CHAPTER 1

Introduction to the Volume

Seeing Infant Development through a Biopsychosocial Lens

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The Biopsychosocial Lens: Conceptual Integration across Domains of Infant Functioning

The development of the human infant from a seemingly passive, dependent, and immature organism at birth to—within a span of 2 to 3 very short years—a walking, talking, seemingly independent person, is a truly remarkable process. The effort to understand these rapid changes has been the domain of infancy researchers for more than 100 years. However, late in the 20th century, the world of infancy research entered an exciting and somewhat intellectually and methodologically challenging era. The introduction of sophisticated technology, providing access to genetic and physiological processes, allowed scientists to study developmental changes that were hard to access observationally. Ultimately, this led to a more integrated view of human development that incorporated the multiple biological and behavioral factors that conspired, in sometimes unknown ways, to produce unique developmental processes and pathways. Changes in the way scientists thought about development shifted rapidly and substantially from a purely maturational perspective (growth causes change) to an environmental perspective (family causes change) to a biological perspective (development is gene driven), and finally to variations on the interactionist theme: nature (genes and biology) and nurture (families, peers, and culture) interacted in complex ways to produce a range of developmental outcomes.

Clearly, the recent interactionist perspectives hold the most promise for understanding how biology, behavior, and environment all contribute to

developmental outcomes. As such, the aim of this volume is to present recent, novel, and paradigm-shifting work that has viewed infant development through a *biopsychosocial* lens. This lens offers a unique perspective on a period of life characterized by rapid changes across different domains of function, broadly characterized as biological, psychological, and social. And, this perspective has implications for how we think about, study, and analyze the data we collect about infants in these different domains.

The conceptual integration of biological, behavioral, and social levels of analysis (Gottlieb, 2007) has been referred to in various ways, including *developmental science* (Cairns, Elder, & Costello, 1996) and *developmental* or *dynamic systems theory* (Lewkowicz, 2011; Lickliter, 2008). Regardless of the label, these approaches articulate clear support for a unique perspective on development, one that gives greater acknowledgment of the complex and reciprocal, rather than prescriptive, role of biological processes in transactional models of development (Calkins, 2011; Sameroff, 2010). The biopsychosocial perspective aims to account for the *processes* and *mechanisms* responsible for growth and change in structure and functioning in children, within the context of families and the broader social context, and with an appreciation of the contribution of underlying biological processes.

The articulation of the basic principles of the biopsychosocial approach was stimulated by several landmark studies of genetic and biological processes in humans and animals. This work led to reformulations of developmental theory and, eventually, a movement toward empirical designs and analytical techniques crafted specifically to reveal the dynamic nature of early development. Thus, the biopsychosocial lens we rely on in this volume provides scholars of infancy with a view of development that crosses multiple levels within and between individuals. The focus of the work in this volume varies considerably from chapter to chapter; as a whole, the work presented here encompasses the genetic, neural, physiological, psychological, familial, and contextual levels of individual functioning, and together yield a richer understanding of the daunting complexity of human infants and their worlds.

Emergence of the Biopsychosocial Perspective in the Study of Infancy

The contemporary study of infant development has yielded remarkable growth in our understanding of the very early emerging skills and abilities of young children. Historically, efforts to study human infants viewed them as somewhat passive creatures whose development depended largely on the maturation of the brain and on the interventions of others. Soon, however, clever research methodologies evolved for studying the appearance and development of skills in humans lacking the linguistic skills to reveal their cognitive and

social knowledge. These methodologies capitalized on the primitive abilities of infants—looking, sucking, and motor movement—to infer skills and knowledge that ranged from the perceptual to the social. In this way, science began to view infants as active participants in their own development, capable of using their social environments to facilitate subsequent learning and skill development. A large body of infancy research conducted throughout the latter half of the 20th century adopted this perspective and focused on identifying patterns of abilities and developments in the broad domains of emotion and cognition, as well on studying the significance of individual differences in these domains for later functioning, adaptation, and mental health (cf. Bremner & Fogel, 2004).

   Two significant changes in the field of child development in the late 20th and early 21st centuries, one conceptual and one methodological, again altered our view of infancy, this time to one that acknowledged the complex interactions among the child's biology, his or her behaviors, and his or her environment (Gottlieb, 2007; Sameroff, 2010; Shonkoff, 2010). First, the field of psychology more broadly, and developmental psychology in particular, began to concede that the "nature–nurture" debate was irrelevant, because the partitioning of genetic and environmental influences in development was likely impossible given their interdependence (Lewkowicz, 2011; Meaney, 2010). Instead, the field began to embrace a more complex view of development that considered how dimensions of both nature and nurture dynamically interact across time. The movement toward this perspective was precipitated by studies of the role of genes in human and animal behavioral and biological phenomena that illuminated the complex ways that genes and environments both participate in the developmental process.

   The first such investigations were done with nonhuman animals and retrospective studies of human adults. For example, several pioneering animal studies focused on the serotonin transporter gene. A repeat length polymorphism in the promoter region of this gene (*5-HTTLPR*) has been shown to affect the rate of serotonin uptake and may play a role in a range of problematic behavioral outcomes, including aggression. This work revealed that rhesus monkeys that were raised by peers, rather than mothers, exhibited more behavioral and physiological problems (alcohol consumption, poor stress reactivity), and deficits in self-regulation (impulsivity, inappropriate aggression, orienting problems, risk taking) if they possessed the risk allele of the serotonin transporter-linked promoter region (*5-HTTLPR*; s/s or s/l) instead of the nonrisk allele (l/l). These findings suggest that the risk allele of the serotonin transporter gene was only predictive of maladaptive outcomes for monkeys in poor-quality rearing environments. For those monkeys that experienced a natural and supportive mother–infant relationship, there was no effect of genotype (Barr et al., 2004; Bennett et al., 2002; Champoux et al., 2002; Suomi, 2006).

   Similarly, in two influential studies of gene–environment (G–E) interactions in human adults, Caspi and colleagues (2002) found that early adverse

experience alone did not predict adult psychopathology. As with the animal studies described previously, adults carrying the risk (s/s or s/l) allele of serotonin were more likely to be depressed when they experienced stressful life events than adults without the short allele or those with the short allele who did not experience stressful life events (Caspi et al., 2002). In a second study, they found that childhood maltreatment alone did not predict antisocial behavior in adulthood, but rather that there was a significantly higher chance of developing later antisocial behavior for those individuals who possessed the risk allele of the functional polymorphism of the monoamine oxidase A (*MAOA*) gene and also experienced maltreatment (Caspi et al., 2003).

The study of G–E interaction suggests that the environment in which genes are expressed alters behavioral outcomes. However, the characterization of this interaction is far from simple and the mechanisms through which development occurs are quite complex. For example, other animal work demonstrates quite convincingly that the effect of the environment occurs at both the biological and behavioral levels. For example, Meaney and colleagues have studied the rearing experience of rat pups and its role in the development of the hypothalamic–pituitary–adrenocortical (HPA) axis, which is principally involved in the behavioral response to stress (Meaney, 2010). Rat mothers naturally differ in the amount of "licking and grooming" (LG) caregiving behaviors they provide their pups; high amounts of these behaviors appear to influence the development of the rat pup's developing stress system. Rat pups of low-LG mothers that are cross-fostered with high-LG mothers become themselves less stress reactive, both physiologically and behaviorally, suggesting that the environmental exposure to different caregiving experiences alters the expression of genes that are implicated in the development of the stress system (Champagne et al., 2008; Meaney, 2010).

These influential studies of the dynamic influences across genetic, physiological, and behavioral levels has guided recent work in the field of infant development. In one such study, researchers examined the effect of the dopamine receptor gene D2 (*DRD2*) on infant physiological responses to stress over the first year of life in the context of infants' experiences with caregivers (Propper et al., 2008). Infants possessing the *taq*1 A1 polymorphism of *DRD2*, associated with impulse-control problems and sensation-seeking behaviors, who were also exposed to sensitive maternal caregiving over the first year of life, exhibited a more optimal and expected cardiac response to stress at 12 months of age, comparable to the cardiac reactivity of those infants possessing the nonrisk version of the gene. Infants without the risk allele displayed typical and effective cardiac response to stress regardless of whether mothers were sensitive, suggesting that the caregiving environment may, in fact, be less important for their regulatory outcomes.

So, as the scientific understanding of human genetic and psychobiological processes has grown, scholars have come to abandon the notion that

development is gene driven and instead have adopted an appreciation of recipro-
cal processes at all levels of development. This perspective has led to a shift in
focus in the field of developmental psychology, and in the study of infant devel-
opment in particular, that has influenced our attempts to understand and study
how specific behavioral developments emerge and influence infant development
and functioning, as well as how those developments feedback to influence both
biological and social processes. Scientists have come to view development as a
fundamentally *dynamic process* involving transactions between the child and
his or her environment that influence children's development, and the behavior
of those who comprise their environment, at multiple biological and behavioral
levels (e.g., Blair, 2002; Calkins, 2011; Lewkowicz, 2011).

Empirical Implications of a Biopsychosocial Perspective

According to the biopsychosocial perspective, the child's biology, behavior,
and social environment are changing one another continually over the course
of development. This view of development has emerged because the science
of development, and the empirical work that investigates these processes, has
become much more interdisciplinary in nature and begun to incorporate bio-
logical constructs and principles, as well as empirical measures and findings,
from the fields of genetics, neuroscience, comparative psychology, psychobiol-
ogy, and psychophysiology. This interdisciplinary nature of the perspective has
led to new challenges in the study of infant development.

   Understanding development in such a comprehensive and transactional way
implies that investigators adopt a multilevel perspective, and perhaps as well, to
actually study development across different levels of influences, ranging from
the genetic to the social (Gottlieb, 2007). This multilevel perspective led to a
critical empirical shift in the way development is studied both in the laboratory
and in the field. Over the last several years, multilevel empirical approaches to
the study of infant development have proliferated. Investigators traditionally
interested in a specific behavioral phenomenon such as temperament, memory,
or attachment began to view these behaviors as embedded in a complex system
of biological and social processes. And, as this volume reflects, the work that
has emerged has surveyed a diversity of specific indicators of these processes,
often using longitudinal designs to study children and their environments over
time.

   One area of growth in this work has been the specification of what con-
stitutes "environment." Although the term often applies to the family environ-
ment, more recently, we have begun to broaden and deepen our understanding
of this term, describing the family and its functioning at a more micro level, and
going beyond the family to the larger social and cultural world in which the child
and the family are embedded. Moreover, when considering G–E interaction, the

environment consists of everything from the cellular to the social. Indeed, as Shanahan and Hofer (2005) noted, the *E* in *G–E* might best be conceptualized as *exposure*, a term that highlights the range of processes that may alter the pathway initiated by the gene's cellular action at biological and behavioral levels across development.

In addition to the challenges of design and choice of methods that are inherent in work addressing biopsychosocial processes, analytical challenges are substantial as well. The models that have been proposed are often depicted in ways that visually represent the various levels and their interdependence, but the translation of these models to statistical analysis has been slower in emerging. Much of the early work on infant development relied on relatively simplistic correlations and regressions to examine longitudinal developmental associations. Cutting-edge research driven by theoretical models designed to capture the multiple levels of functioning and how these levels change over time requires appropriately sophisticated analytical techniques.

The analytic landscape is rapidly evolving in an effort to meet this need and new advanced statistical techniques are being developed for both person- and variable-centered analyses. Within variable-centered approaches, techniques such as repeated measures analysis of variance and regression analyses have been overshadowed by growth curve modeling, path analyses, and time series analyses, with the goal of describing the trajectories of change in variables that are central to infant functioning and identifying multiple predictors of deviation from those trajectories (Laursen & Hoff, 2006). Researchers have also begun to use more person-centered approaches including profile or class analyses to address questions regarding group or individual differences in patterns of development across time and associations among variables at multiple levels of child functioning. Measurement challenges are associated with these techniques, but nevertheless, they offer a means through which researchers can examine trajectories and complex associations among behavioral constructs of interest. A key point here is that, often, developmental pathway models, which are clearly well suited to the longitudinal study of infant development, predated the statistical techniques to test them (Curran & Willoughby, 2003). Nevertheless, the ongoing development and refinement of statistical methods to test such models is key to further advances in this area.

The adoption of a biopsychosocial perspective on infant development has produced a corpus of work that is rich, though often challenging to integrate, a consequence that may be largely a function of its relative youth compared with the larger body of more traditional developmental research. Importantly, though, these studies routinely reveal a complexity in development that has changed the way we think about development in general and that have motivated efforts to identify specific pathways to optimal versus compromised outcomes in childhood. Moreover, studying development across levels of biology, behavior, and environment provides us with insight into the more *proximal*

developmental mechanisms and processes that affect both infant development and the environments in which infants develop, and that can help us to identify critical points of entry for early intervention and prevention. In short, a biopsychosocial lens on development holds the promise of advancing the theoretical, empirical, analytical, and translational agenda of the field of infancy.

Overview of This Volume

The goal of this volume is to provide a selective review of current, cutting-edge work that assesses infant functioning across different biological, behavioral, and/or contextual levels to inform our understanding of development. The authors selected for inclusion in this volume are each conducting research from within a biopsychosocial perspective, incorporating into their work at least two levels of analysis, from the genetic to the environmental. As is clear from the work presented in this volume, integrating this perspective into their work has challenged infancy researchers to grapple with complex conceptual, empirical, and analytical problems. Many questions remain about how best to consider how these transactional processes operate across time and context; how to measure and analyze biological, behavioral, and social processes that may be difficult to disentangle; and how to translate those findings into strategies to positively influence outcomes for young children. Nevertheless, clear from this volume is that these challenges are being met and the field of infancy is quickly evolving to reflect the rapid pace of empirical and analytical advances. In adopting a multilevel approach—a biopsychosocial approach—this volume will provide a conceptual, empirical, and translational road map for research on infant development in the 21st century.

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