

Conceptual Issues in Studying the Development of Self-Regulation

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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.

REGULATION MODEL

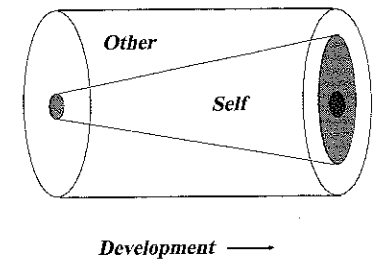


Figure 1.1. Changing balance between other-regulation and self-regulation as the child develops into an adult.

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

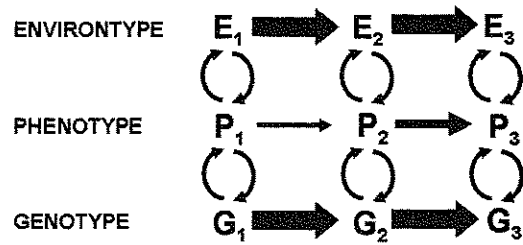


Figure 1.2. Regulation model of development with transactions among genotype, phenotype, and environment.

institutions such as the family, the school, and the community and has been postulated to compose an *environment* 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 environment 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 environment (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 environment 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 environment. The environment 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 environment 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 environment and genotype represent a range of responses. The environment 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 environment 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

enviroment'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 enviroment. 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 enviroment 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 responsiveness. 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 environment. 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 environment 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 environment. 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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How Gene-Environment Interactions Can Influence the Development of Emotion Regulation in Rhesus Monkeys

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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