THIRD EDITION

PERCEPTUAL & MOTOR DEVELOPMENT IN INFANTS & CHILDREN

BRYANT J. CRATTY

Perceptual and Motor Development in Infants and Children

Third Edition

Bryant J. Cratty
University of California, *Los Angeles*

Prentice-Hall, Englewood Cliffs, New Jersey 07632

Library of Congress Cataloging-in-Publication Data

CRATTY, BRYANT J.

Perceptual and motor development in infants and children.

Includes bibliography and index.

1. Child development. 2. Developmental psychobiology. 3. Motor ability in children. 4. Perception in children. I. Title.

RJ131.C7 1985 612'65 85-25763

ISBN 0-13-657164-6

Editorial/production supervision: Mary Bardoni
Cover design: Lundgren Graphics, Ltd.
Manufacturing buyer: Harry P. Baisley

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

ISBN 0-13-657164-6 01

PRENTICE-HALL INTERNATIONAL (UK) LIMITED, *London*
PRENTICE-HALL OF AUSTRALIA PTY. LIMITED, *Sydney*
PRENTICE-HALL CANADA INC., *Toronto*
PRENTICE-HALL HISPANOAMERICANA, S.A., *Mexico*
PRENTICE-HALL OF INDIA PRIVATE LIMITED, *New Delhi*
PRENTICE-HALL OF JAPAN, INC., *Tokyo*
PRENTICE-HALL OF SOUTHEAST ASIA PTE. LTD., *Singapore*
EDITORA PRENTICE-HALL DO BRASIL, LTDA., *Rio de Janeiro*
WHITEHALL BOOKS LIMITED, *Wellington, New Zealand*

PREFACE

An effort was made in this third edition to accomplish two goals. First, the book was updated to include current research information dealing with how children's movement behaviors change with maturation. The second, and most important goal, was to introduce several new and useful threads into the material and the thinking about motor development. It was with this second objective in mind that several content areas new to books on motor development were added to this edition. These include: (a) an overview of early neural changes, and how these influence the acquisition of movement capacities; (b) a chapter on motor learning—how learning and learning strategies are modified in younger and older children; (c) a section dealing with the way in which physiological capacities evolve throughout childhood and early adolescence; (d) a chapter dealing with various qualitative changes in movement development, including overflow, motor planning, reaction time, and rhythm; and (e) a discussion of the variables that negatively and positively influence early motor development. The book concludes with an overview of currently available evaluative tools.

In addition to the new material, several threads of thought are woven into the text. For example, the emphasis is on individual differences. Instead of becoming preoccupied with spurious assumptions about how "all" children must certainly throw a ball at the age of 6, data are presented that illustrate the wide range of qualities seen in children's movement behaviors at various ages. Contemporary directions in research have also provided useful new ways of looking at motor development. Examples of these new directions include modern views of how infants see, look, and perceive; the fascinating study of movement stereotypies; as well as the new research dealing with early social behaviors. Finally I have attempted to "operationalize" ideas and concepts by describing how they are measured, rather than simply employing ill-defined words and vaguely descriptive phrases. This focus on evaluation has permeated most of the text, as well as the final chapter.

Motor Development has been considered by many during the past decade or two as a rather sterile field, one in which new developments are not plentiful. However, I found the writing of this edition fascinating, as I explored the dimensions of movement reflected in the new material, as well as the interactions of other variables as they impinge upon the emerging actions patterns of youngsters.

Among the other fields of knowledge that have important relevance to the study of motor development are those of social psychology (studying play), cultural anthropology (exploring intercultural differences in childrearing), biochemistry (studying the effects of environmental stimulation on brain growth), ethnology

(looking at rhythmic behaviors of animals and children), and linguistics (exploring how language and actions at play intermesh).

I am indebted to several people who helped with the content and production of the text. Larry Hawley, a professional photographer from Hollywood, California, produced many of the strobe pictures found in several of the chapters. Dr. Glen Glaesser helped in the review of the chapter dealing with physiological changes. The parents of 14 infants and children permitted me to photograph their offspring. I would like to thank these parents and their patient children. Esther Thelen and Jana Parizkova pemitted me to use data from their scholarly work. I hope they will be pleased with how I interpreted their findings.

This book is intended as a textbook for upper-division students in physical education, physical therapy, kinesiology, and elementary education. It may be used as a resource for courses in or students of child development, developmental psychology, dance therapy, nursing, and related disciplines. I hope that some of the hypotheses, substantiated and unsubstantiated, that are presented throughout the text will encourage energetic researchers to pursue some of the ideas that are only barely traced in the dirt at present.

B.J.C.

CONTENTS

CHAPTER ONE
SENSORY–MOTOR BEHAVIOR AND DEVELOPMENT THEORIES, MODELS, AND SPECULATIONS

Since the early part of the present century, scholars have been speculating concerning the meanings of the movements appearing during the first days and weeks of human life. These observations have been backed up by increasingly sophisticated instrumentation. The earlier writings of Piaget, based upon penetrating observations derived from watching his own daughters as they developed, are being replaced by the more recent and equally creative work of T. G. R. Bower, Jerome Bruner, and others. They have used sophisticated measuring instruments that reflect such subtle behaviors as breathing patterns and eye blink rates, as well as other physiological and neurological evidences of changes in the infant's emotional and/or intellectual state.

Most writers have not concentrated solely on the manner in which beginning patterns of movement are generated in and of themselves, but rather have attempted to explore the antecedents of intelligence through the use of the most measurable behaviors available, voluntary action patterns. Some have also concentrated on the reasons for the movements shortly after birth. In this chapter two contrasting models dealing with the development of motor behaviors will be briefly explored.

The first is the traditional ideas of Jean Piaget, reflected in his formulation of the sensory-motor period and its six phases. The second model covered is a contemporary framework formulated by the author.

PIAGET

Perhaps no other man in the twentieth century has sparked more interest in the early acquisition of human abilities than the Swiss scholar Jean Piaget. The scope of his writings is immense, as is the library of books and monographs he has produced. His work encompasses the genesis of numerous facets of children's grasp of both the concrete and abstract concepts of their world.[1] If important criteria with which to judge the worth of theoretical speculations are the amount and quality of research they produce, Piaget's work readily meets the test. Hundreds of studies, monographs, and books have been stimulated by Piaget's penetrating discussions about the unfolding of the child's mind.

The Background to Piaget's Ideas

Piaget grew up in a family of scholars. He spent his early years in intellectual debate with his father, a history professor at the University of Neuchatel in Switzerland. Even during his formative years, he displayed a talent for carefully observing the processes of nature. His first published work, at the age of 11, was a brief article dealing with the behavior of an albino sparrow in a park near his home. This article attracted the attention of the curator of the museum of natural history in his town, Paul Godet. Piaget's friendship with Godet led to joint observations in the countryside near Piaget's home, and he continued to observe and record nature. His next publication, at the age of 16, dealt with the development of shellfish that inhabited some nearby lakes. His first books, written as a young man observing the horrors of the First World War, dealt with philosophical as well as natural issues. He argued the question as to whether the aggression he saw around him was an inherent and "natural" part of human behavior, or whether love was the more basic human trait. Piaget turned from philosophy and biology to psychology through a series of accidents. After writing a thesis on mollusks, he traveled to Paris, then the center for psychiatry. This exposure led Piaget to what he called "the clinical method," which involved the careful questioning of patients to discover the deep-seated sources of their confusions.

While he was in Paris, Piaget became acquainted with Theodore Simon, who had been a co-worker of Alfred Binet. Binet had died in 1911, and Simon had continued his work on standardized intelligence tests. Piaget accepted a position on this project. For the next several years he not only did work on test standardization, but more important, during the testing of children from 5 to 6 years of age, became interested in the deeper question of how intelligence unfolds. Piaget became intrigued by the nature of the "wrong" answers the children gave to questions on the tests. Using the clinical methods he had learned from psychiatrists, he probed immature psyches in an attempt to discover not only quantitative, but qualitative dif-

[1] A manageable survey for undergraduates has been produced by Ginsbury and Opper, *Piaget's Theory of Intellectual Development* (Englewood Cliffs, N.J.: Prentice-Hall, 1969). The review and critique by Cohen (1983) may also prove helpful.

ferences between the thinking processes of children and of adults. The titles of the articles he wrote during this period reflect his interest in the use of clinical methods, together with his awakening concern about the intelligence of children. These included "Psychoanalysis and Its Relationship to the Psychology of the Child," and "On Studying the Explanations of Children." He continued to be concerned about moral values, however, as articles such as "Psychology and Religious Values" attest.

Piaget quickly gained prominence as a young man. Recognition brought him an appointment to the University of Geneva, where he was later named director of the Jean-Jacques Rousseau Institute. In 1925 he married one of his students, Valentine Chatney. Together they began detailed observations of the development of two daughters and a son born to them during the latter part of the 1920s.

One of the conclusions Piaget drew from watching his children grow was the conviction that thought sprang from actions, and not from other sources such as language. Perhaps frustrated by his work with abnormal children, during which he attempted to assess them via verbal behaviors, he came to look upon the concrete manipulations of objects via the child's motor abilities as important clues to the quality of emerging intelligent behavior.

Several concepts proposed by Piaget at this time are reflected in his writings on the relationship between movement and intellectual development. A primary concept was his feeling about the term *intelligence* itself. In general, he held to a rather broad definition: He suggested that intelligent behavior was both a type of biological adaptation to an environment,[2] as well as evidence of attempts to bring about what he termed a "harmonious equilibrium" between environmental problems and objects and the child's "mental actions." He did not believe that intelligence was totally inherent, but that within the first days of life the child began to modify even simple reflex actions, evidencing the beginnings of mechanisms he termed "psychological structures." These structures were examined in some detail within the six components of what he called the early sensory-motor period.

Piaget employed several other words in an effort to illuminate how knowledge is acquired, and how the infant and the child adjust to the environment. He used the terms *correspondence* and *transformation* to explain intellectual unfolding. First, the infant and child may merely copy a tree when drawing it, for example. This is a case of simple *correspondence*, with no modifications by the child. With experience, however, the child may begin to draw trees of all types, with or without the presence of a model to copy. The latter, a more sophisticated level of functioning, is what Piaget termed *transformation*.

The terms *accommodation* and *assimilation* were used to denote stages through which a child passes as confrontations with new environmental events (objects, people) take place. The first stage is called *assimilation*. For example, on seeing a rattle for the first time, the infant grasps it in a manner previously learned for

[2]The phrase "biological adaptation" springs from his early background as a biologist; "equilibrium" was probably formulated from his interest in and study of physics.

getting hold of something. Later, however, the infant will begin to *accommodate* to the rattle and learn to shake it, first with effort and concentration, and then with apparently little effort or attention. Moreover, the infant and child often engage in both accommodation and assimilation at the same time. One object may be grasped, and even used, while another is being visually inspected, or assimilated. Accommodation (using the first object) occurs as a second object or event is being assimilated.

Through these complementary processes, the maturing human organism seeks to bring about a balance, or equilibrium, between itself and an environment composed of events and problems of increasing complexity, Piaget believed.

The Six Phases

The "action base" to the formation of intelligence Piaget divided into six primary phases, marked by behavior that at first includes simple "experimentations," primarily sucking, on the part of the neonate and progresses to more complex two-handed coordinations that signal the onset of more sophisticated intellectual behaviors. These six phases will be considered in the following paragraphs: the age ranges indicated are approximate.

Phase I. Struck by the variations in sucking behavior in his own newborn children, Piaget characterized this phase (from birth to one month) as a time during which the infant shows both generalized assimilation of sucking to the nipple, and also differentiated responses involving sucking. That is, he noted that the so-called reflexlike sucking reaction, even during these early days of life, manifests itself in a variety of ways. At times the sucking seems to be motivated simply by the ability to suck! He suggests that this first phase is characterized by the infant's need to seek stimulation, to exercise variations in what simple capacities he or she possesses, and at the same time to manifest various kinds of accommodation as he or she learns to seek the nipple in a variety of ways. Thus, both "seeking responses" as well as sucking responses themselves assume a variety of forms during the first 30 days of existence. In recent experiments, contemporary researchers, whose work will be covered later, have further exploited the ability of the infant to suck in a variety of ways.

This first phase, like Phase II which follows, involves reactions to and about the body itself; it does not involve actions directed toward external people or things. These initial behaviors suggested to Piaget that a kind of self-actualization is beginning to occur, through the exercise and expansion of primitive psychological-behavioral "structures."

Phase II. This second stage within the sensory-motor period, lasting from 1 to 4 months of age, is characterized by what Piaget terms "primary circular reactions." These behaviors, still centered about the child's body, involve attempts by the infant to discover how to repeat actions that initially (and often by accident) lead to satisfactory conclusions.

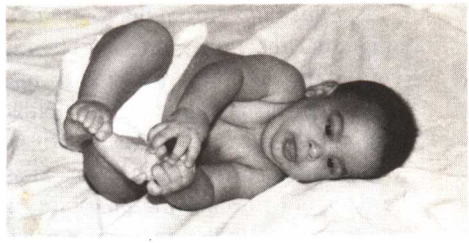

FIGURE 1.1 Primary circular reactions involve the infants own body. Sometimes the thumb, while at other times the feet may prove fascinating.

An expansion of response patterns also occurs during this second period. A child, for example, will tend to expand the sucking response to include thumb sucking, sucking nearby objects as the head is turned, and so on, rather than confining sucking efforts to the nipple. Bruner has noted further that during this period an infant may behave like a child evidencing athetoid tendencies.[3] Piaget, on the other hand, assumes that these are the child's awkward attempts to repeat a satisfactory action. The ability, first an accident, to bring the hand to the mouth, is another example of a primary circular reaction (see Figure 1.1).

Another behavior that appears during this second phase is a kind of perceptual readiness Piaget calls "primitive anticipations." A primitive anticipation would include a sucking response occurring well before the bottle or nipple is brought to the child's mouth.

Two types of behavioral characteristics also make their appearance during this period. These are (a) *curiosity*, a motivational point of great importance, evidenced primarily by visual searching behaviors of nearby objects (see Figure 1.2); and (b) *imitation*. The behaviors imitated during this period are necessarily primitive, and include the echoing of simple vocalizations, as well as of an adult figure's mouth movements with no accompanying sounds.

FIGURE 1.2 During this second period, curiosity makes an appearance, as the infant visually searches the nature of nearby objects.

[3]A type of cerebral palsy characterized by constant and relatively uncontrollable movements.

Phase III. From the fourth to the tenth month, the infant continues to engage in circular reactions, but they begin to include objects external to his or her body. The infant starts to crawl and to manipulate objects of a variety of types; and to attempt to repeat enjoyable manipulative experiences with increasing precision (accommodation). It is interesting to note that Piaget views a chain of events (both actions and causal events in space) as operative and beginning at either end. Thus, he does not rule out the possibility that the child moves because previous movements have caused a dangling object to sway and make a noise, instead of in order to cause the object to make noise and sway. This kind of secondary circular reaction may be depicted as shown in Figure 1.3 and Figure 1.4.

Also apparent during this third phase, according to Piaget, is the presence of "partial reactions"; these are abbreviated movements involving the apparent awareness by the child that classifications of things exist which may not be fully exploited at all times. Piaget cites as examples of these signifiers the tendency to kick partially at a toy that has been previously dealt with in other ways, while not responding at all to unfamiliar toys. Most important, during this third sensory-motor stage, the child manifests the ability to differentiate between strong and weaker movement patterns. Cited as an example was the first chance striking of a chain by Piaget's son Laurent, followed by first a gentle tug and then by increasingly stronger and stronger attempts to swing the chain while grasping it.

A final kind of behavior seen during this period is what Piaget called "deferred circular reactions." These are signified by the termination of a reaching movement, with the later resumption of the movement, after a time delay. Thus, partial or incomplete movement schemas seem capable of being stored, at least for a short period of time, by the child.

Phase IV. The final two months of the first year, according to Piaget, is a time for "coordination of secondary schemes." Unlike the previous stages, in which actions began as accidental behaviors, during this fourth stage the child seems to manifest intention, and then to try a variety of ways of reaching some goal—for example, grasping a matchbox held just out of reach. This child may evidence originality in attempts to reach some goal via the efforts of his or her own

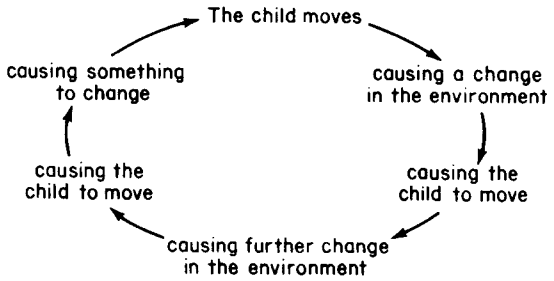

FIGURE 1.3 Secondary circular reaction.

FIGURE 1.4 Circular reactions after the fourth month include the examination of objects external to the body as is happening here.

body; these original actions may not have had any direct or similar antecedents. Formation of original schemes is the hallmark of this fourth period and an extremely important type of event in the life of a child. It would seem to indicate that intention and thought become initiators of action, rather than an accidental movement and its result being instigators. Imitations of movements and tasks improve and refine themselves during this period. The simple anticipatory actions, seen initially in stage III, also assume more distinctive forms and manifest increasing precision.

Phase V. This fifth state (15 to 18 months) is also marked by an increasing variety of behaviors, actions which suggest the child is attempting to learn about the properties of objects he or she is manipulating. Thus the child learns that dropping a bar of soap produces results different from those achieved when a block is similarly released. These explorations in turn lead to a less conservative use of action patterns. Movements are increasingly productive in an exploratory sense, as most children are walking quite well by the beginning of this period.

New means are employed to attain a goal. The imitation of models is expanded to include movements that may not resemble closely those the child has been using previously. In addition, according to Piaget, at times the child's exploratory tendencies are so marked that accommodation takes precedence over assimilation. In other words, the child may evidence more pleasure in relatively brief and crude movement encounters with environmental objects for novelty's sake.

Phase VI. This final period is seen by Piaget as the bridge between sensory-motor behavior and intellectual endeavor. He suggests that children are fully aware and make that awareness known as they actively attempt to search for hidden objects, evidencing the importance of the emergence of thought independent of the sensory stimuli present. Moreover, actions are increasingly delayed, or postponed altogether, unlike the other periods, in which thought and direct and immediate action were often close companions. For example, a child, frustrated and/or confronted with a problem, manifests anger at a later time. It is this final period, lasting from about 18 months to 2 years, that Piaget suggests signals the end of the sensory-motor period and the beginning of cognitive behaviors.

Overview and Contemporary Evaluation

From 1920 to 1980, Piaget broadened his work, and its impact on American psychology was profound. The entire subfield of developmental psychology in the United States may be traced to the interest in Piaget's work which was translated in the 1950s and later. Piaget set about to formulate a system to explain problems that had plagued philosophy and philosophers for centuries. Many Americans of his generation studied only minute portions of human behavior within tightly controlled laboratory settings that usually included a maze and a near-by cage of rats. Piaget, like Europeans before and since, painted theories and models in broad, philosophically rich strokes.

At the same time, Piaget was not the deity that some of his contemporary biographers would have us believe. His insights, while profound, were like those of all of us, at times constricted by the limitations of time and energy, and by the society within which he studied infants and children. Moreover, some have suggested that his ideas were not always subjected to the critical scrutiny of those surrounding him in the institute, where he was known as *le patron,* the boss.

During the past three decades scholars have begun to scrutinize closely some of the ideas in the writings of the prolific Swiss philosopher-psychologist. Some of these questions have been focused on the methods used by Piaget and on the restricted cultural environment in which he formulated his theories about intellectual development.

Other critical reviews have contrasted basic assumptions made by Piaget with research data from the laboratories of others who began to study infants more closely in the 1960s and 1970s. Some of these writers have examined some of the primary ideas Piaget held about the orderliness of the stages through which infants purportedly pass from egocentric infancy to cognitive adolescence. During recent years, useful questions have been arising about various hypotheses found within Piagetian thought and theory.[4] Some of these contemporary insights are useful for those interested in the "movement component" within the unfolding personalities of infants and children. Among some of these recent elaborations upon, and contradictions of, Piagetian theory are the following.

The Infant: A Social Isolate? Piaget painted a picture of early infancy that excluded social influences. Developmental substages within the sensory-motor period were believed to take place during what Piaget termed an egocentric phase of development.[5] Social influences were ignored both in early sensory-motor development and in later intellectual phases. Evidence from carefully arranged experimental studies of infants' responses conducted since the 1960s, however, more than

[4]These critical reviews range from the questions posed by Flavell in the 1960s (Flavel, 1962), to more penetrating efforts at Piagetian analysis carried out by Donaldson in the 1970s (Donaldson, 1978) and Cohen in the 1980s (Cohen, 1983) and include useful experimental tests of Piaget's notions about stages in object acquisition and exploration (Willatts, 1984).

[5]Actually, Piaget believed the infant to be "solipsistic," the most extreme form of egocentricity.