that the role of sleep deprivation in maintaining conduct problems appeared to be equal to or occasionally even greater than the role of parent-child relationship problems. The literature taught us that sleep deprivation could be thought of as a form of stress, with the release of stress hormones such as cortisol (Weissbluth, 1989), and that sleep deprivation disrupted coordination among the various centers of the brain (Dahl, 1996). From either a stress or a brain disorganization perspective, one could expect sleep deprivation to impair self-regulation abilities. Sleep deprivation has two components, the total amount of sleep lost and the disorganization of sleep, or the jet lag component.

The Preschool Project

In a generally low-income sample of preschoolers, we found that a number of children had highly disrupted sleep schedules, as recorded by mothers on a daily basis (Bates, Viken, Alexander, Beyers, & Stockton, 2002). We also found that a sleep disruption index – composed of variable bedtimes, variable amounts of sleep, and late bedtimes – was associated with relatively poor adjustment in the preschool, as recorded by teachers. This was true even after controlling for levels of family stress and parent-child relationship qualities. Consistent with our interest in the adjustment implications of how children's temperament might moderate their experience, we subsequently asked whether the link between disrupted sleep and relatively poor preschool adjustment held more strongly for children who were more temperamentally prone to dysregulation. In fact, children whom mothers described as higher on temperamental unmanageability showed stronger associations between disrupted sleep and poor adjustment in preschool than children who were more temperamentally manageable (Bates, Viken, & Williams, 2003). Temperamentally unmanageable children who had regular sleep did well in preschool and those who had disrupted sleep did poorly, but for manageable children, the effects of organized versus disrupted sleep were less pronounced. Toddlers who were temperamentally high in negative emotionality (i.e., difficult) tended, to a trend degree, to show the same pattern – more difficult toddlers were more affected by the adequacy of sleep.

The Toddler Project

On the basis of the results just summarized, we next began to wonder *how* the link between sleep disruption and poor adjustment might develop. Would disrupted sleep patterns interfere with the development of self-regulation skills? In an effort to answer this question, we have begun pilot studies of toddlers, using actigraphic measures of sleep (Sadeh, Raviv, & Gruber, 2000) in addition to parental diary measures. Results are quite preliminary, so are only summarized tentatively here. First, in one small study of 30-month-olds (N = 16; Novosad & Bates, unpublished), indexes of disrupted sleep were associated with less effective toddler self-regulation in a situation in which the task was to wait to open a gift while the mother completed a questionnaire. According to Mischel, Shoda, and Rodriguez (1989), the most effective, "cool" self-regulation in such a situation would be to attend to other things, whereas the least effective, "hot" self-regulation would be to attend to the gift. With correlations ranging from .54 ($p < .05$) to .78 ($p < .001$), toddlers with short sleep durations looked more at the present than those with longer sleep; toddlers who went to sleep later or those who woke up more often in the night not only looked at but also reached toward and touched the present more. This result needs to be replicated in a larger sample.

In the same small study, but with a few additional participants (N = 21; Staples, Bates, Goodnight, & Novosad, 2005), there was an interaction between disrupted sleep and temperament in predicting how much negative emotion toddlers expressed in an unpleasant, restrictive activity. The interaction was not exactly the same as in the preschool study, but did resemble it in some ways. First, if the toddler's temperament was difficult (negatively emotional) or resistant to control (unmanageable), then high levels of disrupted sleep (late bedtime, variable bedtime, and variable amounts of sleep) were associated with high levels of negative emotion in the restriction task and low levels of disrupted sleep were associated with low levels of negative emotion. If the toddler was temperamentally easy or manageable, the correlation ran in the opposite direction – more well-rested, temperamentally easy toddlers were somewhat more likely to express negative emotion in the restriction task than sleep-deprived, temperamentally easy toddlers. Again, although intriguing, this finding needs replication.

In short, we have found hints that toddlers with disrupted sleep patterns may be more emotionally and behaviorally dysregulated than well-rested toddlers, especially if they have preexisting, temperamental tendencies toward negative emotionality and behavioral dysregulation. An important question that this cross-sectional work cannot answer is whether the self-regulation pattern is a result of the sleep pattern, the sleep pattern is an expression of the self-regulation pattern, or whether the two are linked as parts of a larger developmental process or structure. Ultimately, we plan to follow a sample of toddlers longitudinally to learn if good sleep promotes daytime self-regulation or the reverse or, alternatively, if good sleep is continuously linked to self-regulation.

Longitudinal Relations between Sleep Problems and Waking Adjustment

A preliminary indication of the kind of answer we might expect from longitudinal studies of toddlers comes from a study (Goodnight, Bates, Staples, et al., 2007) of children first assessed at age 5 in the previously mentioned Child Development Project. Following the approach of Gregory and O'Connor (2002) and Wong et al. (2004), we defined sleep problems on the basis of ratings on Achenbach questionnaire items. On the basis of factor analysis, at ages 5–9 we computed a sleep deficit scale, composed of these mother-report items: overtired, sleeps less than most children, and trouble sleeping. We then used these sleep deficit scores to predict externalizing behavior problems, as defined by a combination of mother and teacher reports computed also at ages 5–9. We did this analysis by means of latent growth curve modeling. The intercept parameter of sleep deficit was associated with the intercept parameter of externalizing behavior. That is, the "true" mean level over time in sleep deficit was associated with the "true" mean level in externalizing behavior. Children who are typically high in sleep deficit are typically high in externalizing behavior, and children who are typically low in sleep deficit are typically low in externalizing behavior. Similarly, the two slope parameters were correlated, which means that children who increased faster in sleep deficit also increased faster in externalizing problems. This does not show that sleep deficits cause externalizing behavior or the reverse, but it does show that individuals' sleep deficits and behavioral adjustment are dynamically linked across development. In fact, when we looked for possible lead-lag relations in a traditional cross-lag panel model, we did not find them. In other words, the main associations were concurrent.

We next split the sample into children who were low versus high in temperamental unmanageability, that is, resistance to control, and then recomputed the latent growth model. The model that allowed the paths between the slope of sleep deficit and the slope of externalizing behavior to be different for the temperamentally unmanageable versus manageable children significantly improved the fit of the growth model. In the manageable, temperamentally tractable group, there was no significant link between the rate of change in sleep deficit and the rate of change in externalizing behavior (the standardized path coefficient was .17). However, in the unmanageable, temperamentally resistant group, those children who showed high rates of increase in sleep deficit also showed high rates of increase in externalizing behavior (path = .48). Again, we cannot claim that sleep deficits cause adjustment problems or vice versa. However, the temperament moderator model does add an important detail to our picture of dynamic linkage between sleep and adjustment. As we saw in preschoolers, the children who were temperamentally prone to dysregulation, the high-resistant children, showed the strongest linkage between sleep and adjustment. In this instance, the linkage was in the form of similarity of degree of change in sleep and adjustment across time, rather than an association between the average level of sleep deficit and adjustment.

Future studies are needed to better model the lead-lag relations. Based on the cross-lag panel modeling we mentioned, we do not believe that lead-lag relations will be seen when developmental time intervals are measured in years. However, it remains possible that there will be such relations in shorter time periods. For example, sleep deficits at one point might forecast externalizing problems in future weeks or months. It is also possible to imagine a process in which externalizing problems accelerate sleep deficits. Children who experience an increase in unresolved social problems may feel insecure, which would interfere with sleep. And children who use coercive countercontrol – a key element of externalizing behavior – may defeat their parents' efforts to structure their sleep and thus also increase in sleep deficit. However, for the moment, given the relatively rough ways we have measured the constructs, the findings suggest that sleep deficits and externalizing problems are quite closely linked in time.

CONCLUSION

Self-regulation processes play a large role in developmental psychopathology. There are many specific constructs under the broad rubric of self-regulation, just as there are under the rubric of psychopathology. We took this opportunity to consider a wide array of relevant constructs, reflecting our own development in this field of research. No one research group could consider all of the relevant topics, but as seen in this chapter, we have touched on several. First, in the Bloomington Longitudinal Study work of Olson and her colleagues, we learned that different tasks elicit different types of self-regulation, consistent with dimensions summarized as executive and motivational. We also saw that responsive, involved parenting; toddler intellectual ability; and toddler attentional engagement predicted self-regulation as measured in the early elementary school years and that self-regulation, in turn, predicted reduced levels of externalizing behavior problems on into adolescence. However, as is typical, our additive models only accounted for modest to moderate portions of variance, supporting an interest in multiplicative, moderator models.

Child temperament and child experience are increasingly found to interact in their predictions of child self-regulation and behavioral adjustment. We presented a number of examples, ranging from relatively well-established patterns already seen in the literature to newly emerging findings from our own research. We continue to find ways in which an early temperament variable that is conceptually related to self-regulation – unmanageability or resistance to control – interacts with child experience in shaping behavior traits. For example, temperamentally unmanageable children appear to show stronger links between sleep deficits and adjustment problems than manageable children. We think of this unmanageability variable, which is indexed by parent report of the young child not stopping when prohibited from something, as an early prototype of impulsivity. Impulsivity means that approach tendencies are stronger than avoidance of punishment or more effortful control tendencies. Interestingly, adolescent versions of this tendency, whether in laboratory games or as rated by teachers, show conceptually congruent patterns of interaction with experience in predicting behavioral adjustment. For example, the antisocial tendencies of friends matter more for the growth of impulsive youths' own antisocial behavior than for the growth of nonimpulsive youths' antisocial behavior.

We are encouraged by the relatively consistent emerging patterns of interaction between self-regulation traits and the environment in the development of behavioral adjustment. However, we recognize that the patterns require much additional research, including replications with different measures and samples, to become fully established. We also recognize that, as complex as the processes are that we are seeing, the actual processes could be even more complex. The goodness of fit processes that we have seen in which a given environment matters more for a child with a given personality or the converse, in which a child's personality has stronger implications in a given environment, would theoretically also apply to important people in the child's life, too. For example, their own personalities would be differentially affected by given child behaviors (Bates & Pettit, 1981). And an individual's responses to a social situation might well depend not only on a single personality trait but rather on the interaction among multiple traits. And as Arnold Sameroff (1994) has pointed out, development involves transactions between the child and multiple levels of environmental organization. This enormous complexity could be daunting, but in fact, our young field has made considerable progress toward describing complexities in social development. On the basis of material reviewed in this chapter, we would argue that such progress is evident most especially in description of processes involving the role of self-regulation variables in the development of behavioral adjustment.

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7

Self-Regulatory Processes in the Development of Disruptive Behavior Problems: The Preschool-to-School Transition

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Failures in self-regulatory processes underlie the development of early-onset disruptive problem behavior. Two vignettes drawn from our research studies illustrate this connection. In the first, the setting is a preschool classroom:

> A small group of boys and girls are playing with wooden blocks. The play is quiet and harmonious: two girls and a boy begin building a tower. Then another boy picks up a block and throws it forcefully across the room, nearly hitting his peers. "DON'T!" they shout. Ignoring their protests, he continues whipping blocks across the room, smiling to himself. His peers move to a far corner, leaving him alone. They continue to protest, and he continues to throw blocks. Finally, a girl picks up a block and throws it at his body. He returns fire before the conflict is stopped by a teacher.

The second setting is the home of a 3-year-old boy. During a research visit, his mother has been asked to encourage her child to put toys into a basket without doing it for him:

> The mother's tone is warm and enthusiastic, "Come on, let's clean up. I'll help you!" The child stares straight ahead, as though he did not hear her. During the next 8 minutes, his mother continues to encourage him, trying to make the task into a game ("Do you want to count 'em when you put 'em away?"). He continues to ignore her. Now her face darkens and her voice tone becomes angry as she scolds him for "not following the rules." He hits her with his fists, runs to his door, and tries to escape. His mother shouts "NO!" and he hits her again.

In both cases, children are showing problems in self-regulation that disrupt their relationships with others. Learning to establish cooperative social relationships is a critical task for preschool-age children. Successful adjustment requires that children learn a complex array of social skills, particularly sharing attention and play materials with others, inhibiting aggressive and destructive impulses, following directions, responding appropriately to requests, and delaying gratification of immediate desires. As illustrated earlier, young children often struggle with these tasks, alienating peers and family members. We know that toddlers and preschoolers who manifest high levels of aggression, impulsivity, and inattention, often labeled "externalizing" symptoms, are more likely than others to show persistent maladjustment across the transition from early to middle childhood (e.g., Campbell, Shaw, & Gilliom, 2000; Shaw, Gilliom, Ingoldsby, & Nagin, 2003). Once established, these problems tend to be chronic, placing school-age children at elevated risk for a broad range of serious adjustment problems including academic failure; conflicted relationships with parents, siblings, peers, and teachers; delinquency; and substance abuse (Broidy et al., 2003; Eron & Huesmann, 1990; Moffitt & Caspi, 2001; Tremblay, Pihl, Vitaro, & Dobkin, 1994). Clearly, the preschool years offer a critical window into the development and consolidation of serious and long-lasting patterns of maladjustment.

However, as noted earlier, impulsive, aggressive behavior also is common in early childhood, reflecting normal maturational variations in the development of self-regulatory competence, language, and social understanding (Campbell, 2002; Tremblay, 2000). How, then, do we differentiate benign expressions of aggression and impulsivity from early markers of chronic maladjustment? In this chapter, we outline a conceptual model for understanding the risk potential of early disruptive behavior. We argue that three perspectives are necessary for understanding why some young children persist in their early disruptive behavior, whereas others develop normally: (1) a **developmental perspective** for understanding child problem behavior in relation to the establishment of normal self-regulatory competence and associated developmental competencies, (2) a **transactional perspective** for examining interpersonal processes and contextual factors that exacerbate or diminish children's vulnerability to chronic behavior problems, and (3) a **gender differences perspective** to identify moderators of early developmental pathways to continuity versus discontinuity in externalizing problems.

Our main intent is to address issues and research related to the first perspective, which focuses on the developmental foundations of early disruptive behavior. Under this major heading there are six sections. In the first section, we consider the normal development of aggressive/disruptive problem behavior, differentiating group-level developmental trends from individual difference patterns. In the second section, we briefly review normative milestones in the achievement of self-regulation, which is necessary for understanding deviant expressions; we also outline our core thesis that serious and persistent externalizing problems reflect early failures in the normal establishment of self-regulatory competence. In the third and fourth sections, we examine two self-regulatory difficulties that mark the emergence of chronic externalizing problems – low levels of effortful control and emotion dysregulation. Finally, in the next two sections we show that relations between child self-regulation and behavioral adjustment are best understood in the context of co-occurring developments in other domains of functioning, specifically, social cognition and language.

The second component of our model, interpersonal/transactional processes, is described in four sections in which we show how qualities of the child's relations with family member, peers, and teachers are essential for understanding whether early vulnerabilities in self-regulation crystallize into persistent problem behavior. The third component of our model concerns gender processes. In the final three sections we consider different ways in which child and parent gender may moderate the development and expression of early disruptive behavior.

DEVELOPMENTAL FOUNDATIONS OF EXTERNALIZING BEHAVIOR

Normative Developmental Trends versus Individual Differences

What is the normal progression of disruptive behavior in early childhood? To understand the significance of early externalizing behavior, we must differentiate children's struggles with normal maturational challenges from precursors of serious problems (Hay, Castle, & Davies, 2000; Tremblay, 2004). Relatively little is known about the development of problem behavior in the first 2 years of life. Available studies indicate that the coercive use of force and frank physical aggression are fairly common behaviors in toddler-age children (Alink et al., 2006; Dunn & Munn, 1985; Hay et al., 2000; Tremblay et al., 1999). For example, in a large longitudinal study of French Canadian infants (Quebec Longitudinal Study of Child Development; QLSCD), mothers reported the frequency of children's physical aggression at ages 17 and 30 months (Tremblay et al., 1999). Threatening to hit and hitting were less frequently reported than lower intensity aggressive behaviors, such as grabbing objects and pushing, and had later onsets. Instances of hitting increased most sharply between 17 and 30 months of age, particularly for boys with siblings. By 30 months of age, 50% of children were reported to "sometimes" threaten to hit or hit others. Subsequently, however, rates of all coercive-aggressive behaviors declined steadily across the preschool period (Tremblay et al., 1999). Similarly, in a large longitudinal study of normally developing children in day care (Study of Early Child Care and Youth Development; NICHD Early Child Care Research Network, 2004), mothers rated the frequency of children's physical aggression at ages 24, 36, and 56 months and through the early school-age years. The most frequent form of early aggression, hitting others, occurred in 70% of the sample at ages 2 and 3, but declined to 20% at ages 4 and 5 and to 12% in the third grade. Other forms of disruptive behavior (e.g., "destroys others' things") also showed marked declines across the preschool and early school-age years (NICHD ECCRN, 2004; see also Alink et al., 2006).

Thus, coercive-aggressive behavior is evident in early toddlerhood and peaks between ages 2 and 3 years, declining rapidly across the preschool period. By the time children enter kindergarten, aggressive behaviors are largely inhibited. However, these normative trends summarize average behavioral tendencies across large groups of children. A sizable body of evidence has shown that individual differences in early aggressive, destructive, and impulsive behaviors remain moderately stable across the preschool-to-school transition (Campbell et al., 2000; Cote, Vaillancourt, LeBlanc, Nagin, & Tremblay, 2006; Keenan, Shaw, Delliquadri, Giovannelli, & Walsh, 1998). That is, although normally expected levels of aggression decline with development, a child's position in relation to his or her peers is fairly stable, even across major developmental transitions. Moreover, a subgroup of preschool children continue to show very high levels of problem behavior across the school-age years (Brame, Nagin, & Tremblay, 2001; Broidy et al., 2003; Cote et al., 2006; NICHD ECCRN, 2004; Shaw et al., 2003). For example, Shaw and colleagues examined mothers' reports of conduct problems assessed in 2-year-old boys from low-income family backgrounds; by age 8, 6% showed stable, high levels of aggressive problem behavior (Shaw et al., 2003). Similarly, in the NICHD study, 18% of toddlers in day care, primarily boys, showed moderately to consistently high levels of aggressive-disruptive behavior between 24 months and grade 3 (NICHD ECCRN, 2004).

What developmental factors and mechanisms in early childhood are associated with persistent versus self-limiting patterns of disruptive behavior? Increasingly, disruptive behavior disorders are being viewed as reflecting delays and/or atypicalities in the development of self-regulation. For example, in the NICHD study cited earlier, toddlers who showed *steeply declining* levels of aggression across the preschool period had higher levels of self-regulatory competence at age 54 months than those who showed stable problems. In what follows, we show how the normal establishment of self-regulatory competence provides a foundation for the development of social, emotional, and academic competence.

Development of Self-Regulatory Competence: What Is Normal?

We have theorized that disruptive behavior problems reflect failures in the development of normal self-regulatory competence (e.g., Lopez, Vazquez, & Olson, 2004; Olson, Sameroff, Kerr, Lopez, & Wellman, 2005). What do we mean by "normal self-regulatory competence"? We understand self-regulation as an *ongoing process* of modulating attentional, behavioral, and emotional responding in ways that potentiate socially adaptive outcomes (Kopp, 1982, 1989; Posner & Rothbart, 2000; Thompson, 1994). This broad definition subsumes multiple, coordinated component systems that reflect the influences of a broad range of intrinsic (physiological, cognitive) and extrinsic (social interactions, stress) factors (Cole, Martin, & Dennis, 2004; Fox & Calkins, 2003; Lopez et al., 2004). Moreover, as shown later, the meaning of self-regulatory competence is firmly grounded in developmental time.

Self-regulatory competence emerges gradually in a series of discontinuous developmental phases paralleling the maturation of various cognitive skills (Kopp, 1982, 1989; Ruff & Rothbart, 1996). Each phase is marked by different regulatory challenges that must be mastered for successful social adaptation and smooth transition to the next developmental period to occur (e.g., Cicchetti, Ganiban, & Barnett, 1991). Because adaptive challenges relevant to each phase have different implications for understanding how normal development can go awry, they are briefly reiterated here.

Infancy. In the earliest months of life (ages 0–3 months), "control" takes the form of modulation of physiological arousal states, particularly emotional reactivity to sensory stimuli (Kopp, 1982, 1989; Tronick, 1989). Individual infants differ in the capacity to modulate arousal: some are easily distressed and have difficulty self-soothing or being soothed by caregivers (Rothbart & Bates, 2006). For example, within the first days of life, infants show significant individual differences in the duration and intensity of crying, latency to recover, sootheability, and cortisol response to routine stressors such as medical examinations (Gunnar, Hertsgaard, Larson, & Rigatuso, 1991; Keenan, Grace, & Gunthorpe, 2003). Moreover, some neonates show abnormally *low* levels of emotional distress in response to painful stimuli (a medical heel stick), a possible sign of an underresponsive nervous system that may place them at risk for later disruptive behavior disorders (Keenan et al., 2003).

Between 3 and 12 months of age, infants become increasingly capable of adjusting their affective responses, attention, and voluntary motor behavior in goal-directed ways (e.g., reaching for an interesting toy, shifting attention away from distressing events, or responding to the vocalizations and smiles of caregivers; Kopp, 1982; Ruff & Rothbart, 1996). These modulations help infants efficiently organize their interactions with the social and physical world, setting the stage for more complex forms of control (Kopp, 2002; Posner & Rothbart, 2000).

Toddlerhood. The second year of life marks an important transition phase in the development of self-regulation (Kopp, 1982; Kochanska, Coy, & Murray, 2001). Because of their rapidly maturing cognitive and motoric abilities, infants become aware of social demands and are able to adjust their behavior accordingly. For example, although control is limited to the immediate stimulus environment, young toddlers are capable of complying with simple requests ("give mommy a kiss") and prohibitions ("don't touch – hot!"). The toddler's increased capacity for locomotion leads to a natural escalation in caregiver demands. Moreover, as noted earlier, toddlerhood is a time of heightened aggressive responding.

Between the second and third years of life, the development of representational (symbolic) thought and recall memory underlies the child's increasing ability to delay immediate gratification of desires and engage in self-initiated monitoring of behavior as a consequence of remembered information (Carlson, Mandell, & Williams, 2004; Kopp, 1982). Self-consciousness also begins to solidify during this period, reflecting the child's increasing capacity to differentiate self from others (Stipek, Gralinski, & Kopp, 1990).

Preschool years. The preschool years are a time of dramatic growth in children's self-regulatory knowledge and skills (Kochanska & Murray, 2000; Kopp, 1989; Shonkoff & Phillips, 2000). With rapidly maturing cognitive abilities, children become increasingly capable of self-monitoring their behavior in response to diverse situational demands (Kopp, 1982; Posner & Rothbart, 2000). Ideally, children learn to flexibly adapt to life situations that have different standards of conduct associated with them. As Kopp (1987, p. 34) stated, "Thus it is permissible to shout in a playground but not in a classroom, to run across a meadow but not a street, and to respect another's possessions whether the person is present or absent." More complex cognitive processes play an important role in self-regulatory behavior at this age, such as internalized, self-guiding speech (Berk, 1992; Luria & Tizard, 1961; Vygotsky, 1962) and self-generated strategies aimed at reducing frustration

(Mischel, Shoda, & Rodriguez, 1989). It is this expanded and flexible repertoire of coping responses that marks the emergence of true self-regulatory competence.

Because early childhood is a time of critical development in self-regulation, it also is a period of special vulnerability for children at risk (Moffitt, Caspi, Rutter, & Silva, 2001; Olson, Schilling, & Bates, 1999). Knowledge of normative developmental transitions provides an essential foundation for questioning how disordered self-regulation arises. As we have seen, individual infants vary considerably in their ability to modulate arousal, the earliest hallmark of self-regulation (e.g., Bradley, 2000). At later ages, biologically based differences in behavioral tempo and emotional reactivity may have an important impact on the development of regulatory competence, especially if the child's interaction style leads to conflicts with caregivers and peers (e.g., Melnick & Hinshaw, 2000; Moffitt et al., 2001; Snyder, Prichard, Schrepferman, Patrick, & Stoolmiller, 2004). In the next two sections, we focus on two different types of temperament processes that have been linked to individual differences in child externalizing behavior: regulation of attention and inhibitory behavior, and emotion reactivity and regulation, particularly proneness to anger.

Regulation of Attention/Inhibition (Effortful Control)

A large body of research has shown that highly disruptive children and adolescents have difficulty organizing attention and inhibiting impulsive behavior (Barkley, 1997; Hughes, White, Sharpen, & Dunn, 2000; Moffitt, 2003; Morgan & Lilienfeld, 2000; Newman & Wallace, 1993; Nigg, 2000; Rothbart, Posner, & Hershey, 1995; Teichner & Golden, 2000). Moreover, longitudinal studies have revealed that these regulatory difficulties predict externalizing problems across lengthy periods of development (Moffitt, Caspi, Dickson, Silva, & Stanton, 1996; Olson et al., 1999; Shoda, Mischel, & Peake, 1990). Given that compromised executive functioning is a key risk factor in the development and expression of childhood disruptive behavior disorders, it is important to understand *how* this association develops in early childhood.

We propose that the construct of effortful control plays a key role in the development of early-onset externalizing problems (Olson et al., 2005). Effortful control (EC; Rothbart, 1989; Rothbart & Bates, 2006) refers to a general executive factor of temperament that governs the child's capacity to inhibit a dominant (prepotent) response (e.g., grabbing a toy from a peer) and to initiate a subdominant response (asking for a turn to play).

Effortful control is of great importance to our understanding of children's early behavioral development for several reasons. First, clear trends in the development of effortful control co-occur with milestones in social and emotional development (Posner & Rothbart, 2000). During the latter half of the first year of life, a self-regulative form of attention begins to develop in concert with maturation of the anterior attention network (Posner & Rothbart, 1994; Rothbart, Posner, & Boylan, 2000). With increasing maturation, toddlers begin to coordinate their attentional and inhibitory skills, providing a foundation for important accomplishments in socioemotional development such as the ability to comply with simple requests (Kopp, 2002). More complex forms of effortful regulation continue to develop through the preschool and early school-age years, underpinning the child's ability to respond appropriately to increasingly challenging social and academic demands (Kochanska et al., 2001; Olson et al., 1999).

Second, individual differences in effortful control can be assessed as early as the second year of life (Carlson et al., 2004; Diamond & Taylor, 1996; Gerardi-Caulton, 2000; Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996) and show moderate levels of stability across developmental transitions (Kochanska, Murray, & Harlan, 2000; Olson et al., 1999). Finally, individual differences in EC have been related to a broad range of socioemotional competencies, particularly the child's capacity for behavior regulation according to internalized standards of conduct (Eisenberg, et al., 2000; Kochanska, DeVet, Goldman, Murray, & Putnam, 1994; Kochanska, Murray, & Coy, 1997; Rothbart, Ahadi, & Hershey, 1994).

In short, the emergence of effortful control is a developmental milestone that has important implications for understanding the origins of individual differences in children's social, emotional, and cognitive competence (Kochanska et al., 2000; Posner & Rothbart, 2000). Thus, deficits in effortful control may play a key role in the development of early-onset externalizing problems. Indeed, in recent reports, toddler- and preschool-age children with high levels of externalizing problems have been found to show low levels of effortful control (Hughes et al., 2000; Murray & Kochanska, 2002; Olson et al., 2005). For example, we examined associations between effortful control and externalizing behavior in 3-year-old children with varying levels of risk for school-age externalizing problems (Olson et al., 2005). We assessed individual differences in EC using a behavioral battery (Kochanska et al., 1997) that was supplemented by parent ratings. Both the behavioral index and mothers' ratings of children's effortful control capabilities were negatively associated with ratings of child externalizing problems contributed by mothers, fathers, and preschool teachers. These associations were robust and held even when important covariates such as child IQ and family risk were considered (Olson et al., 2005).

To summarize, a growing body of research and theory suggests that deficient levels of effortful control may underpin the development of early-onset externalizing. However, as shown next, many issues remain to be resolved before we can fully understand the role of effortful control, or any other temperament trait, in the development of psychopathology.

Conceptual and Empirical Overlap

One issue concerns the possible circularity of association between measures and constructs of effortful control and child behavior problems. For example, to what extent are associations between measures of temperament risk and early psychopathology conflated by similar item content? Although relevant studies have supported their independence (e.g., Eisenberg et al., 2005; Lemery, Essex, & Smider, 2002; Lengua, West, & Sandler, 1998), researchers should remain vigilant about the possibility of measurement confounding and, ideally, should include behavioral and rating measures of these constructs. A more challenging question is whether the constructs themselves are confounded. We have conceptualized effortful control as a temperament factor that is associated with externalizing problems but is not the same as them. For example, correlations between effortful control and child externalizing typically are in the .4–.5 range, a robust connection but with a large nonoverlapping proportion of variability. Thus, many children in our sample score low on effortful control but do not have high externalizing scores, and vice versa. Finally, findings from our laboratory have shown that early preschool levels of effortful control predict boys' later externalizing problems, even when prior levels of problem behavior are controlled, and that effortful control mediates associations between parenting and later maladjustment (Chang, Olson, Sameroff & Sexton, submitted). Pending further research, we posit that effortful control temperament and child externalizing behavior are interrelated but theoretically distinct constructs and that low levels of effortful control are important but not sufficient risk factors for the development of chronic disruptive behavior.

Heterogeneity in Effortful Control

The overlap issue is further complicated by marked levels of heterogeneity within the effortful control construct. For example, effortful control is defined by subcomponent processes, particularly attentional organization and inhibitory control (Posner & Rothbart, 2000), that are complex, dynamic constructs in their own right (Carlson et al., 2004; Kopp, 2002; Ruff & Capozzoli, 2003). Various subcomponents of effortful control, although interrelated, may have different implications for understanding the risk potential of early regulatory problems (Olson, Bates, Sandy, & Schilling, 2002). In addition, the role of motivational factors in young children's self-control requires further exploration (Sonuga-Barke, Auerbach, Campbell, Daley, & Thompson, 2005). For example, Olson et al. (1999) found that the motivational context of the task situation had a substantial impact on individual differences in school-age children's impulsive behaviors, including whether self-regulated performance was stable across a 2-year period.

Heterogeneity in Externalizing Problem Behavior

A related concern is that there is significant heterogeneity in the development and expression of child externalizing behavior (Rutter, 2003). The externalizing spectrum contains a very broad range of interrelated yet differentiable problems, including overt aggression, impulsivity, inattention, covert aggression, destructive behavior, and rule violations (*DSM-IV-TR*, 2000). For example, children with early-onset conduct problems and co-occurring symptoms of attention deficit hyperactivity disorder (ADHD) are more likely to show persistent behavior problems (Barkley, Fischer, Smallish, & Fletcher, 2004; Henry, Caspi, Moffitt, & Silva, 1996; Lynam, 1998). Thus, some narrow-band subtypes of child externalizing problems, particularly attention problems, have been more strongly linked with children's effortful control skills than others (Olson et al., 2005). Our findings converge with prior theory (e.g., Barkley, 1997) and research (Hughes, Dunn, & White, 1998; Speltz, DeKlyen, Calderon, Greenberg, & Fisher, 1999) showing that executive function deficits are clearest in preschoolers who manifest co-occurring ADHD symptoms. Further research is needed to determine whether there are unique risk processes associated with the development of different subtypes of externalizing problems (e.g., Hinshaw, 2002).

Interactive Contributions of Other Temperament Systems

Effortful control has been conceptualized as an executive dimension of temperament underpinned by neural systems that regulate other, more highly "reactive" or automatic processes such as anger or fear (Posner & Rothbart, 2000). Increasingly, models of temperament and psychopathology have encompassed the joint contributions of negative emotionality and effortful control (Derryberry & Rothbart, 1997; Rothbart, 2004). For example, Eisenberg and colleagues (Eisenberg et al., 2001) found that school-age children who manifested high levels of dispositional anger combined with low levels of effortful control had higher levels of externalizing problem behavior than those with difficulties in a single regulatory system. Again, little is known about how different combinations of temperament risk factors operate in the early development of externalizing behavior problems (Rothbart & Bates, 2006). Our initial findings have provided strong support for the idea that both regulatory systems make important contributions to early externalizing behavior, but they have not supported interactive models reported by Eisenberg et al. (2001) with older children (Olson et al., 2005). We emphasize that risk processes associated with early forms of externalizing psychopathology may differ from those characterizing stable problems in school-age children. For example, children's anger regulation and effortful control may become more closely linked in later years, because of escalating levels of conflictual experiences with family members and peers (e.g., Nigg & Huang-Pollock, 2003).

Regulation of Negative Emotion

Early-onset externalizing problems also reflect deficits in multiple emotion systems (e.g., Cole, Teti, & Zahn-Waxler, 2003; Keenan, 2000; Lahey, Waldman, & McBurnett, 1999). Negative emotionality plays a particularly important role (Rothbart & Bates, 2006). Both internalizing and externalizing problems have been linked to global constructs of early negative emotionality such as "difficultness" or "proneness to distress" in infancy and toddlerhood (e.g., Lengua et al., 1998; Rothbart & Bates, 2006). However, current models of temperament and psychopathology stress the importance of differentiating distinct subtypes of negative emotion as potential contributors to specific dimensions of psychopathology (e.g., Eisenberg et al., 2001; Rothbart, 2004). In this section, we highlight the child's *ability to regulate frustration and anger* as a unique contributor to early-onset externalizing behavior.

Mounting evidence suggests that proneness to frustration and anger is a specific risk factor for externalizing spectrum disorders (see Chapter 5; Eisenberg et al., 2005; Gilliom, Shaw, Beck, Schonberg, & Lukon, 2002; Keenan, 2000; Rothbart et al., 1994). For example, young children who show angry responses to frustration also manifest higher levels of aggressive/disruptive peer interactions (Denham, 1998; Fabes & Eisenberg, 1992; Hubbard & Coie, 1994; Hughes, Cutting, & Dunn, 2001), as well as generalized externalizing problems (Casey, 1996; Calkins & Dedmon, 2000; Cole, Zahn-Waxler, Fox, Usher, & Welsh, 1996). However, constructs of angry emotionality such as temper outbursts, hostility, and irritable reactivity also are defining features of childhood conduct disturbances, especially problems of aggression (*DSM-IV-TR*, 2000). Thus, it is critical to show that individual differences in temperament risk can be differentiated from constructs of early psychopathology (Moffitt, 2003).

To this end, prospective longitudinal studies have revealed clear temperament antecedents in early life (Braungart-Rieker, Garwood, & Stifter, 1997; Calkins, Dedmon, Gill, Lomax, & Johnson, 2002). For example, Calkins et al. (2002) found that 6-month-old infants who showed high levels of emotional distress to frustration (arm restraint) also were more highly active and showed lower levels of physiological regulation (RSA suppression) than others. Infants who fit this "easily frustrated" temperament profile have been found to manifest elevated levels of noncompliant and disruptive behavior in the toddler (Stifter, Spinrad, & Braungart-Rieker, 1999) and preschool (Aksan et al., 1999) years. Although this is a promising research direction, progress in identifying specific risk mechanisms rests on our ability to resolve some of the conceptual and methodological challenges described in the next section.

Emotion Reactivity or Regulation?

What specific emotion processes place children at risk for disruptive behavior? It is important to distinguish between concepts of emotional reactivity and regulation (e.g., Cole et al., 2004). The term "reactivity" refers to individual differences in the onset, duration, and intensity of emotional reactions (Rothbart & Bates, 2006; Rydell, Berlin, & Bohlin, 2003). These components have been conceptualized as relatively "automatic" response propensities (e.g., Eisenberg, Spinrad, & Smith, 2004). By contrast, emotion *regulation* is conceptualized as an active coping process; for example, adjusting the intensity or valence of one's affective responses to situational challenges in ways that potentiate harmonious social exchanges (Cole et al., 2004). A growing body of evidence suggests that reactive and regulatory processes, although closely intertwined, should be treated as separate phenomena (Calkins, Gill, Johnson, & Smith, 1999; Eisenberg et al., 1997; Gill & Calkins, 2003; Rydell et al., 2003). If problems in emotion *regulation* are central, then at-risk children may be indistinguishable from others except in challenge situations (see Calkins & Dedmon, 2000). It is equally plausible that children at risk for chronic externalizing problems have a dispositional tendency toward angry reactivity that manifests in a broad range of life contexts, not just challenging situations (Arsenio, Cooperman, & Lover, 2000; Rubin, Coplan, Fox, & Calkins, 1995).

Subtypes of Early Externalizing May Reflect Different Emotion Processes

Another intriguing issue concerns the possibility that distinct subtypes of childhood externalizing problems may reflect contrastive patterns of emotion processes. We have been describing a pattern of high (angry) emotional arousability in response to frustrating events. However, a growing body of research suggests that some children at risk for persistent externalizing problems manifest abnormally *low* levels of arousal (Keenan & Shaw, 2003; Lahey et al., 1999; Lopez et al., 2004). For example, studies of school-age children and adolescents have shown that high levels of "callous, unemotional traits" such as low empathy, indifference to approval, lack of guilt, and superficial affective displays are associated with serious and long-lasting conduct problems (Cohen & Strayer, 1996; Frick & Morris, 2004; Lynam, 1998). To date, little research has addressed the early developmental precursors of this distinctive pattern of risky temperament.

Preliminary data in our laboratory suggest that the affective quality of children's responses to moral challenges may be a fruitful direction for further research. For example, in our follow-up assessments of toddlers at risk for chronic externalizing problems, we offered kindergarten-age children a reward for completing an "easy" task that was, in fact, impossible (throwing small beans into a cup that was placed 10 feet away; adapted from Kochanska et al., 1997). Children were briefly left alone to complete this task, which was videotaped. Our data revealed that 32% of the children showed some cheating behavior. Thus, cheating behavior was fairly common and did not signal elevated risk for externalizing problems. However, the affective *style* of the child's cheating was meaningful. Most cheaters did so reluctantly, showing overt indications of frustration (shrugging shoulders, sighing) or anger (e.g., one child yelled "I hate you!" to the examiner, who was out of the room). In contrast, a subgroup of children showed planful cheating behavior with no evidence of distress. For example, immediately after the examiner left the room, one boy calmly walked over to the cup and placed all of the beans in it. Next, he walked back to the starting point, smiled, and danced.

Interactive Contributions of Other Temperament Systems

The way in which a child's disposition to anger *combines* with other temperament systems may be essential for understanding early risk potential. Recent research has shown that the structure of childhood temperament can be defined by three broad individual difference dimensions: negative affect, effortful control, and surgency-extraversion (Rothbart, Ahadi, Hershey, & Fisher, 2001). Earlier in the chapter, we discussed the effortful control system and its links to the regulation of negative affect. It is also important to consider surgency-extraversion, defined by high levels of positive affect, excitement, activity, social extraversion, and attraction to novel situations and experiences (Rothbart & Bates, 2006). Although high levels of surgency have been linked with positive psychosocial adjustment in many previous reports, this association is moderated by the quality of the child's self-regulation (Hinshaw, 2002; Rydell et al., 2003). For example, Rydell et al. (2003) found that children who manifested high levels of surgency *and* self-regulation tended to be socially competent, whereas surgent children with low levels of regulation showed externalizing psychopathology.

Contextual Influences

Although we have been focusing on the regulation of angry affect, *positive* affective expressions in the context of interpersonal conflict have been identified as powerful risk markers for early aggressive, disruptive behavior problems (Arsenio et al., 2000; Cole et al., 2003; Miller & Olson, 2000). For example, Miller and Olson (2000) examined emotion displays during peer conflicts among preschool boys from low-income family backgrounds. Behavioral assessments of children's peer interactions, peer nominations of disruptive behavior and negative social status, and teacher's ratings of disruptive behavior were tracked longitudinally between the beginning and end of a preschool year. Contrary to expectation, children's displays of anger were unrelated to such assessments. However, an intense display of inappropriate positive affect called "gleeful taunting" was a robust predictor of negative peer nominations and teacher ratings of disruptive behavior. As illustrated by the following vignette, gleeful taunting referred to strong displays of positive affect in the context of disruptive peer interaction (Miller & Olson, 2000):

> Focal child J. begins to bang blocks near another child (A.). A. says "Don't!" and J. continues banging the blocks, laughing and approaching A. Angrily, A. asks another child (T.) to help get J. to stop banging ("make him stop, make him stop!"). J. continues chanting "hee, hee" and banging the blocks more loudly. T. yells, angrily, "J. don't do that!" and J., still laughing, throws a block near T. T. returns fire. A. and T. yell "Don't!" in an angry tone, then turn away and play by themselves.

Thus the context of a given emotion behavior plays a critical role in determining its links with children's social adjustment (Thompson & Calkins, 1996). In this case, anger, a common emotional expression during peer conflict, may have been seen as more acceptable than positive affective displays, which were likely a form of emotional aggression. Moreover, anger displays send a clear "stop signal" to one's interaction partner, whereas gleeful taunting implies that the actor is taking pleasure in another's misfortune (Miller & Olson, 2000).

Co-Occurring Developmental Influences

Early childhood is a time of rapid development in all domains of adaptive functioning. Importantly, integration across levels of children's cognitive, social, and emotional functioning is a dynamic, reorganizing process underpinned by increasing levels of cognitive maturation (e.g., Lewis, 2000). Hence, we cannot understand how early regulatory competencies contribute to children's behavioral adjustment without also considering these powerful co-occurring developmental influences. In what follows, we briefly examine early developments in child social/cognitive and cognitive/linguistic functioning that have been linked with the development of externalizing problems.

Early Deficits in Social Cognition

Delays in social cognitive understanding have been posited to play a major role in the development of early-onset and later childhood aggression (Denham, Blair, Schmidt, & DeMulder, 2002; Lemerise & Arsenio, 2000). As with the development of self-regulation, children's understanding of themselves and others changes rapidly across early childhood, and individual differences become quite salient (Denham, 1998; Dunn, Brown, & Maguire, 1995; Wellman, Harris, Banerjee, & Sinclair, 1995). One important set of competencies has been labeled *theory of mind.* Between the ages of 3 and 6, children develop an increased awareness that mental states are internal and that subjective experiences are distinct from the behaviors and contexts associated with them (Wellman, Cross, & Watson, 2001). Moreover, individual differences in such awareness can be measured reliably as early as 3 years of age (e.g., Carlson et al., 2004; Wellman et al., 1995).

Examining these developments in children at risk for psychopathology is a natural and important extension of this work, providing a possible link between early mental representations and later impairments in moral understanding and conduct. For example, even with differences in verbal IQ controlled, aggressive/disruptive toddlers and preschoolers show delays in theory-of-mind understanding (Hughes et al., 1998; Hughes &

Ensor, 2006), whereas young children with advanced theory-of-mind skills manifest higher levels of peer competence than others (Hughes & Dunn, 1997; Slaughter, Dennis, & Pritchard, 2002; Taylor & Carlson, 1997; Watson, Nixon, Wilson, & Capage, 1999).

A related construct, emotion knowledge, refers to children's ability to recognize and encode emotion signals from others (Denham, 1998). Preschool-age children with high levels of emotion knowledge tend to show higher levels of peer acceptance and less aggression than others (Arsenio et al., 2000; Denham et al., 2003). Similarly, young school-age children with high levels of emotion understanding show higher levels of social competence (Denham et al., 2003) and lower levels of disruptive behavior (Denham et al., 2002) than others.

Thus, individual differences in social cognitive understanding develop rapidly across the preschool period and comprise a fundamental "building block" of social adjustment. Further, a sizable body of research has shown that early individual differences in self-regulation and social understanding are closely intertwined (Carlson & Moses, 2001; Carlson, Moses, & Hix, 1998; Frye, Zelazo, & Palfai, 1995; Hala & Russell, 2001; Hughes et al., 1998; Perner & Lang, 1999), although the nature of this association has been debated (Moses, 2001; Perner & Lang, 1999). Recent longitudinal studies show that individual differences in effortful control, particularly inhibitory skills, underlie the development of early mental state understanding (Carlson et al., 2004; Sabbagh, Xu, Carlson, Moses, & Lee, 2006).

Through what mechanisms do early executive skills affect mental state understanding? Are these links direct or indirect? One interesting hypothesis is that associations between early executive function and mental state understanding are mediated through social communication skills, particularly parent-child conversations about the causes of behavior (Denham, Zoller, & Couchoud, 1994; Hughes, 1998; Hughes & Dunn, 1998; Hughes & Leekham, 2004; Ruffman, Perner, Naito, Parkin, & Clements, 1998). Mothers have shown strong individual differences in the frequency with which they discuss others' thoughts, feelings, and motives with their toddlers; frequent "mental state talk" has been linked with higher levels of social understanding in young children (Peterson & Slaughter, 2003; Ruffman, Slade, & Crowe, 2002). Although most prior work has focused on mother-child conversations, preliminary findings from our laboratory suggest that fathers also are influential in helping children understand others' mental states, particularly negative emotions (LaBounty, Wellman, Olson, Lagatutta, & Liu, 2008). To illustrate, in the following vignette a father tries to help his

3-year-old daughter understand emotions that are conveyed by characters in a picture book:

F: What do you think, Molly?
C: Mm.
F: What do you think? Does he look mad?
C: Mm.
F: I think he looks kind of mad. See his hand is like a fist?
C: Mm hmm.
F: He's mad?
C: Mm hmm.
F: How does she look?
C: Um happy.
F: You think he's mad and she's happy? I think she looks worried.
C: Yeah.

As children mature, more complex patterns of social information processing such as hostile attributional biases become important correlates of aggressive responding (e.g., Crick & Dodge, 1994; Dodge, 2006; Orobio de Castro, Veerman, Koops, Bosch, & Monshouwer, 2002). However, there are major gaps in our knowledge of how social cognitive vulnerabilities combine with self-regulatory processes in the development of aggressive/disruptive behavior (Arsenio & Lemerise, 2004; Dodge, 1991). In addition, pathways between early social cognitive understanding and later *distorted* information processing are poorly understood. For example, under what conditions does delayed socioemotional understanding predispose young children to biased (hostile) social information processing in later childhood?

Early Verbal Deficits

A related issue concerns the development of individual differences in children's general cognitive maturity and linguistic skills, especially verbal intelligence. Deficits in verbal intelligence and communication have been robustly linked with the development of antisocial behavior (Lynam & Henry, 2001; Moffitt, 2003; Waschbusch, 2002). This association is detectable early in life: toddler- and preschool-age children with high levels of externalizing problems tend to manifest lower levels of cognitive and linguistic maturity than normally developing peers (Hughes et al., 2000; Moffitt, 1990; NICHD ECCRN, 2004; Pianta & Caldwell, 1990; Stansbury & Zimmermann, 1999). Moreover, early cognitive and linguistic deficits have been found to predict antisocial behavior over long time periods

(Brownlie et al., 2004; Loeber, Farrington, Stouthamer-Loeber, & Van Kammen, 1998; Moffitt, 1993; Stattin & Klackenberg-Larsson, 1993). Although most research has involved boys, Moffitt and Caspi (2001) reported that early verbal deficits also predicted problem behavior onset in girls; however, in other longitudinal studies these effects were specific to boys (e.g., Brownlie et al., 2004).

Through what processes does lower verbal ability affect risk for antisocial behavior? One intriguing possibility is that risk is mediated through self-regulatory mechanisms. Specifically, early self-regulative processes may transact with verbal learning in ways that exacerbate the child's behavioral adjustment problems (e.g., Nigg & Huang-Pollock, 2003). For example, individual differences in toddlers' cognitive/verbal maturity have been linked with their emerging abilities to regulate impulsivity (Hughes et al., 2000; Kopp, 2002; Olson et al., 2002) and strong negative affect (NICHD ECCRN, 2004). These deficits, in turn, place children at risk for conflicted interactions with caregivers (NICHD ECCRN, 2004) and peers (Hay, Payne, & Chadwick, 2004; Olson, 1992). Alternatively, protective social mechanisms may be "driving" associations between early verbal skills and self-regulation. For example, Olson et al. (2002) found that toddlers who experienced enriched verbal communication with primary caregivers had more advanced cognitive and linguistic skills than others and showed superior behavioral regulation at ages 6 and 8 years. These data suggest complex processes of transformation between children and caregivers. As discussed in the following section, the quality of the child's transactions with family and peers is critical to our understanding of *how* early regulatory assets and vulnerabilities become "translated" into enduring patterns of social adjustment.

INTERPERSONAL/TRANSACTIONAL PROCESSES

Most "difficult" toddlers and preschoolers do not manifest behavior problems in later childhood. The quality of the child's early relationships with family and peers is critical to our understanding of why some young children with "challenging" temperaments show persistent disruptive behavior, whereas others do not (Campbell et al., 2000; NICHD ECCRN, 2004; Sameroff, 2000). We propose that transactional processes linking parent-child interaction to self-regulation form a key mechanism in the genesis of child behavior problems. In what follows, we briefly consider prior work linking early interpersonal processes with the development of children's self-regulatory competence.

Caregiver-Infant Synchrony

Infants' relationships with primary caregivers have been construed as "primary learning environments" for the development of self-regulatory competence (Field, 1994). Because infants are wholly dependent on caregivers, the quality of the caregiving environment is thought to play a critical role in determining whether early vulnerabilities find expression in chronic self-regulation difficulties (Shaw, Bell, & Gilliom, 2000; Sroufe, 1996; Wakschlag & Hans, 1999). Through infancy and early childhood, there is a general progression from reliance on caregivers for regulation of arousal to self-initiated modulation of affective reactions and behavioral impulses (Calkins, Smith, Gill, & Johnson, 1998; Derryberry & Rothbart, 1997; Sroufe, 1996). Thus, in early infancy, regulation of negative arousal states is achieved through responsive caregiving.

Parent-infant relationships have been found to differ in the extent of synchrony or attunement, concepts that refer to smooth-flowing, reciprocal, and positively toned dyadic exchanges (Field, 1992; Tronick, 1989). The optimal parental role involves correctly "reading" the infant's signals and providing appropriate levels of responsive communication. Sensitive caregiving, a major component of secure parent-infant attachment relationships, is thought to help the child modulate states of negative arousal, permitting positive social exchanges (Sroufe, 1996). Dysregulation, marked by the presence of dysynchronous interaction and emotional distress in one or both partners, can result from a variety of factors, including insensitive caregiving (e.g., intrusiveness or overstimulation of the infant), unresponsive caregiving, and physical disruptions in caregiving, and also from endogenous infant variables such as developmental immaturity or irritable temperament (Calkins, 1994; Field, 1994; Keenan, 2000).

Infants who experience frequent dysregulated interactions with caregivers may be at risk for delays in the development of self-regulatory competence (Emde, 1992; Zeanah, Boris, & Scheeringa, 1997). Conversely, Feldman, Greenbaum, and Yirmiya (1999) measured individual differences in maternal responsiveness to microshifts in infant affect at 3 and 9 months and found that synchronous interaction predicted self-regulatory competence at age 2, even when the effects of infant temperament and infant cognitive maturity were controlled. In other prospective longitudinal studies, unresponsive mother-infant interaction has been linked to self-regulatory problems in middle childhood (Carlson et al., 1995; Jacobvitz & Sroufe, 1987; Olson, Bates, & Bayles, 1990) and adolescence (Olson, Bates, Sandy, & Lanthier, 2000; Wakschlag & Hans, 1999).

Early Disciplinary Interactions

Achieving a sense of independent mastery is a major developmental challenge for toddlers. In this period of rapid cognitive, social, and motor growth, it is normal for toddlers to test parental limits and resist control. Thus, toddlerhood marks a critical transition point in the development of self-regulation (Kochanska et al., 2001; Kopp, 1982). The manner in which parents and toddlers resolve these developmental challenges may forecast continuing adjustment problems. During the critical second-year transition phase, regulatory competence may be facilitated by caregiver sensitivity to the child's preferred style of engaging the social and physical environment (Shaw et al., 2000). For example, skillful caregivers may be able to channel a highly active toddler's behavior into constructive interactions. In addition, given that levels of noncompliance peak between the second and third years of life, the ways in which caregivers interpret and respond to their toddlers' challenging behavior have important implications for understanding children's long-term behavioral adjustment (Olson et al., 2000).

In many previous reports, highly directive, negatively toned parent-toddler interactions have been associated with noncompliance and other early manifestations of self-control problems (e.g., Campbell, Pierce, Moore, Marakovitz, & Newby, 1996; Crockenberg & Litman, 1990; Kochanska, Aksan, & Nichols, 2003; Lytton, 1979; NICHD ECCRN, 2004; O'Leary, Smith Slep, & Reid, 1999; Smith, Calkins, Keane, Anastopoulos, & Shelton, 2004). Early conflicts around noncompliance may place children at risk for escalating cycles of coercive interactions with parents and siblings, perhaps eventuating in later externalizing behavior (e.g., Denham et al., 2000; Patterson, DeBaryshe, & Ramsey, 1989).

However, it is normal and even healthy for toddlers to show noncompliance toward their parents. Noncompliance can serve many positive developmental functions (e.g., by providing a context for the development of socially appropriate expressions of autonomy; Kuczynski, Kochanska, Radke-Yarrow, & Girnius-Brown, 1987). Qualitative features of noncompliance provide a key to understanding its relevance to early-onset psychopathology. For example, child defiance has been identified as a strong correlate of chronic early-onset behavior problems (NICHD ECCRN, 2004), whereas more skillful forms of resistance such as negotiation have not been linked to maladjustment (Kuczynski & Kochanska, 1990). Within parent-toddler dyads, the specific context of the discipline transactions also has relevance for understanding normal versus atypical development (Kochanska et al., 2003), as does the affective quality of the parent-child relationship; that is, warmth, positive involvement (Brophy & Dunn, 2002; Gardner, 1994; Smith et al., 2004). Finally, it is important to consider parent-child disciplinary transactions within broader familial and social contexts such as marital systems (see Chapters 9 and 10; Feldman & Klein, 2003), and cultural systems (see Chapter 11; Lansford et al., 2005).

What mechanisms underlie associations among early parent-child interaction, child regulatory difficulties, and emerging behavior problems? In a recent longitudinal study, toddlers who showed evidence of affect dysregulation (strong defiance) with their mothers during laboratory play and forced compliance tasks were at elevated risk for poor cognitive and social functioning in the early school-age years (NICHD ECCRN, 2004). Although early manifestations of affect dysregulation were associated with multiple child, maternal, and environmental risk factors, these long-term associations held even when co-occurring early risks were controlled. Thus, early signs of regulatory disturbance were linked with problems in multiple domains of later functioning.

Several findings offered important clues to the underlying processes. First, intriguingly, toddlers in the high-risk group had not been identified by mothers as more temperamentally difficult than others in infancy. Second, the authors identified mothers who were in the lowest quartile of caregiving competence between ages 6 to 36 months; only 24% of their children were in the "dysregulated" group. Finally, mothers in the Affect Dysregulation group reported feeling less close to their toddlers than others. This finding echoes prior longitudinal research showing that mothers' perceptions of their children as emotionally unresponsive to them could be identified as early as 13 months of age, remained highly stable across early childhood, and predicted multiple reports of externalizing problem behavior in late adolescence (Olson et al., 2000). Together, these studies suggest that high-risk dyadic patterns reflect a mismatch between parent and child: predictions from child or parenting characteristics alone would be insufficient. Although a comprehensive discussion is beyond the scope of this chapter, we see the following issues as critical to our understanding of social processes in early behavioral adjustment.

Risk Processes for Self-Regulation Problems

Child self-regulation deficits are most likely to stabilize or increase in the context of chronic social adversity (Borge, Rutter, Cote, & Tremblay, 2004; Campbell et al., 2000). However, specifying the nature of "chronic social adversity" continues to be a great challenge for researchers. First, a large body of research has shown that disruptive behavior problems are "overdetermined": that is, linked to a broad range of risk factors that are not independent (Dodge & Pettit, 2003; Hinshaw, 2002; Sameroff, 2000). Second, social risk factors reflect many different levels of complexity and organization. *Proximal* risk factors index the aversiveness of immediate social experiences that have been linked to poor self-regulation, especially harsh discipline (Dodge, Pettit, & Bates, 1997; Gershoff, 2002; Nix et al., 1999; Snyder & Patterson, 1995), low levels of proactive discipline (Gardner, Sonuga-Barke, & Sayal, 1999), low levels of warmth and responsiveness in parent-child interactions (Pettit, Bates, & Dodge, 1997; Rothbaum & Weisz, 1994), and deficient or deviant teaching of self-regulatory competencies in parent-child discourse about conflict and emotion (Eisenberg & Fabes, 1994). At a more intermediate level, a host of interpersonal *contextual* factors affect the manner in which the child is perceived and responded to by other caregivers. These contextual factors, which also may directly affect the child's ability to develop internal controls, include the mental health of parents (Hay, Pawlby, Angold, Harold, & Sharp, 2003), low self-perceived parenting efficacy (McGroder, 2000; Olson, Ceballo, & Park, 2002), and high levels of marital discord, especially the presence of physically and emotionally aggressive responses to marital conflict (Cummings, Goeke-Morey, & Papp, 2003). At the most distal levels, sociodemographic risks are powerful indicators of the amount of stress and strain on caregiving systems and include low levels of social support (McLoyd, Jayaratne, Ceballo, & Borquez, 1994), high levels of stressful life changes (Grant et al., 2003), and neighborhood poverty and violence (Greenberg et al., 2001). A large body of research has shown that risk factors themselves co-occur and are stable across development (e.g., Deater-Deckard, Dodge, Bates, & Pettit, 1998; Sameroff, 2000). For example, the NICHD study of early physical aggression showed that the number of parenting, family contextual, and sociodemographic risk factors was highly stable between ages 24 months and middle childhood; children in the highest and most stable aggression group tended to be boys with low levels of cognitive functioning who had consistently high levels of cumulative environmental risk (NICHD ECCRN, 2004). The opposite factor – warm sensitive parenting – combined with low levels of sociodemographic risk and showed high levels of coherence and stability across time.

These findings support the power of an *additive* model indexing the sheer number of correlated risk factors (e.g., see Sameroff, 2000). However, not all factors carry equal weight. For example, in the NICHD study cited in the previous paragraph, some risk factors were more closely associated with early and continuing child aggression than others. Support also has been gained for models examining how important child and environmental risk factors *interact* to produce elevated risk for poor adjustment outcomes (see Chapter 6; Bates, Pettit, Dodge, & Ridge, 1998). In these models, temperament risk is moderated by characteristics of the environment. For example, Stoolmiller (2001) found that in cases where boys manifested early signs of manageability problems *and* parents were coercive, children were most likely to show long-term problems of disruptive behavior.

In our view the most critical challenge for researchers is to understand the nature of the *transactional* processes that underlie the translation of early child vulnerabilities into stable adjustment problems. Early self-regulatory skills reflect reciprocal influences between the child and his or her social partners as well as the larger social environment (Calkins & Fox, 2002; Cole et al., 2003; Sameroff & MacKenzie, 2003; Thompson & Calkins, 1996). Central to transactional models is a consideration of how child and environment *transform each other across time* to potentiate different types and levels of adaptive competence. For example, aggressive, noncompliant child behavior tends to elicit hostile, controlling responses from caregivers and peers, creating a positive feedback cycle in which levels of interpersonal negativity and conflict, and consequently the child's symptomatic behavior, may be exacerbated (e.g., Cole et al., 2003; Olson, 1992). The *meanings* that parents attribute to their children's challenging behaviors, especially cognitive biases that negative caregiving events are under the control of the child but not themselves, are especially critical in mediating this link (Bugental, Olster, & Martorell, 2003; Seipp & Johnston, 2005; Snyder, Cramer, Afrank, & Patterson, 2005). Distal features of social context such as unexpected changes in family income also may play an important role in moderating these feedback cycles (e.g., Costello, Compton, Keeler, & Angold, 2003). Contemporary behavioral scientists have yet to surmount daunting conceptual and methodological barriers to the operationalization of complex process-oriented models (Granic & Hollenstein, 2003; Richters, 1997; Sameroff & MacKenzie, 2003). Given that constructs of "regulation" are inherently dynamic and span multiple levels of organization, they are particularly well suited to explication of these processes (Olson & Lunkenheimer, in press).

Family and Peer Subsystems

Relationship processes occur in multiple family subsystems, which to date have been underrepresented in research (e.g., see Chapter 10; Cummings et al., 2003). Most previous studies of parenting factors associated with child behavior problems have focused on mother-child relationships. Recent research has highlighted the importance of examining other family subsystems as influences on the early development of child externalizing behavior, especially father-child relationships (Belsky, Hsieh, & Crnic, 1998; DeKlyen, Biernbaum, Speltz, & Greenberg, 1998; Denham et al., 2000; Kerr, Lopez, Olson, & Sameroff, 2004; Nelson & Crick, 2002; Verlaan & Schwartzman, 2002) and sibling relationships (Aguilar, O'Brien, August, Aoun, & Hektner, 2001; Garcia, Shaw, Winslow, & Yaggi, 2000; Patterson, Reid, & Dishion, 1992).

In addition to family socialization processes, early peer socialization is thought to play an important role in the stabilization of aggressive conduct problems (e.g., Haselager, Cillessen, Van Lieshout, Riksen-Walraven, & Hartup, 2002; Laird, Jordan, Dodge, Pettit, & Bates, 2001). Although most studies have focused on school-age children, there is evidence that preschool-age children with high levels of aggressive, disruptive behavior experience conflictual, coercive peer interactions (Hughes et al. 2000; Miller & Olson, 2000; Olson, 1992). These early patterns may represent an important developmental pathway to the pervasive patterns of social maladjustment that often characterize school-age children with conduct problems (Dodge & Pettit, 2003; Hinshaw, 2002). However, there are many gaps in our understanding of the types of social and developmental processes that lead to these early negative experiences (Hay et al., 2004).

GENDER PROCESSES

The third major component of our model concerns mechanisms underlying sex differences in early externalizing behavior. The child's sex has been shown to be a powerful moderator of the development of externalizing problem behavior in young children (Keenan & Shaw, 1997; Moffitt & Caspi, 2001). For example, during the toddler and early preschool years, few sex differences in children's disruptive behavior have been reported (Achenbach, Edelbrock, & Howell, 1987; Hay et al., 2000; but see Alink et al., 2006, and Cote et al., 2006, for exceptions). During the latter half of the preschool period, sex differences in disruptive behavior become increasingly salient; during the early school-age years, externalizing problems are highly overrepresented in boys (Moffitt & Caspi, 2001). Thus, explaining *how and why* these differences emerge in early childhood is a problem of immense practical and theoretical importance (Loeber & Hay, 1997; Rutter, 2003). To date, very limited attention has been given to examining the origins of externalizing behavior in girls compared with boys (Keenan & Shaw, 1997, 2003). In what follows, we consider possible explanatory mechanisms.

Compensatory Developmental Skills

One important explanation focuses on girls' relative maturity in developmental skills that contribute to control of aggressive-disruptive behavior (Keenan & Shaw, 1997). For example, in early childhood, girls show higher levels of guilt, empathy, and behavioral regulation (Kerr et al., 2004; Kochanska et al., 1994; Kochanska, Gross, Lin, & Nichols, 2002; Smith et al., 2004; Zahn-Waxler, Cole, Welsh, & Fox, 1995), social-cognitive maturity (Denham, 1998), and language development (Estrem, 2005; Morisset, Barnard, & Booth, 1995; Park, Essex, Zahn-Waxler, Armstrong, Klein, & Goldsmith, 2005) than boys. Conversely, preschool-age boys outnumber girls in key early risk factors for disruptive behavior problems such as verbal, inhibitory, and other executive function deficits (Hill, Degan, Calkins, & Keane, 2006; Moffitt & Caspi, 2001; Olson et al., 2005).

Thus, early sex differences in intraindividual risk and promotive factors have been well documented. However, as shown here, individual traits are insufficient for understanding the complex individual/social transactions that underlie the development of chronic behavior problems (e.g., Sameroff, 2000). How, then, do sex differences in developmental maturity reflect and affect patterns of early socialization?

Socialization Processes

To what extent does differential socialization contribute to a widening gender gap in externalizing problem behavior across the preschool-to-school transition? For example, are boys differentially exposed to higher levels of risky parenting and/or lower levels of promotive parenting? The few studies that have addressed these issues have yielded conflicting findings. Some studies have shown that girls receive more active socialization than boys in prosocial behavior (Kerig, Cowan, & Cowan, 1993; Smetana, 1989) and problem-solving skills (Maccoby, Snow, & Jacklin, 1984). For example, Smetana (1989) observed that mothers of girls responded to daughters' moral transgressions by pointing out their consequences, whereas mothers of boys responded with punishment. On the other hand, two large studies spanning the early preschool years revealed few significant differences between toddler-age boys and girls in exposure to risky parenting behaviors (Kerr et al., 2004; Smith et al., 2004).

We also must question whether *similar* parenting behaviors are associated with different developmental outcomes in boys and girls. A small but growing body of research has shown that the same dimensions of parenting differentially predict long-term disruptive behavior in boys and girls. For example, McFadyen-Ketchum, Bates, Dodge, and Pettit (1996) found that high levels of maternal coercion and low levels of warmth predicted increases in boys' aggressive behavior disorders between kindergarten and third grade, whereas the same maternal behaviors predicted decreases in girls' aggression. Cole, Teti, and Zahn-Waxler (2003) found that maternal anger directed toward preschool children predicted continued problem behavior in elementary school for sons, but lower levels of problem behavior in daughters. Martin, Maccoby, and Jacklin (1981) found that, for boys only, low maternal responsiveness at 10 months was associated with lower rates of compliance at 22 months and with higher rates of coercive behavior at 42 months. This finding was replicated by Shaw, Winslow, Owens, Vondra, Cohn, and Bell (1998) using two independent samples of high-risk children. Our preliminary findings strongly support the conclusion that different processes underlie associations between parenting risk factors and externalizing behavior in preschool-age boys and girls (e.g., Kerr et al., 2004). Articulating the specific nature of these processes is an important challenge for researchers.

Sex Differences in Symptom Expression

A third possibility concerns the unique ways in which girls and boys express externalizing psychopathology. The ways in which young children express negative emotions may differ between the sexes. Several studies have shown that in situations that elicit negative affect, particularly anger, young girls tend to express their negative feelings in socially acceptable ways that mask their true feelings (Chaplin, Cole, & Zahn-Waxler, 2005; Cole, 1986; Cole, Zahn-Waxler, & Smith, 1994; Kuczynski & Kochanska, 1990). An interesting finding is that young girls at elevated risk for externalizing symptoms may show the most exaggerated levels of anger masking. For example, Cole et al. (1994) observed individual differences in preschoolers' expressive control during disappointment; the children in this study represented varying levels of risk for school-age externalizing symptoms. Minimization of anger (i.e., saying that one felt "happy" in a disappointing situation) was associated with externalizing symptoms in high-risk preschool girls. As well, a growing body of research has shown that girls tend to express aggression more indirectly than boys; for example, through hostile manipulation of relationship systems (e.g., Crick & Zahn-Waxler, 2003; Ostrov & Keating, 2004). Thus, an exclusive focus on overt symptoms is insufficient for understanding the social and developmental roots of externalizing psychopathology in girls.

SUMMARY

In summary, we have outlined a complex model of the development of early-onset disruptive behavior problems. Our core thesis is that early externalizing problems reflect failures in the normal establishment of self-regulatory competence, particularly temperament systems governing effortful control and anger regulation. Emerging research highlights the need to examine these intrachild risk markers in much greater detail, paying attention to co-occurring developments in other systems of temperament, social cognition, and communication competence. Perhaps most importantly, we must strive to understand processes underlying the *transformation* of early self-regulation problems into stable patterns of behavioral maladjustment. In our view, this requires examining complex transactions between the child, his or her caregiving system, and a broad range of contextual factors that affect the quality of the child's social experiences and learning. The nature of these social regulatory processes, in turn, may be differentially patterned in boys and girls. For example, previously we reported that low levels of effortful control were strongly associated with early-onset disruptive behavior in young preschool-age boys and girls (Olson et al., 2005). Our preliminary data have shown that poor effortful control is linked with troubled family and peer relationships in both sexes. However, significant pathways among early self-regulatory difficulties, parenting behavior, and school-age externalizing problems were found for boys only, suggesting gender-differentiated patterns of risk and promotive mechanisms. Moreover, preliminary findings have revealed dynamic (bidirectional) relations between child and parenting risk characteristics across the transition to school; the nature of these processes differs by child and parent gender (Olson & Lunkenheimer, in press). These data support our contention that all three components of the model are essential for understanding children's early pathways to diverse behavioral adjustment outcomes. In future work we look forward to contributing knowledge of how these components interweave across time in relation to the development of disruptive behavior; that is, what are the processes?

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8

Emotional Dysregulation and the Development of Serious Misconduct

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Emotional dysregulation is a term that is used when aspects of a person's emotional functioning are ineffective or inappropriate or risk compromising the accomplishment of later developmental tasks (Cicchetti, Ganiban, & Barnett, 1991; Cole, Michel, & Teti, 1994; Garber & Dodge, 1991; Keenan, 2000). The term acknowledges that emotions are always regulated (i.e., there is no pure emotion that is unregulated), but that a pattern of emotion regulation has a dysfunctional quality. Although there has been relatively little research on the emotional profiles of children with serious psychological problems, the key symptoms of most childhood disorders feature emotional difficulties, such as hostile defiance, anxiety, angry aggression, tantrums, moodiness, and irritability (Cole et al., 1994; Keenan, 2000). Without the benefit of emotion theory to guide our understanding of the emotional nature of symptoms, it might seem that strong emotions debilitate behavioral functioning.

Contemporary theories, however, regard emotions as adaptive. Emotions are defined as the processes of both appraising circumstances relative to one's well-being and readying to act on circumstances to maintain or regain well-being (e.g., Arnold, 1960; Barrett & Campos, 1987; Ekman, 1994; Frijda, 1986; Lazarus, 1991). This biologically based rapid radar and response system equips us to deal with the ever-changing nature of circumstances and to act without hesitation when necessary (e.g., fleeing from danger). Therefore, emotions motivate action, evolving as a system that is crucial to survival. Although the world today is not as dangerous and unpredictable as it was when emotions first evolved, we can easily appreciate that infant emotional signals continue to be essential for survival. Infant distress signals a problem and elicits reparative action; infant pleasure contributes to building relationship bonds. Thus, from the perspective of typical development, emotions – even negative emotions – are functional and adaptive.

When emotions become implicated in psychopathology, it is because some aspect of a normal, adaptive process has gone awry. Psychopathology is associated with patterns of emotion regulation that compromise functioning in different ways; hence, the term "emotional dysregulation." That is, it is not that a strong emotional reaction is inherently problematic, but that the strategy deployed to achieve the optimal level of intensity is ineffective or the response is inappropriate to the situation. Often, a consistent pattern of responding in this manner will create problems for later developmental accomplishments (e.g., forming and maintaining relationships).

In this chapter, we discuss emotional dysregulation and illustrate how it may develop in relation to a particular class of maladaptive behavior – serious misconduct. We focus on misconduct because its emotional underpinnings have received more empirical attention than other forms of child psychopathology. We share a case study to communicate how a range of emotions contribute to serious misconduct. The case also reveals the transactional nature of the developmental pathway to serious misconduct, a pathway in which child characteristics, parenting, and circumstances continuously intersect over time (see Chapter 1). In the context of family stress and inadequate parenting, an anger-prone child may experience intense anxiety and shame without receiving adequate parental guidance to learn how to cope with such strong emotions. The case illustrates how a particular child came to minimize strong vulnerable feelings, to enjoy and take pride in transgressions, and to have diminished empathy and remorse. That is, the case demonstrates the role of emotional dysregulation in one child's serious misconduct and how such a pattern might have developed. We then consider the research evidence for the emotional portrait that the case depicts, examining studies conducted with children with clinically significant misconduct, as well as studies of related risk factors – temperament, parental depression, and exposure to maltreatment – for the development of serious misconduct.

SERIOUS MISCONDUCT

Serious and persistent misconduct is the essential feature of externalizing symptoms such as aggressive, antisocial, and impulsive behavior. Misconduct is the conceptual core of two disruptive behavior disorder diagnoses, oppositional defiant and conduct disorders (*DSM-IV*; American Psychiatric Association, 1994). Misconduct of this type has diverse presentations. Neither a single behavioral profile nor a single developmental pathway explains the development of serious misconduct (Hinshaw & Anderson, 1996). We describe a pathway that begins with an anger-prone child, in a high-risk family, for whom oppositional defiant disorder (ODD) emerged in early childhood and eventually led to serious and chronic misconduct (Moffitt, 1993). We highlight two themes: (1) a range of emotions can become dysregulated in the development of childhood misconduct, and (2) the developmental pathway to misconduct begins with emotional predispositions and adaptations to family life, leading to chronic disordered behavior, and this pathway is best understood from a transactional framework (Sameroff & Chandler, 1975). We begin with the story of Tony, modified to preserve his anonymity, whom the first author knew at two points in his life.

A CASE STUDY

Tony was 4 years old when the director of his preschool sought psychological consultation. Tony, who had been previously expelled from three preschools, was increasingly disruptive in the classroom. He dominated other children, physically hurting them when they resisted. His teachers found him quick to anger and difficult to redirect once he was angry. They were exasperated by his persistent arguing with their every rule and instruction and a bit frightened by how belligerent he became when they tried to gain control of a situation. Tony's parents agreed to a psychological evaluation for him, which led to a diagnosis of ODD. Tony's parents, however, were unresponsive to referrals for parent counseling, and Tony's behavior problems went untreated. His parents removed him from the preschool, placing him in a neighbor's care.

Years later, the same psychologist evaluated Tony again. Now 15 years old, Tony had been admitted to a residential treatment facility after being arrested for stealing a car. At this time, Tony's diagnosis was conduct disorder (CD). There was extensive evidence of his bullying peers, threatening teachers, truancy, petty theft, and alcohol use. Tony was no longer argumentative; rather, the treatment staff expressed concern about Tony's indifference to rules and to the negative consequences of his rule violations. He received individual or group therapy every day, but had little to say and attended only to prove that he had no problems. Indeed, he presented no major behavior problems in the treatment program until he engineered an escape from the unit. He coaxed a 12-year-old girl in the unit to steal the unit key and then abandoned her shortly after they escaped. He was caught a week later after he had an accident in a stolen car.

The psychologist's two evaluations include background material that provides insight into Tony's developmental history. Tony's mother described him as a baby with a "quick trigger." He appeared to be an anger-prone baby, actively resisting his mother's efforts to diaper him or put him in a car seat or high chair, becoming angry and upset. He cried and kicked, even as an infant, which caused his mother to doubt her ability to be an adequate parent to him. She revealed that she avoided conflict with him. As a result, Tony learned to "rule" his mother; as a toddler, she described him as her "little tyrant" – argumentative, demanding, hard to manage. Throughout early childhood, Tony continued to be willful and easily angered, and he had frequent tantrums. His tantrums subsided by the time he was 6 years old, but he remained argumentative and defiant throughout childhood. Tony's mother continued to give in to his arguments, often fatigued by his demandingness and guilty about Tony's exposure to her husband's abuse of her.

Although his mother tended to minimize it, she appreciated that Tony was exposed to a great deal of marital conflict. His father had a "mean streak," regularly beating Tony's mother. As a teen finally willing to discuss his past in therapy and reflecting on his early years, Tony poignantly described how he felt during those episodes of conflict and violence. He described feeling endangered, helpless and ineffectual to protect his mother, and mortified by his failure to help her. Tony believed he was not physically abused by his father, although his mother reported differently. Tony said he lived in terror of his father's wrath. His father appeared detached to Tony, but when his father was involved, he was cruel and humiliating in response to Tony's behavior. Despite fearing and despising his father, Tony emulated him – bullying and fighting with classmates, defying and insulting teachers, and ignoring his mother's authority in a rude, defiant manner.

There is little in the record to indicate that Tony received any of the love, structure, and discipline he needed to manage his anger-prone nature, to cope with the family problems, and to develop socially appropriate, flexible ways of meeting his own needs and maintaining positive relationships. Rather, the record suggests that Tony spent his earliest years in a highly stressed home, in which he felt frightened and insecure and behaved in a defiant, unruly manner. Tony's misbehavior was minimized and unintentionally reinforced by his stressed mother, who felt little control over her life, including in the context of parenting Tony. Hence, an anger-prone youngster was stressed in a household in which he could not feel safe and secure; the quality of parent-child interactions served to exacerbate Tony's difficulty in modulating anger, and his anger may have been further fueled by rage at his father for rejecting him and harming his mother. Yet, anger existed side by side with overwhelming anxiety, shame, and unworthiness.

Tony detested his mother's weakness and his father's violence, but it took years for him to express how vulnerable and ashamed he felt; initially, only his anger was evident to his teachers and parents.

Thus far, we have focused on the first 7 years of Tony's life, with some insights into those years gained from Tony's therapy when he was an adolescent. But a critical juncture in Tony's life story occurred when he was 8 years old. At that time, he entered the foster care system. His father had injured his mother so badly that she found the strength to leave him and press charges. Tony's father was convicted and received a long sentence. The court felt that Tony's mother, who was now clinically depressed, could not care for Tony adequately, resulting in his foster care placement. No placement lasted more than a few months, however, because Tony's misconduct was so serious. For instance, he was removed from one home because he kicked out a car window after refusing to wear a seatbelt. He was removed from another after he hit the pregnant foster mother in her abdomen.

At age 11, Tony was placed in a foster home in which he felt his life took a turn for the better. The household included a single mother, aged 50 years, and a large number of foster, adopted, and extended family children. There was little adult supervision to go around with so many children; the home was chaotic but pleasant. This placement was Tony's most successful one, lasting until the time he was arrested for car theft and placed in residential treatment. During this placement, Tony achieved decent grades in school although his work was erratic and he was often truant. He came to pride himself on his self-control (e.g., he devoted himself to learning martial arts) and relative independence (because of the low level of adult supervision). He pushed his unhappy past out of his thoughts and, with that, the anxiety and shame he had felt.

Although his relations with most of his peers were unsatisfying and empty, and sometimes embattled, he was accepted into a group of boys who shared his contempt for authority. These superficial friendships provided Tony's first taste of loyalty, relaxation, contentment, respect, and efficacy. Together, these boys enjoyed various rule violations – smoking, drinking, experimenting with drugs, and exploring sex. Tony recalled these as the best years of his life; he was free, unencumbered by family problems, proud of his "superiority" because he did things other kids would not dare to do, and respected by guys he respected. Over time, the group sought more exciting ventures. They engaged in cruel, covert pranks on classmates and moved from minor shoplifting to serious theft. By the time Tony was 15, he had stolen two cars. Notably, in each car, he had an accident, which Tony revealed were caused by "flashbacks." The trauma of his early years, which he thought he had put out of his mind, appeared to lead him to "see" his father (who was back in prison), a telling representation of the lasting effect of Tony's emotional turmoil on his continuing sense of insecurity.

Tony's emotional life, sadly, is similar to that of many children with serious misconduct. Throughout the case study, we see a profile of emotional functioning that includes not only difficulty in regulating anger but also a history of intense anxiety and shame that were not resolved in a satisfactory way. Despite pushing them out of mind, these emotions had the capacity to overwhelm Tony. The development of serious misconduct (a range of acts, including criminal acts, that harmed others) emerges from an interplay of Tony's disposition, the stress he experienced in his family of origin, and the inability of his family to provide him with the tools to manage his proneness to anger and to cope with the high level of stress he endured throughout his early childhood. As a result, Tony did not learn to experience and resolve the emotions associated with his vulnerability, despite the fact that they were normal reactions to his circumstances; in addition, he did not learn how to modulate intense anger. That is, a range of emotional dysfunctions underlie Tony's psychopathology. Moreover, when Tony left his high-conflict, high-stress household of origin, he encountered the first relief from stress he had known and began to feel more positively. Unfortunately, the context for his contentment and pride was a deviant peer group, where his symptomatic behavior, now seemingly uncoupled from anger, was reinforced and matured.

Clinical case studies often highlight the important issues that developmental psychopathology research must examine. We turn now to the evidence on the emotional functioning of children with serious misconduct and of children who are at high risk for this category of behavior problem.

EMOTIONAL PROCESSES AND SERIOUS MISCONDUCT

Because opposition and aggression are thought to be motivated by anger, it has become a focal emotion in developmental psychopathology research on the early roots of serious misconduct. Emotion theories define anger as appraising that one's goal for well-being is blocked and preparing to act to overcome the perceived obstacles (e.g., Campos, Campos, & Barrett, 1989; Frijda, 1986; Lazarus, 1991). Indeed, the physiology of anger involves the mobilization of energy to the musculature, readying the individual to exert force on the environment, and unlike other negative emotions, it is associated with approaching versus withdrawing from perceived adversity (Harmon-Jones, 2004). If we imagine a child frustrated by difficult schoolwork who strives harder to learn the material so that he can go out to play, we see the function of anger for adaptive behavior. Anger is valuable, and the task for science has been to understand how an adaptive process like being able to get angry when goals are blocked becomes dysregulated and linked to harmful acts and lifelong mental health risk.

In early childhood, *poorly modulated* anger often leads to actions that, according to social standards, should be inhibited or avoided. Once a child is school-age, society expects the child to understand those social standards and to exert some control over the misconduct that anger can motivate. The kindergarten child whose anger is not well modulated is primed to act forcefully to achieve blocked goals (e.g., getting her own way), and such forceful behavior often fails to take into account the needs of others and disrupts relationships (with the teachers, with peers) and the social order of the classroom. Yet, the development of serious misconduct, understood through the lens of emotion regulation, cannot focus only on anger, as our case study poignantly shows. Emotions motivate all behavior, including acting according to social standards. For instance, our concern and caring for others or fear of the repercussions of rule violations motivate the restraint of angry impulses. That is, empathy and anxiety serve as emotional motivators of inhibiting aggressive acts, and these emotions must also be considered in understanding the development of serious misconduct. The emotionally well-regulated person has access to the full range of emotions and is able to modulate and change emotional orientation in organizing actions that best suit the multiple features of a situation and the constraints of ordinary life (Cicchetti et al., 1991; Cole et al., 1994).

In addition to recognizing the role of anger, empathy, and anxiety in Tony's childhood experiences, it is also important to underscore the process by which his misconduct became uncoupled from impulsive or intense anger. Although many young school-age clients referred for misconduct are openly hostile and defiant, there are also many older children with misconduct whose misdeeds have no clear or immediate association with anger. Indeed, these clients, like Tony, may seem disturbingly indifferent as they act in antisocial ways and after the consequences of those actions are known; some even take pleasure in these actions and the distress they cause others. The underlying anger that motivated their misconduct at an earlier time may have become dissociated from aggression and defiance as a chronic pattern of misconduct became established, as in Tony's case. Experiences that reinforce and reward misconduct, particularly for a child who has had so little joy in his life, may lead to the coupling of positive emotions (enjoyment and pride) with the power and dominance supported by anger. Indeed, this is the emotional version of the cycle so well articulated by Patterson (1982). Even more clinically interesting is the fact that many conduct problem clients become angry at times when the therapist is trying to help them feel and resolve anxiety, sadness, or shame. Therapists gently try to help them recognize and deal with intense negative emotions, other than anger, that reflect their reactions to parental inadequacies, rejection, and abandonment. An inability to allow oneself to feel these feelings also interferes with functioning, acting as a barrier to intimacy and to mutually supportive adult relationships.

In sum, a full understanding of the role of emotion in serious misconduct requires consideration of the regulation of multiple emotions. Clients with serious misconduct have inappropriate emotional reactions that violate social norms and are also often inconsistent with situational realities. As a result, they get angry when they need not, and even when their anger is understandable in context, it is not modulated by empathy for others, anxiety about being caught or punished, or guilt about transgression. Research has not yet addressed whether strong negative affect overrides empathic responding or whether diminished empathy fails to inhibit misconduct.

We turn now to empirical evidence to portray the broad nature of emotional dysregulation that can lead to a stable pattern of serious misconduct. We focus on four areas: poorly modulated anger in early childhood, the development of an atypical association between positive emotions (pride, joy) and misconduct, diminishing empathy and guilt, and avoidance of appropriate sadness and anxiety. We focus on two types of studies – those that involve the emotional functioning of children with significant misconduct (ODD, CD, or externalizing symptoms in the clinical range) and those that involve children at risk for developing conduct disorder by virtue of their own behavior or by the conditions of their upbringing.

EMPIRICAL EVIDENCE OF LINKS BETWEEN EMOTION AND MISCONDUCT

Does our clinical portrait of Tony have any support in the empirical literature? Has research assessed the full range of emotions that can lead to serious misconduct? To answer these questions, we first turn to studies of the emotional functioning of children and youth with diagnoses of oppositional defiant or conduct disorder or who have externalizing or aggressive symptoms in the clinical range. Much of the work focuses on deficits in cognitive processing of the emotional aspects of interpersonal events (e.g., Dodge, 1991; Lemerise & Arsenio, 2000). In the interest of brevity, we did not develop this aspect in the case study, but we would be remiss to omit it. Tony's father and Tony may both have had such deficits. We include a modest, although smaller, body of work on emotion regulation in children with serious misconduct. This work addresses emotion perception as well as emotion reactivity and regulation.

Emotion Perception in Children with Serious Misconduct

Children with clinically significant misconduct differ from typically developing children in their attention to and recall of emotional stimuli. For example, compared to children without a diagnosis, children with ODD attend to a simulated angry interaction and recall more of its details, but pay less attention to and recall fewer details of a positively toned interaction (Casey, 1996). More generally, children with externalizing disorders are less accurate in identifying the emotional expressions of others and, in some cases, their own emotions (Blair & Coles, 2000; Cadesky, Mota, & Schachar, 2000; Casey, 1996; Cimbora & McIntosh, 2003). For example, when asked which emotions they expressed during an actual peer interaction, children with ODD are less accurate than children without a diagnosis (Casey, 1996). Also, children who are rated high in impulsive antisocial acts and relationship problems are less accurate in recognizing sadness and fear in others' facial expressions in comparison to expressions of anger, disgust, joy, or surprise (Blair, Colledge, Murray, & Mitchell, 2001; Blair & Coles, 2000; Stevens, Charman, & Blair, 2001).

The nature of these emotion-information-processing errors depends on the type of externalizing problem the child presents. The errors of boys diagnosed with attention deficit hyperactivity disorder (ADHD) are random (Cadesky et al., 2000), but include the inaccurate interpretation that negative emotions are positive (Casey, 1996). These types of errors may reflect impulsive responding and inattention to the emotional stimuli. Children with serious misconduct, however, show a systematic bias, identifying a range of emotion expressions as angry even if they are not (Cadesky et al, 2000; Casey, 1996; Orobio de Castro, Merk, Koops, Veerman, & Bosch, 2005). This misidentification may reflect the hostile bias that is associated with reactive, anger-based aggression (Crick & Dodge, 1996).

Efforts to understand the neural underpinnings of aggressive behavior also support the view that individuals with conduct disorder or psychopathy may process emotional information differently. For example, among male youth presented with affectively negative pictures that participants usually find unsettling, CD symptoms are associated with pronounced deactivation of the right dorsal anterior cingulate and reduced activity in the left amygdala (Sterzer, Stadler, Krebs, Kleinschmidt, & Poustka, 2005). This pattern may reflect both a weaker capacity to regulate emotional reactions and a lack of fear or anxiety in response to distressing images, qualities that could sustain antisocial behavior. More research is needed to understand the precise nature of the underlying difficulties in emotional processing that are associated with different forms of serious misconduct. Nonetheless, evidence is accumulating that children and youth like Tony are primed to detect and appraise anger and hostility. Future research must reveal the degree to which biological propensities and learned adaptations to chronic stress contribute to these difficulties.

Emotional Reactions of Children with Serious Misconduct

If one is primed to see the world as a hostile, conflict-ready place, emotion theory tells us that one will therefore be more ready to act forcefully or aggressively. This may explain why children and youth who are high in hostility or callousness expect to act aggressively, as well as feel angry (Frick et al., 2003; Orobio de Castro et al., 2002). Indeed, children with serious misconduct react inappropriately to others' emotions in actual interactions. Casey (1996), for example, shows a number of ways that the emotional exchanges of normal social interaction differ for such children. Children with ODD pay less attention to their partners and engage in less contingent responding during a cooperative task than children without a diagnosis. They express hostility and surprise when their peers are emotionally positive toward them and, consequently, fail to reciprocate the positive emotion. In addition, despite being told to cooperate and help their partners, the children are more emotionally negative. Moreover, although all children (with ODD, ADHD, or no diagnosis) engage in more rule infractions after exposure to a simulated angry interaction, the effect is greatest for children with ODD.

Children with ADHD report more negative moods (i.e., anger, sadness, anxiety, and stress), as measured by electronic diaries, than children with few ADHD symptoms (Whalen et al., 2002). In this study, six of the ADHD children had concurrent ODD diagnoses; thus, it is not known if their negative moods were associated with misconduct or with inattentiveness. In another study of children with multiple behavior disorders, children with multiple diagnoses were angrier than children with a single diagnosis during a competitive game with a computer-generated peer, even when the peer did not engage in provocative behavior; specifically, children with ADHD/CD sounded angrier, appeared to hold a grudge longer, and acted more aggressively toward the peer (Waschbusch et al., 2002). Similarly, highly aggressive boys with ADHD are more emotionally reactive and engage in less effective problem solving in a frustrating peer interaction than boys with ADHD who are low in aggression (Melnick & Hinshaw, 2000). However, in a cooperative task, Casey (1996) shows that children with ODD are less emotionally expressive than children with ADHD, perhaps indicating that anger reactivity is context specific and, when an interaction is not angry, children with serious misconduct may be less emotionally involved.

In sum, the data support the view that serious misconduct is associated with a high readiness to feel and act angrily when the circumstances are competitive, conflictual, or ambiguous, but to be less engaged and interpersonally coordinated when the situation is more cooperative or affectively positive. In addition, there is some neuroimaging evidence that, in conduct-disordered youth, less regulation of angry emotion and less anxiety may be aroused by emotionally negative stimuli. These studies do not address whether serious misconduct can become associated with positive emotion, as has been shown in adults with psychopathy. Children like Tony may come to take pride and pleasure in their aggressive acts and rule violations. Indeed, children with CD feel more excitement and happiness when hearing about delinquent acts than a comparison group without diagnoses (Cimbora & McIntosh, 2003), but without a clinical comparison group the evidence does not make a specific link between positive emotion and misconduct. A study of boys with ADHD, about one-fifth of whom were also diagnosed with ODD, reveals that the boys experience pleasure, often to an inappropriate extreme, when presented with sudden loud noises during an interesting movie (Ornitz et al., 1997). Yet, children with ADHD report fewer, not more, positive moods in their diaries (Whalen et al., 2002) and parents of ADHD children report a similar rate of positive emotion in their children as do parents of nondiagnosed children (Braaten & Rosén, 2000). As these studies focus on attentional deficits, they cannot address the role of misconduct and positive emotion. Crick and Dodge (1996), however, found that children who had a high level of proactive aggression (i.e., instrumental versus reactive aggressive behavior) were more likely to evaluate aggression positively.

The development of feeling positive about misconduct may depend in part on the development of diminishing empathy, guilt, and anxiety regarding the distress one causes others and the consequences to the self of acting in anger. Anxiety inhibits angry impulses, as does concern for the distress that angry actions may cause others. The literature on psychopathy suggests that certain individuals may be predisposed to be fearless or to fail to learn from punishment (e.g., Harpur & Hare, 1994). Clinicians working with children who were exposed to chronic stress, and who lacked adequate adult support for coping with it, believe the children learn to avoid feeling these overwhelming emotions. Tony braced himself against sadness (the realization that his parents were simply inadequate to meet his needs), anxiety (fear of his father's wrath), and shame (the inability to respect and protect his mother). These feelings only emerge in the context of intense therapeutic intervention.

Adults with psychopathy are shown to have reduced anxiety and electrodermal activity to stimuli that induce those reactions in normal individuals (e.g., Patrick, 1994). The role of anxiety and fear in children's misconduct is less clear-cut. Boys diagnosed with CD observing images of crying and wounded children, people in despair, and other scenes of violence report the images as less aversive and show less electrodermal responsiveness than boys with ADHD or without a diagnosis (Herpertz et al., 2005). Youth diagnosed with CD report less fear than comparison youth, and the less fear a youth reports he would feel in response to hypothetical antisocial acts, the more CD symptoms he exhibits and the more likely he is to have committed antisocial acts (Cimbora & McIntosh, 2003). Yet, several studies also indicate that children who report feeling higher levels of fear and anxiety are more likely to have clinically significant conduct problems (e.g., Eaves, Darch, & Williams, 2004; Frick et al., 2003; Frick, Lilienfeld, Ellis, Loney, & Silverthorn, 1999). The literature on sadness and fear in serious misconduct requires a developmental perspective. For at least some children, sustained anxiety early in childhood may lead to efforts to avoid these feelings and perhaps blunt the capacity to feel empathy. For example, Tony appeared emotionally unresponsive to the staff, but yet reported seeing his father, who was in prison, when driving stolen cars. If studies are framed developmentally, much more can be learned about the role of vulnerable emotions in misconduct.

Diminished guilt and empathy also set the emotional stage for acting against the well-being of others. Boys diagnosed with ADHD appear less empathic than boys without diagnoses, although their parents describe them as appearing guilty (Braaten & Rosén, 2000). By contrast, youth diagnosed with CD in childhood report less guilt than those diagnosed in adolescence, who in turn report less guilt than a comparison group (Cimbora & McIntosh, 2003). Moreover, among children with CD, the less guilt they report, the more severe their conduct problems (Cimbora & McIntosh, 2003). This latter finding is consistent with our developmental view of the changing emotional portrait of chronic misconduct. A related finding emerged from a prospective longitudinal study of preschool-age children with high levels of oppositional defiance. Based on observations of the children's reactions to others' distress, preschoolers who had significant (1 to 2 SDs above the norm) externalizing symptoms showed as much concern as typically developing children at age 4 years but, by age 6–7 years, they responded less empathically (Cole, Zahn-Waxler, Fox, Usher, & Welsh, 1996). Also, recall that boys diagnosed with CD who observe images of violence and trauma describe the images as less aversive and show less electrodermal responsiveness than boys with ADHD or without any disorder (Herpertz et al., 2005).

In sum, the evidence supports the view that children like Tony are emotionally unique. Their reactions, their emotion cognition, and their manner of regulating their emotional reactions differ from those of typically developing children. They have a predilection for viewing the world as hostile and for reacting angrily. They have difficulties in accurately perceiving sadness and fear in others and, despite reporting and showing less fear in circumscribed situations, may actually have more fear and anxiety in early childhood. They develop less empathic responding and may come to feel positively about their misdeeds. Little of this research, however, takes a transactional developmental perspective. For a more developmental perspective, we turn to studies of children who are at risk for developing serious misconduct.

THE ROLE OF EMOTIONAL DIFFICULTIES IN RISK FOR SERIOUS MISCONDUCT

Tony's misconduct, we suggest, emerged from a transactional unfolding of his predisposition and emotional adaptations, exposure to stress, and the inadequate support he had for learning to manage his own style and cope with very difficult circumstances. Evidence of concurrent relations between emotional functioning and disruptive behavior disorders suggests that serious misconduct is associated with an atypical emotional profile. However, these relations cannot tell us about the role of emotion in the *development* of serious misconduct. Therefore, we turn to studies of young children who are at risk for the development of serious misconduct. Again, the risk conditions we selected can be associated with different outcomes, but we present two risk contexts that are associated with Tony's experience and are known to be associated with the increased risk of misconduct – parental depression and maltreatment. Because we think the emotional pathway to misconduct is also influenced by child characteristics, we begin with an examination of the role of temperamental predispositions as a risk factor.

Temperament and Risk for Serious Misconduct

Because of the assumption that serious misconduct and anger are closely associated, temperamental anger proneness is a candidate risk factor. Temperament is thought to reflect biological predispositions that affect how strongly one reacts to circumstances and the regulatory capacity one has to modulate those reactions. Much of the pertinent work focuses on infants and toddlers who react negatively to limits and constraints (e.g., Calkins, Hungerford, & Dedmon, 2004; Gilliom & Shaw, 2004; Shaw, Owens, Giovannelli, & Winslow, 2001; Wakschlag & Keenan, 2001), although there is also work with children who appear emotionally shallow (Frick & Morris, 2004).

Anger Proneness

Anger-prone children have more intense, more frequent, and more enduring episodes of anger, as reported by mothers and observed in laboratories (Calkins, Dedmon, Gill, Lomax, & Johnson, 2002; Izard & Abe, 2004). These children are difficult because they are irritable, quick to fuss and cry, emotionally labile, and hard to soothe (Keiley, Lofthouse, Bates, Dodge, & Pettit, 2003; Olson, Bates, Sandy, & Schilling, 2002). As a result, they are less emotionally positive during mother-child interactions, both in infancy (Calkins et al., 2004) and in toddlerhood (Izard & Abe, 2004).

Longitudinal studies indicate that this early anger proneness may have enduring influences on the pathway to misconduct. For example, toddler resistance to control (i.e., anger-based distress) predicts childhood externalizing problems, particularly when mothers are not restrictive (Bates, Pettit, Dodge, & Ridge, 1998). Moreover, early-childhood-onset delinquency is associated with temperamental anger proneness in addition to other factors that were present for Tony – inadequate parenting, being male, school-related problems, and early behavior problems (Moffitt & Caspi, 2001). Being angry provides opportunities to learn to regulate anger, but intense anger that is not easy to repair represents a risk factor for the child and for the caregiver. The anger-prone child will require a particular set of parenting skills, which Tony's parents lacked, to ensure the development of prosocial behavior (Kochanska, 1997).

Callous-Unemotional Traits

As we have asserted, a full understanding of the role of emotion in the development of serious misconduct requires consideration of a number of emotional qualities, including a tendency to be unconcerned about the consequences of one's misconduct on others. This quality has been conceptualized as involving both emotional shallowness and callousness, temperamental dimensions that are linked to serious conduct problems (e.g., Frick & Morris, 2004; Frick et al., 1999) and risk for psychopathy (Dadds, Fraser, Frost, & Hawes, 2005). This temperamental trait has mainly been examined by assessing children's perceptions of others' emotions, a form of emotion understanding, rather than their emotional reactions.

Generally, callous unemotional children are as accurate as other children in identifying happiness and anger from nonverbal cues (Blair et al., 2001; Stevens et al., 2001). One study, however, finds that callous boys make errors in interpreting these emotions from vocal cues (Blair, Budhani, Colledge, & Scott, 2005). In the latter study, the callous children confuse others' anger with fear. Inaccuracy in recognizing sadness and fear is associated with psychopathic traits (Blair et al., 2001; Stevens et al., 2001). In terms of how callous children and youth feel, they do not appear to be more or less anxious than other children (Dadds et al., 2005; Frick et al., 1999), but they are more fearless and prone to enjoy thrill-seeking (Frick et al., 1999). The evidence suggests, then, that temperamental risk for misconduct, particularly proactive or instrumental aggression (in contrast to reactive aggression), may include a proclivity for high levels of physiological arousal that come from engaging in dangerous and daring activities (e.g., Raine, 2002).

In sum, in early childhood, temperamentally angry children have less positive and more conflictual interactions. From a transactional perspective, it is likely the case that anger proneness requires particular environmental conditions to lead to serious misconduct. In older children and youth, being callous and unemotional is associated with less sensitivity to others' emotions, particularly their vulnerable emotions. Few studies, however, examine the developmental relationships between these aspects of temperament, although one study found that less empathic concern emerged around age 6–7 years in a sample of children who were high in externalizing symptoms at age 4 (Zahn-Waxler et al., 1995). For children like Tony, misconduct begins with early anger proneness; in the context of unsatisfying, problematic relationships and chronic stress, it may be difficult to sustain caring for others. Although some children may have biological risk for serious misconduct due to aberrations in their capacity to learn from punishment, exposure to chronic violence and inadequate parenting creates risk by failing to equip the child to deal with anger proneness and to behave appropriately and caringly for others.

Family Factors and Risk for Serious Misconduct

Child characteristics influence parenting, just as parenting influences child behavior. The reciprocal influences contribute to child outcomes, although parents bear the moral burden, and by virtue of their responsibility, clinicians put faith in their influence in guiding children toward healthy outcomes (Cole, 2003). When examined in terms of the emotional life of the family, reciprocal negative emotion exchanges and mismatches between parent and child emotion (e.g., a parent laughing at a child's distress, a child laughing at a parent's frustration with the child) are associated with concurrent and later externalizing symptoms (Cole, Teti, & Zahn-Waxler, 2003; Dumas, LaFreniere, & Serketich, 1995). We turn now to maternal depression (the diagnosis that Tony's mother received) and exposure to violence in the family (as Tony experienced) and how they affect children's emotional development as it pertains to the development of serious misconduct.

Maternal Depression

Maternal depression, the condition that contributed to Tony's mother's feelings of unworthiness and inadequacy, is a risk factor for a number of problematic outcomes for children, including externalizing symptoms (Goodman & Gotlib, 1999). Because depression is a disorder of mood, it is frequently studied in relation to children's emotional functioning. Consistently, maternal depression is associated with children being less emotionally positive during parent-child interactions, in both infancy (Forbes, Cohn, Allen, & Lewinsohn, 2004; Moore, Cohn, & Campbell, 2001) and the toddler years (Diego et al., 2004; Durbin, Klein, Hayden, Buckley, & Moerk, 2005; Hayden, Klein, & Durbin, 2005). The evidence is less clear for paternal depression (Durbin et al., 2005; Forbes et al., 2004).

Maternal depression is also associated with children's negative emotions (sadness, anger, and distress). For example, 3-month-olds whose mothers are depressed express more negative affect than control group infants, although this effect is not seen by 6 months of age (Forbes et al., 2004; Moore et al., 2001). Infants of depressed mothers show more right frontal asymmetry, suggesting a predilection to be more emotionally negative and withdrawn (Dawson, Panagiotides, Klinger, & Spieker, 1997). This asymmetry is also seen in preschoolers with depressed mothers, reinforcing the view that these children experience more negative affect than children of nondepressed mothers (Jones, Field, & Davalos, 2000). Indeed, the interactions of depressed mothers and their toddlers are characterized by negative emotion that is not consistent with the situational context (Durbin et al., 2005).

Our emotional portrait of serious misconduct emphasizes specific emotions rather than general negative affectivity. A number of studies suggest that young children of depressed mothers display more anger in parent-child interactions (e.g., Hayden et al., 2005). Moreover, preschoolers whose mothers are depressed are more likely to inaccurately attribute anger to characters in a vignette (Schultz, Izard, & Ackerman, 2000). Yet, if the relation between parental depression and child outcome were specific to risk for child depression, we would expect to see greater sadness and anxiety, in addition to anger, in the children of depressed parents. Paternal depression, but not maternal depression, was associated with *less* child sadness in parent-child interactions (Durbin et al., 2005). In terms of the fear family of emotions, depressive symptoms were not related to toddler fearlessness (Shaw, Gilliom, Ingoldsby, & Nagin, 2003). Clearly, anger is the dominant emotion in the offspring of depressed parents, but the relation between parental depression and other emotions has not been well studied. One study suggests that toddlers whose mothers are higher in depressive symptoms express less distress after a mishap than toddlers whose mothers had few depressive symptoms (Cole, Barrett, & Zahn-Waxler, 1992). It is possible that maternal depression may lead some children to suppress vulnerable emotions, like sadness and fear, because the child knows the parent is not a reliable source of comfort, as attachment theory suggests.

The association between parental depression and child emotion needs to be considered in relation to its chronicity (Campbell, Cohn, & Meyers, 1995; Durbin et al., 2005; Forbes et al., 2004); it is not the severity of parental symptoms, or even a current diagnosis, but the history of depression during children's lives that is related to their affective functioning. The emotional pathway to serious misconduct for a child living with parental depression is likely mediated by how depression affects caregiving in parent-child interactions. Children who have been exposed to enduring parental depression may model their parent's emotional style (Goodman & Gotlib, 1999), come to expect that their joy is not reciprocated (Field, 1994), and be reinforced by parental attention for anger (Patterson, 1982). Depressed parents find it that much more demanding than nondepressed parents to respond to children's emotional demands, both positive and negative. In addition to Tony's temperamental anger proneness, his mother's difficulty feeling effective and worthy and her inability to help him learn to cope effectively likely contributed not only to his frustration but also to his anxiety and shame.

Family Violence

Children who are exposed to violence or maltreatment are clearly at risk for psychological problems, although the pathways that lead from these harsh contexts to serious misconduct are not fully known (Cicchetti & Manly, 2001; Cummings & Davies, 1994; Fantuzzo et al., 1991; McCabe, Lucchini, Hough, Yeh, & Hazen, 2005). Tony's case suggests a range of emotional reactions that a child might have in an abusive household, including intense anger, sadness, shame, and anxiety. For the anger-prone youngster who already has difficulty regulating anger, exposure to angry, abusive interactions may exacerbate his proclivity for aggression at the same time that it can promote insensitivity toward others and a need to avoid feeling intense anxiety, sadness, guilt, and shame.

Exposure to domestic violence is clearly a risk factor for conduct disorder and associated symptoms. One mechanism for this relationship may be the effects of violence exposure on a child's emotional functioning, including the potential for symptoms of posttraumatic stress (Rossman & Ho, 2000). Research on the emotional consequences of exposure to angry conflict shows that normally developing children react with multiple emotions – angry, sad, anxious, and responsible – when they witness conflict between adults, particularly when it is their parents, when the conflict is unresolved, and when it is physical as well as verbal (Cummings, Simpson, & Wilson, 1993; Cummings, Vogel, Cummings, & El-Sheikh, 1989). Moreover, when children are exposed to significant family violence and marital distress, the effects are stronger (e.g., Cummings, Pellegrini, Notarius, & Cummings, 1989). Finally, there are child factors that influence the strength of this effect. When anger and sadness are induced prior to the exposure, the effects are more robust, a finding that raises the question of whether the anger-prone child may react that much more negatively to domestic conflict than children who are not anger prone (Davies & Cummings, 1994).

The effects of physical conflict among family members on child emotion and later adjustment are also discernible in studies of child maltreatment. Maltreated children have difficulty regulating emotion; they become emotionally disorganized, even when emotionally positive, but are also more likely to be emotionally constricted (i.e., less emotionally expressive) in situations in which negative emotional expressions are normal and contextually appropriate (Maughan & Cicchetti, 2002). In addition, they are more likely to be emotionally labile and to act inappropriately when emotionally aroused (Shields & Cicchetti, 1998).

In terms of specific emotions, maltreated and neglected preschoolers do not differ from typically developing children in their ability to decode others' facial expression of happiness (Pollak, Cicchetti, Hornung, & Reed, 2000). Neglected preschoolers show a response bias for sadness, attributing sadness correctly but also incorrectly more than comparison children (Pollak et al., 2000) and representing other people as sad more than abused and nonmaltreated children do (Waldinger, Toth, & Gerber, 2001). Physically abused preschoolers, in contrast, are *less* accurate at recognizing sadness (Pollak et al., 2000). Fear, an emotion associated with personal vulnerability, appears to be read accurately by maltreated, neglected, and normally developing preschoolers (Pollak et al., 2000). In terms of exposure to angry interactions, however, abused children remain vigilant, actively monitoring angry interactions, and are able to detect anger from much less information than can nonabused children (Pollak & Sinha, 2002; Pollak & Tolley-Schell, 2003; Pollak, Vardi, Putzer Bechner, & Curtin, 2005).

Exposure to angry interactions is known to influence children's anger. Child maltreatment and exposure to unresolved conflict are related to more expressed anger in young children (Crittenden, 1985; Davies & Cummings, 1994; Egeland, Sroufe, & Erickson, 1983). The effect may be specific to particular contexts, as maltreated children are not angrier or sadder after success and failure in a lab-based task (Bennett, Sullivan, & Lewis, 2005). However, maltreated children are more likely to hold angry self-representations (Waldinger et al., 2001). Thus, the available evidence begins to support the view that exposure to angry interactions, in which one person dominates without an interpersonally sensitive resolution, not only models angry behavior. Sustained exposure to hostility and conflict affects a child's readiness to perceive anger and attention to angry interactions, and angry children may even develop a preference for watching angry interactions (Pollak et al., 2000; Pollak &Tolley-Schell, 2003), potentially finding them interesting or arousing (El-Sheikh, Ballard, & Cummings, 1994). All of these findings provide evidence for the role of early emotional development – across emotions – in the early trajectory toward chronic and serious misconduct.

SUMMARY AND CONCLUSIONS

Emotion regulation plays a role in the development of serious misconduct. Tony's story suggests one pathway by which the interplay of early experiences and predispositions leads to increasingly serious symptoms. Although it is by no means the sole pathway to antisocial conduct, it is a pathway that is often seen in clinical contexts. Many clinicians will recognize this particular formulation of the etiology of serious misconduct, yet the extant research does not rise to the level of complexity of the clinical formulation. In part, this is because research on emotion regulation and misconduct has focused on anger to the relative neglect of other emotions that foster and maintain serious misconduct. In Tony's case, we see that the contributions to emotion regulation included the following: (a) difficulty with anger regulation, partly in terms of temperamental predisposition and partly in response to the injustices in the home, which were particularly clear early in childhood; (b) overregulation of emotions that make a person feel more vulnerable and less in control – shame, anxiety, and sadness – that are managed by avoidance rather than by problem resolution; and (c) diminished concern for others, as the intense distress associated with acute concern for his mother, which certainly led to the previously described emotions, gave way to a preference for dominant, aggressive behavior (as seen in the father) that gradually becomes valued.

The pertinent empirical evidence does not address the developmental perspective very thoroughly, but it does provide support for the view that several specific emotions need to be considered. Sadness, fear, and empathy are implicated; children with serious misconduct are less accurate in reading others' distress and may become less concerned over time about it. Research is needed, however, to understand how children with early conduct problems cope with vulnerable (sad, afraid, anxious) emotions and how the array of intense emotions with which they must struggle contribute to them becoming less empathic and feeling proud when they transgress. Moreover, research often examines emotions out of context. There is a need for research that examines emotion regulation in ecologically meaningful contexts, such as social interactions.

The evidence also supports the view that the risk factors associated with Tony's case have emotional effects that contribute to misconduct. Tony's case highlights how the typical sequence in which emotions cement relationships and contribute to social order – empathy for the needs of others and joy in pleasing others, sadness and anxiety when behavior ruptures relationships, and anger that is modulated to lead to appropriate instrumentality rather than to harm to others – is distorted by early experiences, most especially for children who are temperamentally at risk. However, the evidence does not detail how child-parent interactions in the context of risk lead some children to chronic, serious misconduct and others to different outcomes.

Clinical experience suggests that much more needs to be known about the full range of emotions and their developmental course. Because intervention and prevention efforts focus on helping a child modify emotionally dysregulated patterns of functioning, such research is of great clinical relevance.

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9

Regulatory Processes in Children's Coping with Exposure to Marital Conflict

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Associations between predictors of family risk (e.g., interparental conflict) and children's emotional and behavioral dysregulation are well documented (Cummings & Davies, 1994; Emery, 1982; Grych & Fincham, 1990). A central aim of the developmental psychopathology framework is to articulate the processes underlying such associations and how these relations over time are related to the development of psychopathology (Cummings, Davies, & Campbell, 2000). Developmental psychopathology emphasizes process-oriented research concerned with identifying specific responses and patterns of behaviors underlying development, paying particular attention to how these responses and patterns change in different contexts over time. Working from a developmental psychopathology perspective, this chapter examines children's regulatory processes in response to exposure to different forms of marital conflict, as well as the relations of these regulatory responses to their broader adjustment. Specifically, this chapter integrates social (i.e., marital conflict) and regulatory (i.e., children's emotional and behavioral responses to marital conflict) processes to advance understanding of the relationships between children's regulatory expressions in these contexts and their overall adjustment.

INTERPARENTAL CONFLICT AS A FAMILY RISK FACTOR

Exposure to marital conflict is stressful for children (Emery, Fincham, & Cummings, 1992). Children exposed to angry adult interactions display increased arousal and dysregulated behavior (e.g., Cummings, Iannotti, & Zahn-Waxler, 1985; Cummings, Zahn-Waxler, & Radke-Yarrow, 1981). In this context, children report feelings of negative emotions, such as anger and fear (e.g., Goeke-Morey, Cummings, Harold, & Shelton, 2003). However, children's responses to exposure to marital conflict vary widely depending on how parents discuss their differences, underscoring the importance of examining the type of conflict to which children are exposed and not merely the frequency or fact of exposure (Cummings, Goeke-Morey, Papp, & Dukewich, 2002). Specific characteristics of marital conflict – namely, parental expressed emotions and conflict tactics – make a difference in children's reactions and adjustment outcomes. In particular, children's exposure to physically aggressive conflict is most closely associated with both internalizing and externalizing behavior problems in children, as well as poor social functioning and peer relationships (e.g., Cummings, 1998; Graham-Bermann & Levendosky, 1998).

A next step for research is to explain the associations between forms of marital conflict and child adjustment by identifying the mechanisms underlying these associations (Cummings & Davies, 2002). A range of theoretical explanations have been proposed for how and why marital conflict affects children's adjustment, including theories emphasizing *direct pathways* resulting from children's exposure to marital conflict (for reviews, see Crockenberg & Langrock, 2001; Davies & Cummings, 1994; Emery, 1989; Grych & Fincham, 1990). In these theories, exposure to marital conflict is proposed to induce emotional, behavioral, cognitive, and/or physiological responses in children, which are subsequently linked with pathways of normal development or the development of psychopathology. These theories share many general propositions, including emphasis on the significance of children's emotional and behavioral regulatory processes to child outcomes and on the importance of children's evaluations and appraisals of the meaning of marital conflict for themselves and the family (for recent critiques, see Cummings & Davies, 2002; Davies & Cummings, 2006).

In comparison with other *direct pathways* explanations, emotional security theory (EST; Davies & Cummings, 1994) is especially well rooted in *developmental* theory; that is, in attachment theory (Bowlby, 1969), including notions of secure base processes (Waters & Cummings, 2000). This anchor in empirically and theoretically established developmental processes and concepts lends credibility to the theoretical propositions of the approach. Moreover, this approach has been subjected to continual testing and refinement of its theoretical propositions and measurement approaches (see Davies & Forman, 2002; Davies, Harold, Goeke-Morey, & Cummings, 2002; Forman & Davies, 2005), more so than other theoretical accounts for *direct pathways*. Such testing and refinement have included longitudinal model testing; the operationalization of theoretical mechanisms by multimethod assessments (e.g., Cummings, Schermerhorn, Davies, Goeke-Morey, & Cummings, 2006; Davies et al., 2002; Davies, Sturge-Apple, Winter, Cummings, & Farrell, 2006); and greater breadth of assessment of regulatory processes, including physiological responses (e.g., Davies et al., 2007; El-Sheikh, Cummings, Buckhalt, & Keller, 2007). Notably, although social learning theory has been consistently invoked to explain associations between interparental discord and child functioning (e.g., see Crockenberg & Langrock, 2001; Margolin, Oliver, & Medina, 2001), social learning explanations have typically been provided post hoc. Studies have rarely been conducted for the explicit purpose of testing social learning processes as they relate to the proposed mediational pathway among marital conflict, risk processes, and child outcomes (Davies & Cummings, 2006). Moreover, the few direct comparisons with other theories have not directly supported predictions of modeling theory (Davies et al., 2002), although other possible mechanisms, such as acquiring generalized scripts or rules for engaging in hostile behavior, may be derived from social learning theory (Davies & Cummings, 2006).

Other theories stress *indirect pathways* between marital conflict and child adjustment following from effects of interparental conflict on parent-child or other family processes (see reviews in Buehler & Gerard, 2002; Cox, Paley, & Harter, 2001). Current research supports that both direct pathways caused by exposure to marital conflict and indirect pathways reflecting changes in parenting account for child outcomes (e.g., Frosch & Mangelsdorf, 2001; Harold & Conger, 1997; Webster-Stratton & Hammond, 1999). With regard to theories about indirect pathways, the spillover hypothesis posits that parental distress stemming from interparental discord spills over into parent-child interactions, resulting in poor discipline practices, greater psychological control, emotional unavailability, or problems in co-parenting (see Cox et al., 2001). Marital conflict may also undermine the quality of the parent-child relationship, such as is manifested by parent-child attachment security (see reviews in Davies & Cummings, 1994, 2006). EST also provides a model for how marital conflict may undermine child security in family relationships beyond interparental relationships, including longitudinal tests of effects on parenting and parent-child attachment (Davies et al., 2002; Davies, Sturge-Apple, & Cummings, 2004; Sturge-Apple, Davies, & Cummings, 2006). Thus, unique among theoretical accounts in this area, EST provides a comprehensive family-wide theoretical model for relations among interparental discord, emotional security, and child adjustment, including explanatory mechanisms posited to account for both *direct and indirect* pathways.

However, empirical accounts rarely explore both direct and indirect pathways in the same study. The focus of this chapter is on furthering understanding of direct effects of exposure to marital conflict on children's regulatory processes, as guided by EST. For example, children's regulatory responses to social stressors (i.e., marital conflict) are a potential pathway through which marital conflict affects children's adjustment. As noted earlier, children's regulatory responses may include emotional, behavioral, cognitive, and physiological (e.g., El-Sheikh, 1994; Nicolotti, El-Sheikh, & Whitson, 2003) responses. In particular, relatively little is known about children's behavioral regulatory responses to marital conflict and the implications of these behaviors for child adjustment. This chapter examines children's emotional and behavioral regulatory processes in laboratory and home contexts, with the study of behavioral regulatory responses a particular focus for advancing understanding in relation to past studies.

EMOTIONAL SECURITY THEORY

The emotional security theory (EST; Davies & Cummings, 1994) posits that preserving a higher order goal of emotional security within the family is a major operative process involved in children's responses to marital conflict (Cummings & Davies, 1996). Extending notions from attachment theory to a family-wide perspective (Bowlby, 1969; Waters & Cummings, 2000), maintaining a sense of emotional security in the family is viewed as a "set-goal" for children in the context of marital conflict, as well as in other family contexts (parent-child relationships). Moreover, children's emotional and behavioral responses in the context of marital conflict (as well as other family contexts) are seen as functioning in the service of regaining or maintaining this set-goal (see Bowlby, 1969). For example, marital conflict that is negative in nature (i.e., negative emotional displays, destructive conflict tactics) is most likely to threaten a child's sense of security, thus eliciting the most pronounced activation of regulatory response systems.

As in attachment theory, protection, safety, and security are held to be among the most salient goals in the hierarchy of human goals (Bowlby, 1973; Waters & Cummings, 2000). Another similarity is that EST is a developmental theory that assumes that the child's emotional security can be enhanced or undermined by the quality of family relations (Bowlby, 1973; Cummings et al., 2000). A divergence between the two theories (e.g., Ainsworth, Blehar, Waters, & Wall, 1978) is that EST posits multiple family influences on emotional security *in addition* to parent-child attachment (Cummings & Davies, 1996); for a discussion of additional influences posited by EST, see Waters and Cummings (2000). For example, Davies et al. (2002) showed that security in the context of marital conflict and attachment, respectively, independently influenced child adjustment. A long series of conceptual articles, supported by empirical tests of the theory (e.g., Cummings et al., 2006; Davies & Cummings, 1998), have developed the conceptual propositions of EST (e.g., see Cummings & Davies, 1996; Davies & Cummings, 1994; Davies et al., 2002).

CHILDREN'S REGULATORY PROCESSES IN RESPONSE TO MARITAL CONFLICT LINKED TO CHILD ADJUSTMENT

EST emphasizes the transactional process between a child and the family system in predicting children's outcomes (Davies, Cummings, & Winter, 2004). The transaction model of development (Sameroff, 1995) conceptualizes children's development as a dynamic interaction between the child and the environment that is continuously changing. Under this framework, marital conflict is not simply an environmental stressor that affects children's development; rather, marital conflict has effects on children depending on their prior exposure to marital conflict and the characteristics of any ongoing conflict, with children's regulatory processes among the processes accounting for the dynamic interaction between the child and family context.

Understanding how the transactional processes between children's regulatory responses and exposure to forms of marital conflict contribute to explaining children's risk for developing adjustment problems is an important aim for research in this area. EST has made various propositions toward advancing our understanding of relationships among marital conflict, children's regulatory processes, and child adjustment from a developmental psychopathology perspective.

Children's regulatory processes have been implicated as a possible pathway by which marital conflict relates to children's broader adjustment (Davies & Cummings, 1994; Laumakis, Margolin, & John, 1998). Children's emotional and behavioral responses to marital conflict are associated with their well-being (e.g., Davies & Cummings, 1994; Martin & Clements, 2002). At the same time, children's emotional and behavioral responses to interparental conflict are also conceptualized as regulatory processes in the service of preserving the goal of emotional security.

A key contribution thus is the definition of the relatively global construct of emotional security in terms of specific regulatory processes that are measurable and therefore allow for the tangible operationalization of this explanatory construct. Expanding on these notions in the context of EST, preserving a sense of security in the face of marital conflict is posited as a critical goal that organizes children's responding. Drawing from core notions of attachment theory (Bowlby, 1969), EST thus proposes a control system model in which preserving emotional security is a set-goal that influences children's reactions to marital conflict.

Moreover, emotional security is operationalized by a well-defined and testable class of regulatory processes occurring in the context of interparental conflict (Cummings & Davies, 1996; Davies & Cummings, 1994). One regulatory process is children's emotional reactivity to interparental disagreements, which may include physiological reactions (El-Sheikh, Cummings, & Goetsch, 1989). When disagreements are perceived as threatening, children may react with fear, anger, or sadness. Both the characteristics of the disagreement and the child's history of exposure to conflict influence the form, intensity, and duration of these emotions.

Another regulatory process is children's behavioral reactions. Insecure children may attempt to end the disagreement via their own involvement either directly as a mediator or indirectly as a distracter. Alternatively, children may remove themselves from the immediate environment to avoid exposure to destructive conflict, or they may become highly dysregulated in the context of emotional arousal and the threat to emotional security. Reflecting one gap addressed in this chapter, relatively few studies have examined children's behavioral responses, including attempts to regulate parents' marital conflicts, or the relations between emotional and behavioral regulatory responding, despite the theoretical foundation in EST for expecting both emotional and behavioral reactions to be interrelated in children's reactions to marital conflict. Physiological responses, including sleep, may also reflect relations between emotional security and child outcomes (see Cummings & Davies, 1996, and recent empirical studies in Davies, Cicchetti et al., 2007, and El-Sheikh et al., 2007).

Consider this concrete example: if children observed aggression by one parent toward the other, which is a distinctly destructive conflict behavior, their responses of negative emotional reactivity and overinvolvement in the marital dispute would be among those expected according to EST. These responses reflect the children's emotional insecurity regarding the interparental relationship (see Cummings, Goeke-Morey, & Papp, 2003; Goeke-Morey et al., 2003). They also function as a regulatory response system toward regaining the set-goal of emotional security about the interparental relationship. Applying secure base and control systems concepts to the family context, it follows that children's emotional security about marital conflict can be assessed by the organization of regulatory processes occurring in the context of interparental conflict that serve the goal of preserving the child's emotional security (Cummings & Davies, 1996; Davies et al., 2002).

A useful analogy for thinking about regulatory processes in the service of emotional security is to think about emotional security as a bridge between the child and the world. When the marital relationship is functioning well, it serves as a secure base, a structurally sound bridge that supports the child's exploration and relationship with others. When destructive conflict erodes the bridge, children become hesitant to move forward and lack confidence or may move forward in a dysregulated way, unable to find appropriate footing within themselves or in interactions with others (Cummings et al., 2006).

THE IMPORTANCE OF DISTINGUISHING BETWEEN CONSTRUCTIVE AND DESTRUCTIVE MARITAL CONFLICT

A long series of studies have helped identify the parameters of marital conflict that are constructive versus the parameters of conflict that are destructive from the children's perspective. The initial research on these questions was based on laboratory videotaped and live presentation of marital conflict simulations (see Cummings & Davies, 1994). More recently, research has been further developed by coding specific marital conflict behavior and children's specific emotional and behavioral responses in the home (Cummings, Goeke-Morey, & Papp, 2003, 2004; Cummings, Goeke-Morey, Papp, & Dukewich, 2002) and laboratory (Goeke-Morey et al., 2003), including observations of marital conflict resolution interactions (Du Rocher Schudlich & Cummings, 2003). Among the parameters identified as destructive are defensiveness, personal insults, verbal hostility, nonverbal expressions of hostility, stonewalling, and physical aggression. Marital conflict behaviors found to be constructive include problem solving, compromise, expressing positive feelings in the context of conflict, making supportive statements, and the verbal expression of affection.

For example, consistent with this conceptual model for children's regulatory functioning in family contexts of marital conflict, Cummings et al. (2003), using a home diary methodology, found that some forms of conflict (e.g., threat, personal insult, verbal and nonverbal hostility) elicited negative emotions in children, which were therefore categorized as destructive conflict strategies, whereas other forms of conflict (e.g., support, affection) elicited positive responding and thus were categorized as constructive conflict tactics. Based on an analog approach to the study of children's responses to specific conflict tactics, Goeke-Morey et al. (2003) found support for similar categorizations and that children were more likely to regulate their exposure to conflict (i.e., intervene or avoid) when exposed to destructive conflict tactics compared to constructive tactics.

Contextualizing responses to destructive and constructive conflict in terms of EST, marital conflict that is destructive in nature is more likely to threaten a child's sense of security compared to constructive conflict. However, conflict intensity or frequency is not necessarily a hallmark of destructive conflict. In fact, evidence is accumulating that even relatively intense conflicts that include overtly constructive elements (e.g., problem solving, support) may not be threatening to children's sense of security (Cummings et al., 2003; Goeke-Morey et al., 2003).

With regard to a developmental model, regulatory responses, *in response to destructive conflict*, affect children's responses to subsequent marital conflict (i.e., sensitization; see Davies et al., 2006). Over time, emotionally insecure children's patterns of responding to marital conflict (i.e., increased emotional reactivity, behavioral dysregulation) increase their risk of developing both internalizing and externalizing behavior problems.

For example, children's negative responding (e.g., yelling, misbehaving, being physically aggressive) to destructive conflict expressions in the home was linked with their concurrent behavior problems (Cummings, Goeke-Morey, & Papp, 2004). With repeated exposure, children may develop maladaptive coping processes that over time can affect their adjustment. As an example, a child exposed to destructive marital conflict may misbehave in an attempt to stop the conflict, thereby reinstating his or her goal of emotional security. However, with repeated exposure to conflict, this coping response may become maladaptive and develop into externalized behavioral problems. Children's regulatory responses to marital conflict thus serve as a potential pathway through which they gradually develop emotional and behavioral dysfunction.

RESPONDING TO DESTRUCTIVE MARITAL CONFLICT: THE KEY ROLE OF EMOTION REGULATION

According to EST, emotion regulation plays a key role in understanding children's responses to marital conflict (Cummings, 1998; Cummings & Cummings, 1988). Consistent with a functionalist view (e.g., Thompson, 1994), emotions are conceptualized as internal monitoring and guidance systems that assist children in coping with exposure to marital conflict. A key function of emotional expression is to help appraise the marital conflict situation and motivate behavioral responding. At the same time, emotional responses are expected to guide behavior and therefore should be related to behavioral reactions. For example, Schermerhorn, Cummings, DeCarlo, and Davies (2007) recently found that longitudinal relations between destructive marital conflict and children's behavioral responding (e.g., mediation, behavioral dysregulation) were mediated by emotional reactivity. Further developing theoretical propositions of EST, children have a superordinate goal of maintaining their emotional security, and they appraise marital conflict in terms of the effects that marital conflict has on this goal. Conflict expressions, such as destructive conflict tactics, that threaten children's goal elicit emotional arousal in children. According to EST, this emotional reaction *guides children's behavioral reactions,* including motivating their efforts at mediation, or, alternatively, driving behavioral dysregulation in children as a reaction to the threat to emotional security, including angry, aggressive, or hostile reactions (Cummings, Goeke-Morey, & Papp, 2004).

GAPS ADDRESSED: MARITAL CONFLICT, REGULATORY PROCESSES, AND CHILD ADJUSTMENT

To contribute further to the understanding of these questions, the remainder of this chapter explores these issues: (1) characteristics of marital conflict and children's regulatory responding in laboratory and home settings, including identification of commonalities in responding across these settings, thereby increasing confidence in any results found for children's emotional and behavioral reactions and their interrelations; (2) links between specific marital conflict characteristics and children's regulatory responses; and (3) the role of children's regulatory responses, including emotional responses (i.e., happy, mad, sad, scared) and behavioral responses (i.e., involvement, avoidance, dysregulation), in predicting children's adjustment. In summary, links between social-ecological (specific contexts of marital conflict) and children's regulatory (i.e., behavioral, emotional) responses are examined to improve our understanding of how interparental conflict characteristics relate to the development of behavior problems in children.

Consistent with a developmental psychopathology framework, and fostering the ecological validity of any findings, children's emotional and behavioral responses can be examined *in response to actual instances of marital conflict* and *through multiple methodologies,* including a laboratory discussion task and home diary reports. In our Couples & Kids Project, we recorded children's responses to actual instances of interparental conflict in two different contexts: children's self-report in the laboratory and observations of children's behavioral reactions to marital conflict in the home as documented by parental diaries. Incorporating children's self-reported responses to marital conflict allows for a fuller understanding of their regulatory processes than can be gained by employing observational methods alone. For example, children's internalized responses to conflict situations (e.g., withdrawal, fear) are difficult to observe and may be assessed more accurately via child ratings (Cummings & Davies, 1994). In the context of responding to marital conflict, there have been no differentiated studies of emotional and behavioral responses measured in this rigorous observational context as predictors of child adjustment.

In this chapter, we also report results using home-diary methodology, thereby assessing these processes in *the naturalistic home context*. Thus, our research innovations include both capturing child responses to actual conflict situations in the home and lab contexts and examining the possibility of linkages of these responses to children's broader adjustment. Additionally, we differentiate marital conflict characteristics into specific conflict tactics and by parent gender, examining children's reactions to exposure to both mothers' and fathers' specific conflict expressions (Cummings, Goeke-Morey, & Raymond, 2004). Given the limited research on the specific effects of fathers' conflict expressions on children's responses compared to mothers, our exploration also addresses important gaps in understanding children's reactions to fathers' as well as mothers' behaviors during marital conflicts.

Research Questions Guiding the Exploration of Children's Regulatory Processes and Marital Conflict

Consistent with EST, destructive conflict is expected to threaten children's sense of emotional security, eliciting heightened negative emotional reactions and elevated behavioral responses in children, whereas nondestructive conflict behaviors are not expected to have such effects.

- Research Question 1: Does children's responding vary systematically as a function of the relative constructiveness or destructiveness of parents' emotions and behaviors during conflicts? It is expected that negative and destructive marital conflict characteristics (i.e., negative emotions, destructive tactics) will elicit negative emotional responses (Cummings et al., 2003) and elevated behavioral responses (Cummings, Goeke-Morey, Papp, & Dukewich, 2002) in children.
- Research Question 2: How are children's negative emotional responses related to children's behavioral responses to marital conflict? It is expected that children who are negatively emotionally aroused will be more likely to behaviorally react to regulate their exposure to marital

conflict. Although this prediction is guided by EST, there has been scant empirical study of these relations between emotional and behavioral regulation. More specifically, negative emotional responses (mad, fear, sadness) are expected to relate to children's dysregulated (i.e., crying, aggressive), avoidant, and involved behavioral responses, following the proposition of EST that emotions organize, motivate, and/or direct children's behavioral reactions, either toward the goal of regaining desired levels of emotional security or as an expression of distress and dysregulation caused by a threat to emotional security.

- Research Question 3: How are children's emotional and behavioral responses related to children's adjustment? It is expected that children's negative emotional responses and heightened behavioral responding will positively relate to children's internalizing and externalizing behavioral problems, as well as to children's self-reported anxiety and depression, reflecting the threat to children's sense of emotional security indicated by these responses to marital conflict.

STUDYING MARITAL CONFLICT IN A COMMUNITY SAMPLE: THE COUPLES & KIDS PROJECT

The Couples & Kids Project is a multiwave investigation of family process and child development in a community-based sample of families from South Bend, Indiana, and neighboring areas. Parents and children came to the Center for Children and Families on the campus of the University of Notre Dame to participate in laboratory observational procedures and to receive training in home-based recording of marital conflict and child reactions. One of the primary goals of the Couples & Kids Project is to examine the effect of family processes (i.e., marital conflict) on children's adjustment using a process-oriented perspective, paying particular attention to distinguishing between constructive and destructive conflict expressions (see Cummings et al., 2003).

Studies from this project have focused on: (1) children's responses to conflict using both home diaries (e.g., Cummings et al., 2003; Cummings, Goeke-Morey, & Papp, 2004) and analog measures of conflict (e.g., Goeke-Morey et al., 2003); (2) associations between marital conflict and parental symptomatology (e.g., Du Rocher Schudlich, Papp, & Cummings, 2004), as well as how the interplay between these two predict child outcomes (e.g., Papp, Goeke-Morey, & Cummings, 2004); and (3) direct tests of the EST (Cummings et al., 2006; Davies et al., 2002).

Our studies of children's regulatory responses to conflict and how these regulatory responses are related to children's broader adjustment included

263 families with a child between the ages of 8 to 16 (median age = 11.0 years; 135 boys, 128 girls) drawn from the Couples & Kids Project. The largely middle-income sample was representative of the ethnicity of the surrounding community (87% European American, 8.5% African American, 3% biracial, 0.5% Asian, and 1% Hispanic). On average, couples had been married for about 12 years; all couples were living with each other and the target child for at least 2 years prior to participating in the study.

Laboratory Assessment of Interparental Conflict

Following the format of the standard marital conflict resolution task often employed by marital researchers, parents chose and discussed two areas of disagreement for about 15 minutes (see Du Rocher Schudlich & Cummings, 2003). We were interested in recording a range of their conflict resolution behaviors, including optimal and nonoptimal approaches to conflict resolution. Accordingly, in one discussion, parents were instructed to choose a topic of conflict that had occurred recently or came up often that they felt they had *difficulty handling* or resolving. In the second discussion, parents were instructed to choose a topic of conflict that had occurred recently or that came up often that they felt they *handled well* as a couple. Parents were asked to discuss the topic in the manner they would at home. We videotaped the interactions, and with parental permission, we showed to the child only the discussion that parents thought they *handled well*.

A trained observer coded the parents' videotaped interactions for the specific emotions expressed and conflict tactics used by each parent, so that we could precisely characterize marital conflict as a stimulus in our analysis, which is critical to interpreting children's responding according to EST. The emotions coded were positive, angry, sad, and scared. We coded the interactions for both destructive and constructive categories following guidelines provided by Goeke-Morey et al. (2003), who examined children's emotional reactions to specific marital conflict tactics in both a U.S. and Welsh sample. Conflict tactics were categorized as constructive if they elicited more positive than negative emotional responses in children and included behaviors such as support and problem solving. They were classified as destructive conflict tactics if they elicited more negative than positive emotional responses and included behaviors such as nonverbal anger and personal insult. This classification of tactics as constructive versus destructive was remarkably consistent across the U.S. and Welsh samples.

In the laboratory, constructive emotions and tactics were relatively prevalent by the parents in *both* conflict resolution tasks. That is, they used more constructive conflict tactics than destructive conflict tactics. The most commonly used constructive conflict tactics during the laboratory interaction were calm discussion and problem solving. However, it is important to note that parents still used destructive conflict tactics with considerable frequency. The most commonly used destructive conflict tactic was nonverbal anger. Both mothers and fathers expressed more happiness than anger, sadness, or fear. There were some differences as a function of parental gender in conflict expressions. In comparison to fathers, mothers expressed significantly more sadness and anger. In sum, parents' laboratory conflict interactions were primarily constructive and representative of incidents of everyday marital conflict. However, destructive conflict behaviors also occurred and were somewhat more likely to be expressed by mothers.

Children's Regulatory Responses to Marital Conflict in the Laboratory Context

After the parents provided consent for their child to see the marital conflict interaction that parents felt was *handled well*, a trained research assistant showed children this videotaped interaction. Children were instructed to answer several questions designed to tap their emotional and behavioral regulatory responses. An initial question was, "How would you *feel* if you were in the same room as your parents?" Children selected an emotion from the list of happy, mad, sad, and scared and rated the intensity of this emotion on a 10-point scale. All of the children responded to this question, and each of the emotional responses was reported. In addition, while viewing the tape, children answered this question: "What would you *do* if you were in the same room with your parents?" Children's responses were coded for answers that reflected involvement, avoidance, and dysregulation. Many children ($n = 164$) expressed responses that indicated involvement in parental conflict, such as offering suggestions to parents, comforting a parent, or taking sides. Twenty-nine children expressed avoidance; examples of avoidant behavioral reactions are running away or going to one's room. Six children expressed dysregulated behavioral reactions, such as yelling, crying, or misbehaving. Some children indicated more than one response, whereas some children indicated no behavioral response to watching their parents' interaction.

Home Assessment of Interparental Conflict

Using the Marital Daily Records (MDRs) reporting procedure (see Cummings, Goeke-Morey, Papp, & Dukewich, 2002) with a subset of the larger study ($n = 99$ mothers and 93 fathers), we examined conflict characteristics of the disagreements that children in the study saw or heard (i.e., the conflicts that were reported to occur in the children's presence). Parents received detailed training on completing diary reports and were instructed to independently complete a diary report soon after the conflict interaction occurred. For the 15-day reporting period, this subset of mothers and fathers returned 560 and 377 MDRs, respectively, *for conflicts that occurred in the presence of the children* involved in this study, representing approximately one-third of the MDR reports that were returned. In other words, children were reported to be present during about one-third of the marital conflicts (see Papp, Cummings, & Goeke-Morey, 2002).

Using a checklist format, spouses indicated (endorsed or not endorsed) all of the conflict tactics used by themselves and their spouse throughout each conflict interaction. In addition, spouses rated their own and their partners' positivity, anger, sadness, and fear throughout the interactions. Standardized scores of each variable were summed to form the following composites of mothers' and fathers' conflict expressions. Constructive conflict included humor, support, affection (physical and verbal), compromise, apology, and problem solving. Destructive conflict included threat, verbal and nonverbal hostility, withdrawal, physical distress, defensiveness, pursuit, personal insult, and aggression (both toward an object and a person). Emotion variables included positivity and negativity (sum of anger, sadness, and fear).

Children's Regulatory Responses to Marital Conflict in the Home Context

When their child was present for the interparental disagreement, mothers and fathers completed the Child Response Record (CRR), rating the child's emotional responding along dimensions of positivity or negativity (sum of anger, sadness, and fear) and the child's behavioral responding: involvement (sum of helped, comforted, interrupted, took sides, tried to make peace, asked about it later), avoidance (avoided parents), and behavioral dysregulation (sum of cried, misbehaved, froze, yelled, was aggressive).

Children's Adjustment

Children's adjustment was assessed based on both parent and child reports, which strengthened the measurement of child adjustment. Child behavior problems were rated by mothers' and fathers' independent reports on the Child Behavior Checklist (CBCL) for ages 4 to 18 (Achenbach, 1991). The

CBCL is widely used, and many studies document its validity, stability, and reliability (see Achenbach, 1999). Parents rated how often their child had exhibited internalizing problems (e.g., "nervous, high-strung, or tense") and externalizing problems (e.g., "bragging, boasting"). The internalizing score was computed by summing scores on the withdrawn (9 items), somatic complaints (9 items), and anxious/depressed (14 items) scales. The externalizing score was computed by summing scores on the delinquent behavior (13 items) and aggressive behavior (20 items) scales. In the current sample, mothers' and fathers' respective CBCL scores were internally consistent (all coefficient alphas > .83). Standardized scores are provided by the computer scoring system of the CBCL and are used in subsequent analyses.

Children completed the Child Depression Inventory (CDI; Kovacs, 1981), which is a commonly used self-report instrument for measuring depressive symptoms in children and adolescents. The CDI has demonstrated reliability and validity properties in past research (Sitarenios & Kovacs, 1999). Children respond to items assessing sadness, self-blame, loss of appetite, insomnia, interpersonal relationships, and school adjustment by selecting which of the three descriptions best fits how they have been feeling during the past 2 weeks (e.g., "I do most things O.K., I do many things wrong, I do everything wrong") for 27 items. Total scores range from 0 (*no depression symptoms*) to 54 (*all depression symptoms clearly present*).

Children also completed the Revised Children's Manifest Anxiety Scale (RCMAS; Reynolds & Richmond, 1978), which was used to assess their levels of general anxiety. The RCMAS is widely used and demonstrates desirable psychometric properties (Gerard & Reynolds, 1999). The RCMAS contains 37 items that load onto two scales: anxiety (28 items) and a social desirability index (9 items). In our studies, we employed the anxiety score. The endorsed responses are summed, resulting in anxiety scores that potentially range from 0 to 28, with higher scores reflecting greater anxiety.

SUMMARY OF FINDINGS: MARITAL CONFLICT AND CHILDREN'S REGULATORY RESPONSES IN THE LABORATORY CONTEXT

Children's Emotional Regulatory Responses

Overall, children's emotional responses to their parent's marital conflict in the laboratory were more positive than negative. This finding is perhaps not surprising, because parents' conflict behaviors were relatively positive and constructive in this context. However, there were significant differences in the incidence of children's feelings of happiness, anger, fear, and sadness.

Exposure to their parents' conflict elicited more happiness than anger, sadness, or fear and significantly more sadness than fear or anger. Although conflicts were relatively constructive and positive, parents were nonetheless discussing self-defined areas of disagreement and conflict. In that light, the relative positivity of children's responses highlights recent findings that marital conflict is not necessarily stressful for children, if parents handle matters positively and constructively (Cummings et al., 2003; Cummings, Goeke-Morey, & Papp, 2004; Goeke-Morey et al., 2003).

Pertinent to Research Question 1, children's emotional reactions were related to their parents' expressed emotionality during marital conflict. When mothers expressed anger; children were less happy; when fathers expressed anger, children were more angry and sad. Higher levels of mothers' sadness during conflicts elicited lower levels of child happiness and higher levels of child anger, fear, and sadness. Higher levels of mothers' fear during conflict were related to higher levels of child anger and sadness, whereas higher levels of fathers' fear during conflict were linked with higher levels of child sadness. At the same time, mothers' and fathers' positive emotionality (i.e., happiness) related to more happiness and less anger in children.

Children's reactions were also related to parents' *specific conflict tactics*. Generally, destructive tactics were linked with lower levels of child happiness and higher levels of child anger, whereas parental use of constructive tactics was linked with higher levels of child happiness. Children's anger was positively associated with parents' nonverbal and verbal anger conflict tactics. Maternal nonverbal anger and paternal defensiveness were negatively related with children's feelings of happiness during their parents' laboratory conflict. At the same time, children's happiness was linked to higher levels of parental compromise. Both calm discussion and problem solving were related to significantly less anger in children. In summary, parents' emotional expressions and conflict tactics influenced children's emotional reactions to marital conflict. Specifically, parent displays of positive emotions *in contexts of marital conflict* were associated with an increase in positive emotional reactions in children, such as feeling happy. Similarly, constructive conflict tactics also were related to an increase in positive emotional responding in children. In contrast, destructive conflict tactics were related with less positive emotional responding and an increase in angry emotional responses in children.

Children's Behavioral Regulatory Responses

Children's behavioral reactions to marital conflict were also related to parents' emotionality and the conflict tactics as predicted. Children were more likely to exhibit dysregulated behavioral responses when mothers were sad or afraid during marital conflict. Interestingly, when fathers were sad in this context, children were more likely to be avoidant. Children thus reacted differently depending on which parent was sad during conflicts.

Children's behavioral reactions to marital conflict were also related to the *specific conflict tactics* used by parents during marital conflict, consistent with theoretical expectations. Children were more likely to exhibit dysregulated behavior when exposed to maternal physical distress and more likely to exhibit avoidant behavior when exposed to paternal nonverbal anger or physical distress. Avoidant behaviors were thus again more likely in response to fathers' conflict behaviors, whereas dysregulated behaviors were more likely in response to mothers' conflict behaviors.

These results raise the intriguing possibility that the meaning that conflict tactics have for children's emotional security may be partially influenced by the parent's gender. One recently articulated hypothesis, the *differential reactivity hypothesis*, posits that children are more reactive and distressed by fathers' marital conflict expressions compared to mothers' conflict expressions (see Cummings, Goeke-Morey, & Raymond, 2004). For example, Crockenberg and Forgays (1996) found girls' negative emotional responses correlated with fathers', but not mothers', marital aggression. Using an analog paradigm, Goeke-Morey et al. (2003) found that fathers' enactments of physical aggression toward their spouses elicited greater negative emotional reactions in children compared to mothers' enactments of physical aggression. Children may be particularly wary of fathers' conflict expressions compared to mothers' expressions, and thus avoid fathers. At the same time, children were more distressed by certain nonaggressive marital conflict tactics when expressed by mothers than by fathers. The greater dysregulation in reaction to mothers' conflict behaviors indicates that an explanation that fathers' conflict behaviors are always more distressing to children is probably too simple. Although these results support the importance of differentiating between mothers' and fathers' conflict expressions, the differential reactivity hypothesis needs further exploration and probably greater refinement (e.g., children's reactions may depend on the *type* of parental conflict behavior).

Interrelations between Emotional and Behavioral Regulatory Responses

Pertinent to Research Question 2, children's sad and scared responses during the marital conflict were linked with higher levels of dysregulated behavioral reactions. At the same time, happiness and sadness were each positively associated with children's involved behavioral reactions. Although these results are consistent with the notion that children's emotional and behavioral reactions to marital conflict are interrelated, they also raise questions about whether relations between emotional and behavioral reactions depend on the specific emotions and forms of involvement. Accordingly, children's involved behavioral reactions were further classified into specific behaviors, such as taking sides or smiling/laughing. These findings underscore the importance of further differentiating children's specific behavioral reactions. For example, child happiness was positively related to children's making a comment during their parents' laboratory marital disagreement, whereas taking sides with one parent during marital conflict was positively related with children's scared emotional responses. Further research is needed to understand the processes underlying child forms of involvement in marital conflict and to examine what emotional factors predict specific forms of child involvement.

SUMMARY OF FINDINGS: MARITAL CONFLICT AND CHILDREN'S REGULATORY RESPONSES IN THE HOME

Children's Emotional Regulatory Responses

Consistent with expectations for Research Question 1, destructive conflict and negative emotional expressions were positively linked to children's negative emotional regulatory responses (i.e., anger, sadness, fear), according to both mothers' and fathers' home diary reports (see Cummings, Goeke-Morey, Papp, & Dukewich, 2002). Also consistent with predictions, parental constructive conflict and positive emotional expressions were *negatively* linked to child negative emotional regulatory responses, and *positively* related to higher levels of children's positive emotional responses (see Cummings, Goeke-Morey, & Papp, 2002; Cummings et al., 2003).

Children's Behavioral Regulatory Responses

Consistent with the laboratory analyses described earlier, according to mothers, destructive conflict and negative emotions in the home were linked with greater child involvement, avoidance, and behavioral dysregulation (see Table 9.1). Mothers also reported that constructive tactics were linked with less avoidance and behavioral dysregulation by children, whereas positive emotion related to lower levels of child involvement, avoidance, and behavioral dysregulation (Table 9.1).

Table 9.1. *Multilevel modeling of relations between marital conflict in the home and child behavioral responses: Maternal report ($n = 99$)*

Marital conflict characteristics	Child regulatory responding		
	Child involvement	Child avoidance	Child dysregulation
Destructive Tactics	.08 (.03)	.24 (.03)	.27 (.04)
	3.21**	6.97**	7.47**
Negative Emotion	.01(.004)	.02 (.004)	.05 (.01)
	3.14**	4.39**	7.64**
Constructive Tactics	.01 (.02)	−.11 (.05)	−.08 (.04)
	.48	−2.44*	−2.19*
Positive Emotion	−.01 (.01)	−.06 (.01)	−.06 (.01)
	−2.41*	−6.33**	−6.07**

Note: Table presents unstandardized coefficient; (*SE*); *t*. $^{**}p < .01$. $^{*}p < .05$.

Fathers' reports of conflict and child responding in the home showed a similar pattern of results (see Table 9.2). According to fathers, parental expressions of destructive conflict and negative emotions in the home were linked with greater avoidance and behavioral dysregulation (Table 9.2). Fathers also reported that constructive tactics were linked with less involvement, avoidance, and behavioral dysregulation by children, whereas parental positive emotion related to lower levels of avoidance and behavioral dysregulation.

Findings were thus highly consistent across home and laboratory contexts, with apparently even stronger findings in the home than laboratory,

Table 9.2. *Multilevel modeling of relations between marital conflict in the home and child behavioral responses: Paternal report ($n = 93$)*

Marital conflict characteristics	Child regulatory responding		
	Child involvement	Child avoidance	Child dysregulation
Destructive Tactics	.03 (.03)	.23 (.05)	.27 (.05)
	.94	4.79**	5.89**
Negative Emotion	.01 (.004)	.03 (.01)	.04 (.01)
	1.61	4.44**	4.77**
Constructive Tactics	.05 (.02)	−.19 (.06)	−.14 (.04)
	2.12*	−3.36**	−3.22**
Positive Emotion	.01 (.01)	−.06 (.01)	−.06 (.01)
	1.25	−5.36**	−5.92**

Note: Table presents unstandardized coefficient; (*SE*); *t*. $^{**}p < .01$. $^{*}p < .05$.

although this is a tentative conclusion that has not yet been directly tested. One possible explanation for this difference is that the nature of real everyday conflicts in the home results in greater elevation of emotional security as a primary goal than does marital conflict in the laboratory. According to attachment theory, exploration and play are competing behavioral systems with emotional security, with the emotional security system elevated in times of relative stress or threat (Bowlby, 1969, 1973). In the context of real marital conflict in the home, children's responses may be more closely attuned to the set-goal of emotional security, and so emotional security concerns are more likely to be elevated in relation to play or exploration systems than in the laboratory.

REGULATORY RESPONSES AND CHILDREN'S ADJUSTMENT

Regulatory Responses to Laboratory Conflict and Children's Adjustment

Children's emotional and behavioral responses to their social environment (e.g., marital conflict) have implications for their later adjustment. For example, Du Rocher Schudlich, Shamir, and Cummings (2004) found that children's responses to marital conflict related to how children handled peer conflicts. Thus, children's reactions to marital conflict affect their social development as well. From a developmental psychopathology perspective, examining children's regulatory processes is important in understanding the mediating processes underlying the relationship between exposure to marital conflict and children's later adjustment.

Although dysregulated and avoidant child responses to marital conflict have been implicated as maladaptive, these behaviors are likely maintained because they are adaptive for children in the short term (Cummings et al., 2000). Children may be using these behaviors to regulate their exposure to conflict by trying to stop the conflict, such as, for example, yelling at their parents, or avoiding the conflict by leaving the room. Thus, these behaviors help children cope with marital conflict by regulating their exposure to marital conflict or by helping ameliorate parents' conflicts. However, with repeated exposure to conflict, children's regulatory behaviors may become maladaptive over time.

Pertinent to Research Question 3, children's regulatory responses in both the laboratory and home were related to their overall adjustment. In the laboratory context, children's negative emotional responses during marital conflict were significantly related with children's self-reported anxiety on the RCMAS and the CDI. Further, children's dysregulated behavioral reactions were related to higher levels of both children's anxiety and depression. Children's regulatory processes were also related to parent reports of their children's adjustment. For example, children's angry emotional reactions during marital conflict were related to higher levels of externalized behavioral and total behavioral problems as reported by mothers.

Our theoretical perspective is that children's regulatory behavior (i.e., dysregulated behavioral responses and negative emotional responding) to social stressors (e.g., marital conflict) puts children at risk for developing behavioral problems. That is, although children's patterns of responding may be adaptive for them in the short term as they try to maintain their goal of emotional security, these patterns of behavior over time may manifest as behavioral problems. However, longitudinal tests of children's regulatory responding to marital conflict over time are needed to establish a causal effect.

Regulatory Responses to Marital Conflict in the Home and Children's Adjustment

Children's behavioral and emotional regulatory responding to marital conflict in the home were also linked to their adjustment. Specifically, maternal ratings of child avoidance of marital conflict in the home related to greater child-reported anxiety symptoms. In addition, maternal ratings of child dysregulation in response to marital conflict in the home related to higher levels of child-rated depressive symptoms and to higher levels of internalizing and externalizing problems. In summary, children's regulatory processes in coping with exposure to everyday marital conflict in both home and laboratory contexts were linked with their adjustment.

CONCLUSIONS AND FUTURE DIRECTIONS

A primary goal of this chapter was to outline conceptualizations and explore hypotheses derived from EST on the role of regulatory processes in children's adjustment as related to how parents handle everyday marital conflicts. Consistent with expectations for Research Question 1, in both home and laboratory contexts, destructive marital conflict was related to regulatory responses conceptualized as indexing children's emotional insecurity; that is, negative emotionality and activation of behavioral responding geared to regulating or avoiding marital conflict, or heightened behavioral dysregulation. At the same time, constructive conflict strategies and positive emotionality, taking place in the context of marital conflict, were linked with children's positive emotionality and the lack of activation of behavioral responses. With regard to Research Question 2, relationships between emotions and behaviors varied according to the specific behaviors examined. As expected, negative emotionality was linked with dysregulation, avoidance, and more negative forms of involvement (e.g., taking sides). Concerning Research Question 3, support was found in both home and laboratory contexts for links between negative emotional and behavioral forms of regulation and children's adjustment problems.

Our study used actual instances of marital conflict in the laboratory and home to capture a variety of marital conflict characteristics (emotions, conflict tactics) and then assess children's responses to these behaviors. These methods, therefore, complement the findings from analog studies, which have used simulated conflict scenarios involving actors. Diary methods are an especially promising means of measuring marital conflict and children's reactions to it, as these events and reactions to those events naturally transpire in the fully articulated contexts of everyday family functioning (e.g., Cummings et al., 2004; Papp et al., 2002).

Future research should aim not only to further distinguish between children's regulatory behaviors during marital conflict but also to further examine the interrelation between children's emotional and behavioral regulatory processes. Additionally, children's regulatory processes should be examined longitudinally in an effort to understand the mechanisms underlying children's regulatory processes and the implications of children's regulatory processes in the context of marital conflict for their adjustment over time.

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10

Family Subsystems and Children's Self-Regulation

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The family context plays a critical role in the early development of both normative and psychopathological outcomes (Cummings, Davies, & Campbell, 2000). Parents can be sensitive to their child's needs and express warmth in their interactions, or they can engage in intrusive, rejecting behavior that undermines the child's well-being. Similarly, married couples can communicate effectively, engage in mutual problem solving, and enjoy humorous exchanges, or they can get embroiled in coercive cycles of escalating conflict that can easily end with domestic violence. Fathers may be involved or psychologically unavailable. As these examples attest, the family is composed of a number of family subsystems (e.g., mother-child, marital, father-child, sibling) that can affect the development of children's self-regulation. The interplay among these different subsystems can alter developmental trajectories depending on whether family relationships act as risk or protective factors. For instance, the adverse consequences of marital conflict (a risk) may be buffered or dampened if the child has a close and supportive relationship with one parent in the family (a protective factor). In a two-parent family, the mother-child and father-child relationships can be concordant (both warm and sensitive) or discordant (one warm, one rejecting), and these differences within concordant and discordant families have consequences for the children involved.

The goal of this chapter is to discuss the development of young children's self-regulation in the context of multiple family subsystems. It starts with a brief introduction to young children's compliance and self-regulation before turning to a more thorough discussion of the different family processes that come into play when multiple family members come together and how these within-family processes are related to the emergence of self-regulation in early childhood. We then turn to a brief review of some of our recent work examining family subsystems and young children's self-regulation.

EARLY SELF-REGULATION

Toddlerhood, and particularly the years between 2 and 3, marks a significant developmental period in children's emerging self-regulation (Emde, Biringen, Clyman, & Oppenheim, 1991; Kochanska, 1993; Kopp, 1982). Young children's compliance to parental requests is often viewed as an indicator of early self-regulation (Vaughn, Kopp, & Krakow, 1984). Kochanska and Aksan (1995) make a distinction between two types of compliance, situational and committed, that are observed in early development. Situational compliance represents a form of compliance in which children comply to parental requests only with continued prompting, whereas committed compliance consists of a child's whole-hearted enthusiastic endorsement of the parent's agenda (Kochanska & Aksan, 1995). This whole-hearted endorsement of parental requests is considered an early indicator of a child's internalization of parental standards for conduct and predicts later internalization and conscience development. Committed and situational forms of compliance also have different developmental paths, with committed compliance increasing and situational compliance decreasing with age (Kochanska & Aksan, 1995; Kochanska, Aksan, & Koenig, 1995; Kochanska, Coy, & Murray, 2001).

Children's committed and situational compliance have been assessed during both "Do" and "Don't" contexts (Braungart-Rieker, Garwood, & Stifter, 1997; Kochanska & Aksan, 1995; Kochanska et al., 1995, 2001; van der Mark, Bakermans-Kranenburg, & van Ijzendoorn, 2002). "Don't" tasks require children to comply to parental prohibitions in which children are instructed not to touch or play with attractive and desirable toys or objects within their reach (Kochanska & Aksan, 1995). In contrast, "Do" tasks require children to comply to parental requests to sustain unpleasant or mundane activities (Kochanska & Aksan, 1995). A typical "Do" task is a standard clean-up paradigm where the parent is instructed to have the child clean up toys used during earlier activities. Children's compliance appears to differ across these two contexts, with children displaying higher levels of committed compliance at an earlier age during "Don't" versus "Do" tasks (Kochanska & Aksan, 1995; Kochanska et al., 2001). Moreover, as children mature, their rates of committed compliance increase more rapidly during "Don't" versus "Do" tasks (Kochanska et al., 2001). Taken together, these findings suggest that "Do" tasks represent more developmentally challenging contexts for toddlers and preschoolers than "Don't" tasks (Braungart-Rieker et al., 1997; Kochanska & Aksan, 1995).

Children's early self-regulatory skills, and compliance more specifically, appear to develop within the context of affectively positive interactions with parents (Kochanska, 2002; Kochanska & Aksan, 1995). For example, Kochanska and Aksan (1995) found that shared positive affect, reflected by an ongoing pattern of reciprocity and responsiveness within the parent-child relationship (Parpal & Maccoby, 1985), was positively related to children's committed compliance in a clean-up paradigm. Parental control strategies have also been linked to children's compliance (Braungart-Rieker et al., 1997; Kochanska & Aksan, 1995). Power-assertive discipline techniques are negatively related to committed compliance, whereas guidance and gentle control strategies are positively associated with it (e.g., Braungart-Rieker et al., 1997; Kochanska, Forman, & Coy, 1999).

Despite the importance of understanding within-family dynamics, there have been few paradigms for the empirical examination of family subsystems. In the research described in this chapter, we focus on a new research paradigm we designed to assess family dynamics and their contribution to the development of young children's self-regulation. We refer to this paradigm as the *family clean-up task*, which we formulated to capture the family-level dynamics that emerge when one observes whole-family interaction consisting of mother, father, and two siblings. The family clean-up task lasts 5 minutes, is an example of a "Do" task, and is conducted in the laboratory after children and their parents have completed a series of interaction tasks (e.g., family free play, triadic jealousy paradigm, parent separation; see Volling, Blandon, & Gorvine, 2006, for a detailed description). Before summarizing the findings from our research program utilizing the family clean-up task, we present the family systems model guiding our work.

FAMILY SYSTEMS MODEL OF EARLY SELF-REGULATION

Our current understanding of parental socialization practices and children's early self-regulation stems from studies that have focused primarily on mother-child dyads. Few studies have examined the role that fathers might play in the development of early self-regulation, although there are some notable exceptions (Feldman & Klein, 2003; Power, McGrath, Hughes, & Manire, 1994). One reason for this oversight is that most developmental theories of socialization assume that mothers provide the formative early experiences that determine children's internalization of standards and conduct and that one can then test children's success in acquiring this developmental milestone by observing whether compliant behavior generalizes to other contexts involving other adults or caregivers (e.g., Feldman & Klein, 2003). There is little appreciation of children being socialized in

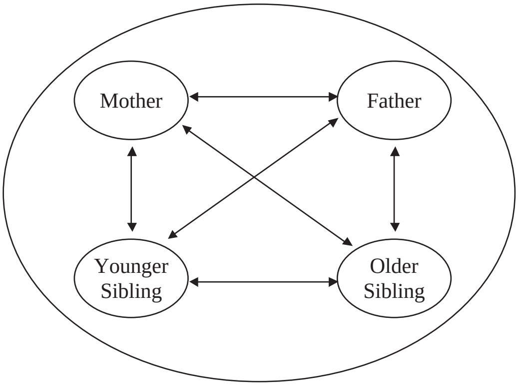

Figure 10.1. The multiple relationships within the four-member family system.

family systems in which both mothers and fathers together teach, instruct, discipline, and develop close, mutually responsive relationships with their children.

Independent observations of mother-child and father-child dyadic interactions in isolation from other family members do not allow us to capture the dynamic nature of whole-family interactions. Therefore, it is necessary to take a broader family perspective when we include fathers in our research designs (Belsky, 1981). In the current model, which underscores a family systems perspective in the study of early self-regulation, we argue that emergent systemic dynamics come into play when all family members are together that cannot be captured when one strictly focuses on dyadic interaction. Even though researchers may now include fathers in their research designs, many investigators measure father-child dyadic interaction and compare it with mother-child dyadic interaction. Including information on two dyadic relationships does not adequately reflect the emergent systemic properties of family systems and does not capture the systemic perspective we are advocating here. When family members are observed interacting in a whole-family setting, several processes that may influence a young child's development become apparent. In our current work, we also included two-child families because nearly 80% of children in the United States grow up with at least one sibling and thus do not experience parenting in isolation from their sibling (Reiss, Niederhiser, Hetherington, & Plomin, 2000).

In Figure 10.1, we present the four-member family system, noting the possible bidirectional relationships that can exist between the different dyads (i.e., parent-child, marital, and sibling) within the family. It is certainly possible to measure each of the dyads in isolation from other dyads by conducting, for instance, a problem-solving task for marital interaction, a clean-up session with the mother-child dyad, and another clean-up session for the father-child dyad. However, even the most sophisticated statistical analyses cannot adequately address dynamic within-family processes by simply including separate indicators of dyadic interaction in data analyses. As we show shortly, there are emergent systemic processes that can only be measured with multiple family members present. Similarly, it is commonplace for researchers to conduct separate analyses for mother-child and father-child dyads, using fathers' behaviors to predict the children's compliance with father and mothers' behaviors to predict children's compliance with mother. The major problem with such an approach, of course, is that children are socialized within families and mothers' and fathers' behaviors are not independent variables, no matter how we choose to measure them.

In addition to the dyadic relationships within the family, at least two emergent within-family processes are possible when the four-member family system is observed as a whole unit. The first is *co-parenting* or the process by which mothers and fathers work together to either support or undermine each other's efforts in child rearing (McHale, 1995). Figure 10.2 presents how the four-member family system can be pulled apart into four different triadic subsystems. For co-parenting to be observed, two parents must be present, and thus, dyadic parent-child interactions are insufficient (top half of Fig. 10.2). Figure 10.2 shows that parents can either co-parent the older sibling or co-parent the younger sibling. Although it may be possible for mothers and fathers to work together and co-parent both children at once, we chose to focus on co-parenting of each individual child for our first attempt at addressing within-family processes.

The second emergent family process (shown in the bottom half of Fig. 10.2) is *differential parenting*, which is also referred to as differential treatment or sibling favoritism. Differential parenting reflects the difference in how a parent treats one sibling in relation to the other sibling. Within the context of the family system, it is clearly possible for direct one-on-one parent-child interaction to occur; however, the questions we address here are whether direct parent-child interaction is sufficient in predicting the development of early self-regulation or whether other family processes that often go unmeasured in traditional mother-child dyadic research predict additional variance in children's developmental outcomes above dyadic measures.

In the remainder of this chapter, we focus on the within-family dynamics we have observed in our family clean-up paradigm, noting differences

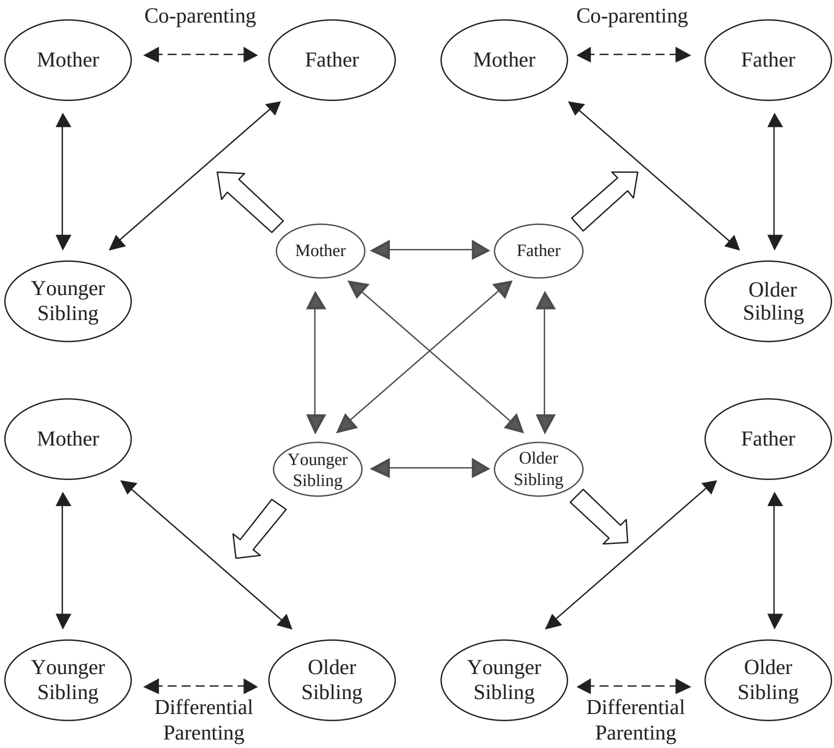

Figure 10.2. The emergent family dynamics of co-parenting and differential parenting within the family.

between siblings (older versus younger) and parents (mothers versus fathers) as they manage the family clean-up task. We do not analyze mothers' and fathers' behavior separately in predicting children's compliance to one or the other parent, but instead examine mothers' and fathers' behaviors simultaneously in the same analyses. As a result, we demonstrate how the interaction between the child and one parent (e.g., father) acts as a moderator of the effect of the other parent-child relationship in predicting children's self-regulation.

We end with a discussion of co-parenting and differential treatment as two different family-level dynamics examined in our own work, showing both how such systemic properties within the family can explain additional variance beyond that accounted for by dyadic measures of parent-child interaction and how parenting behaviors interact with these within-family dynamics to predict sibling outcomes. The work summarized here is the first to use a family clean-up paradigm to examine the development of children's early self-regulation within the context of the family system. This approach allowed us to move beyond dyadic interactions to examine other family subsystems and the resulting family dynamics, such as co-parenting and parent differential treatment.

CHILDREN'S SELF-REGULATION WITHIN THE FAMILY

One of the first questions we wanted to address in our research program was whether there was evidence of within-family *differences* in how older and younger siblings complied with mothers and fathers and how mothers' and fathers' parenting differed during the family clean-up task. The family clean-up task also allowed us to examine within-family differences (mothers versus fathers, older versus younger siblings) in parents' socialization of older and younger siblings and developmental differences in compliance across preschool and toddler siblings. Evidence for such parent and sibling differences would provide preliminary support for the existence of within-family processes that could be examined further in predicting children's self-regulation. Research by Kochanska (e.g., Kochanska et al., 2001) has demonstrated, both cross-sectionally and longitudinally using mother-child dyads, that older children in preschool and elementary school perform more committed compliance than younger children in toddlerhood.

There is a general age trend suggesting that, whereas committed compliance increases with age, situational compliance decreases. Given that the siblings in our research were of two different ages, one in toddlerhood and the older one usually a preschooler or of early school age, we expected similar age differences to be apparent, with older siblings performing more committed and less situational compliance than their younger siblings. Using the family clean-up paradigm with a sample of 59 families participating in the Parent-Child and Sibling Relationships Study (PCSRS), Volling, Blandon, and Gorvine (2006) reported that older preschool siblings used more committed compliance, but also more refusal, with their parents than their16-month-old toddler siblings, who engaged in more passive noncompliance. Siblings did not differ with respect to situational compliance. In a recent attempt to replicate these findings with a second sample of 57 families participating in the Marriage and Child Development Study (MCDS) with their 2-year-old and an older sibling (ages 3 to 7; $M = 58$ months) in the family clean-up task, we found remarkably similar findings. Specifically, older siblings used more committed compliance than their 2-year-old siblings, and 2-year-olds used more passive noncompliance than the older siblings (Blandon & Volling, 2008). Again, there were no differences in situational compliance for the two siblings.

In addition to studying sibling differences in compliance, Volling, Blandon, and Gorvine (2006) examined whether parents treated older and young siblings differently during the family clean-up paradigm and whether mothers' and fathers' parenting differed. Indeed, they found that siblings were parented differently by their mothers and fathers, with older siblings being the recipients of more gentle guidance by mothers and fathers than their toddler siblings. Parents were also more likely to engage in shared positive affect with older compared to younger siblings (Volling, Blandon, & Kolak, 2006). These analyses with the PCSRS families also revealed that mothers used more gentle guidance (Volling, Blandon, & Gorvine, 2006) and engaged in more shared positive affect (Volling, Blandon, & Kolak, 2006) with their children than did fathers.

Blandon and Volling (2008) replicated several of these findings using the MCDS families. Although siblings were not treated differently during the family clean-up paradigm, mothers' and fathers' parenting differed. Specifically, mothers were more inclined to use gentle guidance and engaged in more shared positive affect with the children than did fathers. These findings underscore the differences in parents' and siblings' behavior within the family, demonstrating consistently across two separate studies that mothers use different levels of guidance and positive affect than fathers and that older and younger siblings engage in different levels of compliance consistent with age trends and are also treated differently by their parents.

MOTHERS AND FATHERS AS IMPORTANT CONTRIBUTORS TO EARLY SELF-REGULATION

Because we take a systemic perspective to the study of early self-regulation, we examined indicators of mothers' and fathers' parenting behaviors simultaneously in predicting children's compliance. We found significant statistical interactions between mothers' gentle guidance and fathers' gentle guidance during the family clean-up task in predicting both the older and younger siblings' committed compliance (Volling, Blandon, and Gorvine, 2006). Specifically, maternal gentle guidance was positively associated with the older siblings' committed compliance to mothers, but only when fathers were also using high levels of gentle guidance with the older sibling. No such relation between maternal gentle guidance and committed compliance was found when fathers were using low amounts of gentle guidance.

We interpreted this significant interaction between maternal and paternal gentle guidance as possibly reflecting the co-parenting that was ongoing during the family clean-up. The significant interaction between mother and father behavior had a different pattern for the younger siblings. In this case, when both mother and father were high on gentle guidance with the toddlers, the toddlers were less likely, not more likely, to use committed compliance. These disparate findings across siblings most likely reflect the developmental differences between toddler and preschool siblings and the young toddlers' inability to comply with parents' clean-up requests consistently without persistent parental prompting. In addition, the correlational design of the PCSR study means that the findings might just as easily reflect a child effect (i.e., parents are using high levels of guidance with a nonresponsive toddler) as a parent effect.

Recent analyses of the MCDS sample revealed a very similar set of findings. Recall that children in the MCDS study were older than those in the PCSR study, with the younger siblings approximately 2 years of age ($M = 27$ months) and the older siblings approximately 5 years of age on average ($M = 58$ months). Because committed compliance increases with age, we would expect that most children by late preschool and early elementary school should comply to parents' requests on a routine basis. Toddlers in this study were between 2 and 3 years of age, the developmental period considered significant for the early emergence of self-regulatory competence. As a result, we expected to find more significant results for the younger toddlers than for the older siblings. Indeed, we only found a significant interaction between maternal and paternal gentle guidance in predicting the 2-year-olds' committed compliance to fathers (Blandon & Volling, 2008). Similar to our earlier findings, paternal gentle guidance was positively related to the younger siblings' committed compliance to fathers when mothers were also using high levels of guidance with the younger sibling during the family clean-up, but not when mothers were using low levels of gentle guidance.

Another measure of early self-regulation is the strange situation, in which infants must adapt to the comings and goings of parental figures. As part of the PCSR study, we conducted strange-situation assessments of mother-infant and father-infant attachment when the younger siblings were 12 and 13 months of age and then used these early indicators of attachment security to predict the younger siblings' committed compliance in the family clean-up when they were 16 months old. Neither the security of the mother-infant nor father-infant attachment relationship predicted the toddler siblings' committed compliance separately. Only the interaction between mother-infant and father-infant attachment explained unique variance in predicting the 16-month-old toddler siblings' committed compliance. Toddlers complied more with mothers when they had a secure mother-infant attachment, but were also insecurely attached to their father. There was no relation between the security of the mother-infant attachment and the toddlers' committed compliance when the father-infant attachment was secure (Volling, Blandon, & Kolak, 2006).

In line with a family systems perspective, these results demonstrate that mothers' and fathers' behaviors interact in significant ways to predict children's outcomes. Often, fathers are disregarded in research studies because they clearly do not spend as much time interacting with their children as do mothers. More time with children is equated with greater influence. However, even though fathers may not spend as much time with their children and even when their behavior does not predict children's outcomes independently, our results indicate in several instances that fathers' behavior moderates the effect of mothers' behavior in predicting children's compliance outcomes. We have demonstrated this moderating influence in two separate studies with children of different ages and with different measures of parenting (e.g., gentle guidance, attachment). A family systems perspective claims that members of a family can influence other members within the family through their influence on individuals and on dyadic relationships within the family (Minuchin, 1974) and not simply through the direct, one-on-one parenting that children receive from mothers.

COMMITTED COMPLIANCE AND EARLY CONSCIENCE

Some might argue that even though we are observing children's committed compliance in the family clean-up paradigm, there is still no indication that it predicts or is related to the development of conscience or the early internalization of parental standards for conduct. In an effort to ascertain whether our measures of children's committed compliance might be valid indicators of early internalization and conscience development, we had mothers and fathers in the MCDS study complete a measure of conscience development (Kochanska, DeVet, Goldman, Murray, & Putnam, 1994); this measure yields two scales assessing *affective discomfort* (e.g., guilt, remorse after transgression, prosocial response to another's distress) and *moral regulation* (i.e., confession, internalized conduct, concern by other's transgressions). Again, given the age difference between siblings, we expected the results to hold for the 2-year-old toddler and not necessarily for the older sibling. Indeed, only for the toddlers did we find significant associations between observed compliance/noncompliance in the family clean-up paradigm and parents' reports of conscience. Fathers' reports of moral regulation were positively associated with the 2-year-old siblings' committed compliance to both mother and father. Mothers' reports of moral regulation were negatively related to the toddlers' refusal of maternal requests to clean up, whereas fathers' reports of affective discomfort were inversely related to the toddler siblings' refusal of paternal clean-up requests (Groenendyk & Volling, 2007). Thus, at least in the case of our 2-year-old siblings, committed compliance as measured in our family clean-up paradigm is correlated with independent indicators of early internalization and conscience development.

CO-PARENTING AND CHILDREN'S SELF-REGULATION

We interpreted the interaction effects between mothers' and fathers' behavior in predicting children's compliance during the family clean-up task as a reflection of the co-parenting occurring between mothers and fathers. Co-parenting refers to the extent to which spouses support or undermine each other's efforts at parenting their children (Belsky, Crnic, & Gable, 1995; McHale, 1995). Belsky et al. (1995) noted several ways in which spouses can either work together to support one another or actually work against each other in the course of parenting their children. In the case of children's compliance, supportive co-parenting during a clean-up session would include instances when both parents give the same request simultaneously, one parent repeats a request made by the other parent, makes additional comments to increase the likelihood the child will follow through with the other parent's request, or actually complies with the other parent's requests. Unsupportive co-parenting includes episodes in which one parent refuses to follow through with the other's request, critically comments on what the other parent is doing, gives competing directions, or interrupts the ongoing interaction of the other parent with the child. Few studies have examined the links between co-parenting and children's outcomes. However, Belsky et al. (1995) reported that unsupportive co-parenting was related to parental problems with discipline and that toddler sons in these families had more externalizing behavior problems (see also McHale & Rasmussen, 1998; Schoppe, Mangelsdorf, & Frosch, 2001).

Although much of the existing co-parenting work focuses on triadic interaction contexts as representative of family-level process (i.e., mothers, fathers, and one child), we used the family clean-up paradigm including four family members. As part of an exploratory investigation, we coded the family clean-up paradigm of the PCSR study for co-parenting using the definitions provided by McHale (1995). Instances of co-parenting included parents supporting one another while assisting their children in cleaning up the playroom (i.e., co-parental cooperation), as well as when they interfered with each other's efforts (i.e., co-parental competition). This section presents the findings from this research.

We conducted several hierarchical regression analyses to examine whether (a) co-parenting predicted unique variance beyond parenting and (b) parenting interacted with co-parenting to predict children's committed compliance. We focused only on committed compliance in these analyses, given its association with early internalization (see Kochanska, 2002), and averaged parents' gentle guidance and shared positive affect scores to create a responsive guidance composite for mothers and for fathers.

In the four models tested for the younger siblings, co-parenting explained additional variance in only one: 6% of the variance in the toddlers' committed compliance to their mothers was explained by partner cooperation above and beyond mothers' and fathers' responsive guidance. None of the parenting by co-parenting interaction terms was significant when examining the toddlers' committed compliance to either mothers' or fathers' clean-up requests. On the other hand, two of four models revealed significant interaction terms when examining the older siblings' committed compliance: fathers' responsive guidance by partner cooperation predicted the older siblings' committed compliance to father, and mothers' responsive guidance by partner cooperation predicted the older siblings' compliance to mother.

For the older siblings' compliance to mother, Figure 10.3 indicates that, when partner cooperation was high, there was a positive association between the older siblings' committed compliance to mothers and maternal responsive guidance. No relationship was found between maternal responsive guidance and children's committed compliance when partner cooperation was low. Figure 10.4 shows that when partner cooperation between parents was high, there was a negative association between fathers' responsive guidance and the older siblings' committed compliance. No such association was found when partner cooperation was low.

These multivariate analyses provide insight into the complex interactions between parent-child relationship quality and co-parenting during the family clean-up session. They also suggest that mothers' and fathers' behavior may interact differently with co-parenting to predict compliance outcomes. Specifically, high partner cooperation between mothers and fathers appeared to compensate for low levels of responsive guidance between the

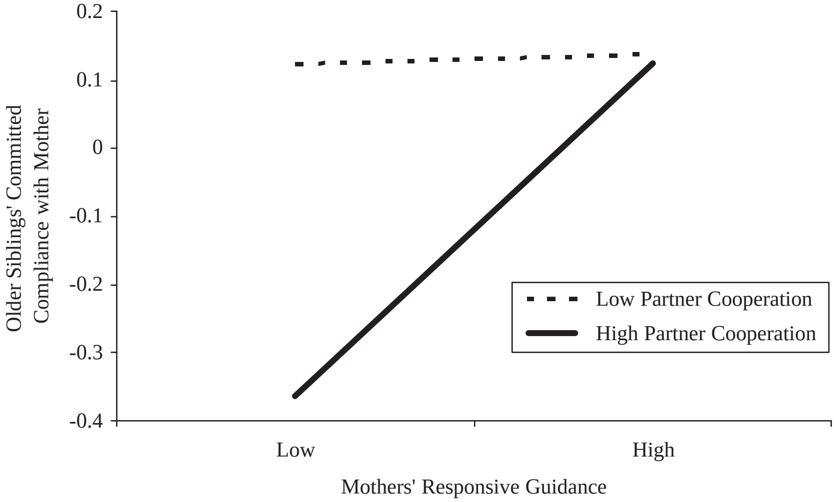

Figure 10.3. The interaction between mothers' responsive guidance and partner cooperation predicting the older siblings' committed compliance to mother.

father and the older sibling. Thus, when both mothers and fathers worked together in a cooperative manner to co-parent during the clean-up session, the older siblings performed more committed compliance despite the fathers' low levels of responsive guidance.

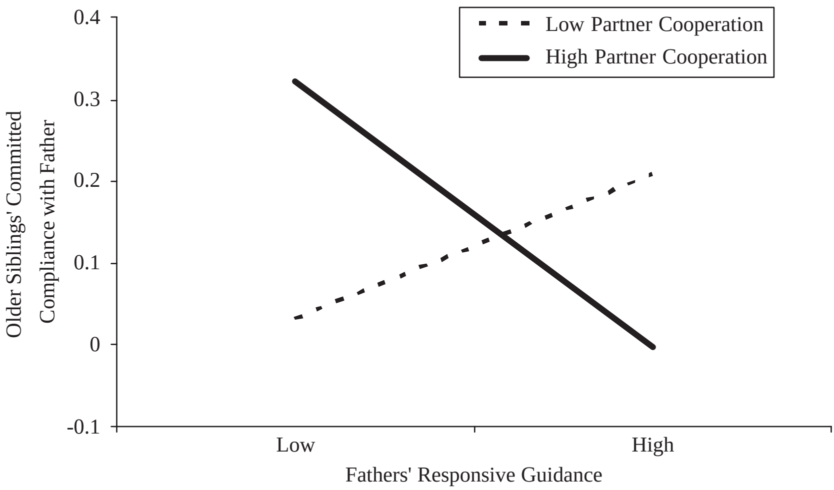

Figure 10.4. The interaction between fathers' responsive guidance and partner cooperation predicting the older siblings' committed compliance to father.

A different picture emerged in the case of the mother-older sibling relationship. Here, it was under conditions of high partner cooperation that maternal responsive guidance with the older sibling showed a positive relation with the older siblings' committed compliance. It is not completely clear why different associations and interaction effects emerged for mothers and fathers when considering partner cooperation, but it is possible that co-parenting and parenting may be linked differently for mothers and fathers, just as others have found different associations between marital relationship quality and parenting for mothers and fathers (Belsky, Youngblade, Rovine, & Volling, 1991; Brody, Pellegrini, & Siegel, 1986). Mothers' parenting and co-parenting appear to be highly linked in that high partner cooperation coupled with high levels of maternal responsive guidance was associated with high levels of committed compliance on the part of the older sibling. Fathering and co-parental cooperation revealed more of a compensatory pattern so that, under high levels of co-parental cooperation, older siblings still performed more committed compliance regardless of the fathers' low levels of responsive guidance. Because mothers tend to be the gatekeepers of social relationships within the family and are considered experts in child care (Coltrane, 1996; Hochschild, 1989), mothers may be leading the clean-up interactions and, as a result, may be better at negotiating the co-parent and parent role as they orchestrate the clean-up plan. Fathers may be more inclined to co-parent with the mother as they follow and cooperate with instructions she is giving and may be less likely to initiate clean-up requests independently. Further research is certainly needed to determine whether this may be the case.

DIFFERENTIAL PARENTING AND YOUNG CHILDREN'S SELF-REGULATION

Another within-family process that may be examined during whole-family interaction involving siblings is differential parenting or, more specifically, the difference in how a parent treats one child in relation to another. If parental expectations about maturation and the ability to regulate one's emotions and behaviors differ for younger and older siblings in the family (Kopp, 1982), this should be evident in the different levels of parenting each child receives during the family clean-up. There is a fairly extensive literature linking differential parenting with children's problematic behavior in early childhood, middle childhood, and early adolescence (e.g., Brody, Stoneman, & McCoy, 1992; Feinberg & Hetherington, 2001; McGuire, Dunn, & Plomin, 1995; Stocker, Dunn, & Plomin, 1989; Volling & Elins, 1998). This research has focused mostly on differential control and differential affection and has found that, in general, behavior problems are positively associated with more differential control and less differential affection. In other words, children receiving more control and less affection from their parents in relation to their sibling often exhibit more problem behaviors. Because most, if not all, of these studies are correlational, it is difficult to discern the direction of effects. Do children develop externalizing behavior problems because parents discipline and control them more than their sibling and express less love and affection toward them? Or do parents use more control and less affection with the sibling with more difficult behavior problems?

Regardless of the direction of effect, what is clear from the research on differential parenting is that, in families with two or more children, differential parenting often predicts children's behavior problems and the quality of the sibling relationship. Therefore, differential parenting may also predict young children's self-regulation and compliance. To address this possibility, Volling, Blandon, and Gorvine (2006) used the parenting variables (e.g., gentle guidance) during the family clean-up session in the PCSR study to create differential parenting scores. These scores were created by subtracting the maternal gentle guidance directed to the younger sibling during the clean-up task from the maternal gentle guidance directed to the older sibling. Many studies report correlations between differential parenting and children's adjustment outcomes, but they do not address whether differential parenting explains additional variance above the effect of direct parenting (i.e., behavior directed toward the individual child). Perhaps direct parenting, and thus, the dyadic interaction between parent and child, is sufficient in predicting children's compliance. In that case, there is little support for our argument that emergent family processes observed only when multiple family members are together are important for understanding the early development of self-regulation. There is evidence that differential parenting continues to predict unique variance in sibling relationship quality and adjustment outcomes in middle childhood and adolescence (e.g., Brody, Stoneman, & McCoy, 1992; Feinberg & Hetherington, 2001), and we wanted to address this possibility by looking at young children's committed compliance.

Volling, Blandon, and Gorvine (2006) found that differential maternal guidance explained marginally more variance in the older siblings' committed compliance to mother after controlling for direct maternal guidance. What was more interesting, however, was the significant interaction between differential maternal guidance and direct maternal guidance in predicting the older siblings' compliance. That is, under conditions of low maternal guidance, older siblings still complied more with maternal requests if mothers were using more gentle guidance with them in relation to their younger sibling. These findings suggest that differential parenting may be a salient within-family process and that its effects on sibling outcomes can differ depending on the level of parenting each child receives. However, the findings only held for mothers and older siblings, and not with fathers in general or with younger siblings. Further, we were unable to replicate these findings in the MCDS sample, so we must remain cautious in our interpretation of these results.

We have plans to continue our investigation of differential parenting in predicting children's *noncompliance* by examining the passive noncompliance and refusal we also coded during the family clean-up paradigm. We may have more success in predicting these "negative" outcomes, which are more similar to the externalizing behaviors and adjustment difficulties addressed in the majority of differential treatment studies to date.

CONCLUDING REMARKS

Aggression, noncompliance, and defiance in the toddler and preschool years may be the earliest signs of behavior and emotion dysregulation and can place a child at risk for later psychopathology (Campbell, Shaw, & Gilliom, 2000; Olson, Sameroff, Kerr, Lopez, & Wellman, 2005). In this chapter, we focused on young children's compliance as a means of assessing self-regulation in early childhood and presented a family systems model of early self-regulation that underscores the multiple relationship systems that exist within the family and the inherent limitations of research devoted exclusively to the study of mother-child dyads. By focusing on two-parent families with two children, we were able to address co-parenting between mothers and fathers and differential parenting of siblings as two within-family processes that were related to young children's compliance. Our work also underscores that, at any point in time, parents may direct different levels of guidance or positive affect to older and younger children in the family and that siblings of different ages use more or less committed compliance, which is consistent with a developmental perspective. How parents manage to discipline and care for two or more children in a family, who are at different developmental levels, is rarely examined in research on children's self-regulation, and the role of siblings in the development of self-regulatory competence is virtually ignored. The developmental level of the child also appeared to play a role in how mothers' and fathers' behaviors were related to committed compliance, with older siblings appearing to be enthusiastically compliant when both mother and father were guiding and instructing them to clean up the playroom, and toddler siblings performing less committed compliance when both parents were instructing them to clean up. As noted earlier, we cannot disentangle the direction of effects from these correlational data, but regardless of whether we have uncovered a parent or child effect, the fact is that parenting did not relate to children's compliance in the same manner for two different-aged children in the same family.

Moreover, mothers and fathers do not use similar levels of guidance in directing their children to clean up. The parenting behavior of mothers and fathers had different relations with co-parenting, such that mothering and co-parenting were positively related, but co-parenting appeared to compensate for low levels of fathering. Thus, we cannot assume that relationship dynamics within the family predict parenting for men and women in the same manner.

Children obviously live and develop in a complex social world that involves parents, siblings, friends, and extended family members. Yet, research lags sorely behind in attempting to capture the complex family dynamics that may contribute to a young child's early social and emotional development. The current research finds that family influence is not always additive, with mothers and fathers having independent effects. However, in most cases, the behavior of one parent interacts with that of the other to determine developmental outcomes, thus underscoring the necessity of knowing the quality of family relationships that children have with significant family members other than their mothers.

The present research is not without its weaknesses. Some could legitimately argue that many children do not live and grow up in two-parent families, and therefore, findings from our family clean-up paradigm may not generalize to other family structures. This is certainly the case. Most children, however, are not raised and socialized solely by their mothers either, yet rarely do we question the near-exclusive focus on mothers in research addressing both normative development and the development of psychopathology (also see Phares, Fields, Kamboukos, & Lopez, 2005). Our family clean-up paradigm is also relatively short (5 minutes) because families can work together to clean up a playroom fairly quickly. Further, the contrived lab task may not represent what family members actually do at home. For this reason, we are currently planning a new study in which families will be observed in their homes and asked to participate in a family prohibition task ("don't" task) where mothers and fathers must keep their two children from touching a set of attractive toys. This study will allow us to extend the time frame in which to observe parental control strategies and whether children comply or do not in a different family paradigm. This latter research is also longitudinal so we will be able to use earlier information on family relationships in infancy to predict self-regulation in toddlerhood and the preschool years.

Our current research represents one way of investigating within-family dynamics, but certainly does not exhaust the possibilities for examining within-family differences, as well as the effects of shared and nonshared family influence on siblings within the family (see Jenkins, Simpson, Dunn, Rasbash, & O'Connor, 2005, for a recent example). As we end this chapter, our hope is that future research on the development of early self-regulation will acknowledge a family systems perspective and begin to explore the complexity of family relationship dynamics that can contribute to the well-being and healthy development of young children.

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11

Culture and the Development of Regulatory Competence: Chinese–U.S. Comparisons

TWILA TARDIF, LI WANG, AND SHERYL L. OLSON

One of the most stunning demonstrations of differences in behavior regulation across cultures can be found by simply walking into preschool or early elementary classrooms in Chinese societies (including Hong Kong, Taiwan, and Singapore) versus those in the United States. Before even making it to the center of the classroom, one is immediately struck by the differences – found in classroom after classroom, school after school – in the appearance of the "cubbies" and other entry areas. In both Chinese and American preschools, children have cubbies in which they can place their personal belongings (school bags and the like) and outdoor clothing. In both, these cubbies tend to be arranged as a line of boxes or hooks on a wall near the entrance to the room. In both, there are names and pictures of the children on the cubbies in addition to their belongings. When empty, they are almost identical.

But from the minute the first child arrives at school, the differences begin to appear, and they magnify with each additional child who comes into the classroom. What is the difference? In the few seconds (this rarely lasts even as long as a minute in either place) between parents dropping off their child and the child entering into the classroom proper, children's belongings get placed in the cubby. Once they are placed there, the Chinese children's cubbies emerge neat and full of order, every cubby showing the same type of arrangement (with different actual items inside the cubbies) as the next. In contrast, the North American children's cubbies have the semblance of clothes being thrown onto hooks, shoes or boots tossed into a box, and bags and other items haphazardly arranged, facing this way and that as one moves down the row of cubbies. How do these differences occur, and why do they matter?

In this chapter, we address self-regulation in a cultural context. We consider the role that culture plays not only in shaping patterns of self-regulatory behavior but also in *creating* them. The picture of an entryway at a local preschool in Chinese versus North American cultures can serve both as metaphor and as example of how, given equal amounts of time and equal pressures to transition children from one activity to the next, we find differences, over and over again, in how parents, children, and teachers from each culture regulate and adapt their behavior. In all cultures studied thus far, regulatory competence not only predicts future social outcomes (Chen, Wang, & DeSouza, 2006; Eisenberg, Fabes, Guthrie, & Reiser, 2000; Fox & Calkins, 1993; Rubin, Coplan, Fox, & Calkins, 1995; Saarni, 1998) but also mediates the relation between parenting and problem behaviors (Eisenberg et al., 2005).

In this chapter, we examine how children growing up in different cultures – we focus here on Chinese and American cultures – have different preferences for regulatory behaviors and how the regulatory behaviors and expectations that groups and individuals have may lead to differences not only in behavior but also in physiologically based regulatory processes. Our focus on these two cultures stems from a variety of sources, including the frequent dichotomies that have been used to describe and differentiate these cultures (e.g., collectivistic vs. individualistic, shame-oriented vs. guilt-oriented, somatic vs. psychological focus of emotions), and also the insights we have achieved in our own research and those of many others who have begun to focus on a number of aspects related to self-regulation that are particularly informed by looking at these two cultures. It is important to state at the outset, though, that our understanding of "culture" is as a dynamic system that organizes and provides meanings and contexts for, but does not determine, individual activities, beliefs, and values (Cole, 1996; Miller, 2002; Shweder et al., 1998).

Cultures change over time, and the role or extent to which culture intervenes and shapes everyday life can change from moment to moment (Hong, Morris, Chiu, & Benet-Martinez, 2000). Thus, we place primary focus on contemporary practices that are rooted in larger traditions, but assume that as cultural values and priorities change, so might the practices. Our view of culture and of the issues in this chapter is, by necessity, a transient one. We expect that these results may change over time as the circumstances and the people in these cultures change – but we also assume that some processes may change more quickly than others, and hence there is a basis for looking at stable differences that have developed over long time periods and been repeated in multiple generations and across multiple circumstances.

Most importantly, we propose that varying cultural preferences for self-regulation can be examined from a consideration of differences in the expression and regulation of emotion and that these differences are not just "social" phenomena. Instead, we argue that they are biological phenomena as well and are both reflected in the parents' temperaments and, crucially, re-created in each new generation of children through a complex interplay of genetic predispositions and socialization experiences in families, schools, and preschools, as well as larger societal experiences and systems of belief. We begin by examining the initial question of whether cultural differences may be found at fundamental levels of temperament and biological reactivity and consider the physiological underpinnings of regulation more generally. We then move beyond the individual to considering the role that parents and other socializing agents such as schools and peers may have on determining preferences and creating pressures for regulation within a given cultural context. Next, we consider higher order differences in regulation abilities at cognitive and behavioral levels that may contribute to and also help shape or potentially remove differences in emotional responding across cultures. Finally, we are interested not only in whether mean levels of behaviors, values, or expectations differ across cultures but also in whether the relationships between child and parent, child and peer, or individual patterns of biology and behavior are equally predictive of regulation successes and difficulties across cultures that differ dramatically in what are considered "normal and healthy" regulatory behaviors. To integrate these perspectives, we present a framework for emotion regulation as a complex system that incorporates cultural, cognitive, behavioral, and physiological elements as a model for future research.

REGULATION AND THE ENVIRONMENT: WHAT IS INVOLVED?

Regulation, in our definition, relies heavily on the concept that immediate responses to the environment can be adaptive or maladaptive, depending on the larger interplay between who one is and both the short- and long-term consequences of making a particular response. A well-regulated response is the response that is maximally adaptive, both in the short and long term, for the individual and the particular situation. A well-regulated response may be the immediate response of an individual, but is more likely to involve a fine-tuning of the immediate response or response tendency on a variety of levels – psychological, behavioral, and physiological (Rothbart, Bates, Eisenberg, Damon, & Lerner, 2006; Rothbart, Kohnstamm, Bates, & Rothbart, 1989; Rothbart, Posner, Kieras, McCartney, & Phillips, 2006). Because different cultures have different values and norms for appropriate or "adaptive" behavior and these values and norms differ according to age, gender, and a number of other factors – for instance, rank, in an occupational setting – (Begley, Lee, & Hui, 2006; Chia, Wuensch, Childers, & Chuang, 1994; Markus & Kitayama, 1991; Pan, 1995; Tang & Dion, 1999; Wan et al., 2007), it is not surprising that individual, gender, and cultural differences in responding to a variety of emotion-provoking stimuli have been found at all of these levels.

In this chapter, we focus particularly on how differences in cultural values and norms can affect development and result in long-term tendencies toward particular regulation tendencies and strategies. Specifically, we present evidence for regulatory differences that begin in infancy and have biological underpinnings as well as biological, behavioral, and social consequences. Both cultural and individual differences have been found even in early infancy: some infants show high arousal and distress during routine immunizations and medical procedures, whereas others appear relatively calm (Caudill & Weinstein, 1969; Thomas & Chess, 1977). Normally, these behavioral manifestations of emotion are accompanied by corresponding differences in physiological arousal – as measured by heart rate (HR), HR arrhythmias, or limbic-hypothalamic-pituitary-adrenal (LHPA) axis indicators such as blood or salivary cortisol levels. Not surprisingly, individual differences in these early patterns of behavioral and physiological responses have been found to predict both biological and behavioral adjustment throughout the life span (Calkins & Fox, 2002; Cicchetti, Ackerman, & Izard, 1995; Gunnar, Tout, de Haan, Pierce, & Stansbury, 1997; Moffitt & Caspi, 2001; Olson, Schilling, & Bates, 1999; Stifter, Spinrad, & Braungart-Rieker, 1999). For instance, some studies have demonstrated that infants and toddlers who are highly reactive during inoculations and anxious in novel situations (e.g., when greeted by a stranger or when confronted with an adult wearing a strange mask) show similar types of reactivity or inhibition (Kagan & Reznick, 1989) in their later years. In addition, work by Gunnar and colleagues has found that preschoolers often have a disrupted pattern of cortisol release in response to the social demands of the U.S. preschool setting and that children with more difficult temperaments are more susceptible to these disruptions than children with less difficult temperaments (Dettling, Gunnar, & Donzella, 1999; Dettling, Parker, Lane, Sebanc, & Gunnar, 2000; Watamura, Donzella, Alwin, & Gunnar, 2003; Watamura, Sebanc, & Gunnar, 2002). Finally, adults who had been categorized as inhibited in their second year of life were found to show greater amygdala responses in an fMRI paradigm to novel faces when compared with adults who were not categorized as inhibited at that early point (Schwartz, Wright, Shin, Kagan,

& Rauch, 2003). These findings speak both to the biological component of temperament and its stability.

At the same time, a number of studies have shown that behavioral strategies such as distraction and verbal stimulation introduced by parents or health care professionals can modulate these responses and have lasting effects on infants' tendencies toward negative arousal up to a year or more later (Cohen et al., 2006; Felt et al., 2000; Larsson, 1999). Other studies show that parents serve as important moderators or amplifiers of children's tendencies toward arousal, anxiety, and inhibition (e.g., Chang, Schwartz, Dodge, & McBride-Chang, 2003; Rickman & Davidson, 1994) and that different cultural environments can produce different consequences for the same behavioral tendencies (e.g., shyness in U.S. vs. Swedish culture; Caspi, Elder, & Bem, 1988; Kerr, Lambert, & Bem, 1996). Thus, learning how to regulate emotional and behavioral responses is not just a critical task of early development (Cole, Martin, & Dennis, 2004; Kopp, 1989; Shields & Cicchetti, 1998; Thompson, 1994) but also one that fundamentally involves parents and caregivers, who have their own specific pressures and practices for their own and their infants' regulation of both positive and negative emotional states and behaviors.

Complicating this picture is the fact that, although persistent states of over- or underarousal would clearly be dysfunctional in all cultures, there is no single pattern or model of emotional and behavioral responding that is appropriate for all situations or all individuals. Different cultures, different genders, and different situations require very different types of emotional and behavioral expressions, and regulating emotional and behavioral expression requires the control of both positive and negative emotions and action in all of these contexts (Campos, Frankel, & Camras, 2004; Cole, Teti, & Zahn-Waxler, 2003; Raver, 2004; Soto, Levenson, & Ebling, 2005). Thus, adjusting one's affective and behavioral reactions to "fit" the demands of varying life situations is a necessary component of normal social competence and one that must also be learned early in life (Eisenberg, Guthrie, & Fabes, 1997). Learning to find one's cubby, say goodbye to mom or dad, and put away one's belongings before entering the classroom are common environmental challenges to preschool children across cultures, but how children, parents, and schools respond to these challenges reflects the social demands of these different cultures.

Thus, we are interested in finding not only the different outcomes for particular aspects of temperament or self-regulation but also the *strategies* that children and caregivers in different cultures use to develop "optimal" levels of emotional responsivity in a given situation. In addition, because we focus on different levels of emotional reactivity and regulation, we are also interested in the relations among behavioral strategies, displays of emotionality, and the physiological mechanisms related to these strategies and displays as a way to frame and understand emotion regulation and help explain cultural differences in emotion regulation norms and behaviors.

REGULATION OF BEHAVIORAL AND PHYSIOLOGICAL AROUSAL ACROSS CULTURES: FROM TEMPERAMENT TO HEART RATE VARIABILITY

Individual differences in temperament are reflected in how infants react and regulate their reactivity, which is measured by the time it takes to soothe them after an initial reaction to an adverse stimulus such as a routine immunization, intense sensory experience, or movement restriction (Fox & Henderson, 1999; Fox, Polak, DelCarmen-Wiggins, & Carter, 2004; Fox & Reznick, 1989; Rothbart et al., 1989; Thomas & Chess, 1977), as well as in a wide variety of other social and nonsocial situations (see recent reviews by Kagan, Fox, Eisenberg, Damon, & Lerner, 2006; Rothbart, Bates, Eisenberg, et al., 2006). Temperament itself is part of a more general system that involves modulating reactivity both physiologically and behaviorally.

Although individual differences in behavioral reactions to novel situations during infancy and toddlerhood have been widely discussed, the question of whether there are cross-cultural differences in reactivity and temperament during infancy is a controversial one and has received relatively little research attention outside of some very early studies demonstrating differences between Asian and Caucasian babies (Caudill & Weinstein, 1969; Freedman & Freedman, 1969; Kagan, Arcus, Snidman, & Feng, 1994; Kagan, Kearsley, & Zelazo, 1978). Specifically, across a variety of studies and paradigms, Caucasian American newborns and young infants have been found to be consistently more "irritable" and reactive than Chinese, Japanese, Chinese American, and Asian American infants (see also Camras et al., 1998, 2002; Camras, Oster, Campos, & Miyake, 1992; Lewis, Ramsay, & Kawakami, 1993). More recent studies, primarily with older children, support these earlier findings in a number of behavioral paradigms and report that Chinese or Chinese American children show consistently less emotional expressivity (both for positive and negative facial expressions) than U.S. Anglo-European children (Camras, Bakeman, Chen, Norris, & Cain, 2006; Camras et al., 1998; Garrett-Peters & Fox, 2007; Kisilevsky et al., 1998). Thus, Chinese infants and children have been found to be less physiologically or behaviorally reactive across a variety of stressors than their European American counterparts. However, because these differences may arise from a number of sources and have the potential to influence and predict later behavior in important ways, a number of questions emerge from these findings.

First, what are the *relationships* between behavioral reactivity and physiological reactivity? Presumably, children who are highly reactive behaviorally are reflecting greater physiological reactivity in their autonomic nervous systems (ANS; Bauer, Quas, & Boyce, 2002; Calkins, 1997; Schmidt, Fox, Schulkin, & Gold, 1999; Snidman, Kagan, Riordan, & Shannon, 1995). However, a number of characteristics, such as behavioral interventions, specific biosocial contexts, gender, temperament, and age, may mediate this relationship such that physiological reactivity does not bear a simple relationship to behavioral reactivity (Buss, Goldsmith, & Davidson, 2005; Donzella, Gunnar, Krueger, & Alwin, 2000; Felt et al., 2000; Gunnar, Bates, & Wachs, 1994; Gunnar & Nelson, 1994; Quas, Hong, Alkon, & Boyce, 2000). Moreover, a number of different types of behavioral reactions may stem from very similar physiological underpinnings. For example, both fear/anxiety and anger/frustration provoke ANS reactions, but the behavioral manifestations of these reactions are quite different (see Levenson, 2003, and others; but also see Lewis & Ramsay, 2002, and Lopez, 2006, for indications of how cortisol responses may differ across emotional modalities).

Thus, although Chinese and European American children also differ in a number of measures of ANS reactivity, such as HR variability in unfamiliar situations (Kagan, Arcus, Snidman, & Feng,1994), increased behavioral reactivity may not show the *same* relationship to increased physiological reactivity across cultures. Interestingly, in one of a very small number of studies that has examined cross-cultural differences in *both* behavioral *and* physiological reactivity to stress in infants, Lewis et al. (1993) found that 4-month-old Japanese infants in the United States were less behaviorally distressed, but had higher release of cortisol in response to routine inoculations than same-aged Caucasian American infants. Most interesting in these results were that Caucasian American infants were overrepresented in the "high behavioral distress, low cortisol" quadrant and Japanese infants were overrepresented in the "high cortisol, low behavioral distress" quadrant when the behavioral and cortisol data were divided based on a simple median split across the two dimensions.

Similar findings of differing relationships across experiential, behavioral, and physiological levels of emotional reactivity have been obtained across a number of studies with adults from a variety of cultural groups (see Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005; Tsai, Chentsova-Dutton, Freire-Bebeau, & Przymus, 2002; Tsai & Levenson, 1997; Tsai, Levenson, & McCoy, 2006). Most interesting is that studies examining the relationships among these factors in adults from differing cultural groups suggest that the *links* between behavioral and physiological reactivity to emotion-inducing stimuli may not be the same for adults from differing cultural groups and that different factors may serve as mediators between these two levels of emotional reactivity and regulation. For instance, in a study examining facial expressions of emotion, experienced emotionality, and physiological responding to discussions about areas of conflict in dating Chinese American and European American college students (Tsai, Levenson, & McCoy, 2006), differences between groups were found on some levels but not others. Moreover, the factors accounting for variation across individuals differed depending on the type of response. In particular, Chinese Americans showed greater levels of negative affect facial expressions and European Americans greater levels of positive affect facial expressions, despite no differences in experienced emotionality during these discussions. In addition, there were cultural differences in autonomic reactivity as measured by cardiac interbeat interval (IBI) but not galvanic skin responses (GSR), and the variability in IBI was much more highly related to cultural factors (the extent to which individuals identified with American cultural values) than to other factors such as temperament or experienced emotionality. In a completely different paradigm (Soto et al., 2005), Mexican American and Chinese American college students' experienced emotions, facial expressions of emotions, and physiological reactions (using a composite score across measures of ANS reactivity) were tested on their responses to an acoustic startle under a variety of conditions. In this study, no differences were found in the composite physiological reactivity score, despite clear differences in experienced emotion (with Chinese Americans reporting less experienced emotion for both positive and negative emotions than Mexican Americans) and differences in attempts to control one's physiological reactions (again with Chinese Americans reporting lower levels of attempted control). In addition, no overall differences were found in levels of positive or negative facial expressions between the two cultural groups. However, within-group differences revealed that Chinese Americans who expressed greater orientation to Chinese culture expressed fewer negative emotions in this situation, and conversely, Mexican Americans who expressed greater orientation to Mexican culture expressed greater amounts of negative facial expressions, suggesting some impact of culture on the degree of emotion expressed even in this relatively nonsocial situation.

Although the authors of these studies conclude that physiological responses (which varied the least across the groups studied) may be less susceptible to cultural influences, multiple and repeated experiences in a particular cultural milieu may affect both behavior and physiology, as well as the relationship between the two. Importantly, an individual could become more reactive if placed in a cultural setting that values and enhances emotional expressions to changes in the situation or interprets ambiguous social situations as threatening, whereas the same individual could become more placid if placed in a cultural setting that values and enhances regulatory control. This response has already been demonstrated in behavioral studies – for instance, by longitudinal follow-ups of adult outcomes for shy and inhibited children in the United States (Caspi et al., 1988) versus Sweden (Kerr et al., 1996) – but we propose that future research must also consider the role of multiple levels of physiological differences in reactivity across cultures. Specifically, we echo Kagan et al. (2006) and others in suggesting that long-term differences in cultures and cultural practices may result in population differences in the presence of genetic variations (Kumakiri et al., 1999; Nakamura, Ueno, Sano, & Tanabe, 2000; Rutter, Moffitt, & Caspi, 2006) and in phenotypic expressions of the physiological reactions (e.g., increased cardiac or cortisol reactivity, right frontal activation in EEG paradigms) that underlie emotional reactivity and regulation. Nonetheless, it is important to consider the *specific* aspects of the cultural milieu and cultural experiences that might generate and lead to these differences and to realize the importance of gene-environment interaction effects that might moderate these differences (e.g., see Rutter et al., 2006; Tuvblad, Grann, & Lichtenstein, 2006) – rather than to paint broad strokes and to treat cultural differences as evidence of "fundamental" differences in people from different cultural groups, such as the discussion of "essentialism" and its dangers when discussing temperament as a construct (Kagan, Fox, Eisenberg, Damon, & Lerner, 2006).

It is not "culture" that produces differences, but the cultural practices, over the long and the short term, that support and further differentiate or moderate different regulation tendencies. It is important to remember, also, that these differences can be as great between the United States and Sweden as between the United States and China. Similarly, because of similar societal pressures, individuals from originally different cultures (e.g., Chinese Americans vs. Mexican Americans) could also be more similar in a U.S. setting (see also Camras et al., 2006, for similarities between Chinese American and European American mothers) than individuals from the same gene pools (e.g., Caucasians in United States vs. Sweden; ethnic Chinese children adopted into non-Chinese U.S. families vs. Chinese children growing up in mainland China) who live in different cultural environments.

SOCIALIZATION OF EMOTION REGULATION IN DIFFERING CULTURAL CONTEXTS

In this section, we examine complex, multilevel cultural processes that bear on how children learn to adjust their behavioral and emotional responses to environmental challenges. First, we discuss how culturally salient values and ethnotheories concerning the control and expression of emotion may affect the socialization of self-regulation skills in young children. Next, we examine the myriad ways in which cultural values and socialization goals may be transmitted to children. Here we consider differences in patterns of support, discipline, and modeling and in how parents structure children's interactions with their physical and social worlds. Finally, we consider the development of self-regulation skills in early peer and school contexts.

Ethnotheories of Child Emotion Expression and Regulation

In all cultures, parents respond to the behavior of children in ways that reflect their beliefs about socially desirable conduct. Parents' beliefs reflect complex categories of implicit meanings that derive in part from folk knowledge about the nature of children and their place in society (LeVine, 1974; White, LeVine, Stevenson, Azuma, & Hakuta, 1986). Increasingly, these beliefs have been regarded as central components of children's socialization (Harkness, Super, Rubin, & Chung, 2006; Schwarz et al., 2005; Super & Harkness, 1986, 2002). For example, parents' "ethnotheories" about children's development have motivational properties: they define what is desirable and undesirable, thus providing a frame of reference for interpreting and responding to child behavior (Keller et al., 2005, 2006; Lieber, Fung, & Leung, 2006; Olson, Kashiwagi, & Crystal, 2001; Super & Harkness, 1986; Super, Harkness, Berry, Dasen, & Saraswathi, 1997). In the following section, we examine cultural values that may influence the manner in which Chinese as compared to U.S. parents foster emotional and behavioral restraint in their children.

Restraint of Strong Emotional Expressiveness

Cultural endorsement of emotional restraint has been linked to low levels of emotional reactivity and expressiveness in Chinese children (Liu et al., 2005). A number of values govern social rules concerning the suppression of strong emotion. First, emotional unresponsiveness is seen as an index of social and psychological maturity (Russell, Yik, & Bond, 1996; Wu & Bond, 1996), whereas strong positive or negative affective expressions are viewed as signs that are likely to lead to imbalance (Chen, Swartzman, Kazarian, & Evans, 2001; Kleinman, McHugh, & Vallis, 1986; Leung, 1998; Potter, 1988; Russell et al., 1996; Wu, Tseng, & Wu, 1985). In addition, emotional control is seen as necessary for strengthening desirable moral traits ("li" – propriety) and for maintaining social harmony (Chen et al., 2006; Lin, 1981). A multinational survey of parents' perceptions of child behavior confirmed the low salience of emotional expression in Chinese culture (Kohnstamm, Halverson, Mervielde, & Havill, 1998; Zhang, Kohnstamm, Slotboom, Elphick, & Cheung, 2002). In this study, free descriptions of child personality were obtained from parents in different countries, including mainland China. Content analyses revealed that, across all cultural groups, Chinese parents used the lowest percentages of descriptors relating to emotion characteristics. In addition, other studies have found that Chinese Americans and Chinese American mothers actively discourage emotional expression when asked about child-rearing practices and goals (Chen, Liu, Li, Cen, Chen, & Wang, 2000; Kagan et al., 1978; Lin & Fu, 1990; Wu & Bond, 1996). These findings are in contrast to U.S. Anglo-European parents' focus on maintaining positive and excited/enthusiastic emotional states, as well as the importance of "talking about" both positive and negative emotional states (Eid & Diener, 2001; Kitayama, Markus, & Kurokawa, 2000; Tsai, Knutson, & Fung, 2006; Wang, 2001).

Restraint of Extreme and Disruptive Behavior

Because of the strong cultural emphasis on maintaining social harmony, socially disruptive behaviors are viewed negatively and prohibited in Chinese families and schools (Chen, Chen, Wang, & Liu, 2002). Almost all types of "uncontrolled" behaviors, especially aggressive, disruptive behavior, are seen as problematic (Chen, Cen, Li, & He, 2005). Thus, from a young age, children are taught to suppress impulsivity, anger, defiance, and aggression. As with aggressive children in Western cultures, the consequences for displaying aggressive behavior are negative – aggressive Chinese children have been found to experience a variety of social, academic, and psychological problems (Chen, Rubin, Li, & Li, 1999; Chen, Rubin, & Li, 1995b).

Conversely, controlled, respectful, and harmonious behavior is deeply valued in Chinese culture (Chen et al., 2000; Ho & Bond, 1986). Children are encouraged to comply with parents' demands and with general social expectations regarding appropriate conduct (Chen et al., 2000). Thus, in one study, "well-behaved," "obedient," and "polite" were the most common terms of praise awarded to Chinese children (Chen et al., 2003). Whereas most Western children are socialized based on the idea that assertiveness and independence are the central indexes of mature social functioning, Chinese children have traditionally been brought up in an environment in which the overarching importance of group cohesion and of one's place in the social hierarchy greatly affects the perception of social competence. In China, it has not been a child's social initiative that is indicative of interpersonal aptitude, but rather the existence of responsible conduct, unselfish behavior, and prosocial self-regulation. For example, Chen and colleagues (Chen, He, De Oliveira, et al., 2004) demonstrated that several "collectivist" cultures (including China, Brazil, and Italy) and "individualistic" cultures (including the United States and Canada) valued different patterns of social behavior. Parents in all cultures preferred behavior that was both highly social and highly regulated. However, in China and other more "collectivistic" cultures, a child who showed low social initiative but who was still highly regulated would most likely be regarded alongside the highly regulated social child. Conversely, U.S. parents reported that they would be less worried if their child had high social initiative and lower regulation than they would if their child was well regulated but shy. However, as we discuss later, these differences appear to be changing with a second generation of "only children" and the greater focus on social and economic competitiveness in China, as well as an increased focus on self-regulation in the United States.

Focus on Training and Effort

A common belief in Chinese culture is that human behavior is malleable – effort is viewed as the major way to improve oneself (Stevenson, Lee, Chen, & Stigler, 1990). Indeed, in a comparative multinational survey, Chinese parents had relatively high proportions of descriptors of child conscientiousness such as "diligent" and "careful" (Zhang et al., 2002). Similarly, a child's inability to maintain on-task behavior is often attributed to low levels of effort rather than an attentional deficit or inability to perform the task (Crystal, Chen, Fuligni, & Stevenson, 1994; Crystal & Stevenson, 1991). Cultural values around issues of effort also appear to underpin childrearing practices of rigorous, early training (Chao, 1994; Chao, Taylor, & Wang, 2000). For example, most Chinese parents agree that toilet training should occur as early as possible (Chen et al., 2000). This cultural trend has also been observed in empirical studies; in one study comparing Canadian and Chinese 2-year-olds, most Chinese children came to the laboratory completely toilet-trained, whereas most Canadian subjects arrived in diapers (Chen et al., 2003). Chinese parents conveyed that their children had been toilet-trained by the age of 1 year, and several parents indicated that they had begun the toilet-training process with their child at only 6 months. In a questionnaire study examining a number of different aspects of "training," Chinese parents consistently responded positively to items reflecting the importance of training children in a variety of dimensions "as early as possible" (Lieber et al., 2006).

Cultural Socialization Practices for Regulating Emotions

Cultural values are thought to guide the ways in which parents respond to and shape their children's behavior (see Wan et al., 2007, for the importance of cultural vs. individual values). Socialization practices, in turn, may affect the pace and course at which the child becomes regulated (Chen et al., 2003). Nonetheless, comparative cross-national research on this issue is in its infancy. As shown in this section, most research has focused on cultural differences in child-rearing practices, particularly on styles of support and discipline. Far less attention has been given to indirect influences, such as modeling, and how parents structure children's interactions with their physical and social environments. Finally, although most previous research has focused on parenting behavior, peer and school settings also are powerful contexts for the socialization of self-regulation.

Parenting Strategies and Responses

Compared with North American parents, Chinese parents have been found to endorse high power strategies such as physical punishment in child rearing (Chao, 1994; Chao & Kim, 2000; Lim & Lim, 2004; Nelson, Hart, Yang, Olsen, & Jin, 2006; Rubin et al., 2006). Chinese parents also have been found to express lower levels of overt warmth to their children than their Western counterparts (Wu & Chao, 2005). Some have suggested that authoritarian styles (i.e., high power combined with low warmth) are normative among Chinese parents.

Recently, however, this widely held view has been reexamined (Lansford et al., 2005). First, some investigators have questioned whether Western concepts of authoritarian discipline sufficiently capture indigenous folk meanings of Chinese child-rearing behaviors (Chao, 2001; Chao & Kim, 2000; Lieber et al., 2006; Wu & Bond, 1996; Xu et al., 2005). For example, aspects of traditional Chinese parenting practices, such as the strong emphasis on training, correlate with both "authoritarian" and "authoritative" parenting styles. Furthermore, so-called authoritarian parenting styles may have different meanings in Chinese versus U.S. cultures. Chao (2001) has argued that, in China, high parental power is associated with traditional moral values such as benevolence, propriety, wisdom, and trustworthiness. In contrast, constructs of authoritarian parenting in the United States have been associated with lack of sensitivity to the child's needs and with dominating harsh control (Baumrind, 1966, 1968). Thus, this simple dichotomy is not sufficient for understanding parenting behavior in Chinese culture or, according to some authors, even for understanding subtleties of harsh parenting within U.S. families – some who may be using physically aggressive strategies while emotionally charged or dysregulated themselves versus others who may have strict rules and use physical forms of discipline but engage in these practices while emotionally "cool" (Deater-Deckard & Dodge, 1997). Finally, perhaps reflecting differences between generational cohorts, a recent study of Chinese parents has found endorsement of harsh parenting to be low among contemporary urban parents in mainland China (Chang et al., 2003).

Whereas it is critical to keep in mind differences in cultural values when studying self-regulation cross-culturally, it also is important to note where more universal indicators of regulation lie. Generally, the cultural normativeness of physical discipline has been identified as an important moderator of children's behavioral adjustment outcomes (Chen, Rubin, & Li, 1997; Lansford et al., 2005). In cultural groups that espouse high levels of physically punitive child rearing, the link between harsh discipline and child aggression becomes weaker (Lansford et al., 2005). Thus, Chen, Wang, Chen, and Liu (2002) questioned whether cultural attitudes moderate the impact of authoritarian parenting on aggressive behavior in Chinese children. Contrary to expectation, they found that, as in Western cultures, parental power assertion (over their 2-year-olds) predicted increased verbal and physical aggression at the age of 4 years, whereas inductive parenting predicted *less* aggression in the preschool years (Chen, Wang, et al., 2002). Zhou, Eisenberg, Wang, and Reiser (2004) also found that, as in Anglo-American families, authoritarian parenting (including corporal punishment and verbal hostility) in Chinese families of school-age children was associated with low levels of effortful control and high dispositional anger and frustration. Similarly, Chen et al. (2006) found that Chinese toddlers who experienced inductive maternal discipline had low levels of aggressive behavior in the preschool years, whereas high maternal power strategies predicted later behavior problems.

Chen, Wang, et al. (2002) also found that both child and parent gender moderated associations between parenting and child aggression. Paralleling a large body of research on Western children, Chinese boys were significantly higher in verbal and physical aggression than girls. Though the magnitude of associations was weak, high levels of maternal induction and warmth were important predictors of low aggression in Chinese girls, but not boys. In contrast, boys' aggression was more strongly linked to high power strategies in fathers. Chang et al. (2003) also found that parenting styles and discipline strategies used by Chinese fathers were more highly related to their sons' aggression, whereas mothers' discipline strategies did not result in different levels of aggression for boys and girls. One suggestion for this finding lies in traditional Chinese beliefs that it is the father's role to discipline children, particularly boys.

Parents also implicitly teach desirable conduct through other types of reactions to their child's behavior. In a cross-national study of Chinese and Canadian parents, for instance, Liu and colleagues (Liu et al., 2005) found that Chinese mothers had higher scores on *encouragement* of autonomy and connectedness, suggesting a pattern of high direction and involvement. However, relative to Chinese parents, Canadian parents were more likely to *support* the child's autonomy and exploration. Similarly, Wang and Fivush (2005) examined verbal interactions around a story discussion task in Chinese and U.S. mother-toddler dyads. In this study, U.S. mothers initiated more interactive and elaborative conversations and employed a "cognitive approach" to emotion regulation by providing explanations for the causes of children's feeling states. In contrast, Chinese mothers took a directive role in posing and repeating memory questions and focusing on social interaction and used a "behavioral approach" to emotion regulation by emphasizing discipline and proper conduct.

Finally, Chen and colleagues (Chen et al., 1998) compared Chinese and Canadian mothers' responses to the child personality attribute of shyness. Canadian mothers perceived shyness-inhibition in toddlers negatively. However, Chinese mothers responded to child shyness with acceptance, encouragement, and satisfaction (Chen et al., 1998). Thus, Chinese and U.S./Canadian parents appear to reinforce their children's behavior in different ways – for some behaviors (e.g., shyness-inhibition), totally opposite approaches are taken, whereas for others (e.g., independence-autonomy), parents from these cultures appear to reinforce the same values and behaviors, but in different ways. Both of these differences can result in differing socialization pressures in these cultures.

Parents as Models

We have been discussing strategies that parents use to foster self-regulation in young children. However, there are also many indirect means of teaching children culturally desirable patterns of behavior and emotion regulation. For example, parents serve as behavioral models, and, as mentioned earlier (see Deater-Deckerd & Dodge, 1997), parental displays of regulated versus dysregulated behavior can have important consequences for their children. Yang (Yang & Bond, 1986; Yang, Kim, Yang, & Hwang, 2006) reviewed several studies measuring the temperamental quality of self-restraint in Chinese and U.S. adults and found that, across studies, Chinese adults tend to show more inhibition and less impulsivity than their U.S. counterparts. As parents are the central role models for young children, it makes sense that Chinese children would thus be more likely to emulate highly regulated behavior more often than Anglo-European U.S. children. As discussed earlier, Chinese adults also tend to express less emotionality under a variety of circumstances than U.S. adults, so from a social-learning (e.g., Bandura, 1977) perspective, it would also make sense that children growing up with less expressive parents would become less expressive themselves.

Preschool Environments

Self-regulation, as emphasized in Chinese culture, is not only reflected in children's experience in school but is also demonstrated in many aspects of children's routines. Chen and colleagues (Chen, He, & Li, 2004; Chen, Rubin, & Li, 1995a; Chen et al., 2003), for instance, found that not only are the use and practice of routines more prevalent in Chinese (vs. Canadian) children's early school experiences but also that Chinese children's success in learning and working within these routines forms an important component of their academic evaluation. Moreover, after four decades of observation of both Chinese and U.S. preschoolers and elementary school children, researchers found a striking and surprisingly consistent difference: children from these two cultures not only show different aspects of "learning" to be important but they also show consistent differences in their relative focus on these abilities, with Chinese children more able to focus attention and deliberately concentrate on precise, effortful tasks (Chao, 2001; C. Chen & Stevenson, 1995; Kessen, 1975; Li, 2001; Stevenson et al., 1990; Stigler & Perry, 1988). From an educational perspective, school-related self-regulatory skills, such as attending, inhibiting distraction, and focusing concentration, are of great concern to U.S. teachers and are predictive of academic accomplishment. Nonetheless, Chinese preschools and Chinese parents, in contrast to their U.S. counterparts, engage in many more practices that help establish and develop such skills (Sy, Fang, & Huntsinger, 2003; Sy & Schulenberg, 2005).

Peer Interactions in Different Cultural Contexts

As children spend more time with peers, they are exposed increasingly to the effects of other social agents on emotion and have the opportunity to learn or practice regulatory strategies. A number of publications have examined the difference in the relations between reticent behavior in unfamiliar peer situations and its consequences in Chinese and Canadian children.

As mentioned in earlier sections, in the United States and Canada, social initiative is viewed as a major index of social competence, and the lack of active social participation and assertiveness is considered maladaptive (Rubin, Asendorpf, Rubin, & Asendorpf, 1993). Consequently, self-control is often considered less important, especially when it is in conflict with the attainment of individual social and psychological goals (Triandis, 1995, 2001). However, social initiative is not so highly valued in Chinese and other group-oriented cultures, perhaps because social initiative does not bode well for mutual support and cohesiveness in the group (Chen & Columbus, 2000). Thus, it is not surprising to find that shyness-inhibition, as a major socioemotional characteristic, has different contributions to peer interactions and relationships in Chinese and Western cultures (Chen et al., 1995b). Specifically, shy/reticent behavior was positively associated with peer rejection, such as overt refusal and disagreement, and negatively associated with positive peer responses such as approval and cooperation in Canadian children. However, reticent behavior was associated with positive responses in Chinese children, particularly when they made low power initiations (Chen, Zappulla, et al., 2004). Because traditional Chinese culture puts more emphasis on self-control, Chinese parents feel comfortable with the fact that children demonstrate shyness from early on. Both parental and peer acceptance of more reticent children, therefore, reflect cultural values such as the encouragement of behavioral control and academic achievement in China. As a result, self-control is valued in kindergartens and elementary schools, and Chinese children who display this quality are popular.

In addition, Wang et al.'s (Wang, Chen, & Chen, 2002) longitudinal study of Chinese toddlers found that children who showed high positive affect before age 2 were more likely to engage in prosocial/cooperative behaviors in peer interactions and less likely to show behavior problems at age 4. The reverse pattern was true for those toddlers who showed high levels of negative affect. Thus, despite cross-national differences in affective reactivity between Chinese and Western children (Camras et al., 2006; Camras et al., 2003; Kisilevsky et al., 1998), the significance of affect may be equivalent across cultures. Nonetheless, if negative affect is more strictly regulated in one culture than another, then the impact of that negativity is more likely to be reduced in peer socialization experiences.

Recently, however, with the enormous social and economic changes taking place in China, educational and socialization ideals have changed dramatically. Competitiveness has gradually become a more positive quality, and children are encouraged to be more socially active. This kind of change in the relationship between children's temperament and social adaptation illustrates the important role that culture as a dynamic and ever-changing system plays in socialization (Chen et al., 2005). It will be interesting, therefore, to see the results of future studies – both in terms of peer/parental acceptance of more restrained forms of behavior as well as more fundamental differences in behavioral and physiological reactivity for future generations of Chinese children.

Cognitive Regulation of Emotion: The Role of Executive Functioning in Mediating Cross-Cultural Differences in Emotion Regulation

A key component in the regulation of emotion is the ability to suppress or override competing attentional and behavioral responses (Kochanska, 1993; Posner & Rothbart, 2000; Rothbart, Bates, Damon, & Eisenberg, 1998). Executive functioning processes are generally considered to be those that control and switch attention in response to competing demands for attention or that replace routine, reflexive behaviors with more appropriate ones (Cohen, Dunbar, & McClelland, 1990; Davidson, Amso, Anderson, & Diamond, 2006; Diamond, Bialystok, & Craik, 2006; Goldman-Rakic, Grafman, Holyoak, & Boller, 1995). Although there remains considerable debate as to precisely which cognitive abilities comprise executive functioning (Lyon & Krasnegor, 1996; Posner & Rothbart, 2000), commonly identified component processes include the following: the ability to inhibit irrelevant information or task sets, shifting set or mental flexibility, and the ability to hold and update information in working memory (Baddeley, 1996, 2003; Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). Generally, executive functions encompass the skills necessary for purposeful, goal-directed activity across time or task demands (Diamond et al., 2006; Lezak, 1993; Shallice, 1988; Stuss, 1992).

The ability to suppress irrelevant or interfering stimuli or impulses is essential to normal thinking processes and has an important role in self-regulation (Barkley, 1997; Blair, Granger, & Razza, 2005; Diamond, 2005; Nigg, 2001; Olson, Sameroff, Kerr, Lopez, & Wellman, 2005; Rueda, Posner, & Rothbart, 2005; Rueda, Posner, Rothbart, Baumeister, & Vohs, 2004). Studies of normal preschool-aged children have found that changes in inhibition-related functions have also been used to explain the development of other cognitive abilities (Diamond & Gilbert, 1989; Ridderinkhof, van der Molen, Band, & Bashore, 1997), including a development of a theory of mind (Carlson, Mandell, & Williams, 2004; Carlson, Moses, & Breton, 2002). It is interesting to note that cross-cultural studies of Chinese and U.S. preschoolers have consistently found that Chinese preschoolers outperform their U.S. counterparts on a wide variety of executive functioning tasks, even though they do not do any better on tests of social understanding (Sabbagh, Xu, Carlson, Moses, & Lee, 2006; Tardif, So, & Kaciroti, 2007).

As discussed earlier, Chinese culture tends to place an important focus on training and restraint in addition to the ability to complete a number of "regulatory tasks" (such as folding one's blanket after a nap, lining up appropriately, turning the page in a specified way during instructional time, etc.). Not only are these expected tasks and routines in the life of preschoolers but they also play an important role in assessments of academic performance in the early school years (Chen et al., 1995a, 2003). Thus, executive functioning may play different roles in the development of children in diverse cultures – as an important "outcome" and predictor variable in Chinese cultures versus an ancillary or mediator variable in U.S. learning environments and cultures.

Importantly, executive functioning skills can also be trained, and improvement in executive functioning skills has resulted in improvements in the social cognition tasks that they generally predict (Flynn, O'Malley, & Wood, 2004; Kloo & Perner, 2003). Even more central to the claim that cultural differences affect directly the physiological underpinnings of emotional reactivity and regulation are recent findings that training in the executive functioning attentional component has also been found to have a direct impact on the efficiency with which neural networks for attention are activated (Rueda et al., 2005). Because these prefrontal systems are relatively immature during childhood and show continued, protracted development throughout adolescence and into early adulthood (Davidson et al., 2006; Diamond et al., 2006; Diamond, Gibson, & Petersen, 1991; Diamond, Stuss, & Knight, 2002), training and attention to executive functioning skills during childhood may have important impacts not just on preschoolers or young children but also for these children's abilities to regulate their emotions when they reach adulthood.

Our framework further suggests that additional research in this domain across cultures is crucial to understanding how executive functioning abilities develop in the brain and how both brain and behavioral regulatory systems might be influenced by the more general "cultural" training that occurs in Chinese versus U.S. home and preschool contexts. Specifically, we suggest that, through a variety of home and school socialization pressures, Chinese children have traditionally received more executive-functioning-relevant "training" than their U.S. counterparts, and this training may have a direct influence on the executive functioning differences that have been found. More importantly, these differences may also be potential mediators for cross-cultural differences in expressed and experienced emotion found in Chinese versus North American children and adults.

Suggestions for Future Research

To pull these elements together, future research examining the role of culture on emotion regulation needs to consider a number of issues. First, emotion regulation itself needs to be seen as a complex system that includes cultural, cognitive, behavioral, and physiological levels of analysis. Most importantly, each of these levels needs to be seen as dynamic and potentially changing, with changes in one level of the system likely to affect all aspects of the system. However, the particular ways in which levels of the system interact are still poorly understood. We do know that cultural differences exist in parental values and parenting techniques, in children's and adults' behavioral expressions of emotion, in executive functioning tasks, and in physiological aspects of emotional responding. These cultural differences have also shown evidence of change and will continue to change over time with exposure to differing amounts of other cultural experiences or socialization pressures (e.g., in immigration or adoption contexts). But we do not know how they work together and will not be able to develop adequate models of regulation unless we include multiple elements (e.g., behavioral and physiological) of emotion regulation in our cross-cultural studies and multiple cultures or individuals with vastly different socialization experiences and physiological reactions in our behavioral and physiological studies.

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12

Self-Regulation and the Development of Behavioral and Emotional Problems: Toward an Integrative Conceptual and Translational Research Agenda

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Within the field of developmental psychopathology, there is growing interest in research examining the development of self-regulatory processes and its relevance to understanding the emergence of clinically significant problems with behavior or emotion. Earlier chapters in this book present current conceptual approaches and sets of empirical findings that address these issues. In this chapter, we discuss this exciting and rapidly advancing area of research with a primary goal of considering points of integration across some of the main themes described in the previous chapters; we also present some thoughts about key directions for future research.

Specifically, in this chapter we address the following four areas: (1) definitional and conceptual issues that underscore the construct of self-regulation as a set of complex multifaceted processes, (2) the importance of contextual effects in shaping these processes throughout development, (3) the ways in which failures in the development of self-regulatory competencies may lead to clinically significant problems, and (4) one example of a developmental nexus of regulatory interactions during adolescence – self-regulation in the context of pubertal maturation, sleep, emotion, and cognition. We believe that this example helps illustrate some key principles, including the potential value of a neurobehavioral framework for understanding some aspects of self-regulation, as well as some implications for translational research on the development of self-regulatory processes.

INTRODUCTION: SELF-REGULATION AS A COMPLEX, MULTIFACETED PROCESS

We begin this chapter by considering conceptual issues regarding the construct of self-regulation. That is, what exactly do we mean when we speak of “self-regulation”? On the one hand, this term places an emphasis on a set of intrinsic qualities/abilities within the individual (as indicated by the use of the word "self"). On the other hand, as convincingly argued by several authors, social context inherently influences and interacts with nearly all aspects of self-regulatory processes. One of the central challenges, conceptually, is how to integrate these complementary frameworks and then, methodologically, how to translate them into (measurable) investigative approaches to advance our understanding of development.

In this book, several authors emphasize this process-oriented view of regulation. Rather than being construed as a separate, innate ability that resides within the individual, "self"-regulation is viewed as a constellation of processes and transactions that exist between a developing person and his or her environment, which permits adaptive capacities to control and modify various aspects of internal state and external behavior, in accordance with one's goals and values.

If one accepts this model of a complex constellation of transactional processes, the greatest challenge is to specify how to begin to parse such complexity in ways that can lead to a deeper understanding of the development of clinically significant problems with self-regulation. In other words, what are the most useful ways to slice through these multiple layers of complexities, in ways that might provide traction to advance the ultimate long-term goal of informing early intervention strategies?

Conceptually, there are several different ways to approach these questions. For example, from a broad developmental perspective on self-regulation, these self-regulatory processes could be considered along three different dimensions: (1) the development of *self*; (2) the development of a set of specific regulatory abilities, including the maturation of capacities to reliably control emotions, behavior, arousal, attention, motor systems, and and so on; and (3) the development of coordination *between* these two levels (i.e., the ability to control behaviors, emotions, etc., specifically *in service* of the self).

Some might argue that the development of virtually all regulatory processes is inherently intertwined with the development of *self*-regulatory processes. For example, consider the most oft-cited definition of emotion regulation (Thompson, 1994): *Emotion regulation consists of the extrinsic and intrinsic processes responsible for monitoring, evaluating, and modifying emotional reactions, especially their intensive and temporal features, to accomplish one's goals.* Clearly, regulating emotions and behavior in the service of one's *goals* involves a key dimension of "self" as a central component guiding this process. This type of conceptualization makes a great deal of sense from an adaptive systems perspective. That is, the evolution (and the individual development) of regulatory processes ultimately serves to promote the survival and reproductive goals of the individual, and thus, these processes are inherently self-promoting. Therefore, it might be reasonable to consider the development of virtually all regulatory capacities as inherently intertwined with self-regulatory processes.

Conversely, one can make a compelling argument for the potential advantages of considering the separate components that contribute to the development of these broadly intertwined self-regulatory capacities. To illustrate this point, let us consider the regulation of complex motor control. One can imagine an individual (e.g., a professional athlete) who develops a set of physical skills for controlling his or her body with remarkable precision and expertise, but who also demonstrates a very poor capacity for self-control when trying to align these abilities in the service of long-term personal goals such as academic pursuits. Although some might argue that this individual is simply showing different levels of self-regulation in different contexts (i.e., excellent self-control in the context of competing in a sport, but poor self-control in the context of academic performance), we contend that the more substantive difference is that these two "contexts" require fundamentally different aspects of regulatory processes. That is, several of the neurobehavioral systems (and specific skill sets) that promote excellent regulatory control in football or figure skating are fundamentally different from those that serve the specific type of self-regulation skills needed for academic successes. There are clearly some areas of overlap, yet one would not want to make strong predictions about academic success based on the specific measures of motor control that would be of greatest interest to a prospective coach.

To address this idea in a more rigorous way, let us zoom in on a more specific measurable system and consider the development of attentional control. It is clear from a large body of research that there are several different components within this system that develop at different rates and that serve different capacities. For example, the type of simple visuomotor control that allows a child to look quickly and accurately at a pinpoint of flashing light develops very early in childhood, whereas the capacity to perform an anti-saccade (the capacity to look quickly and accurately in the *opposite* direction in response to a flash of light) represents a regulatory ability that continues to develop through adolescence. Moreover, these two regulatory abilities rely on two different sets of neurobehavioral systems (see Luna & Sweeney, 2004). It is not a case of simply one system responding differentially in two different contexts, but rather two fundamentally different components of a complex system.

The issue of components versus contexts is not simply a subtle semantic issue. These examples represent crucially important conceptual issues with implications for how to best understand even more complex self-regulatory processes relevant to developmental psychopathology. To return to our earlier point about the component of "self," for example, one might imagine that one pathway to failure in the development of self-regulation occurs primarily because an individual develops an impaired sense of self that subsequently interferes with his or her capacity to exert reliable self-control in specific ways. In contrast, another individual might develop a very strong and healthy sense of self, but show impairments in the capacity to exert regulatory control over specific categories of behavior and/or emotion. Thus, at a conceptual level, there would appear to be value in considering these components and their interactions in understanding the complexity of factors that could lead to impairments in the development of self-regulatory processes.

THE IMPORTANCE OF CONTEXT

In addition to these levels of complexity *within* the individual, a further dimension of complexity is highlighted by several of the chapters in this volume: the crucial role of social context. The inherent role of context in the study of regulatory processes and the emphasis on person-environment transactions are central to the introductory, conceptual chapter by Arnold Sameroff. In Chapter 1, he reintroduces his theory of the development of regulatory processes first presented in 1975 and again in 1983 (Sameroff, 1983; Sameroff & Chandler, 1975). As stated in this introductory chapter, regulation involves an individual's experience with the environment and human self-regulation is defined as "knowing one's self, knowing one's context, and knowing how to interact with the context to achieve individual goals."

The complexity of developing systems and the general systems principles of wholeness and order are also considered from this perspective. Central to this principle is the idea that the parts cannot be isolated from the whole because relationships can never exist within single elements (e.g., tones in isolation versus in a melody; Sameroff, 1983). As Sameroff argues, there is risk in examining self-regulation processes in parts and isolated from the whole, such as assessing individual traits rather than an individual's development within an environment, or in examining one regulatory process in isolation from others (e.g., attention processes separate from emotion processes). Doing so may obscure the larger picture in which many interacting systems are playing a role, leaving us with little information about the complexity of self-regulation. The approach of separating parts from their wholes for empirical purposes, without sufficiently attending to the unity and coordination of regulatory processes, is problematic for the study of developmental processes. In the face of this challenge posed by the complexity of self-regulatory processes and the necessity for simpler empirical constructs, Sameroff emphasizes the need to acknowledge this complexity and examine how the larger "whole" of self-regulation develops in coactive and transactional relationships with the environment. He underscores the need to study regulatory processes across multiple levels, as first presented in the transactional theory of development (Sameroff & Chandler, 1975).

Self-Regulation across Multiple Levels

The need to study regulatory processes across multiple levels – including biological, behavioral, and socio-ecological approaches, is a central theme throughout this book. Keenan and Jacob (see Chapter 3) begin by considering how regulatory processes in neonates, such as "poorly modulated stress responses," may be an antecedent to subsequent emotional and behavior problems. More specifically, their program of research focuses on individual differences in neonates' cortisol response to challenge and how these differences relate to early behavior; their work also examines prenatal contextual effects on regulatory processes. They assess the impact of maternal psychological state on the regulation of stress and behavior in the neonate through its effects on the placenta, the fetus's developing nervous system, and neurobehavioral development. They also propose that these effects could be caused by (1) maternal genetic predispositions for stress regulation during pregnancy or (2) the context of the organism's resources such as the family.

One might, however, consider even greater complexity, based on life course models of disease epidemiology and health outcomes (Kuh & Ben-Shlomo, 2004) and cumulative risk models of development (Sameroff, Seifer, Barocas, Zax, & Greenspan, 1987). These models underscore the impact of accumulated exposure to aversive physical and social environments on health and development. For example, a significant amount of research has demonstrated relations between early economic adversity and subsequent health problems in adulthood, including cardiovascular disease, cancer, diabetes, and stroke (Lynch & Smith, 2005). Further, although the current prenatal environment is critical for understanding the development of some aspects of neonatal stress reactivity, might it also be important to consider the context within which the mother and her reproductive system (and patterns of stress response) developed? Such an approach adds another level of complexity to the study of regulatory processes, bringing in the potential value of a transactional analysis of the mother's development before child bearing and mediators and moderators of neonatal outcomes. In a similar way, the combination of maternal genetic predispositions and the specific prenatal environment may provide additional explanatory power for understanding individual differences in neonatal reactivity. It is thus easy to appreciate the range of complexities and interactions that contribute to the emergence of a specific developmental trajectory of self-regulatory capacities for dealing with stress. Yet, it is also important to acknowledge the need to try to parse some measurable dimensions of these complexities in order to advance research and understanding.

Lopez, Olson, Felt, and Vazquez (see Chapter 4) provide an extensive review of research on the neurophysiology of emotion regulation. Central to their thesis is that emotion regulation consists of a chain of neurocognitive processes influenced by hormonal and neural systems. They describe how exposure to a feared stimulus such as a snake sets off a chain of reactions in central and peripheral physiological systems such as subcortical brain areas (e.g., amygdala) and hormonal systems such as the limbic-hypothalamic-pituitary-adrenal (LHPA) axis. These processes are also associated with changes in cortical brain areas such as the prefrontal cortex. When assessed at the interface of temperament and caregiving and cultural experiences, these changes may provide important insights into the interconnections between contextual and physiological regulation and their relations to children's behavior problems. For example, Lopez and colleagues describe the critical role of the amygdala in fear processing and also the role of frontal asymmetry in social withdrawal. Citing an extensive body of research on frontal asymmetries, they review evidence that greater right frontal activation is associated with socially withdrawn behavior. Attending to multiple regulatory systems, they describe how this circuitry is intimately connected to peripheral systems and how the prefrontal cortex can serve to facilitate the regulation of emotion.

This theme of investigating multilevel influences on the development of regulatory processes is also central to Chapter 2, in which Suomi reviews relevant findings from research with rhesus monkeys. He demonstrates the importance of considering interactions among biological, behavioral, and environmental factors that affect monkeys' capacities to regulate fear and aggression, and he describes a buffering effect of parental rearing that affects serotonin concentrations and levels of aggression. This work provides evidence that patterns of regulatory behavior can be modified by early caregiving relationships.

More specifically, these findings highlight the importance of considering gene $\times$ environment $\times$ development interactions in the emergence of self-regulation and behavior problems. That is, it appears that various genetic influences and environmental contexts, at *particular points in development*, interact to influence the trajectory of regulatory processes. These types of models have crucial implications for informing interventions. Particularly vulnerable periods of development (at the level of social and context influences) in particularly vulnerable individuals (based on genetic and early experience) could represent key windows of opportunity at which to have a positive impact on the trajectory of development of self-regulatory capacities.

Once again, however, it is important to appreciate the complexities and multiple levels of interactions. For example, this research in nonhuman primates also points to the significance of considering gene-gene interactions and environment-environment interactions at key points in development. Controlled *experimental* animal studies are likely to be crucial to disentangling such complexity, in ways that would be impossible in human studies. Yet, as with understanding human development, it will be critical to examine how contextual factors and targeted interventions may affect the development of regulatory processes in transaction with multiple interacting genetic vulnerabilities. Such endeavors are highly complex in their own right and will require examination of multiple levels of interactions. Grappling with this complexity at the interface of biological, behavioral, and social-ecological processes is one of the greatest challenges for the study of regulatory processes today. To effectively accomplish this task, highly skilled interdisciplinary teams with large samples of longitudinal data allowing for complex transactional analyses will be needed to understand how the development of regulatory processes in context affects both the development and amelioration of child behavior problems.

Caregiving Context

Many of the chapters on regulation in this book consider the caregiving context. During the early childhood years, caregiving relationships serve as the primary and most proximal context for the child, making this an essential dimension to the study of developing regulatory processes. Keenan and Jacob (see Chapter 3) discuss the need to assess aspects of developing biobehavioral systems in neonates that are influenced by caregiving approaches.

They describe how early caregiving behaviors may influence distinct aspects of the stress response such as physiological feedback loops rather than initial activation (e.g., the LHPA axis). Likewise, Calkins (see Chapter 5) reemphasizes the critical role of attachment relationships in the development of self-regulation. She argues that an examination of the complex processes by which caregiving and attachment relationships exert their effects is an essential step in advancing this field of research. Citing animal findings from Hofer (1994), she suggests that one important process by which caregivers exert their effects on the development of regulation may be the use of specific types of tactile stimulation. For example, certain patterns of touch may lower an infant's heart rate in ways that facilitate the infant's capacity to generate adaptive responses in the face of stress.

In other work addressing the importance of caregiving environments, Olson and colleagues (see Chapter 7) review research documenting relationships among harsh discipline, low levels of warmth, deficient or deviant teaching of self-regulatory competencies, and child behavior problems. They propose that transactional processes linking parent-child interaction to self-regulation is a key mechanism in the development of child behavior problems. They review findings documenting the importance of mutually regulated, well-synchronized patterns of interaction during infancy and sensitive and responsive caregiving, as opposed to highly directive and negatively toned exchanges.

The transactional nature of caregiving and child temperament in the development of child behavior problems is also illuminated by Cole and colleagues (see Chapter 8). Neglectful parenting in the context of maternal depression and violence are described as critical context-level processes that can, independently or in combination, powerfully affect a child's experience, expression, and regulation of *multiple* emotions. A difficult temperament, in combination with these experiences, may lead a child to engage in serious misconduct or develop severe behavior problems.

Addressing interactions between difficult temperament and parenting has been central to the work of Bates, Goodnight, Fite, and Staples (see Chapter 6). They report that children rated by their mothers as "unmanageable" were more likely to evidence high levels of externalizing behavior problems if their mothers engaged in less verbal or physical restraint or scolding. They also report instances where child impulsivity moderated relations among parental warmth, deviant peers, social-information-processing biases, and child behavior problems. Adolescents who had deviant peers were more likely to demonstrate increased levels of externalizing behavior problems at 16 years if they were high on impulsivity and reward seeking. Positive endorsement of aggression was also predictive of aggression, but only for those high on impulsivity. Impulsive and reward-seeking youth, however, were less likely to demonstrate externalizing behavior if they experienced positive parenting experiences such as parental warmth.

The interactions between parenting behaviors and children's temperament are also relevant to some interesting findings regarding children with behaviorally inhibited or fearful temperaments (see Chapter 6). Behaviorally inhibited and fearful children have a tendency to exhibit distress in the face of novelty and are at risk for developing subsequent problems with anxiety (Pérez-Edgar & Fox, 2005). Furthermore, many anxious individuals have heightened sensitivity to threat and punishment (Gray, 1987). It is interesting to note that temperamentally fearful children, but not fearless children, evidence higher levels of regulation as assessed by internalized compliance if they experience gentle as opposed to harsh parental discipline (Kochanska, 1991). For a child who is already experiencing heightened levels of anxiety, it is possible that the experience of harsh discipline may weaken regulatory competence by interfering with attention and cognitive processing, as has been demonstrated in clinically anxious children (Vasey, Dalgleish, & Silverman, 2003). Conversely, under some conditions, a warm and secure attachment appears to be important for fearful children (Kochanska, 1995), perhaps because it serves to reduce high levels of fearfulness and provides a context for optimal regulation (but see Arcus, 2001; Rubin, Burgess, & Hastings, 2002). These findings underscore the importance of considering individual differences in sensitivities to reward and punishment cues and how the regulation of these underlying temperament systems interact with different environmental experiences to influence behavioral outcomes and the development of regulatory processes.

Family Context

In their respective chapters, Volling, Blandon, and Kolak (see Chapter 10) and Cummings, Papp, and Kouros (see Chapter 9) delve into the further complexities of environmental experiences as they apply general systems theory principles to research on children's regulatory processes within family contexts. Volling and her colleagues make excellent use of the general systems theory principles of wholeness and order in their study of children's regulation. Rather than investigating the effect of different dyadic relations on children's outcomes, these authors examine unique family processes that occur when all family members are assessed together. They find evidence of emergent systemic processes that occur only when multiple family members are present; like Sameroff (Chapter 1), they argue that examination of the parts separated from the whole, such as independent analyses of mother-child and father-child dyads, can obscure the complete picture of the development of self-regulation within the family. By examining the family as a unit, Volling and colleagues demonstrate within-family processes such as co-parenting and differential parenting and uncover how parents' use of gentle guidance is associated with older siblings' committed compliance, but only in the context of paternal gentle guidance. Under conditions of low maternal guidance, older siblings complied with requests if mothers used more gentle guidance with them compared to their younger siblings. These findings demonstrate that mother and father's behavior interact differently with co-parenting to influence children's outcomes and this influence varies based on the level of parenting each sibling receives. This approach highlights the importance of examining the family as a whole in the study of the development of regulatory processes.

Cummings, Papp, and Kouros (see Chapter 9) consider the context of marital conflict, emphasizing the importance of children's need for emotional security. They describe research assessing children's emotional and behavioral responses. These responses are viewed as part of regulatory processes that organize children's behavior in the service of establishing or maintaining the intrinsic goal of emotional security. They assess the organization of children's regulatory processes within different contexts such as constructive versus destructive conflict and examine these processes in relation to children's adjustment. When parents expressed negative emotions such as anger or sadness, children evidenced higher levels of anger, fear, and sadness, whereas when parents expressed positive emotion during conflict, children displayed more positive emotion. Thus, regulatory responses indicative of emotional insecurity occurred primarily in the context of what they view as destructive parental conflict, whereas regulatory responses reflecting emotional security were observed under conditions of constructive conflict. Children's negative emotions also were associated with behavioral dysregulation and avoidance during martial conflict, linking to children's adjustment problems.

Cole and colleagues (see Chapter 8) also consider the impact of negative family contexts, describing how early adverse family environments contribute to patterns of emotion dysregulation that can lead to the development of serious behavior problems. Clearly more research is needed to deepen our understanding of how neglect and maltreatment within the context of family violence and other profound adversities compromise the development of regulatory competence. This work also underscores how important it can be to examine how regulatory processes may serve adaptive functions in some highly adverse contexts, but may serve maladaptive functions in another context (Thompson & Calkins, 1996). Examinations of transactions between regulatory processes at the interface of family and community violence and adversity may provide important insights into the development of both internalizing and externalizing disorders, perhaps via the development of regulatory processes reflecting heightened threat and punishment sensitivity, and impulsivity and reward sensitivity, respectively.

Culture

Another important level of contextual influence on regulatory processes is pointed out by Tardif, Wang, and Olson (see Chapter 11), who emphasize the profound impact of cultural influences on socialization practices, regulatory processes, and behavior – particularly via values and ethnotheories. For example, while valuing social harmony and the notion that human behavior is malleable, Chinese parents may emphasize effort and emotional restraint in difficult situations. Because nearly all types of socially disruptive behaviors are viewed as highly negative within Chinese culture, children's everyday contexts may be structured to enhance prosocial behavior and regulatory skills (such as folding one's blanket following naptime and lining up in an orderly fashion). Although these are also desirable practices in preschools within the United States, the relative importance and degree of socialization of these behaviors appear to be much greater in Chinese preschools, reflecting Chinese cultural values and belief systems.

The transmission of cultural values into socialization and teaching practices may also have important implications for children's development of aspects of cognitive skills that contribute to self-regulatory processes. For example, Chinese preschoolers have been found to demonstrate significantly higher levels of key executive functions (e.g., voluntarily controlling one's attention, holding information in mind) compared to U.S. children (Sabbagh, Xu, Carlson, Moses, & Lee, 2006; Tardif, So, & Kaciroti, 2007). This higher level of functioning may protect children from socially disruptive behavior problems. Indeed, what is viewed as adaptive in one culture may vary significantly across other cultures and is an important factor to consider in studying the development of self-regulatory processes and behavior problems and in designing culturally appropriate interventions.

Context Specificity of Regulatory Processes

As illustrated by Tardif and colleagues in Chapter 11, the conceptualization of adaptive behavior and regulation is highly culture-bound and often determined by what is considered appropriate behavior for a particular cultural context (Castillo, 1997). Cultural beliefs about how emotions should be expressed and regulated are also context dependent. Tardif, Wang, & Olson (Chapter 11) review data suggesting that controlled, respectful, and harmonious behavior is highly valued in Chinese cultures (Chen, Li, Li, Li, & Liu, 2000; Ho, 1986); accordingly, children are taught to suppress anger and aggression (Chen, 2000). Anger is also discouraged among the Utku Eskimos, whereas it may be commonly expressed in American and Muslim cultures (Ellsworth, 1994). Differences in appraisals of emotions appear to account for some differences in emotional intensity and expression (Roseman, Dhawan, Rettek, Naidu, & Thapa, 1995).

Indeed, there are many aspects of emotional and behavioral expressions that may appear to be "dysregulated" but that may serve adaptive functions in particular contexts. For example, infant crying often serves as an important and adaptive social signal used to communicate to others (Barr, 2000). This ability allows preverbal children to recruit support, care, and nutrition in ways that can be crucial for survival. Moreover, various emotional expressions also serve important adaptive functions by enhancing survival (see Chapter 2). Negative emotions such as fear and anger can represent highly functional and adaptive responses to threat (see Chapter 8). Indeed, the accompanying action tendencies – preparation to flee in response to fear or attack in response to anger – ready the individual to behave in a manner that promotes survival in many contexts. Yet, these fast automatic response preparations and action tendencies can also contribute to maladaptive patterns of response in some contexts. It is important to consider the component of the emotional process that involves action readiness and avoid the tendency to equate strong negative emotional expressions as automatically indicative of "dysregulation." Similarly, it is overly simplistic to equate positive emotional expression with adaptive regulation, as illustrated in the case study described by Cole and colleagues in Chapter 8, in which positive emotions are coupled with antisocial behavior.

Indeed, because of the complexities of self-regulation, the same emotions may contribute in a positive or negative way toward adaptive behavior depending on the particular individual and the particular context. The development of affect regulation and self-regulation requires a gradual refinement of emotional responses that can take a multitude of forms. Social contexts, caregivers, and family and cultural influences play key roles in shaping and refining these responses during key periods of development. Individual differences in emotional tendencies create important vulnerabilities to particular kinds of problems. Thus, a temperamentally bold and ebullient child may be at greater risk for externalizing problems in particular environments, whereas a fearful inhibited child may be more vulnerable to developing an anxiety disorder in a social, family, and cultural context that leads to maladaptive emotional responses for that child at a key point in development. Therefore, rather than considering globally "positive" or "negative" environments regarding the development of self-regulatory processes, it is crucial to consider the interactions between individual vulnerabilities and specific environments.

In this volume, the authors provide several examples of conditions in which positive emotional expression and its regulation can be maladaptive. These include situations when children gleefully taunt their peers during conflict (Miller & Olson, 2000). Gleeful taunting, as demonstrated by positive emotions during aggression, predicted low peer acceptance and high levels of inappropriate social behavior (Miller & Olson, 2000). Studies focusing specifically on positive emotions during conflict and aggression have demonstrated that children who expressed more happiness while engaging in aggressive conflict with peers were more likely to be involved in disputes (Arsenio & Lover, 1997). Furthermore, although aggressive children have been found to exhibit relatively equivalent levels of happiness and anger, high levels of happiness expressed during aggressive interactions are related to high levels of overall aggressive behavior and low levels of peer acceptance in children.

Conversely, Cummings and colleagues (see Chapter 9) provide interesting data reflecting contexts in which expressions of positive emotions are adaptive, such as during constructive marital conflict. Likewise, children may also express positive emotions during and following challenging situations, and this expression may be associated with optimal outcomes, such as facilitating emotional recovery. In these contexts, one important effect of positive emotional expression, particularly following challenge, may be to correct, restore, and speed equilibrium and homeostatic processes (Fredrickson & Levenson, 1998; Frederickson, Mancuso, Branigan, & Tugade, 2000). Indeed, following perturbations, some individuals recover quickly in their expressive behaviors, whereas others recover slowly (Davidson, 1998). Such processes reflect an individual's affective style and are likely to play a role in determining children's behavioral outcomes.

To assess the adaptive significance of expressing positive emotions following challenge in children, Conway and colleagues examined the expression of multiple emotions across the transition from frustrating to playful contexts (Conway, 2005; Conway, McDonough, & Sameroff, submitted). Their primary hypotheses were that children who demonstrated shorter latencies to expressing positive emotions following challenge and adapting to changing conditions would evidence fewer behavior problems. Indeed, the results demonstrated that children with shorter latencies to expressing positive emotions had lower levels of parental ratings of internalizing problems (Conway & McDonough, 2006). These data suggest that the ability to generate positive emotions following challenge is associated with low levels of child behavior problems and may even protect children from the development of behavior problems. These findings underscore the importance of carefully considering the context within which regulatory processes occur in determining whether a child's behavior is adaptive or maladaptive. The adaptive value of regulatory processes may often be specific to a particular context.

Moreover, children who are exposed to multiple environmental experiences infused with positive affect (e.g., affectively positive caregiving experiences) may, over time, build long-term emotional resources due to this cumulative exposure to maternal positive affect and individual experiences of positive affect; this exposure may "build" or predict the development of self-regulatory abilities. Support for this hypothesis comes from data documenting that maternal positive affective expressions during mother-infant free play are associated with a reduction in infant crying across the first year of life (Conway, McDonough, Clark, & Smith, 2001). Furthermore, mothers who expressed more positive affect during free-play interactions with their infants at 7 months had infants who were more likely to display better attentional abilities and behavioral competence at 33 months (Conway, 2002; Conway, McDonough, & Sameroff, 2002). Specifically, such children were rated as having lower levels of externalizing problems (e.g., aggression), internalizing problems (e.g., depression, anxiety), and higher levels of behavioral competence, and these relationships were mediated by attentional control.

These data suggest that positive emotional experiences have very important contributions to the development of self-regulation. Further research on the complexity of positive emotions in relation to self-regulation and behavior problems is greatly needed. Promising directions include investigating the development of regulatory competencies associated with positive emotional experiences and how these regulatory processes can be harnessed in combination with other regulatory systems to promote adaptive behavior. This is particularly critical during periods of rapid developmental transition and risks for child behavior problems.

CLINICALLY SIGNIFICANT FAILURES IN THE DEVELOPMENT OF REGULATORY COMPETENCIES

A central thesis presented in this volume is that failures in adaptive self-regulatory processes underlie the development of psychopathology, particularly early-onset disruptive behavior problems (presented by Olson and colleagues in Chapter 7). This thesis is echoed by Calkins (Chapter 5); Cole, Hall, and Radzioch (Chapter 8); and Bates, Goodnight, Fite, and Staples (Chapter 6). For example, Olson and colleagues emphasize parent-child transactional processes linking to self-regulation as representing key mechanisms underlying the development of child behavior problems, thereby underscoring the importance of the development of efficient effortful control and emotion regulation abilities for regulatory competence. They also propose that developing abilities in the areas of social cognition and language can provide support for the development of regulatory competence.

Calkins posits that the development of self-regulation becomes increasingly hierarchically organized over time, with one of the first levels of control in early infancy centering on the regulation of physiological arousal, which gradually becomes integrated into more complex forms of behavior regulation across development. She argues that increases in self-regulatory abilities typically lead to a decline in problem behavior, whereas failures in these capacities lead to a cascade of self-regulatory difficulties and often to clinically significant problems, such as externalizing and internalizing disorders. Her longitudinal studies of child aggression emphasize different subcomponents of self-regulation and assess how the capacity to regulate across a number of levels influences children's adaptive behavior. These subcomponents of self-regulation include behavioral control, cognitive control, executive function, attention regulation, emotion regulation, and physiological regulation.

Cole, Hall, and Radzioch (see Chapter 8) also consider the development of multiple aspects of emotion regulation, describing how the failure to experience and regulate a full range of emotions is critical for understanding the role of emotion in the development of serious misconduct. They underscore the need to study a combination of emotions and states, such as fear, sadness, shame, vulnerability, and powerlessness. The authors propose processes by which the failure to experience and successfully regulate strong negative emotions is avoided and replaced with a need for dominance, lack of empathy, and, in some cases, a coupling of positive emotion with misbehavior. Indeed, by simply focusing on one particular emotion such as anger, one may obscure the complexity of the multiple emotion processes and unique relations that may place children at risk for behavior problems.

In this volume, several authors contend that developments in co-occurring domains can be used and harnessed in the service of regulation. Aspects of these ideas were considered in two seminal papers published by Claire Kopp (1982, 1989), which addressed the developmental antecedents of self-regulation and the regulation of distress in early childhood. In these papers, she paid particular attention to motoric, attentional, cognitive, and linguistic achievements that occur during early childhood and may aid children in self-regulation via physical self-soothing, attention shifting, and verbal expression. In a similar way, Mary Rothbart and colleagues (1992) also described how the strategic use of learned behaviors at various developmental periods can lead to reductions in distress. These behaviors include physical sucking and gaze aversion, withdrawal and communication with others, and the development of voluntary self-soothing behavior or distraction strategies. More generally, the development of a wide range of executive functions, cognitive control, and perspective-taking abilities may enhance other regulatory processes and provide protection against failures in self-regulatory capacities that contribute to the development of clinically significant behavior problems.

Yet, these perspectives also raise many questions. Under what conditions do developments in one domain of regulation facilitate regulatory processes in another – and, perhaps more importantly, confer risk or protection from behavior problems? How can our understanding of the development of self-regulatory processes and their relations to behavior problems be enhanced by assessing multiple regulatory processes and their interactions across development? More generally, given such complexity of multiple developing and interacting systems, how might investigators find specific areas of focus that can provide traction to inform practical, clinically relevant issues regarding prevention or early intervention strategies?

Although it is beyond the scope of this chapter to provide a comprehensive approach to answering these large and important questions, let us offer one set of thoughts. We offer suggestions about conceptual approaches and ideas about how translational research can address questions about clinically significant failures in the development of regulatory competencies. In brief, we offer support for four principles:

1. There is a need to move beyond generic models of "dysregulation" and move (conceptually and methodologically) toward specific models that focus on particular aspects of specific regulatory systems at particular periods of development. Although these specific investigative slices must be considered within a larger multisystem transactional framework, there is also a need to pose (and test) specific hypotheses about what aspect of self-regulation is impaired.
2. There is value in research that identifies key maturational intervals in the development of specific regulatory capacities that appear to be most sensitive to the influence of learning and experience; these key intervals can then become targets for intervention studies aimed at improving regulatory competence. Again, there is a need to balance, on the one hand, a full appreciation for the complexity and continuous nature of complex developmental processes and, on the other hand, a focus on specific intervals that may offer unique opportunities for intervention relevant to a specific regulatory system.
3. It is important to develop research that identifies some key nexus of regulatory interactions that create, in effect, "tipping points" in the trajectory of development, where the balance of complex interacting systems becomes a bit precarious and thus is easily affected by either positive or negative influences. That is, in addition to sensitive periods in the development of specific regulatory systems as described earlier, there may also be sensitive periods created by the interactions across multiple regulatory systems, at key points in development.
4. There are great opportunities for research that uses a neurobehavioral framework to identify mechanisms that underpin these sensitive periods – not as a way to reduce these complex transactional systems to simple biological explanations, but rather as a way to leverage understanding about the type and timing of behavioral and social interventions that can affect a specific set of systems in specific ways at a particular time in development.

A DEVELOPMENTAL NEXUS OF REGULATORY INTERACTIONS DURING ADOLESCENCE

To illustrate these four principles with greater specificity, we focus on an area in which some scientific traction is already being made in ways that are relevant to the broader discussion of the development of self-regulatory processes in this volume. We focus on the development of sleep during adolescence and the complex nexus of interactions in sleep/arousal, affect regulation, cognitive control, and self-regulation in adolescence. This focus not only illustrates the points outlined earlier in this section, but it also highlights the importance of including adolescent development as another crucial maturational period relevant to the development of self-regulation. Although most of the chapters in this volume have focused on earlier periods of development, it is valuable to recognize that adolescence is a key time not only in the development and refinements in maturation of "self" (Harter, 1999), but also in the development of regulatory capacities influencing cognitive, affective, motor, and attentional control.

Investigation of continuities and transactional relations among sleep, emotion, and behavior problems in context from infancy to adolescence is essential for understanding those problems' etiology and prevention. Development of these complex systems encompassing self-regulation can tip toward positive or negative trajectories, leading to both adaptive and maladaptive outcomes or, as discussed in this volume, success or failure in developing self-regulatory competencies. Such outcomes may hinge on a delicate balance and coordination of these systems over time, creating a window of opportunity for early intervention. Adolescence, as a critical developmental period of transition, brings a double-edged sword of plasticity – one that creates risks and vulnerabilities as well as conferring a period of opportunities for positive adaptive influences (Dahl, 2002; Stevens & Neville, 2006).

Another advantage to this example is that it provides a nice illustration of how a neurobehavioral framework can provide unique insights into the development of these complex interacting regulatory systems. More specifically, it illustrates how a deeper understanding of biological mechanisms at the nexus of several interacting regulatory systems can create a "tipping point" in development that is sensitive to social context in ways that have direct relevance to social policy (e.g., school start times, education programs, prevention strategies) with direct clinical relevance to health.

Why is a Focus on Sleep in Adolescence Relevant to Understanding the Development of Self-Regulatory Processes and Psychopathology?

First, there is growing evidence that sleep problems contribute significantly to a broad range of behavioral and emotional health consequences in youth. Second, there is evidence that brain/behavior/social context interactions in early adolescence contribute directly to these sleep problems. Third, there is evidence that failures in self-regulatory processes are centrally intertwined with these problems. In the following sections, we briefly review the evidence and arguments for each of these statements and then discuss their relationship to the broader themes of this chapter.

Sleep Problems are Common in Youth and Contribute to Major Health Consequences

There is growing evidence that many youth in the United States obtain insufficient sleep – particularly on school nights. Late-night bedtimes combined with early school start times contribute to what is increasingly regarded as an epidemic of sleep deprivation in adolescents (Gibson et al., 2006; Hansen, Janssen, Schiff, Zee, & Dubocovich, 2005; Millman, 2005). A recent large study of sleep habits ($n = 1602$ students in 7th to 12th grade) found that 45% of adolescents report insufficient sleep on school nights and 28% complain they often feel "irritable and cranky" as a result of getting too little sleep (Carskadon, Mindell, & Drake, 2006). The consequences of insufficient sleep among youth – including cognitive, emotional, and physical health effects – are the focus of increasing concern among public health and education professionals.

These negative effects include the overlapping domains of impairment of sleep and emotion. Growing evidence shows that sleep loss has a major impact on emotional functioning (Dinges et al., 1997; Pilcher & Huffcutt, 1996; Zohar, Tzischinsky, Epstein, & Lavie, 2005). Because worry, emotional distress, and physiological arousal can lead to difficulties getting to sleep (Alapin, Fichten, Libman, Creti, Bailes, & Wright, 2000; Tang & Harvey, 2004), these interactions can create a negative synergy of sleep and emotional disturbances – a spiral of effects that can be particularly problematic in adolescence (Dahl, 1996, 2002). More specifically, the affective consequences of sleep loss (e.g., tiredness, irritability, negative mood, decreased distress tolerance) can be particularly problematic at this maturational interval because adolescents are also dealing with other affective burdens, such as the physical changes of puberty, social and academic stresses, early romantic relationships, adolescent mood swings, and so on. Thus, there is increased risk for creating a vicious cycle of sleep and affective impairments.

In addition, emerging evidence from cognitive and behavioral neuroscience demonstrates the crucial importance of sleep for learning and memory. Studies in animals and humans have provided compelling evidence showing that learning is sustained and enhanced by sleep (Frank, Issa, & Stryker, 2001; Stickgold, 2005); including both implicit (or procedural) learning and explicit (or declarative) learning (i.e., memory for facts and episodes). The neural mechanisms of this learning consolidation are beginning to be elucidated (Fischer, Nitschke, Melchert, Erdmann, & Born, 2005).

Insomnia also increases risk for psychiatric disorders. It is a significant risk factor for both a first episode of major depressive disorder (MDD) and recurrent depressive episodes. In a review of nine studies, Perlis et al. (2006) estimated that patients with persistent insomnia have a 3.5-fold increased risk for depression relative to individuals without insomnia. This is observed in older adults (Livingston, Blizard, & Mann, 1993; Mallon, Broman, & Jerker Het, 2000), middle-age adults (Dryman & Eaton, 1991; Weissman, Greenwald, Nino-Murcia, & Dement, 1997), and young adults (Breslau, Roth, Rosenthal, & Andreski, 1996; Chang, Ford, Mead, Cooper-Patrick, & Klag, 1997). In adolescents at risk for depression and enrolled in a prevention trial (Clarke et al., 2001), insomnia symptoms at baseline predicted onset of a depressive episode at the 2-month follow-up point (chi square $2 = 5.3$, $p = .02$) (Clarke, personal communication, April, 2006). In a longitudinal study of 11- to 17-year-olds sampled from managed care rosters, insomnia at time one was associated with lowered self-esteem at time two (odds ratio 2.7) and increased depression (odd ratio 3.6; Roberts, Roberts, & Chen, 2002). A longitudinal study of sons of alcoholic men found that sleep problems in early childhood predicted the development of anxiety and depression in adolescence (Wong, Brower, Fitzgerald, & Zucker, 2004).

There is also growing evidence that sleep deprivation can increase risk for a broad range of problems with substance use (Bootzin & Stevens, 2005). For example, a study of sleep schedules, daytime sleepiness, and frequency of alcohol, tobacco, and coffee use in a national sample of approximately 4,000 Finnish 11- to 15-year-old boys and girls showed that irregular sleep schedules and daytime sleepiness accounted for 26% of the variance in substance use in 15-year-old boys and 12% of the variance of substance use in 15-year-old girls (Tynjala, Kannas, & Levalahti, 1997). In another study, looking at a sample of more than 4,500 12- to 17-year-olds, adolescents who had trouble sleeping reported more use of alcohol (odds ratio of 2.6), marijuana (odds ratio of 2.4), and cigarettes (odds ratio of 2.2). In studies following up alcoholics after treatment, sleep problems preceded and predicted relapse (e.g., Brower, 2001; Brower, Aldrich, & Hall, 1998; Drummond, Gillin, Smith, & DeModena, 1998).

Sleep problems influence the risk for obesity and metabolic syndrome: sleep deprivation increases appetite, weight gain, and insulin intolerance through metabolic and neuroendocrine responses to sleep loss (Spiegel, Tasali, Penev, & Van Cauter, 2004). Although the majority of this work has been done in adults, there are emerging data showing the same pattern of findings in children (Bass & Turek, 2005). The enormous epidemic of obesity and Type 2 diabetes in children and adolescents raises a compelling set of questions about the role of sleep loss and erratic sleep-wake schedules in what is probably the single largest public health concern relevant to the physical health and well-being in the United States.

Sleep loss also increases the risk for accidents. The single largest source of mortality in older adolescents is from deaths due to accidents – particularly lethal automobile crashes. There is compelling evidence that sleep deprivation creates impairments in attention, reaction time, and judgment at levels that are comparable to being intoxicated with alcohol, and youth appear to be particularly vulnerable to sleepiness and nighttime accidents (Arnedt, Owens, Crouch, Stahl, & Carskadon, 2005; Carskadon, 2002a). Although we lack data on the role of lack of sleep in accidents in early adolescence, it is likely that similar lapses in attention and judgment contribute to accidents such as falls, and bicycle or pedestrian accidents. In summary, the current epidemic of sleep problems in adolescence creates an enormous set of risks and negative consequences for health.

Sleep Problems in Youth Develop as a Result of Interactions between Biological Changes and Social Context

This epidemic of sleep and circadian problems in adolescence can be best understood within a developmental perspective that considers interactions between biological and social changes at the onset of puberty. Biologically, there are three sets of normal maturational changes in adolescence that create an increased vulnerability to sleep problems: (1) nighttime sleep becomes lighter (less deep stage 4 sleep) and more prone to external disruptions (Busby, Mercier, & Pivik, 1994; Busby & Pivik, 1983; Jenni, Achermann, & Carskadon, 2005); (2) daytime sleepiness increases during puberty, probably reflecting an increased need for sleep during this period of rapid physical growth, cognitive development, and emotional changes (Carskadon, 2002b; Dahl, 1996); and (3) biological changes in the circadian system at puberty shift sleep timing preferences in the direction of a delayed sleep phase (Carskadon, 2005; Lee, Hummer, & Jechura, 2004). These biological changes interact with social and psychological influences on sleep and schedules in adolescence in ways that often lead to very late bedtimes. Key social factors include less parental control over bedtime and access to stimulating social activities (movies, music, the Internet, and interactions with peers, including instant messaging, text messaging, and cell phones). These social influences are synergistic with biological tendencies toward phase delay, which can spiral quickly into a pattern of extremely delayed bedtimes in adolescents. Yet, school usually requires a fixed, early wake-up time. These forces converge to constrain time available for sleep on school nights, resulting in very high rates of youth obtaining insufficient sleep (Carskadon, 2002b; Carskadon et al., 2006; Hansen et al., 2005).

Adolescent Sleep Problems are Intertwined with Self-Regulatory Processes at Several Levels

At the simplest level, the most common sleep problem in adolescents stems from the constellation of factors that leads to delayed sleep onset times. This sleep problem in turn is usually rooted in one or more of several contributing influences: (1) behaviors that interfere with going to bed (late-night activities on school nights that range from TV, Internet, homework, to cell phones, etc.); (2) difficulty going to sleep (problems decreasing vigilance and arousal that can include anxiety, ruminative thinking about stressful events, conditioned insomnia, etc.); and (3) maladaptive habits (including caffeine use, "catch-up" sleep on the weekends and holidays that occurs at a circadian time that is incompatible with school schedules, etc). Each of these influences can be viewed through the lens of self-regulatory processes. Going to bed at a set time and down-regulating arousal to facilitate sleep require a range of well-developed regulatory processes. Exerting self-control over attention and behavior and aligning them to the goal of getting enough sleep and operating consistently on a schedule that is compatible with school requires coordination of an even broader range of self-regulatory processes, particularly because parents of adolescents typically impose less external constraints, and increasingly sleep habits and patterns are dependent on the adolescent making responsible decisions for him- or herself. In a similar way, managing sleep habits on weekends and holidays (when catch-up sleep often occurs at a nonoptimal circadian time, because adolescents go to bed even later at night and then sleep in very late on Saturday and Sunday) requires a broad set of self-regulatory capacities. Finally, understanding and avoiding several nonadaptive ways of coping with the accumulated sleep deprivation (excessive use of stimulants, long and late naps, etc.) also requires well-developed self-regulatory processes.

Sleep Deprivation Also Undermines Self-Regulatory Processes

It is also crucial to emphasize a set of influences that operate in the other direction: insufficient sleep contributes to impairments in cognitive control, affect regulation, and attention. As described earlier, sleep deprivation in adolescents contributes to irritability, impulsivity, reactive aggression, emotional lability, and low frustration tolerance. These impairments undermine self-regulatory control. Thus, these bidirectional interactions (poor self-regulation leading to late night schedules and sleep deprivation, and sleep deprivation undermining self-regulatory processes) can lead to a negative spiral of effects. These negative spirals are relevant not only to the virtual epidemic of sleep problems in adolescence but also to the growing interest in the clinically significant effects of sleep deprivation on affect regulation, learning, and physical health described earlier.

The Value of a Neurobehavioral Framework

A major reason for choosing this example of sleep/arousal and affect regulation is to illustrate the potential value of a biological framework aimed at understanding the specific neurobehavioral underpinnings to key components within these complex interacting regulatory systems. More specifically, it has become clear that puberty-specific changes in the neural systems of sleep and circadian regulation play a critical role in adolescent vulnerabilities, leading to a natural tendency to prefer going to bed later/sleeping in later. In addition, we have gained biologically based insights as to why humans adapt more easily to phase delays than phase advances (i.e., why it is biologically easier to adjust to jet lag when flying west, by staying up later and sleeping in later, compared to flying east). However, of equal importance is the recognition that these small biological changes at puberty are not deterministic. If adolescents maintain good sleep habits and schedules, they can easily go to sleep early and maintain early schedules. In fact, the evidence suggests that the social contexts of adolescents, including TV, the Internet, music, peer interactions, late-night activities, and of course school start times that force adolescents to get up early independently of their bedtimes, are much more important factors than the biological changes in sleep and circadian systems. Most importantly, we can see how it is a set of interactions – the biologically based tendencies that emerge at puberty combined with a social context that amplifies these tendencies – that leads to clinically significant problems with sleep deprivation and the resulting negative spiral of health consequences.

The value of a neurobehavioral framework, in this example, is that it can help focus the timing and specific targets for early intervention efforts. For example, cognitive and behavioral interventions to establish good sleep habits and patterns in the developmental window just before the pubertal transition may prevent the negative spirals before they progress to a vicious cycle of dysregulation seen so often in late adolescence. In a similar way, aiming at particular dimensions of these complex overlapping sleep and affective problems, in ways that are informed by a neurobehavioral framework (see Jenni & Dahl, 2008), can provide better traction for making specific behavioral and cognitive changes in particular high-risk groups. For example, youth with Generalized Anxiety Disorder often struggle at bedtime with distressing (and arousing) worries and ruminative thoughts that interfere with going to sleep and/or distractions that interfere with going to bed; these struggles can be targeted with a cognitive behavioral intervention in early adolescence, before these sleep and affective problems spiral further (Dahl & Harvey, 2008). In a similar way, Haynes, Bootzin, Smith, Cousins, Cameron, and Stevens (2006) have shown preliminary data that improving sleep in adolescents with substance use problems (with a similar behavioral intervention) decreased problems with daytime aggression.

In summary, these examples demonstrate the potential value of a neurobehavioral framework to focus investigations into these complex, multiple interacting regulatory systems, thereby advancing our understanding of key intervals of development and specific targets for intervention that can help tip the balance in positive ways toward healthy trajectories and away from clinically significant failures in self-regulation. It is easy to imagine a wide variety of similar approaches, creating investigative slices into several different periods of development and focusing on very different levels of regulatory control that may be similarly amenable to interventions. Achieving a more mechanistic understanding and testing specific aspects of conceptual models of interacting regulatory systems ultimately hold great promise for informing clinical approaches to early intervention and social policies affecting health in youth. These approaches can find a balance between the need for specific slices and areas of focus while still retaining a larger appreciation for the complexities and multiple levels of interacting systems.

The conceptual framework provided by Olson and colleagues (see Chapter 7) will be critical to these new frameworks. Use of a gender-based approach may help elucidate the developmental trajectories of child behavior problems, co-morbidities, and early antecedents. Investigations of developmental pathways to behavior problems and co-morbidities and the role of multiple regulatory processes are essential next steps in this research. Large longitudinal studies carefully designed to allow for complex transactional analytic techniques are urgently needed (Sameroff & MacKenzie, 2003). Such efforts promise to have profound implications for translational research on regulatory processes and child behavior problems.

As evidenced throughout this volume, there is a rapidly growing wealth of information about the development of regulatory processes and child behavior problems that have important implications for translational research. Although there are many difficult challenges ahead, particularly in finding effective ways to bridge and balance several contrasting approaches, there also is ample reason to be optimistic about the prospects for an exciting future of translational research on regulatory processes and child behavior problems.

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