PSYCHOLOGICAL DEVELOPMENT FROM INFANCY

Image to Intention

Edited by
Marc H. Bornstein and William Kessen

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CHILD DEVELOPMENT

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Volume 2

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PSYCHOLOGICAL DEVELOPMENT FROM INFANCY:

Image to Intention

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Series Prologue

CROSSCURRENTS IN CONTEMPORARY PSYCHOLOGY

Psychology is today an increasingly diversified, sophisticated, pluralistic, and specialized discipline. Research investigators venture beyond the confines of their narrow subdiscipline only rarely; typically to do so requires a seemingly heroic effort. Nonetheless, regardless of specialty, psychologists frequently encounter similar problems, ask similar questions, and share similar concerns. Yet there are far too few forums for the expression or investigation of common supradisciplinary problems, questions, or concerns. The series *Crosscurrents in Contemporary Psychology* is intended to serve as such a forum.

The principal aim of this series is to provide integrated perspectives on supradisciplinary issues in psychology and therefore to countervail the growing tendency toward specialization. The contributions to this series are calculated to explore issues that cross psychological subdisciplines. Each volume will take a different perspective or level of analysis and will concern itself with a different specific intra-disciplinary theme. Each volume will interrelate psychological subdisciplines and a variety of disciplines outside psychology.

Because of the nature and intent of this series, its contributing authors come from the broad spectrum of psychologists and social scientists. Indeed, contributions from anthropology to zoology are appropriate. Typically, however, the authors are noted authorities actively contributing to the contemporary psychological literature.

Although each volume in the series is self-contained, comprehensive, and valuable of itself to the discipline, the series of books as a group endeavors to bring new or shared perspectives to bear on a wide variety of topics in psychological thought and research. As a consequence of this structure and the flexibility and scope it provides, books in the series *Crosscurrents in Contemporary Psychology* will appeal, individually or as a group, to psychologists with diverse interests.

Crosscurrents in Contemporary Psychology is a series whose stated intent is to explore a broader range of supradisciplinary issues in psychology. In its concern with larger problems, the series is devoted to a growth of interest in the interconnectedness of research, method, and theory in psychological study.

Marc H. Bornstein
Editor

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PART II: COGNITIVE DEVELOPMENT

Preface

As one reads or surveys the literature in developmental psychology, two themes consistently reappear. First, infancy is held to be a unique period of human development. In many respects, infants have been segregated practically and experimentally from the psychological study of the life span, and the sociology of infancy studies has left the scientific study of infants somewhat secluded. Nevertheless, a second, seemingly contradictory theme exists in theories of development. Many commentators assert that higher order, mature behaviors assume or reflect or continue lower order behaviors found in infancy. Both positions are unarguable, and both are more than implicit in developmental thought. Yet to a certain degree these two positions have not been properly reconciled. Just how are infancy and later development interrelated?

The original impetus for this book derived from our observation of the paradox of uniqueness and continuity. We came to believe that it would be useful for the field of developmental studies if a group of active and prominent investigators addressed the issue of development from infancy. In adopting the theme *Psychological Development from Infancy,* we hoped that the contributors to this book would address the nodal question of what precursors to later cognitive and social development may be identified in early infancy.

Because of historical precedent (or accident), the task we assigned was obviously not easy to meet. Nevertheless, our contributors responded estimably and the result is, we believe, a fortunate advance for developmental thought. We take this opportunity to thank them formally for their efforts and to thank E.J. Gibson of Cornell University, J. Mandler of the University of

California, San Diego, and P. Mussen of the Institute of Human Development at the University of California, Berkeley, who agreed to read and assess in printed commentary the contributions to this book. We believe that these commentary sections enrich the original contributions by providing readers with the interpretations and assessments of other distinguished scholars.

The contributions to this collection are organized along traditional lines in developmental psychology, distinguishing among perceptual, motor, cognitive, language, and social development. Obviously and correctly, our contributors did not feel constrained by our arbitrary divisions, and there is, as a consequence, considerable spillage of interest and topics among the chapters. The commentators reflect this pluralism as well.

Several audiences will find this book of interest. Because it represents recent, inclusive, and substantive statements by prominent investigators in developmental psychology, it meets the needs of specialists in the several areas of psychological development. As a whole it also meets the needs of a variety of advanced students and research investigators in psychology who are interested in the origins and ontogeny of behavior. Finally, the topics covered explore motor, perceptual, cognitive, language, and social development from empirical as well as theoretical vantages. We believe, therefore, that this book will be read profitably by students as well as by our professional colleagues.

Several good workers aided in the preparation of this volume. We especially thank Sondra Guideman, Rose Fioravanti, Julie Grabel, Beverly Hoffmann, Sharon Olsen, Arlene Rakower, Liz Novins, and Carol Smith for their good humor and patient assistance in the production of the book.

Marc H. Bornstein
William Kessen

For our parents

1 Introduction

William Kessen
Yale University

Not so long ago, we had occasion to celebrate the centenary of developmental psychology, an anniversary marked by the publication of Charles Darwin's notes on son Doddy in *Mind.* The event was noteworthy for several reasons, but, for those of us who try to make sense of early human mind, Darwin's biographical sketch claims our current attention primarily for two reasons. In the first place, we have lived so long with the idea of continuous development, both in its phylogenetic and its ontogenetic forms, that it is difficult for us to reclaim the revolutionary character of Darwin's proposals about the lives of children. Second, there are signs in contemporary communities that the hundredth birthday of evolutionary ontogenesis may also mark its decline, even its imminent demise. Should we maintain our commitment to the notion of continuous connected human development from infancy to adulthood?

It is worth remembering how the scientific study of children was twinned at its birth with the larger developmental principle that all life derives from its past and grows toward its future. Spencer, who had the bad luck to publish his *Principles of Psychology* just four years before the appearance of *The Origin of Species,* pushed the application of evolutionary principles to psychology as hard as he could and, along the way, he proposed the apparently eternal succession of reflex, instinct, memory, reason, feeling, and will. Yet even Spencer did not make the ontogenetic leap. For him, the hierarchical order of "the growth of intelligence" was a *phylogenetic* succession. As he said (1899):

> . . . high intelligence . . . lies latent in the brain of the infant . . . . Thus it happens that faculties . . . which scarcely exist in some inferior human races, become congenital in superior ones. Thus it happens that out of savages unable to count up to the number of their fingers, and speaking a language containing only nouns and verbs, arise at length our Newtons and Shakspeares [p. 471].

For Spencer, as for all other evolutionists of his time, the only hope for ontogenetic change was in waiting for the tedious flow of phylogenetic change. The developmental revolution was to come in the recognition that Newton and Shakespeare were epigenetically available even in the savage Papuan.

In the last 20 years of the nineteenth century, the ontogenetic principle burst into life. Preyer, Taine, Hall, and Chamberlain were but the most audible proclaimers of the new doctrine—ascribed to Haekel but in the very air—*ontogeny recapitulates phylogeny.* In the life of the child could be seen the life of the race and, happy biconditional, in the life of the race could be seen the life of the child. The feverish recognition of the applicability of the developmental principle to the growth of the child produced a literature of enthusiasm that can best be compared with William Jennings Bryan's speeches on the virtue of silver.

But there was a way to go yet. The child as a reflection of the species is a static and, as it turned out, not a richly productive theoretical advance. It was left to James Mark Baldwin and Sigmund Freud to take the liberating next step—the step to epigenesis. Yes, they said in their very different ways, there are analogies (perhaps even homologies) between the growth of the mind and the growth of the species, but they are not *analogies of content* (Spencer's reflex to Spencer's will); they are *analogies of construction.* Each higher level of functioning does not lie latent in the baby, awaiting its scheduled call. Rather, each developmental moment is a moment of creation, an ever-recurring exchange between what the child's mind is and what his experience asks of him. Baldwin (1895) made the contrast between antique doctrines and the new vision:

> The old argument was this,— . . . consciousness reveals certain great ideas as simple and original. . . . If you do not find them in the child-mind, then you must read them into it.
>
> The genetic idea reverses all this. Instead of a fixed substance, we have the conception of a growing, developing activity. . . . Are there principles in the adult consciousness which do not appear in the child consciousness; then the adult consciousness must, if possible, be interpreted by *principles* present in the child consciousness; and when this is not possible, the *conditions* under which these later principles take their rise and get the development must still be adequately explored [p. 2f.; italics mine].

Development can be understood only as a continuous interplay of principles and conditions, the dance of ontogenetic adaptation.

The ontogenetic principle — regularity of progression — and the more

demanding epigenetic principle—continuous adaptation—have been adhered to, give a little, take a little, for the last 100 years of child study. To be sure, the range of variation within the general adherence has been wide — Freud and Gesell and Piaget and Skinner all claim the sensible epigenetic middle ground. Now, the new dialecticians have rediscovered Baldwin, and the skeptical historian of developmental psychology may wonder whether many prized ideas in our study of children have not been sidesteps in evasion of the implications of an epigenetic analysis. Whatever our theoretical predisposition, most of us prefer conceptions of the child that do not require constant revision. The literature is not crowded with specific testable propositions about how the child's mind at a particular moment in his life is transformed by his environment or his experience to a new level of functioning.

The editors' sense that concrete proposals for the working of epigenetic change are rare and their recognition of the recent tendency, noted earlier, to be dubious about the developmental principle altogether led to the book that lies before you. In its most general form, the question we asked of our developmental colleagues was: Can we illustrate, in theory and data, the development of the child from one specifiable period of his life to another? In its narrower form, the question reads: Can we show, specifically and rigorously, how the infant becomes the noninfant?

Let us say briefly why we chose infancy as the testing ground for the more general question.

No one can speak wisely about all of development; some scissions must be made in the 70-year strand in order to avoid vacuous speculation. Readers of textbooks and of scholarly treatises as well are familiar with our favorite lines of division — between preschool and school, between adolescence and adulthood, between maturity and senility. The most common cutting point, and the only one that runs back to antiquity and that has never left modern expositions of development, is the line between the infant and the noninfant. The segregation of talkers from nontalkers—to pick the most persistent definition of the boundary—has profound cultural roots in dress, games, caretaking, expectations of responsibility, and ascriptions of competence, but the boundary has more academic marks. The methods that are used to study the behavior of the littlest people do not often overlap the methods used to study *what are purported to be the same conceptual issues* in older children. The theories used by those of us who look at babies and those who look at, say, the preschool child are different in central propositions as well as in parameters. Even the marks of mind that we observe—the basic "responses" of legendary consequence—shift markedly when we go from newborns to yearlings to 2-year-olds. There is not room here to explore many of the implications of the infant-noninfant wall that developmental psychology faces, but several summary notes will help get you ready for the chapters of the present book. Some developmental psychologists have effectively denied the boundary by concentrating their at-

tention on processes assumed to be general. The most widely held such functional position has been maintained by the researchers committed to a learning analysis of behavioral change over age. Some developmental psychologists have recognized the wall between infants and noninfants and have called on a paired proposition—the existence of stages and the operation of general theoretical principles — to handle the boundary. Psychoanalytic theorists and Piaget are chiefs here; again, the skeptical observer sees more theoretical and empirical work going on within stages than between them. Some developmental psychologists seize on concepts of continuation (temperament, IQ, social class) to pierce the wall in the ballistic assumption that there are underlying (a favorite word for all of us) regularities in personal traits. Finally, there is a new return to the oldest idea of all — that infancy is not momentously connected with the rest of the developmental course but represents a biological continuation of pregnancy, which may be interesting in its own right but need not deter us in the study of later changes with age.

The last-noted position, the indifference proposition, is rare enough to emphasize another major characteristic of the segregation between infants and noninfants. In spite of our faltering attempts to get over the wall, there had been little doubt until recently that the events of the first months of life are of far-reaching consequence for later development. Perhaps the single shared ideological commitment of learning theorists, psychoanalysts, Piagetians, Wenerians, and maturationalists has been the belief in the high significance of the early months and years of life. Personalities are shaped, basic knowledge is acquired, directions are set. In sometimes lunatic fashion, mothers are urged to perform early-days rituals of caregiving, and frights are raised about the consequence of insufficient early support to intellectual growth, all in the name of infancy's uniquely formative and defining place in life.

Thus, the editors saw a potentially productive paradox. Developmentalists study infants and noninfants in different ways, we talk about them in different ways, we have grave trouble connecting them up. Yet we persist in the rarely examined conviction that what happens to infants is a determinant of all later development. The transition from nontalker to talker seemed ideally suited to put our attention precisely on the problem of developmental transitions, their theory, and their data.

The book that follows on our introduction is made up of 11 original chapters and three commentaries on those chapters. We invited essays from 13 investigators who have worked with and thought about both infants and older children. We asked them to take some particular topic of interest to them and to attempt to make their way over, through, or around the boundary that segregates infants from noninfants. As you will see, they have carried out their assignment with uniform high intelligence and good spirit. We

leave to our commentators and to our readers to judge with what success.

Amid the fine variety of the chapters you are about to read, there are some recurrent themes. First among them, naturally enough in light of our assignment, is the issue of *continuity.* Not always addressed directly, the question of getting from infant to noninfant with a coherent set of ideas is constantly present. Several other persistencies lie under the major one. *Liberation from the response* appears throughout; whether the exemplary case is drawn from perception or action, language or thought, the critical move from the conceptual importance of the visible response to the importance of the mental act that must be inferred is usual. In a happy controversial phrase from one of our authors, mind begins to control muscle. Closely tied to the peculiar reduction of the response are the problems of *context* and *decentration.* No attempt to understand perception or language (and perception and language are models for the rest of developmental study) can conscientiously ignore the troubling puzzle of how young children parcel out their experience into categories of figure and ground, of important and less important, of same and different. The development of a textured organized surrounding, in which some things go with some other things and some things matter more than other things, is a heart issue of this book. When the editors first talked about the book, we wanted to call it *From Image to Intention* in order to emphasize our conviction that *one* of the defining problems of the development from infancy to noninfancy was the coming on of plans, the child's shift from species-general solutions of presented problems to particular solutions, from solutions based on the here-and-now to solutions based on memory, symbol, and reasoning. The title was canned, but the issue remains. How does the young child move toward that less automatic, less quick, and less uniform treatment of a problem he faces that marks the transition from image to intention?

Continuity, response-to-thought, context, and image-to-intention are everywhere concerns of the book's authors. However, the best contribution of these chapters almost certainly is not in solving fundamental and general psychological questions that we can hardly put into words but rather in wrestling, specifically and concretely, with the "principles" and "conditions" that carry the child from birth to conversation.

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PERCEPTUAL AND MOTOR DEVELOPMENT

2 Perspectives on Infant Motor System Development

Claire B. Kopp
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INTRODUCTION

Movement is so fundamental to human existence that performance of countless acts scarcely intrudes upon consciousness. Yet one has only to see a single individual struggling with "nonbidding" limbs in executing otherwise routine tasks to appreciate the personal significance of motor behaviors. They are means to communication, exploration, tension release, skill, self-care, mastery, and work. Furthermore, empirical studies suggest that movement contributes to learning, perception, attention, memory, problem solving, motivation, and socialization. Movement has an ubiquitous character.

Because of this and sometimes despite it, the study of movement, its origins, controls, functions, and influences, has fascinated researchers for years. Although not without controversy, historic analyses of human motor research show trends often paralleling interests evident in other areas of psychological investigation. For example, studies of adult motor performance have shifted from a product orientation to examination of links between information processing and motor performance (Irion, 1966; Pew, 1974; Stelmach, 1976). As is seen later, a similar shift from product to process has characterized research on infant motor development.

The study of acquisition of voluntary movement, only one domain of a much larger research field, has been of particular interest to developmentalists. At the very least, to scientist as well as layman, awesome transformations of infant motor patterns take place—from first rudimentary forms, to endlessly practiced transitional structures, to mature configurations skill-

fully executed. But beyond fascination, there is theory. Increasingly, developmentalists have thought about the significance of movement and ascribed to it a singular role in development. Infant motor acts are, after all, striking characteristics of the first two years of life and represent a common means by which the very young convey their abilities and feelings. Eventually, infant movement became the *sine qua non* of cognitive and social development. Only in the last decade or so has this view been questioned.

REFLECTIONS

To gain some perspective on ideas that governed much of our earlier thinking, it is useful to review in a summary way former periods of theory and research. This review is selective and arbitrary. For example, for organizational purposes four phases of research have been delineated, covering the period from the turn of the century to the present time. Although several common threads link the phases, one of the most striking concerns the emphasis and interest developmentalists placed on the age period of motor acquisition. Thus, almost all the ensuing discussion relates to the first year of life.

The first phase, spanning several decades (through the 1940s), was the "cataloging" period when details concerning the ontogeny of prehension and postural control were assiduously collected (Bayley, 1935; Castner, 1932; Gesell, 1929a; Gesell & Thompson, 1934; Halverson, 1931; Hetzer & Wolf, 1928; McGraw, 1935, 1943; Shirley, 1931). This was the necessary descriptive period in the first stage of scientific inquiry.

During this period, gathering descriptions appeared to be of greater interest than investigation of issues, although there were a few notable exceptions. Among them, for example, was Dennis's (1941) study of developmental rates of prehension, locomotion, and social responses of twins reared under restrictive conditions. Dennis, following Gesell's (1929a, 1929b) maturational bias, hypothesized a greater intrinsic influence on development than would be observed consequent to specific experiential conditions. Although he anticipated few differences in rates of change between his twins and infants reared in more usual home situations, his results only partially confirmed his expectations. The twins evidenced considerable delay on developmental items that involved social responses or practice. In contrast to Dennis, Watson and his associates (Jones, 1926; Watson & Watson, 1921) approached the study of motor behaviors from the vantage point of a behaviorist. As such, they attempted to teach prehension to very young infants; Watson's results were disappointingly negative.

The major conceptual theme emerging from this period inextricably linked infant motor development to growth of the mind. Baldly stated, without activity there could be no infant intellect — the beginnings of

prehension represented the growth of mind (Gesell, 1929a). Not only was Gesell one of the foremost proponents of this view; he also proposed that rate of prehensile change reflected growth of mind. Thus, the belief spread that motor acts — particularly those involving hands — were necessary preconditions to mentality and that motor precocity was advantageous. Virtually no one at the time questioned this motor-mental bond (see an earlier review by Wellman, 1931); what caused controversy was the issue of rate with respect to its consequences (Bayley, 1935; McGraw, 1935). Neither Bayley's nor McGraw's data supported Gesell's contention, but their findings were ignored for many years.

Gesell, a prodigious, gifted writer, was fascinated by Darwin, evolution, studies of infancy in other species, and anthropology. He often paralleled human ontogeny with evolution. As early as 1929, Gesell (1929a) wrote that the mechanisms of evolution and individual growth had much in common but differed mainly in relation to time. "What evolution achieves in ages, the infant in his growth accomplishes in brief moments [p. 374]." Yet, Gesell continued, the infant grows and adapts in a manner comparable to the evolutionary process.

Later Gesell (1952) elaborated his evolutionary theme by noting, "In the race and in the child alike the contrivance and use of tools are closely correlated with the genesis of practical reasoning. . . [p. 55]." Writing in almost lyrical style, he compared (1948) infant prehensile approach movements to primitive scooping tools, repetitive banging to paleolithic stones used for splintering other stones, and pulling, pushing, and probing activities observed toward the end of the human infant's first year to possibly "retracing in a condensed manner maneuvers by which the race falteringly and accumulatively mastered the elementary physics of its environment [p. 90]."

Many of these ideas were totally alien to developmentalists of the period. Not until recently, with research from our own and other fields, have some of these views received a forum and subsequent endorsement. Nonetheless, it is a curious fact that, although Gesell's biologic, evolutionary, and maturational tenets were out of phase with and largely unacceptable to mainstream psychology, his linking motor function with growth of mind was sanctioned. The implications were profound for, to professional and parent, imperfect or late acquisition of infant motor skills spelled impairment of development or poor intellectual capability.

A second period of research (from 1960 through the early 1970s), coincident with American psychology's acceptance of Piaget's developmental theory, heralded renewed attention to infant motor acts. A conceptual unity existed between the first and second periods because Piaget (1952, 1954) highlighted sensorimotor activity as *the* basis of early and later intelligence. From the very first editions of his writings on infants to a recent theoretical chapter, he has consistently stated the necessity for infants to act upon their world in order "to know" (Piaget, 1936, 1970). Though articulated dif-

ferently from Gesell's maturational theory, Piaget's mental-motor point of view was clear and was embraced by many. Inadvertently, Piagetian theory also contributed to an emphasis on *rates of change* because some developmentalists, interpreting Piaget, placed heavy emphasis on the environmental side of Piaget's organism–experience equation. Thus, experiences were favored that could foster motor precocities.

On an empirical level, the second research phase vastly differed from the preceding one. Theory, heretofore largely neglected, was used extensively to formulate research questions. For example, the classic study of White, Castle, and Held (1964) concerning the role of varied experiences on the sequence and rate of visually directed reaching, was both a test and replication of Piaget's theory and ad hoc observations. So too were the sensorimotor series designed to measure prehensile sequences (Corman & Escalona, 1969; Uzgiris & Hunt, 1966).

In this second research phase, motor behaviors were explored for their role as mediating mechanisms, not solely for description. Thus, Bruner (1968, 1970, 1973) examined prehensile skills for their instrumental value in infant play and problem solving, and Bower (1974) utilized observations of reach and grasp as a means to study early perceptual discriminations. Developmental processes were beginning to assume a role as important as developmental products.

During the 1960s the entire nature of infant research underwent rapid change with the introduction of new measurement techniques and subsequent evaluation of infant attention, discrimination, and memory. As the implications of this research began to be appreciated, questions arose about the motor-mental bond. The issue centered on abilities of motorically immature infants to learn by using auditory and visual mechanisms. Kagan (1971) was among the first to argue that these new data could not be ignored. His point of view received added support from studies of infants who had restricted motor usage. Décarie's (1969) dramatic evidence proved that infants with missing portions of limbs could develop object permanence even though object interactions were limited, and Kopp and Shaperman (1973), following a child born without any limbs, observed that even in these circumstances sensorimotor and psychometric intelligence evolved. Ever so slowly, the edifice erected on the foundation of motor-mental structure began to show cracks.

Somewhat paralleling the time span of the second research phase, a third phase appeared with an orientation derived from ethology and comparative psychology (Hess, 1970; Lorenz, 1965; Tinbergen, 1951). With an emphasis on observation and description, it appeared at first glance that ethologically based studies of infant behavior were similar to the "catalogs" generated earlier. However, this was only partially true, for on a conceptual level the approaches showed differences. In ethology, descriptions are not seen as

endpoints; they are used to study genetically programmed units of behavior (smiling, crying, reaching and grasping) for their adaptive functions and as a means to delineate types of motor acts used in nonverbal communication systems (Blurton-Jones, 1972). However, on another level, ethologically oriented researchers bear resemblance to catalogers of the first phase — many disclaim the role of theory in research. With the exception of Bowlby (1969, 1973), Ainsworth (1973), and a few others, much ethological research is atheoretical by choice (Blurton-Jones, 1972). Finally, it should be noted that ethologically oriented research has been biased toward study of infant motor acts in the *service* of social interactions. Included in this category is research on smiling as well as prehension and locomotion (Ainsworth & Bell, 1970; Ainsworth & Wittig, 1969; Ambrose, 1961; Blurton-Jones & Leach, 1972; Freedman, 1964, 1974; Richards & Bernal, 1972).

In earlier phases, a central issue of dispute turned on the motor concomitants of intellectual growth; with ethologically based research, controversy arose rather in the context of social development. At the nub of the controversy was the role of infant motor acts in the development of infant-caregiver attachment. Ainsworth's (1967) seminal work in Uganda and her subsequent laboratory research relied heavily on proximity-seeking behavior of infants, whether by prehension or locomotion, as an index of attachment. As use of her experimental paradigm spread, questions were raised about insufficient emphasis on visual and vocal interactions (Ferguson, 1971; Walters & Parke, 1965). It is probably not coincidental that recent ethologically oriented studies show increased use of these measures of attachment.

Finally, a fourth phase of interest is beginning to appear. However, it is too recent to determine its direction or definition. There is a group of researchers exploring the relationship between vision and prehension. For example, the role of visual input and feedback on reaching and grasping behaviors is being examined (Field, 1976, 1977; Lasky, 1977; McDonnell, 1975). Another group of researchers has debated the concordance and integration of visual manipulative behaviors (Rubenstein, 1974; Ruff, 1976; Schaffer, 1975). The study of individual differences in prehensile acts also has received some attention (Kopp, 1974). It is far too early to state what will emanate from this phase. However, it is interesting to notice that again the focal point of interest relates to abilities that begin to emerge early in the first year.

In this brief overview, trends and issues that have dominated thinking and research in motor system development have been presented. Historically, three main themes emerge: (1) Increasingly, developmentalists have turned to theory to guide research on infant motor acts, (2) a shift has occurred from studying movement solely as product to studying movement as mediating mechanism, and (3) conceptual and research emphasis has been

attached to motor changes that occur early in the first year of life. This last point brings us to the next section in which the theme of the remainder of the chapter will unfold.

AN EXPANDED VIEW

An intriguing aspect of research concerning infant motor development relates to the scientific community's preoccupation with immature forms of prehension and locomotion. Granted, substantial theoretical issues have been addressed by research, but consider the additional questions that could be posed if attention were directed to the older infant. A fundamental question should involve an inquiry into the various ways children use self-controlled prehensile and locomotor activities to facilitate or impede their own cognitive and social growth. Surely, such studies would yield meaningful implications for short- and long-term individual differences. Yet research on the infant motor system, reflecting a one-age-period interest, invariably denies significance to mediating influences of motor behaviors observed past eight or ten months of life. Therefore, succeeding portions of this chapter are devoted to a broadening of perspectives. The focus is on the entire age range of infancy—from early months through the second year.

Before proceeding, it is useful to present the framework that has guided much of this line of thinking. The influence of Piaget, Flavell, and Bruner will be apparent. Furthermore, my concern for expanding age periods of inquiry stems from a belief that in the second year of life the infant begins to obtain knowledge that *one has about one's own movement.* With functionally mature prehension and locomotion *guided* by cognition, the child begins to be aware that it is the self, not others, that controls one's actions, and that movements can be planned and directed to many activities in the service of many needs. In essence, mind begins to control muscle with consequent expansion in the ways that movement is employed as means to chosen ends. This self-generating data base stems from the profound cognitive leaps made earlier and includes awareness of means–ends relationships, object permanence, refined sensory differentiation, improved recognition memory, and so forth.

In contrast, the younger infant has far fewer *means* and understands far less than the older infant. During the period of acquisition of motor behaviors, cognition is at a primitive level. In large measure, the infant knows little of why and what is done, and the motor system bound by biological constraints reflects largely the operation of unplanned survival and adaptive mechanisms. The developing prehensile and locomotor system can be used in only limited ways for limited activities.

With this orientation serving as a background, the remainder of the

chapter is focused as follows: First, on the basis of several strands of thinking and empirical evidence, data are presented to show minimal flexibility in form and function of motor acts during the genesis of new behaviors (the ontogenesis period). These findings indicate that immature forms of voluntarily controlled prehension and locomotion are constrained in their ranges of application; thus, infants reveal far more similarities than variations. Although one consistent individual difference — rate of change — has been observed during ontogenesis, additional findings demonstrate this has limited developmental significance.

Subsequently, the chapter focus shifts to the time span when prehension and locomotion become functionally mature. Signs indicate increased flexibility of motor behavior and changing potentials for long-term environmental influences. Next, contributions of locomotion to self-awareness and of prehension to intellectual development are discussed. In these areas one is forced to speculate because empirical data are sparse. Last, the chapter ends with a few comments aimed at redirecting our thinking in the area of motor development.

THE PERIOD OF ONTOGENESIS

In this section, I adopt the thesis that basically unalterable motor behaviors lead to predictable object and social interactions during a major portion of the first year of life. Both behavior and sequence probably are mediated by genetic preadaptions. If this thesis has validity, then we may expect the following: (1) A species-general sensory-motor repertoire should be observed in all but the most damaged of infants, essentially independent of environmental circumstances. (2) The specific behaviors that are observed should reflect a characteristic sameness; that is, abilities should be used in more or less the same way for basically similar types of interactions. (3) Major individual differences should be observed only under special conditions of organism insult. In subsequent discussion, data pertaining to these points will be examined. However, before turning to research, current thinking on biological influences should be summarized.

Biological Influences

A view of infancy that is increasingly gaining acceptance is that human beings are born with genetic preadaptions for early social interactions, sensorimotor knowledge, attainment of motor skills, and communication systems (Ainsworth, Bell, & Stayton, 1974; Bowlby, 1969; Bruner, 1970, 1973; Emde, Gaensbauer, & Harmon, 1976; Hinde, 1974; Piaget, 1952, 1954; Scarr-Salapatek, 1976). It is suggested that the appearance as well as

early functional change of specific sensorimotor behaviors — attention, habituation, postural control, prehension, vocal signals, affective expressions, and object permanence among others—are mediated by biologically based structures. The developmental rationale underlying such mechanisms may be numerous, but a crucial one is that of survival. Many sensorimotor behaviors are potent influences that draw caregivers into interaction with helpless infants (Bell, 1974; Bowlby, 1969; Scarr-Salapatek, 1976).

The sensorimotor repertoire is also an adaptive mechanism, providing infants with means for early learning, with abilities to detect the familiar in contrast to the novel, with capabilities to develop affiliative interactions with persons other than caregivers, and in general, with abilities to bring organization into their world of experiences (Bowlby, 1969; Bruner, 1972; Scarr-Salapatek, 1976). A nonselective endowment of adaptive systems implies that the young of all human groups and societies have ongoing potential for growth.

Questions invariably arise regarding the length of time biological factors mediate sensorimotor behaviors and the specific role of experiences. There is growing consensus that genetic preadaptations are operative throughout a considerable portion of the first year of life, contributing to the appearance of new forms of behavior and fostering change in those previously emerged (Emde et al., 1976; Wohlwill, 1973). Of course, admitting a relatively long biological influence does not denigrate the role of the environment. The environment activates change (Flavell, 1972), provides the "materials and opportunities" for learning (Scarr-Salapatek, 1976), influences motivation to engage in activities, and promotes some early developmental precocities (Zelazo, Zelazo, & Kolb, 1972).

Genetic preadaptations underlying postnatal sequences of reflexive and voluntary motor behaviors can be inferred from neurophysiological and anatomical studies of animal and human infants (Bergstrom, 1969; Conel, 1941; Purpura, Shafer, Housepion, & Noback, 1964; Skogland, 1960). Moreover, findings indicate that certain structural changes in subcortical and cortical processes logically can be linked to types of motor activity and patterns of activation (Bergstrom, 1969; McGraw, 1943). For example, various forms of postnatal brain maturation parallel behavioral transitions, starting from random, poorly controlled movements to those of later periods that are ordered with respect to temporal and spatial dimensions. The latter specifically infers activation of cortical inhibitory centers. To date, no findings have emerged to contradict inferred links between maturing brain organization and motor functions.

Normal and Atypical Motor Development

Motor sequences, linked as they are to biological underpinnings, has been documented with respect to locomotion by Shirley (1931) and Gesell and

Amatruda (1941) and to prehension by Bruner (1970), Castner (1932), Halverson (1931), Piaget (1952), Uzgiris (1967), and White et al. (1964). It is unnecessary to recapitulate specific observations except to comment that locomotion involves emergent control of head, trunk, and limbs for head raising, body turning, prewalking progression, and upright locomotion and that manipulation entails progressive control of arm, forearm, wrist, hand, fingers, and thumb for sequences of bi- and unimanual reaching, grasping, transfering, and releasing.

Concentrating momentarily on normal infants, findings show little variability in the organization or function of initial forms of nonreflexive prehensile and locomotor behaviors (acts that are self-induced, in contrast to those elicited solely by reflex activation). Consider, for example, data and observations collected by means of developmental examinations such as those of Bayley (1969) or Gesell (Gesell & Amatruda, 1941), which contain catalogs of expected responses. These tests are used worldwide (see Werner, 1972), but no researcher has reported individual or group differences in purely motoric control items (e.g., swiping, reaching, rolling, or crawling) or those that represent attention (e.g. memory, exploration, alertness, or social differentiation), except those in rate of development or frequency of use of particular behaviors (Bayley, 1949; Dennis, 1941; Konner, 1976; McGraw, 1935; Phatak, 1970; Pikler, 1968; Werner, 1972). No modification of motor functions or of any early sensorimotor behaviors can be found, despite vastly differing caregiver practices or even early specialized training (Konner, 1976; McGraw, 1935; Zelazo et al., 1972).

What factors constrain infant function? Bruner (1970), in a series of studies on prehensile functions, described some limitations. At four to five months, reaching, though activated and often leading to successful grasping, lacks autoregulation in organization and patterning. Once initiated, these early forms of prehensile activities must be carried to an endpoint or terminated midway; corrections *en route* are beyond capability. Moreover, each new emergent component of prehension requires extraordinary attentional demands. Although by six to eight months modulated reaching and grasping can be incorporated into several ways of approaching objects, there is still little differentiated use of objects (Uzgiris, 1967, 1976) and little appreciation that self is distinguished from object (Piaget, 1952). However, infants freed of some attentional demands of prehension start to focus on object features (Bruner, 1970).

In summary, during the period of ontogenesis prehensile acts are constrained by difficulties in correction of acts, limitations in spatiotemporal patterning, inability to plan, and attentional demands (Bruner, 1970). It is hardly surprising that functions can be directed solely to objects of determinate size, shape, and number (Halverson, 1931).

Although the research discussed in the foregoing paragraphs has been limited to normal infants, it can be inferred that many of these findings

have implications for infants who have suffered biological insult or who have been exposed to deleterious caregiving. With respect to the former, researchers have observed that the same motor repertoire is used for essentially similar types of object and social interactions under conditions of visual, auditory, and even neuromuscular handicap (Décarie, 1969; Eibl-Eibesfeldt, 1975; Fraiberg, 1971; Kopp & Shaperman, 1973). Of course, in a few instances of central nervous system dysfunctions (e.g., athetosis, spasticity, or blindness), distortions of major expression may occur, and programmatic interventions may be necessary to facilitate function (Fraiberg, 1971).

Among other findings yielding similarity of function are those obtained from studies of infants born with Down's syndrome. Typically, these children have a multiplicity of physiological, neuromuscular, and intellectual problems. By school age, their intelligence quotients are two or more standard deviations below the average range. However, during ontogenesis, the appearance, function, and effects of their motor repertoire essentially duplicate those of normal infants, albeit changes occur more slowly. Although Down's syndrome infants are frequently hypotonic and slow to move and have limited ranges of affective expressiveness, they eventually achieve most of the prehensile and locomotor milestones found on developmental examinations (Carr, 1975; Dicks-Mireaux, 1972), despite the fact that they are limited in certain kinds of explorations. Likewise, other research demonstrates many analogues in motorically mediated affective responses of young normal and Down's syndrome infants, although a delay in genesis of new behaviors and a constricted variety of acts were also noted (Cicchetti & Mans, 1976; Cicchetti & Sroufe, 1976).

Other examples of atypical infants could be cited, but the point seems clear: Even when there is marked impairment, when learning is limited, and when the opportunity to engage actively in interactions is restricted, the form and function of motor acts as measured by developmental examination data correspond to those of intact infants. During early infancy, the most striking individual and group differences relate to rates of developmental change.

Similar conclusions are reached about the abilities of infants reared under less-than-optimal conditions. All too often, unfortunately, comprehensive deprivation leads to apathetic, bland, developmentally delayed infants who show low investment in objects and have meager response repertoires (Barrera-Moncada, 1963; Provence & Lipton, 1962). Nonetheless, examination of observational reports and developmental data forces us to conclude that postural and manipulative acts mirror those of children reared under more positive circumstances (Collard, 1971; Provence & Lipton, 1962). Movements may be uncoordinated and poorly modulated, but even deprived infants reach for a caregiver and occasionally hold a toy (Provence & Lipton, 1962).

It was once thought that the immature motor system was highly flexible. Indeed, "plasticity" was the term used by White and Held (1966) to describe variations in visual–motor development that occurred as the result of several different kinds of planned enrichments of institution-reared infants. If by plasticity these authors meant that they found differences in amounts of distributed attention, time of onset of components of reaching, and amount of hand regard, there can be no disagreement. However, White's data, as well as that of others, show that the basic structural and functional organization of motor behavior is relatively immutable to change, so that plasticity should not be construed to mean "capable of being (easily) molded."

Without belaboring the point of genetic preadaptations and species generality, we note that no study has demonstrated that the *fundamental motor acts* of early infancy are changed by insult to the organism or by atypicality of rearing conditions. However, integrity of the organism and opportunities provided by the environment may impose constraints on rate of development and quality of response. In addition, motivation may be affected. Nonetheless, all available data speak to a species-general repertoire of behaviors during the period of ontogenesis.

Given that developmentalists may agree on the foregoing points, there still may be disagreement about the significance of variations in timing or in rates of developmental change. Rate of change during ontogenesis is the focus of the next section.

Individual Differences During Ontogenesis

From the first days of life, individual differences are observed. Some infants are more expressive, intense, or alert than others, and within the normal developmental range some will show a fast pace of developmental change in motor skills. Are these variations in rate significant?

As a prelude to answering this question, it is useful to discuss briefly motor precocities. In the first year of life, locomotor and prehensile precocities are not uncommon. Found among infants worldwide, they may stem from caregiving practices, special training, or genetic factors (Geber & Dean, 1957; Konner, 1976; McGraw, 1935; Rebelsky, 1972; Super, 1976; Werner, 1972; Zelazo et al., 1972). The developmental literature accords precocities a special role, ascribing to "advanced" prehensile and locomotor abilities a means by which *early* cognitive and social abilities may be achieved. This perspective, seemingly ignoring powerful evidence of infant learning without motor concomitants, derives in part from the emphasis placed on manipulative acts by Bruner (1970), Gesell (1952), and Piaget (1952, 1954, 1970). Nonetheless, examination of data shows that within the normal range, precocious or delayed development of motor skills offers at best only temporary advantages or disadvantages. These data are explored in the following paragraphs.

A construct useful for understanding implications of variation in rates of developmental change is Blank's (1964) "focal motor hypothesis." Briefly restated, the hypothesis encompasses the following points. At the time when a developmental skill is newly emerging (i.e., the focal period), there is wide variation of abilities; some infants have acquired the skill whereas others show only tentative beginnings. During the focal period, precocities and delays are highly related to overall developmental status, because many of the behaviors that are measured are *functions of the emergent skill.* For example, an infant who shows precocious development of manipulative abilities may apply hand skills to a greater variety of objects than does an infant whose manipulative skills are not well refined. Last, Blank suggests that when a skill becomes part of the general behavioral repertoire, individual variation is markedly reduced.

Data that corroborate the focal motor hypothesis and attest to its usefulness are available. With respect to prehension, Blank (1964) validated her own construct with an investigation of the relationships among developmental test scores, level of prehensile skills, and quality of manipulative play in infants 20 to 28, 39 to 46, and 71 to 73 weeks old. Seeking a focal period in the development of hand skills, she utilized a detailed measurement system of play that included specifications of frequencies, time counts, variation of acts, and spontaneity parameters. These were analyzed with respect to different levels of Griffiths' (1954) developmental test scores, which in turn were analyzed in relation to eye–hand and other subscale scores.

It was only at the youngest age periods that Blank observed the most advanced forms of play among infants whose developmental quotients were in the upper ranges of group abilities. It was also in this period that the highest correlations were obtained between eye–hand subscale scores and overall scores ($r = 0.93$). At later age periods, manipulative play generally was not significantly related to developmental quotients. These data suggest that a focal period of hand skills occurs at about five to six months of age. Therefore, precocities and delays in prehensile skills and their associated effects on function are most apparent at that time.

It is not surprising that other researchers also obtain moderate to high correlations between fine motor skills and cognitive-social abilities of 6-month-old infants (e.g., Yarrow, Rubenstein, & Pedersen, 1975). Yet, extending the focal motor construct, one has to question whether this relationship would have been maintained. Unfortunately, these researchers did not include other age periods.

Turning to locomotor skills, other kinds of evidence can be used to infer indirectly a focal period, which, as might be expected, occurs towards the latter part of the first year. For example, in correlational studies, Bayley (1935) examined prewalking progression (e.g., crawling and creeping) with

developmental mental and motor sigma scores at 4 to 6, 10 to 12, 18 to 24, and 33 to 36 months. Her data showed that the highest correlations, signifying greatest variability, were obtained for mental age scores ($r = 0.42$) at the 10-to 12-month period, the usual age of creeping and beginning upright locomotion. Bayley found that correlations in the first age period (4 to 6 months) were 0.32 and in the latter periods only 0.20 and 0.16.

In light of these trends, it is not surprising to find that long-term developmental studies demonstrate even more powerfully the attenuated effects of rates of change. With respect to childhood intellectual abilities, early gross motor precocities or delays lose virtually all their impact (Bayley, 1935, 1949; McGraw, 1935). There is, however, some clinical evidence that suggests that very early gross motor precocities may be *deleterious* for some cognitive functions. High energy levels and early locomotion may promote object inattention and blurring of cue distinctiveness during infancy (Heider, 1966).

Developmental findings on prehension are generally consistent with empirical data on locomotion (McCall, Hogarty, & Hurlburt, 1972; Nelson & Richards, 1939; Shirley, 1933). McCall's longitudinal data are particularly interesting because he obtained a 6-month psychomotor trend that had a low, though significant, relationship with a 24-month developmental profile. It did not, however, relate to later intellectual performance. The 6-month trend incorporated visually guided manipulative acts and gross and fine motor behaviors, including reaching, grasping, banging, and playing with objects — acts interpreted as embodying perceptual contingencies. Although sample, methodology, and data analyses of McCall et al. (1972) differ from those of Blank (1964), his data provide additional support for a focal period of prehension.

Given these findings, one is forced to conclude that individual differences in rates of change of *immature* motor skills have an evanescent quality. As Bayley (1933) wrote many years ago, "Superiority in one function does not insure superiority in the subsequent development of more complex functions . . . [p. 81]."

Summary and Comments

Two points have been made in this section. First, during the period of ontogenesis, basic motor competencies are probably mapped by genetic preadaptations. Thus, emergent behaviors have a species-general quality. They are observed in almost all infants and across almost all rearing conditions and are applied in similar ways, irrespective of infant and culture. Second, differences in rates of developmental change in motor abilities are unrelated to long-term development. There is only a brief period when individual differences in motor skills are highly correlated with overall developmental capabilities.

Our understanding of the nature of early infancy has theoretical and practical significance because upon it depends the intensity of our efforts to single out infancy as being more crucial to development and more worthy of study than later periods. The purpose of this section was not to deny signficant change roles to early life but to show that its function is universal and fundamental. Perhaps the first phase of infancy is even less momentous than we thought.

However, it is appropriate to ask if any of the conclusions reached in this review conform to theory. In the main, findings presented as evidence for species-typical behaviors of young infants are congruent with the views of Piaget (1952, 1954, 1971), Gesell (1929a, 1952), and Bruner (1970). Although each theorist articulated different maturational-environmental biases and emphasis, each one inferred a commonalty to early infant behaviors. Moreover, all posited a biological basis that contributes to a relatively undeviating emergent pattern of motor acts, as expressed by Piaget in the context of hierarchal development of prehension with invariant sequences, by Gesell in discussions of maturationally programmed growth gradients present even in instances of atypicality, and by Bruner with comments on genetically derived programs fostering regulation of movement with consequent freeing of attentional demands.

In general, developmental theorists have been less concerned with individual differences than with generic characteristics of infants. Nonetheless, Gesell did devote attention to this issue for, in his role as practitioner, he was called upon to determine suitability of infants for adoptive placement (1929a). However, beyond that responsibility, Gesell was intrigued by variations in rates of development and documented numerous atypical cases (Gesell, 1929a; Gesell & Amatruda, 1941). He, more than any other theorist, accorded infant precocities an important long-term role. Notwithstanding, developmental findings generated over four decades attest to the unstable features of infant motor precocities or delays.

Finally, the previously cited data base can be used too as partial negation of motor-mental linkages espoused by theorists and commonly repeated in professional and lay literature. Although no one would want to deny the importance of movement, even if its significance were only to aid in reduction of tension, there is no evidence at present that actually defines motor concomitants of cognitive growth. It is likely that continued search for these presumed linkages during early infancy will be fruitless. However, investigation of older aged infants may show that some motor functions have a lasting influence on aspects of cognitive and social development. We explore this supposition in the next section of this chapter. Turning to the older infant, the period associated with functional maturation is explored. Promising areas for future research are presented.